Genes in Eyecare

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This information has been gathered from several sources; however, the principal source is V. A. McKusick's Mendelian Inheritance in Man on CD-ROM. Baltimore, Johns Hopkins University Press, 1998. Other sources include McKusick's, Mendelian Inheritance in Man. Catalogs of Human Genes and Genetic Disorders. Baltimore. Johns Hopkins University Press 1998 (12th edition). http://www.ncbi.nlm.nih.gov/Omim

See also S.P.Daiger, L.S. Sullivan, and B.J.F. Rossiter Ret Net http://www.sph.uth.tmc.edu/Retnet disease.htm/. Also E.I. Traboulsi's, Genetic Diseases of the Eye, New York, Oxford University Press, 1998. And Genetics in Primary Eyecare and Clinical Medicine by M.R. Seashore and R.S.Wappner, Appleton and Lange 1996. M. Ridley's book Genome published in 2000 by Perennial provides additional information. Ridley estimates that we have 60,000 to 80,000 genes. See also R.M. Henig's book The Monk in the Garden: The Lost and Found Genius of Gregor Mendel, published by Houghton Mifflin in 2001 which tells about the Father of Genetics. The 3rd edition of F. H. Roy's book Ocular Syndromes and Systemic Diseases published by Lippincott Williams & Wilkins in 2002 facilitates differential diagnosis. Additional information is provided in D. Pavan-Langston's Manual of Ocular Diagnosis and Therapy (5th edition) published by Lippincott Williams & Wilkins in 2002.

M.A. Foote wrote Basic Human Genetics for Medical Writers in the AMWA Journal 2002;17:7-17.

A compilation such as this might suggest that one gene = one disease. This simplistic assumption would sometimes be incorrect. The most common cause of genetic disorders is multifactorial inheritance which includes genes and environmental factors. Single gene disorders appear in about 1/100 newborn and chromosomall abnormalities in about 1/150.

Gene symbols are written in ***BOLD ITALICS***. The indicated gene may be mutated, deleted, duplicated, or translocated to a different location. Nearly two thousand genes are mentioned.

. Ongoing research provides new information so that specific details need frequent updating. The reader is reminded that this is of necessity a work in progress: we will update information as it becomes available. Comments and suggestions from readers are welcomed.

A.

Name	Gene	Comments
Aarskog-Scott, facial-digital-genital syndrome. (XR, XD). MIM 100050	***FGDY, FGD1, AAS*** at Xp11.21,or at Xq13.	Females are only partly affected, males have lax joints, abnormal cervical vertebrae, short stature, shawl scrotum, clinodactyly, and hypertelorism.
Aase-Smith syndrome-I. (AD). MIM 147800	***PHA3*** at 17p11-q21	Hydrocephalus, Dandy-Walker malformation, congenital joint contractures, congenital neuroblastoma, ventricular septal defects, cleft palate, ptosis, and death in infancy. See distal arthrogryposis-IIB (MIM 601680), Marden-Walker (MIM 108120, 248700), and Gordon syndromes (MIM 114300).
Aase-Smith syndrome-II. (AD). MIM 205600	Gene	Congenital hypoplastic anemia, triphalangeal thumbs, and distal arthrogryposis. Compare with Diamond-Blackfan anemia.(AR, AD), ***DBA*** at 19q13.2. (MIM 205900
abetalipoproteinemia (AR). MIM 200100, 107730	***APOB*** at 2p24-p22 for a microsomal triglyceride-transfer protein.	Bassen-Kornzweig syndrome, unable to synthesize the apolipoprotein B peptide of low density lipoprotein, fail to absorb and transport lipoproteins, have hypolipoproteinemia, hypocholesterolemia, coronary artery disease, ataxia, muscle weakness, kyphosis, slurred speech. Signs develop after age 10. May have ptosis, nystagmus, ophthalmoplegia, macular degeneration, and retinopathy. Treat with vitamins A and E. See also Abelson leukemia (AD) ***ABL*** at 9q34.1 (MIM 189980)
abetalipoproteinemia. (AR)	***MTP*** at 4q22-q24	A defect in a microsomal triglyceride transfer protein causes another abetalipoproteinemia.
ABO blood type (AD)	***ABO*** at 9q34	More risk of peptic ulcer and thromboembolic disease. See adenylate kinase deficiency. (MIM 103000).
acanthocytosis . (S, AR, AD)	***AEI, EPB3, SLC4A1*** at 17q21-q22.	Have spherocytosis and anemia. See MIM 100500, 200150.
acanthosis nigricans (AD)	***INSR*** at 19p13.3.	Insulin receptor gene. See diabetes.
acatalasemia. (AD)	***CAT*** at 11p13.	Takahara disease with ulcers of the gums.
Achard syndrome. (AD). MIM 100700	Gene	A connective tissue disorder, an atypical Marfan syndrome, arachnodactyly, with micrognathia and ligament and joint laxity in hands and feet. May be similar to Marfan syndome. (MIM 154700). See also Achard-Levi syndrome which can be caused by a midbrain stroke. Have dysostosis and ligament laxity. See also Achard-Thiers syndrome, diabetes in bearded women.

achondrodysgenesis (AR, rarely AD) MIM 222600	***DTD, DTDST*** at 5q32-q33 .	Diastrophic dysplasia. Subtypes include: type 1 ***ACG1A*** (MIM 200600), type 2 ***ACG2*** (MIM 200610), type 3 (MIM 200710), and type 4 (MIM 200720). See MIM 200700 for Grebe (AR) dysplasia ***CDMP1*** at 20q11.2 (MIM 601146), ***CDMP2,*** (MIM 601147).
achondroplasia (S, AD, AR). MIM 134934	***ACH, FGFR3*** at 4p16.3 is a negative regulator of bone growth.	Robinow-Silverman-Smith syndrome, incidence 1/20,000, with dwarfism, skeletal anomalies, deafness, strabismus, hyperopia, and optic atrophy. Achondroplasia is the commonest skeletal dysplasia and produces the most frequent form of short-limb dwarfism.
achondrodysgenesis-hypochondro-dysgenesis-II. (AD)	***COL2A1*** at 12q13.11-q13.2	Short-limb dwarfism.
F syndrome (AD). MIM 102510	Gene may be ***LMBR1*** at 7q36	Acropectorovertebral syndrome, skeletal dysplasia, and often syndactyly.
ACHOO syndrome (AD). MIM 100820	Gene	May affect 25% of the population. A photic stimulus induces a single or a multiple sneeze reflex.
achromatopsia. (AR)		See color vision.
Ackerman glaucoma. (AR)	Gene	Have juvenile glaucoma and dental defects.
acrocephalopoly-syndactyly. ACPS. type I. (AR, AD)	***FGFR2*** at 10q25.3-q26	See Pfeiffer, formerly Noack syndrome, also called ACSV. Craniosynostosis, broad thumb and great toe, and polysyndactyly.
ACPS. type II. (AR). MIM 201000	***FGFR2*** at 10q25.3-q26	Carpenter syndrome with mental retardation, craniosynostosis, preaxial polydactyly, brachydactyly, syndactyly, and corneal opacities. Is a severe form of Apert syndrome. (MIM 101200).
ACPS. type III (AD). MIM 101120	Genes.	Sakati-Nyhan-Tisdale syndrome is rare. Craniosynostosis, acrocephaly, leg hypoplasia, preaxial polydactyly, and hypertelorism.
ACPS. type IV zaeus. MIM 201020, 272350	Genes.	The Goodman and Summitt syndromes are both variants of Carpenter syndrome, with obesity, acrocephaly, syndactyly, and polydactyly.
acrocephalosyndactyly, ACS. type I. (AD, AR). MIM 101200	***FGFR2*** at 10q25.3-q26	Apert syndrome is also called ACPS2, incidence 1/130,000, signs are. oxycephaly (tower skull), parrot-beaked nose, hydronephrosis, syndactyly, hypertelorism, exophthalmos, and external strabismus. Mutations in ***FGFR2*** are involved in several syndromes: Apert (MIM 101200), Carpenter (MIM 201000), Crouzon (MIM 123500), Jackson-Weiss (MIM 123150), and others.
ACS. type II (AD). MIM 180750	***TWIST*** at 7p22-p21	Robinow-Sorauf syndrome patients may have polydactyly of the great toes but otherwise resemble Saethre-Chotzen syndrome.
ACS. type III (AD). MIM 101400	***SCS, TWIST*** at 7p22-p21	Saethre-Chotzen syndrome, signs are craniosynostosis, pointed nose, cleft palate, heart defect, hypertelorism, and strabismus. A few have learning disability or are mentally retarded.
ACS. type IV (AD). MIM 180750	***ACS IV***	Also called Robinow-Sorauf syndrome. Clinodactyly, camptodactyly, ulnar deviation, hypertelorism, and strabismus. Resembles Saethre-Chotzen syndrome (AD) (MIM 101400).
ACS. type V . (AD) MIM 101600	***FGFR2*** at 10q25.3-q26, ***FGFR1*** at 8p11.2-p11.1	See Pfeiffer, Crouzon, Noack, and Apert syndromes. Can also cause cancer.
acoustic neuroma. (AD, S)	***NF2*** at 22q12.2	Compare with ***NF1*** at 17q11.2.
acrodermatitis enteropathica (AR). MIM 201100	Gene may be ***SLC39A4*** at 8q24.	Zinc deficiency manifests in infancy, acrodermatitis, diarrhea, and failure to thrive.
acrofacial dysostosis (AD)	***AFDN*** at 9q32	See Nager syndrome. (MIM 154400)
acromegaloid changes, cutis verticis gyrata, and corneal leukoma (AD). MIM 102100	***ACL***	Rosenthal-Kloepfer syndrome onset by age 1 year. Tall with large hands and feet, longitudinal folds in scalp skin, pituitary tumors, keratitis and bilateral corneal leukomas.
acrorenoocular or acral-renal-ocular syndrome (AD, AR). MIM 102490	Gene	Thumb hypoplasia, polydactyly, horseshoe kidney, mental retardation, Duane anomaly (MIM 126800), ptosis, and optic nerve colobomas. (MIM 126800).
acromicric dysplasia. (AD). MIM 102370	Gene	Severe growth retardation, short hands and feet, carpal tunnel syndrome, hoarse voice, and mild facial anomalies. See Moore-Federman syndrome (AD), (MIM 127200).
acute retinal necrosis syndrome	***ARN*** or ***BARN***	Bilateral retinal necrosis is mostly caused by a herpes infection. See Leigh syndrome. (MIM 256000), and can occur with a varicella-zoster virus infection.

acyl CoA dehydrogenase deficiency. type 1. (AR). MIM 201470	***ACADS, SCAD*** on chromosome 12	Short chain type, very rare.. Deficiency of mitochondrial short chain acyl, CoA, butyryl CoA.. Can manifest in infancy or later in life.
acyl CoA dehydrogenase deficiency. type 2. (AR). MIM 201450	***ACADH, ACADM*** at 1p31.	Medium chain type, carnitine deficiency, ***CACT*** at 3p21.31. A deficiency of acyl CoA occurs in 1/10,000 births. With this deficiency the child can die at about age 2 years. Some have Reye syndrome, (AR) ***SCD*** at 5q31.1(MIM 212140) adrenal unresponsiveness..
acyl CoA dehydrogenase deficiency. type 3. (AR). MIM 201460	***ACADL, LCAD*** at 2q34-q35 .	Long chain type. ***LCAD*** deficiency has its onset before age 6 months and is a more severe type.
Addison disease. (AR, XL). MIM 240200, 169710, 269200, 240300.	***APECED, AIRE*** at 21q22.3. Some have a deletion from ***DAX1*** at Xp21.3-p21.2 for a hormone receptor.	Female preponderance, familial hypoadrenocorticism, adrenal hypoplasia, adrenal unresponsiveness, hypoparathyroidism, pernicious anemia, vascular collapse, seizures, ataxia, alopecia, hepatitis, and hypogammaglobulinemia. Is associated with ***HLA-DR3*** and ***HLA-DR4***. See Schmidt disease. **APS-II.** Compare with: Bernard-Sergent syndrome with adrenal cortical insufficiency and the polyglandular autoimmune diseases, ***PGA-1, PGA-2***, and ***PGA-3***.
adenomatous polyposis coli. (AD)	***APC, FPC*** at 5q21-q22	See Gardner syndrome (AD) (MIM 175100) and Turcot syndrome (AD, AR). (MIM 120436, 175100, 600259.)
adenosine deaminase deficiency or excess (AD). MIM 102730	***ADA*** at 20q13.11, ***AMPD3*** at 11pter-p13, ***DSRAD*** at1q21.1-q21.2.2	Metabolizes adenosine to inosine, mutation causes severe immunodeficiency and asthma. Shows reduced activity in autism. ***DSRAD*** in erythrocytes is for the RNA-specific type.
adenosine kinase. (AD)	***ADK*** at 10q11-q24	An important enzyme for the heart, CNS, and immune system.
adenylate cyclase-I. MIM 103072	***ADCY1*** at 7p13-p12, brain	At least eight more genes can be involved. Adenyl cyclase 2 ***ADCY2*** at 5p15.3, ***ADCY3*** at 2p24-p22, ***ADCY4*** at 14q11.2, ***ADCY5*** at 3q13.2-q21, ***ADCY6*** at 12q12-q13, ***ADCY7*** at 16q11.2-q13, ***ADCY8*** at 8q24.2, and ***ADCY9*** at 16p13.3.
adenylate kinase deficiency. (AD). MIM 103000.	Three subtypes, ***AK-I*** at 9q34.1, and ***AK-II***, and ***AK-III***.	Hyperpyrexia, tachycardia, hemolytic anemia, rigidity, and renal failure. See the anemias. Types 2 and 3 are mitochondrial.
adenyl succinase deficiency. (AR)	***ANADSL*** at 22q13.1	See autism. (MIM 209550).
The adrenal glands produce at least 28 substances, including aldosterone, cortisone, and ACTH.		
adrenal hyperplasia-I. (AR)	***STAR*** at 8p11.2	Defective synthesis of cortisol. Congenital adrenal hyperplasia, **CAH**.
adrenal hyperplasia-II. (AR).	***HSD3B2*** at 1p13.1.	Salt wasting and incomplete masculinization in males.
adrenal hyperplasia. (AR)	***CYP21, CA21H*** at 6p21.3	For 21-hydroxylase deficiency a salt-wasting subtype.
Adie syndrome (AD). MIM 103100	***HAS***	Holmes-Adie syndrome can appear in second or third decade. Loss of tendon reflexes in ankles and knees, chronic cough, tonic pupil often unilateral, iridoplegia, slightly enlarged pupils. Iris is very sensitive to methacoline..
17-alpha hydroxylase deficiency. (AR)	***CYP17*** at 10q24.3	Adrenal hyperplasia.
11-beta hydroxylase deficiency. (AR)	***CYP11B1, P450C11*** at 8q21	Congenital adrenal hyperplasia, and hypertension. See the salt-losing syndromes. One gene is ***HSD3B2*** at 1p13.1 Compare with: ***CLD*** at 7q22-q31.1 (MIM 214700), and ***CLCNKB*** at 1p36 for Bartter-3 syndrome. (MIM 602023).
adrenal hypoplasia, congenital (XR). MIM 300200 (AR). MIM 240200	***DAX1, AHX, AHC*** at Xp21.3-p21.2	Deletion here causes adrenal insufficiency with hypogonadotropic hypogonadism. Nine mutations have been identified in ***NROB1*** at Xp21. May have anencephaly. Note ***MRX*** maps to Xp21.3-p22.11.
adrenal hypoplasia. (AR). MIM 202150, 202155	Gene on chromosome 6.	Mutation causes ataxia. Some have respiratory distress. May be misdiagnosed as sudden infant death syndrome. Compare with: Addison disease. (MIM 240200, 240300) and Schmidt disease (MIM 269200).
adrenergic receptors, alpha. . MIM 104219.	***ADRA1A*** at 5q23-q32. .	There are at least six more alpha receptors. Type 2C is at 4q16.1.
adrenergic receptors, beta. MIM 104220	***ADRA1B*** at 5q33	There are at least two more beta receptors.

adenine deaminase. (AD). MIM 102700	***ADA*** at 20q13.11	Many subtypes. Severe immunodeficiency and asthma. Shows reduced activity in those with autism.
adenosine deaminase. MIM 601059	***DSRAD*** at 1q21.1-q21.2	The RNA specific type in erythrocytes metabolizes adenosine to inosine. Patients with **SCID** are unable to produce adenosine deaminase.
glucocorticoid deficiency. (AR)	***MC2R*** at 18p11.2	Show adrenal unresponsiveness.
cortisol resistance. (AD)	***GRL*** at 5q31-q32	A glucocorticoid receptor deficiency.
salt-wasting disease. (AR). MIM 602023	***CLCNKB*** at 1p36	Bartter syndrome-III, ***CLCNKB*** at 1p36, (MIM 602023) and see chloride diarrhea ***CLD*** at 7q22-31.1. (MIM 214700). The ***DRA*** gene (MIM 126650) may be responsible.
adrenocortical leukodystrophy. (XL)	***ALD1*** at Xq28. ***ALDR*** at 12q11-q12 is for the receptor.	Adrenomyeloneuropathy is a childhood degenerative disease with paraplegia and blindness.
adrenoleukodystrophy, neonatal. (AR). MIM 202370	***NALD, PXR1, PEX5*** at 12p13.3	Adrenoleukodystrophy is the most frequent peroxisomal disorder. Cholesterol and long-chain fatty acids accumulate in cells. Diffuse hair loss from scalp and eyebrows. See Zellweger syndrome, and see Scholz disease. Adrenomyeloneuropathy (**AMN**) (MIM 300100) is an adult variant of adrenoleukodystrophy with onset in late childhood.
adrenoleukodystrophy. (AR)	***PEX1*** at 7q21-q22, ***PEX10*** at 7q22.	Neonatal mental retardation, seizures, esotropia, and cataract.
adrenoleukodystrophy. (XL). MIM 300100	***XALD, ABCD1*** may be at Xq28 ***AIRE*** at 21q22.3.	Very long chain fatty acids (VLCFA) accumulate in this demyelinating disorder. Affects the CNS and adrenal system of 1/50,000 people. Onset in late childhood. Compaare with achalasia, Addisonianism, and alacrima. (MIM 231550).
adrenoleukodystrophy-like disease. MIM 601081	***ALDL1*** at 12q11-q12	Adrenomyeloneuropathy is a childhood degenerative disease with paraplegia and blindness.
ADULT syndrome (AD). MIM 103285	Mutation in ***p63*** at 3q27.	Acro-dermato-ungual-lacrimal-tooth syndrome. The gene ***p63*** (a member of the ***p53*** gene family) is expressed in basal cells of different organs.
aganglionic megacolon (AR). MIM 207500	Gene	Incidence 1/5000. Severe anal atresia. See also imperforate anus. (XL). (MIM 301800).
AEC or Hay-Wells syndrome. (AD). MIM 106260	Mutation in ***p63*** at 3q27. Some may be inherited AR.	Ankyloblepharon, ectodermal defects, cleft lip/palate, alopecia, hypodontia, coarse wiry hair, dystrophic nails, cleft lip, hypodontia, filiforme adnatum (fused eyelids). The ***p53*** gene family includes ***p53, p63***, and ***p73***. The gene ***p63*** has alpha, beta and gamma forms and influences ***p53*** which is a tumor suppressor***.*** Mutations in ***p63*** occur in: AEC, EEC, ADULT, split hand-split foot, and the limb-mammary syndromes. Compare Bowen-Arms trong syndrome (AR) (MIM 225000).
agammaglobulinemia-I (XR). MIM 300300	***XLA, AGMX1, BTK, IMD1*** at Xq21.3-q22 (one pedigree shows AR inheritance)	Immunodeficiency-I or Bruton disease the commonest inherited antibody deficiency depends on a tyrosine kinase gene. Lacking mature B lymphocytes, they are subject to bacterial but not to viral infections. The affected boys have rheumatoid-arthritis-like symptoms.
agammaglobulinemia-II (XR)	***XLA2, AGMX2, IMD6, GHD*** at Xq21.3-q22	With growth hormone deficiency. See the tyrosine kinase gene. The gene for another XL agammaglobulinemia with growth hormone deficiency is at Xp22. For an AR type ***IGHM*** is 14q32.33 see MIM 147020.
Swiss agammaglobulinemia (XR). MIM 300400, 312863	***SCIDX1*** at Xq13.1-q21.1, ***SCIDX2*** at Xq13.1.	Defects of thymus and tonsillar systems. AR or AD inheritance is also possible. (MIM 200900).
agammaglobulinemia. (AR)	***HYRC1*** at 8q11	Other genes can be involved. See also hypogammaglobulinemia, (AR), (MIM 240500).
agammaglobulinemia. (AD)	***ADA*** at 20q13.11	Adenosine deaminase. Other genes are ***IGHM*** (AR) at 14q32.33, ***MCM4*** at 8q11.2, and ***RPTP rho*** at 20q12-q13.1.
agenesis of the corpus callosum. (AR, AD, XL) MIM 217990, 218000	***ACCPN*** at 15q13-q15	Agenesis of the corpus callosum is a component of several syndromes. For the XL type with seizures and microcephaly the gene is on chromosome Xp. Death before age 3 years.
Aicardi syndrome (XD, XR, S). MIM 304050	***AIC*** at Xp22 or a translocation t(X;3)(p22;q12).	With agenesis of the corpus callosum the affected females at birth have severe mental retardation, flexion spasms, microphthalmia, chorioretinal abnormalities, and colobomas of optic nerve and choroid. Lethal in hemizygous males.

Aicardi-Goutieres syndrome (AR). MIM 225750	One gene is ***AGS1*** at 3p21. .	Soon after birth have severe, progressive, familial, encephalopathy with microcephaly, calcification of the basal ganglia, white matter abnormalities, CSF lymphocytosis, and increased interferon-alpha. Cree encephalitis is similar. Compare with the pseudo-TORCH syndrome. (MIM 600158).
AIDS, acquired immunodeficiency syndrome	Not a genetic disorder.	Breakdown of the immune system, Kaposi sarcomas, and CMV retinitis. More common in homosexual men and users of intravenous drugs.
Alagille arteriohepatic dysplasia. (AD, S). MIM 118450, 601920	***AGS, AHD***, ***JAG1*** at 20p12.1-p11.23	The deletion causes intrahepatic ductular hypoplasia, neonatal jaundice, posterior embryotoxon, and eccentric pupils. At least 70% survive to age 20.
Albers-Schönberg syndrome. (AR, AD)	***MCSF*** at 1p21-p13, ***OPTB1*** at 11q12-q13.	Osteopetrosis or marble bone disease can be mild or severe. See ***CA2*** at 8q22-q13. (MIM 259730).

Albinism and Albinoidism. Have a deficiency of melanin. Albinos may have decreased vision, grey-blue translucent irides, photophobia, pendular nystagmus, and blood vessels in the fovea. Mutations in ***MNK, ATP7A*** at Xq12-q13.3 can cause albinism. Those with anodontia-hypotrichosis-albinoidism (AR) have short stature, strabismus, nystagmus, cataracts, and high myopia. Kline syndrome (AD) is a irido-dermato-auditory dysplasia with partial albinism, deafness, hypertelorism, hypertrichosis, blepharophimosis, and heterochromia iridis. See the Bartter syndromes (AR) where some have tyrosinase-negative oculocutaneous albinism. Genes are ***BSND*** at 1p31, ***SLC12A1*** at 15q15-q21.1, ***ROMK1*** at 11q24, ***CLCNKB*** at 1p36, and ***SLC12A3*** at 16q13. A temperature-sensitive oculocutaneous albinism also depends on tyrosinase.

Lewis ocular albinism (AD) is tyrosinase positive, they have lentigines and deafness.

For Waardenburg type II with albinism (AD or XL) see (MIM 103470).

Cross or Kramer syndrome (AR) (MIM 257800) is an Amish oculocerebral syndrome with posterior fossa defects, skin hypopigmentation, mental retardation, microphthalmia, microcornea, aniridia, nystagmus, and optic atrophy. Hypopigmentation is also present in Preus syndrome (AR) (MIM 257790). The gene for rufous albinism has been mapped to 16q24.3 or to 9p23. For brown albinism ***OCA-3*** (MIM 203290) see ***TRP-1*** at 15q11.2-q12 (MIM 115501) but also said to be at 9p23.

Patients with akbinoidism have very little visual impairment. Subtypes include oculocutaneous albinoidism (AD) and punctate oculocutaneous albinoidism and some cases are associated with Apert syndrome.

Piebaldism depends on defects in the ***kit*** gene. Those with AR piebaldism have deafness, and those with AD piebaldism have ataxia and deafness.

Mesodermal dysgenesis of the anterior chamber (AD) signs are oculocutaneous albinism, external ophthalmoplegia, iris atrophy, flat cornea, Peters anomaly, keratoconus, and microphthalmia. In a syndrome with anodontia, hypotrichosis, and albinoidism (AR) other signs are short stature, strabismus, nystagmus, distichiasis, cataracts, and high myopia. Seems to relate to ***FOXC1*** at 6p25.

Several syndromes combine albinism and deafness, see Lewis, Teitz, Waardenburg, Winship, and Ziprowski-Margolis. The gene for a late-onset sensorineural deafness with ocular albinism maps to Xp22.3.

Gene	How inherited	MIM number	Condition
OA1, XOAN at Xp22.3	XR	300500	Mutation causes Nettleship-Falls ocular albinism, an Amish or yellow type with abnormal decussation of retinogeniculate axons at the chiasma. Yellow albinism ***OCA1-B*** is at 11q14-q21 (MIM 203100). ***OCA1-A*** for a tyrosine negative albinism is also at 11q14-q21 (MIM 203100).
OA2, AIED at Xp11.4-p11.23	XR	300600	Åland Island eye disease, Forsius-Eriksson ocular albinism with deafness, mental retardation, epilepsy, microphthalmia, nystagmus, and myopia.
OA3, OAR at 6q13-q15, ***P, PED, D15S12*** at 15q11.2-q12	AR	203310 203200	Witkop punctate oculocutaneous albinism with congenital albinotic fundi, nystagmus, and strabismus. See also ***OA-2*** (MIM 300600) and ***EYCL3***. (MIM 227220).
OASD, XOAD at Xp22.3.	XR	300650	Ocular albinism cum pigmento, Winship albinism with sensorineural deafness, onset after puberty.
TYR at 11q14-q21	AR	203100	Tyrosinase deficiency causes **OCA-1A, OCA-1B, OCA-1C,** and ***OCA ITS*** for temperature-sensitive albinism. ***MITF*** at 3p12-p14.1 regulates ***TYR.*** Tyrosinase-negative oculocutaneous albinos have pink skin and white hair.
P, PED, D15S12 at 15q11.2-q12	AR	203200	**OCA-2,** affects 1/36,000 but more blacks. These tyrosinase positive oculocutaneous albinos often have macular hypoplasia. See also ***OA-3*** (MIM 203310) and ***EYCL3***. (MIM 227220).
TYRP1, CAS2, GP75 at 9p23	AR	115501 203290	**OCA-3** and **OCA-4**, for xanthous or brown and ***OCA-5*** for rufous tyrosinase positive albinism. Affected blacks have copper-red hair.
HPS1 at 10q23.1-q23.3. Possibly a gene at 4p15-p16 and a pseudogene at 22q12.2-q12.3.	AR	203300	Hermansky-Pudlak oculocutaneous tyrosinase positive albinism is a delta storage pool disease with a bleeding diathesis, pulmonary fibrosis, and granulomatous colitis. Ceroid-like material accumulates in the reticuloendothelial system. Translucent irides, nystagmus, and pale fundi.
HPS2, ADTB3A, EPB42 at 15q15	AR, AD	185050	Hermansky-Pudlak albinism **OCA-6A,** (gene is palladin), with a platelet storage pool deficiency and a bleeding diathesis.

HPS3 at 3q24	AR		Is a susceptibility gene for Hermansky-Pudlak syndrome-III. ***GMPS*** also maps here. (MIM 600358).
CD63, MLA1, TPK4 at 12q12-q13.	AR	155740	Hermansky-Pudlak oculocutaneous albinism. Is this ***HPS4***? Melanoma associated, often have epistaxis and pulmonary fibrosis.
NID, CHS1 at 1q 42.1-q42.2	AR	214500	Chédiak-Higashi tyrosinase positive oculocutaneous albinism, immune deficiency with anomalous leukocyte inclusions, anemia, thrombocytopenia, lymphadenopathy, and nystagmus. Retinal vessels are smaller and fewer. Death before age 10.
ADFN, ALDS at Xq26.3-q27.1	XR	300700	Ziprowski-Margolis or Woolf syndrome may be classified as albinoidism or ocular albinism with deafness, piebald skin, and heterochromia iridis.
LYST, KIT, PBT at 4q11-q12.	AD	172850	Albinoidism, piebald trait.
PAX3 at 2q35	AD	193500	Albinoidism. See Waardenburg syndrome, type III. .
Gene	AR	211370	Anodontia-hypotrichosis-albinoidism, oculoosteocutanous syndrome, short stature, brachymetapody, mental retardation, strabismus, nystagmus, cataracts, distichiasis, and high myopia.
MITF at 3p12-p14.1	AD, XL	156845 103470	Teitz syndrome. Albinoidism with deafness. ***PAX3*** (at 2q35) regulates ***MITF*** which regulates ***TYR***. (MIM 203100).
M YO5A, RAB27A at 15q21.	AR	601081	Griscelli albinis m with partial immunodeficiency.

Name	Gene	Comments
Albright osteodystrophy-I (XD, AD, XR, AR) MIM 103580, 203330, 300800.	***AHO1, GNAS1, GNAS,*** at 20q13.22-q13.3	Hereditary pseudohypoparathyroidism, ectopic calcification, hypothyroidism, seizures, and mental retardation. Affects more females than males. See Cushing syndrome-I. Gene ***GNAS1*** (AR) (MIM 219080).
Albright osteodystrophy-II (AD, XL, AR). MIM 103581	***AHO2*** at 15q11-q13, ***GNAS1*** at 20q13.22-q13.3	Hypothyroidism, short stature, tetany, and mental retardation.
Albright-III. (AD)	***BDMR*** at 2q37	Mental retardation. (MIM 600430).
alcohol intolerance. (AD)	***ALDH2*** at 12q24.2	***FAS*** for the fetal alcohol syndrome maps here too.
aldehyde dehydrogenase-6. MIM 600463	***ALDH6*** at 15q26.	There are at least eight dehydrogenase genes including ***ALDH1, ALDH3, ALDH4, ALDH5, ALDH7***, and ***ALDH9***.
aldose reductase. (AR). MIM 103880	***ALDR1*** at 7q35	Several genes or pseudogenes can be responsible. Increased risk of kidney disease in diabetics. See aldehyde reductase (AR) (MIM 103830).
aldolase A deficiency. (AR).	***ALDOA*** at 16q22-q24 .	Have anemia, mental retardation, and ptosis.
aldosteronism. (AR)	***CYP11B1, P450C11*** at 8q21	Beta hydroxylase deficiency and arterial hypertension
Aldrich or Wiskott-Aldrich syndrome. (XR) Alexander disease. (AR, AD). MIM 203450	***WAS, IMD2*** at Xp11.23-p11.22 ***GFAP*** at 11q21-q23	Signs include eczema and thrombocytopenia. Rare dysfunction of astrocytes which have many Rosenthal fibers, a non-lysosomal leukodystrophy, neurologic degeneration and dysfunction, alpha-B-crystallin accumulates in the brain, diffuse demyelination, atrophy of the medulla oblongata and upper spinal cord, seizures, retardation, ataxia, spasticity, hydrocephalus, and gaze-evoked horizontal nystagmus. Most die in their first decade. See Canavan disease (MIM 271900) and see the presenilins.
alkaptonuria or alcaptonuria (AR). MIM 203500	***AKU*** at 3q21-q23	Lack homogentisic oxidase, homogentisic acid accumulates in blood, dark urine, pigmentation of cartilage and elastic tissue, osteoarthritis, atherosclerosis, ochronosis (ochre coloring especially near insertion of medial and lateral rectus muscles), and heart disease apparent soon after birth, worse in males than in females, a few have an adult-onset type. In their twenties have pigmentation of peripheral cornea, sclera, and conjunctiva.
Allgrove syndrome (AR). MIM 231550	***AAA*** at 12q13 For lipoma see ***BABL*** at 12q13.	Adrenal insufficiency, ACTH insensitivity, achalasia, aldosteronism, microcephaly, short stature, palmoplantar hyperkeratosis, and alacrima.
alopecia universalis.		See hair.
Alpers-Huttenlocher syndrome. (AR). MIM 203700	***AHS*** is mitochondrial.	Progressive encephalopathy, childhood-onset, diffuse degeneration of cerebral gray matter, developmental delay, seizures, hepatic cirrhosis, lung involvement, and a deficit in the respiratory chain. ***COX*** deficiency is involved.
alpha-1 adrenergic receptors	***ADRA1B*** at 5q33, ***ADRA1C*** at 8p21, ***ADRA1D*** at 20p13	There are at least four more receptors including ***ADRA1A*** at 5q23-q32 or on chromosome 20. They affect blood pressure. See also the beta adrenergic receptors.
alpha-1-antichymotrypsin. (AD).	***AACT*** at 14q31-q32.3	Inhibits plasma protease.

alpha-1-antitrypsin deficiency . (AR). MIM 107400	***APi*** at 14q32.1	Necrotizing vasculitis of liver and lung emphysema. Increases the risk of coronary disease especially in those who smoke or are obese.
alpha ketoglutarate dehydrogenase deficiency. (AR).	***OGDH*** at 7p14-p13.	Causes metabolic acidosis and early death.
Alport syndromes At least six subtypes including an XL variety, an AR type, and an AD type with renal failure but without deafness, (MIM 161900). For another AD type the gene is at 13q33-q34, (MIM 104200). Most have hemorrhagic nephritis, deafness (especially males), and bilateral, progressive, anterior lenticonus. Affected boys soon die but affected girls have a normal life expectancy. In the juvenile type they reach endstage renal disease by age 30.		
(XD type) MIM 303630	***COL4A5*** at Xq22	With leiomyomatosis.
(XD type) MIM 301050	***ATS, ASLN*** at Xq22-q24	With nephropathy and deafness.
(AR type, rarely AD) MIM 203780 Alport (AD and XD types) . MIM 308940	***AE3, COL4A3, COL4A4*** at 2q36-q37 ***COL4A3*** at 2q36-q37	Basement membrane collagen. See also hematuria. (MIM 120070, 120131). Several subtypes. Leiomyomatosis with nephropathy and deafness. (XD). For AD types mutations in ***COL4A5*** (MIM 303530) and ***COL4A6*** (MIM 303631) may be responsible.
Fechtner syndrome. (AD). MIM 153640	***MYH9*** at 22q12.3-q13.2	A variant of Alport syndrome with nephritis, macrothrombocytopenia, deafness, and cataract. See Epstein syndrome (MIM 153650.).
Alström-Hallgren syndrome . (AR). MIM 203800	***ALMS1, ALSS*** at 2p14-p13.	Signs appear before 10 years of age, obesity, diabetes mellitus, nephropathy, deafness, cataract, nystagmus, retinitis pigmentosa, but generally no mental retardation.
Alström-Olsen syndrome. (AR)	Gene. Seems to be the same as ***LCA-2.***	Amaurosis congenita with mental retardation, microcephaly, hypoplasia of the cerebellar vermis, nystagmus, keratoconus, atrophic retinal lesions, and salt and pepper pigmentary retinitis. See ***LCA-1*** (MIM 204000) and ***LCA-2*** (MIM 204100).

Alzheimer disease a diffuse brain atrophy, is the most common cause of dementia. It affects 2% or 3% of the population, generally between 70 and 80 years of age**.** See also the amyloidoses, parkinsonism, mental retardation, Pick disease, and dementia.

Among those with Alzheimer disease less than 1% have Down syndrome, trisomy 21. From 5% to 10% of Alzheimer patients have AD mutations in ***APP***. ***APP*** is cleaved to make Aß peptide in amyloid in all cases of Alzheimers but not in all cases of dementia. The disease begins in the mid 50s and progresses rapidly. Mutations in the presenilins ***PSEN1*** at 14q24.3 and ***PSEN2*** at 1q31-q42 also play a role. The presenilins and ***APP*** increase production of amyloid beta protein in the brain. They are involved in 50% of early-onset (age 30 to 50) Alzheimer disease. Mutations in ***PSEN1*** account for 40% of early-onset Alzheimers but only 5% of all cases of Alzheimers.

The most common type of Alzheimer disease (90% to 95% of cases), a late onset type, is generally sporadic. Signs appear in the 70s and 80s and the disease progresses more slowly. Age is the important risk factor. Lipid metabolism both within and outside the brain has a role in Alzheimer disease. The risk is higher in those who have ***APOE4*** at 19q13.1. More women than men are affected. Early symptoms are loss of the sense of smell, short term memory loss, confusion, disorientation, personality changes, and disorders of gait and behavior. Most have a shuffling gait and fixed dilated pupils. Secondary symptoms include depression, anxiety, restlessness, hallucinations, and sleep disorders. Late-onset Alzheimer disease (onset after age 60) relates to the actions of more than 50 genes including genes on chromosomes 4, 6, 10, and 12. Other genes that may be involved in Alzheimers are: interleukin-6, human leukocyte antigen, alpha-1 antichymotrypsin, and angiotensin converting enzyme. About 10% of those over age 70 have dementia and more than half of those with dementia have Alzheimers. Among those over age 85 possibly 30% have clinically significant dementia.

Normally the amyloid precursor protein ***APP*** in the outer membrane of cells is cut into segments. These peptides are 39 to 43 amino acids long. The cutting occurs at alpha, beta, and gamma sites. Cuts at the alpha site produce harmless fragments. In Alzheimer disease the beta and gamma secretases become more active. The beta secretase enzyme **BACE1** produces the amino terminus and the gamma secretase cleaves the carboxyl terminus of the peptide from ***APP***. The cleavage site lies within the membrane spanning domain of ***APP*** so acts within the lipid layer of the cell membrane. The most common peptide is Aß1-40 and the most toxic peptide produced is Aß1-42. These peptides are promptly exported from the cells. In extracellular space the peptides fold, form a sticky cluster, a beta-containing aggregate, a toxic plaque. The age-related decrease in adenosine triphosphate ***ATP*** also has a role here.

The Aß peptides clustered outside the cell trigger changes in ion passageways the **AMPA** type channels in the outer membrane of neurons allowing calcium to flow into the neuron. **AMPA** is alpha-amino-3-hydroxyl-5-methyl-4-isoxazole-propionic acid. The excess calcium in the neuron leads to cognitive defects because of the prevalence of **AMPA** receptors in the hippocampus and cortical regions involved in memory and critical thinking. The extra calcium (CA^{2+}) also leads to the addition of an excessive number of phosphate groups (PO_3) to the tau protein. Normally tau stabilizes microtubules that give a cell its structural integrity. Tau is increased inside the

neurons and then forms long fibrils that eventually become neurofibrillary tangles. Calcium is a common kinase trigger. Kinases control many cellular functions by adding phosphate groups to proteins. Brain cells filled with hyperphosphorylated tau become dysfunctional.

Cholinesterase inhibitors help to restore cholinesterase levels in the brain and this enhances cholinergic neurotransmission and aids Alzheimer patients. Drugs that may be some help in Alzheimer disease such as donepezil, galantamine, and rivastigmine inhibit acetylcholinesterase and prolong the effect of acetylcholine.. See Aricept, Cognex, and Exelon. See also memantine which inhibits glutamate-sensitive channels. Anti-inflammatory medications may delay Alzheimer disease or slow its progression.

Some Alzheimer patients are hypersensitive to tropicamide. Tacrine can be some help in the treatment of Alzheimers.

Clinically Alzheimer disease may be indistinguishable from Pick disease.(AD), gene ***MAPT*** at 17q21.11, (MIM 157140) have neuropathy, heart failure, defects of kidney and liver, muscular weakness, ophthalmoplegia (internal and external), strabismus, amyloid deposits, vitreous opacities, and keratoconus.

Gene	How inherited	MIM number	Condition
A2M2 questioned	Mito	502500	Susceptibility to Alzheimer disease. Mutations in ***APBA1, APBA2, APBB1***, and ***APBB2*** can also increase susceptibility:
DCP1, ACE at 17q23	AD	106180	An angiotensin-converting enzyme seems to increase the risk of Alzheimer disease and so does the (AR) gene ***BCHE*** for pseudocholinesterase at 3q26.1-q26.2. (MIM 177400).
AAT, AT at 14q32.1	AR	107280	Alpha-1 antichymotrypsin deficiency increases the risk of developing Alzheimers.
FALZ, FAC1 at 17q24		601819	Fetal Alzheimer antigen, a zinc finger DNA-binding protein. ***FAC1*** is the symbol for the tau gene.
MTHFD at 14q24	AD	172460	Phosphoribosylglycinamide formyl transferase, with neural tube defects. Compare ***AD3*** at 14q24.3 (AD) (MIM 104311).
AD1, APP, CVAP at 21q11.2-q21	AD	104760 104300	Alzheimer-1 disease has an early onset. Up to 10% of Alzheimer cases are inherited in the AD manner. The amyloid beta A4 precursor ***APP*** is regulated by retinoic acid especially in epithelial tissues. Alpha, beta, and gamma receptors exist for retinoic acid. See amyloidosis and schizophrenia. See tau protein and see Down syndrome. (MIM 190685).
AD2, APOE, APOE4 at 19q13.2	AR	107741 104310	Alzheimer-2 disease, a late-onset type. Relates to an apolipoprotein E type 4 allele at 19cen-q13.2.
AD3, PSEN1 at 14q24.3	AD	104311	Alzheimer-3 disease. The gene for presenilin-1 increases production of amyloid beta plaques in the brain so is involved in early-onset Alzheimers. Signs can appear as early as age 40.
AD4, TM2, PSEN2, at 1q31-q42	AD	600759	Alzheimer-4 disease. Gene is for presenilin-2 which increases production of amyloid plaques. Onset after age 50. See also ***APP***. (MIM 104760)..
AD5 at 12p11.23-q13.12	AD	602096	Alzheimer-5 disease, familial.

Name	Gene	Comments
amaurosis fugax	Gene	Episodes of loss of vision, often caused by hypertension, or atherosclerosis, especially in heavy smokers. Their vascular insufficiency may be in the vertebrobasilar arterial system or in the ipsilateral carotid artery. Amaurosis fugax may provide a warning of transient ischemic attacks, or stroke, or Wegeners granulomatosis. Gene cluster is at 14q32.1.
amaurosis congenita (AR). MIM 204400	At least 6 different loci.	May have keratoconus and hepatomegaly. See Leber amaurosis congenita of several types. (MIM 204000). See also amaurotic idiocy (MIM 204600).
amelogenesis imperfecta-I. (XD)	***AIH1, AMELX, AMG, AMGX*** at Xp22.3-p22.1	Many kinds of amelogenesis, some are AD, some XD and some AR. The tooth enamel may be hard but too thin or it may be soft and erodable.
type-II. (AD, AR, XL)	***AIH2*** at 4q11-q21	Hypocalcification can also cause cone-rod dystrophy.
type-III. (XR)	***AIH3*** at Xq22-q28	Other subtypes have been reported.

Amyloidosis. Amyloid (more than 7 subtypes) is an abnormal glycoprotein that forms nodular deposits in mesodermal tissues. Idiopathic amyloidosis (AD) causes an accumulation of amyloid in many tissues. Familial Mediterranean fever (AR) predisposes to amyloidosis, the risk is greater in males. See also Alzheimer diseases.

Lubarsch-Pick primary amyloidosis (AD) patients have neuropathy, heart failure, defects of kidney and liver, muscular weakness, ophthalmoplegia (internal and external), amyloid deposits, vitreous opacities, strabismus, and keratoconus. ***APP*** is for an amyloid precursor protein, two precursor-like proteins depend on the genes ***APLP1*** and ***APLP2***.

See also Muckle-Wells syndrome (AD) (***MWS*** at 1q44) with urticaria, progressive deafness, and amyloidosis. (MIM 191900.)

Gene	How inherited	MIM number	Condition
APCS, SAP at 1q12-q23	AD	104770	Susceptibility to amyloidosis. P component in serum.
APBA1 on chromosome 9? or at 21q21.3-q22.05		602414	Amyloid beta A4 precursor protein-binding. Gene ***APBA2*** is on chromosome 15q, ***APBB1*** at 11p15, and ***APBB2*** on chromosome 4. More susceptible to Alzheimers.
APLP1 at 19q13.1	AD	104775	Amyloid precursor-like protein-I. Some get late-onset Alzheimers.
APLP2 at 11q23-q25	AD	104776	Amyloid precursor-like protein-II. See Alzheimer diseases.
APPL1 at 9q31-qter	AD	104740	Amyloid beta precursor-like protein-I.
CRYBA4 at 22q11.2-q13.1	AD	123631	Beta A4 amyloid gene. Beta A4 crystallin gene. ***CRYBA1*** is at 17q21 for crystallin beta A-1, (MIM 123610)
SAA1, SAA2, SAA4 at 11p15	AD	104750 104751 104752	The genes are for serum amyloid. Six subtypes including ***SAA3*** a pseudogene, and ***SAA5***, and ***SAA6***. See also Hirschsprung disease (S, AR, XR) and rheumatoid arthritis.
RET, MEN2A at 10q11.2	AD	164761 171400	Amyloid neuropathy. Mutations in these genes have a role in many diseases.
TTR, PALB at 18q11.2-q12.1	AD	176300	Mutation in transthyretin, a transport protein for both thyroxine and for vitamin A, results in Swedish or senile systemic amyloidosis. Amyloid neuropathy.
CST3 at 20p11	AD	105150	A mutation in the gene that codes for cystatin-3 causes Iceland amyloidosis or amyloidosis-6 with cerebral amyloid angiopathy.
APP, CVAP, AD1 at 21q11.2-q21	AD	104760 104300	Mutation in the gene for amyloid beta A4 precursor causes Dutch cerebro-arterial amyloidosis and Alzheimers. See ***AD4*** (MIM 600759). See ***USH1E*** at 21q21.(MIM 602097). ***APP*** is regulated by retinoic acid. Gene ***RARG*** for the receptor is at 12q13 (MIM 180190).
APOA1 at 11q23	AD	107680	Iowa or van Allen amyloidosis is apo A-1 derived.
BWS at 11p15.5 ***GSN*** at 9q34	AD AD	130650 137350	See Beckwith-Wiedemann syndrome. (MIM 130650, 602031). Amyloidosis V, Meretoja or Finnish type. The gene product is gelsolin. See also lattice corneal dystrophy-II. (MIM 137350).
B2M at 15q12-q21	AD	109700	Amyloidosis related to hemodialysis. The mutated gene is beta-2-microglobulin, some have carpal tunnel syndrome. (MIM 115430, 176300).
FGA at 4q31	AD	134820	Mutation in the gene for fibrinogen alpha polypeptide causes renal or visceral amyloidosis.
LYZ on chromosome 12	AD	153450	Lysozymes bind and cleave the glycosidic bond linkage in sugars. Lysozyme is antibacterial and a tumor necrosis factor receptor. Mutations can cause renal or visceral amyloidosis.
APOA1 at 11q23, ***FG*** at 4q28, and ***LYZ***	AD	107680 105200	Amyloidosis-VIII is a familial, visceral type with hepatomegaly and the nephrotic syndrome.

Amyotrophic lateral sclerosis, some ALS patients have dementia, one subtype causes parkinsonism with dementia. For familial amyotrophic neuralgia (AD) the gene ***HNA*** is at 17q24-q25. See also ***ITGB4.*** (MIM 147557). (Note ***GRIN2C*** (MIM 138254) also maps here.)

Name	Gene	Comments
amyotrophic lateral sclerosis type-I. (AD). MIM 105400	***ALS1, SOD1*** at 21q22.1-q22.2	Charcot, Lou Gehrig, or Young syndrome with pulmonary oxygen toxicity, muscle weakness, and bulbar paralysis.
type-II (AR). MIM 205100	***ALS2, NOUFS1*** at 2q33-q35	Juvenile-onset spasticity. For a juvenile sclerosis with dementia. (AR) the gene ***ALSJ*** may also be at 2q33-q35.
type-IV (AD). MIM 602433. type-V (AR). MIM 602099.	***ALS4*** at 9q34 ***ALS5*** at 15q15.1-q21.1	Juvenile-onset. Juvenile.
analbuminemia (AR)	***ALB*** at 4q11-q13	They form anomalous proteins.
Andersen-Warburg syndrome. (XR, S) MIM 600990	See Norrie disease, ***NDP*** at Xp11.4-p11.3. (MIM 310600)	Affects males. Mental retardation, deafness, microphthalmia, iris atrophy, lagophthalmos, and corneal opacification. Compare with blepharocheilodontic syndrome. .MIM 119580.
androgen insensitivity. (XL). (MIM 300068)	***DHTR, KD, AIS*** at Xq12	Several subtypes are reported.

Anemias. See also the blood dyscrasias. Iron deficiency causes microcytic hypochromic anemia. Among those of African ancestry 1/600 develops sickle-cell anemia.

Name	Gene	Comments
dyserythropoietic-I. (AR)	***CDAN1, CDA1*** at 15q15.1-q15.3.	Congenital anemia. Gene ***CDA2*** is at 20q11.2.
hemolytic. (AD)	***SLC4A1, EPB3*** at 17q21-q22	Human erythrocyte anion exchanger causes a band three defect.
hemolytic. (AD)	***RHAG*** at 6p21.1-p11	Rhesus blood group glycoprotein.
hemolytic. (AD)	***RH2*** at 1p36.2-p34	Rh null type. Hemolytic anemia.

hemolytic. (XL)	***PGK1, PGKA*** at Xq13, ***G6PD, G6PD1*** at Xq28	Phosphoglycerate kinase deficiency.
hemolytic anemia. (AR)	***PKLR, PK1*** at 1q21-q22	Pyruvate kinase deficiency.
hemolytic type-II. (AD).	***SPTA1*** at 1q21-q22	Anemia, jaundice, and hyperbilirubinemia.
sideroblastic anemia. (XL). MIM 301310.	***ASAT*** at Xq13	With spinocerebellar ataxia.
Elliptocytosis The gene is spectrin. Signs are: elliptical red cells, anemia, and jaundice.		
type-I. (AD). MIM 130500	***EPB41*** at 1p34.2-p33	For elliptocytosis the gene is spectrin. They have elliptical red cells, anemia, and jaundice.
Malaysian -Melanesian type (AD). MIM 109720	***AE1, EPB3, SLC4A1*** at 17q21-q22.	Red cell fragility, anemia, and jaundice.
erythroblastosis fetalis. MIM 111680.	***RHD*** at 1p36-p34.	Rh blood group D. Encodes antigens D and G. Hemolytic anemia of the newborn, jaundice, kernicterus, bilirubin deposited in the brain, edema, purpura, ophthalmoplegia, retinal hemorrhages, optic atrophy, and yellow conjunctiva and eyelids. Among the 10% who survive, expect deafness and mental retardation.
Fanconi anemia. (AD)	***ADPRT, PPOL*** at 1q42	Pseudogenes are at 13q34 and 14q24.
hemolytic anemia. (AD)	***GPX1*** at 3q11-q12	Glutathione peroxidase deficiency.
Fanconi pancytopenia type-I. (AR). MIM 227650	***FA1, FANCA,*** at 16p24.3 Complementation group A. ***LAT1*** at 16q24.3	There are seven complementation groups; Signs include: leukemia, small stature, microcephaly, congenital defects of heart and kidneys, mental retardation, and strabismus.
Fanconi pancytopenia type-II. (AR). MIM 227660	***FACB, FANCB, FA2*** Complementation group B. Genes at two loci.	Factor X deficiency. Pancytopenia with thumb deformity, anemia, bleeding, leukemia, hyperpigmentation, heart defect, kidney defect, deafness, microcephaly, mental retardation, and strabismus.
Fanconi type-III. (AR). MIM 227645	***FANCC*** at 9q22.3-q31	Complementation group C. Influences apoptotic pathways in response to oxidative damage.
Fanconi type-IV. (AR). MIM 227646	***FANCD*** at 3p26-p22	Complementation group D. D1 and D2 subgroups also exist.
(AR). MIM 600901	***FANCE, FAC E*** at 9p21-p22	Complementation group E. ***FANCF*** has also been reported.
Fanconi, de Toni-Fanconi anemia (AR). MIM 276700.	***FANCG/XRCC9*** at 9p13. Some have triplication of chromosome 1q, 1q12-q21 q31-q32.	Disorders of calcium and phosphorus metabolism with progressive aplastic anemia, renal anomalies, congenital abnormalities, and cancer. May have retinal hemorrhages..
sideroblastic anemia, hypochromic (XR). MIM 301300	***ALAS2, ASB, NH1*** at Xp11.21	Hypochromic anemia.
sideroblastic anemia. (XR). MIM 301310.	***ASAT*** at Xq13	Severe anemia and spinocerebellar ataxia.
sideroblastic anemia. (AR). MIM 249270	***TRMA*** at 1q23.2-q23.3	Anemia, diabetes mellitus, and deafness.
megaloblastic anemia (AD, AR)	***DHFR*** at 5q11.2-q13.2 (AD), ***MGA1*** at 10p12.1 (AR)	Juvenile pernicious anemia. Mutations in ***TRMA*** at 1q23.2-q23.3 (AR) (MIM 249270), cause anemia, diabetes, and deafness.
microcytic anemia. (AR)	***MAR*** at 5q12-q32, ***IRF1*** at 5q31.1.	Defective iron metabolism causes hypochromic anemia. ***SATB1*** at 3p23, binds DNA (MIM 602075).
macrocytic anemia. (AD)	***IRF1*** at 5q31.1, ***MAR*** at 5q12-q32	Refractory anemia.
hemolytic (AR)	***GLCLC*** at 6p12	Gamma-glutamylcysteine deficiency.
hemolytic (AR)	***BPGM*** at 7q22-q34	Diphosphoglycerate deficiency.
hemolytic (AD)	***AKI*** at 9q32, ***AKII*** at 1p34, ***AKIII*** at 9p24-p13	Adenylate kinase deficiency.
pernicious anemia. (AR)	***GIF*** at 11q13	They lack gastric intrinsic factor.
hemolytic (AD)	***TPI1*** at 12p13	Triosephosphate isomerase deficiency.
type-III. (AD).	***SPTB*** at 14q23-q24.2	Anemia and jaundice.
neonatal anemia. (AD). (MIM 121200)	***EBN1*** at 20q13.2-q13.3	Spherocytosis, hemolytic anemia, diabetes mellitus, and vomiting.
dyserythropoietic-II. (AR)	***CDAN2*** at 20p11.2-q11.2	Congenital anemia
dyserythropoietic-III. (AD)	***CDAN3*** at 15q21	Congenital anemia.
aldolase deficiency. (AR)	***ALDOA*** at 16q22-q24	A rare cause of hemolytic anemia.
methemoglobinemia, alpha type. (AD)	***HBA1*** at 16p13.3-p13.11	Alpha thalassemia. The gene ***HBA2*** at 16pter-p13.3. is for an alpha hemoglobin locus (MIM 141850).
hemolytic anemia. (AD)	***GPI*** at 19cen-q12	Glucosephosphate isomerase deficiency.

Diamond-Blackfan anemia (AR, AD). MIM 205900	***DBA*** at 19q13.2	Congenital hypoplastic anemia, triphalangeal thumbs, microphthalmos, hypertelorism, strabismus, and infantile glaucoma. Compare with the AaseSmith-2 syndrome.(MIM 205600).
hemolytic. (AD)	***ADA*** at 20q13.11	The deficiency syndrome is inherited AR.
hemolytic. (AD)	***GSS*** at 20q11.2	Glutathione synthetase deficiency.
hemolytic. (AD) hemolytic. (AD)	***PFKL*** at 21q22.3 ***HK1*** at 10q22, ***GPI*** at 19cen-q12	Phosphofructokinase deficiency. Hexokinase deficiency.
spherocytosis, type 1. (AD).	***SPTB*** at 14q23-q24.2	See acanthocytosis. Hemolytic anemia, and jaundice. The gene is spectrin.
spherocytosis, type 2. (AD)	***ANK1, SPH2*** at 8p11.2-p11.1	Gene product for this iron-overload anemia is is ankyrin. .
Japanese spherocytosis. (AD, AR)	***EPB42*** at 15q15, ***SLC4A1*** at 17q21-q22 (MIM 109270)	Hemolytic anemia. Genes ***SPTA1*** at 1q21-q22 and ***EKV*** at 1p36.2-p34 may be involved. For AD acanthocytosis the gene ***EPB3, SLC4A1*** at 17q21-q22 is a solute carrier and an anion exchanger
spherocytosis . (AR)	***LOR*** at 1q21	The gene product is loricrin.
thalassemia, alpha-I type . (AD). MIM 141800	***HBA1*** at 16p13.3-p13.11	Heinz body anemia, hemolytic, hypochromic, Mediterranean or Cooley anemia.
alpha-II type. (AD)	***HBA2*** at 16pter-p13.3	Alpha anemia.
alpha thalassemia .(AD)	***HBHR, ATR1*** at 16p13.3	Hemoglobin H disease with mental retardation.
alpha thalassemia. (XL)	***ATRX, ATR2*** at Xq13	Mental retardation, facial paralysis, and strabismus.
beta thalassemia. (AD, AR).	***HBB*** at 11p15.5, ***CYB5*** at 18q23, ***DIA1*** at 22q13.31-qter	Sickle-cell anemia, osteonecrosis, and jaundice.
delta thalassemia. (AD)	***HBD*** at 11p15.5	Hemoglobin Lepore and other anemias.
ADULT syndrome (AD). MIM 103285	Mutation in ***p63,TP63*** at 3q27-q29. (MIM 603273).	Acro-dermato-ungual-lacrimal-tooth syndrome. Early onset of permanent teeth and excessive freckling. (***p53*** is at 17p13-p12, MIM 191170).
amyotrophic lateral sclerosis.	AD. MIM 105400, AR. MIM 205100	One gene may be on chromosome 21q. Affects 1/80,0000 Most die from respiratory involvement.
anal atresia. MIM 271259, 602553, 207500	See the Pallister-Hall and PIV syndromes, and the CHARGE, VATER, and VACTERL associations.	The child with anal atresia is likely to have defects of the spine, and of the renal, urinary, and genital tracts.
Andersen syndrome. (AD). MIM 600681	***KCNJ2, HHIRK1*** at 17q23, controls potassium current Kir 2.1.	Ventricular arrhythmia, periodic paralysis, and dysmorphic features.. See ***LQT 7***. See Bartter syndromes and see ***KCNJ1*** on chromosome 11q, (MIM 600359);. ***KCNJ4*** at 22q13.1, (MIM 600504); and ***KCNJ5*** on chromosome11, (MIM 600734).
anencephaly. MIM 206500 .	Gene	Failure of the anterior neural tube to close, affects 1/750. Two thirds of these patients are female, and half are stillborn. Many have spina bifida. (AD, AR, XR). (MIM 182940).
Angelman syndrome. MIM 105830, 234400, 601623.	***UBE3A*** at 15q11.2-q13. May depend on uniparental disomy (UPD) or on another mechanism.	Deletion of part of the long arm of chromosome 15 when inherited from the mother causes the child to have Angelman syndrome, but other causes are responsible for a few cases. Affects 1/20,000 and 70% have seizures. Signs include absence of speech, mental retardation, severe learning disability, sleep disorders, ataxia, are hyperactive, and constantly happy. Treat with valproate and clonazepam. Compare with the Prader-Willi syndrome. (MIM 176290).
Annette von Droste-Hulshoff syndrome	Gene	Premature birth, retinopathy of prematurity, abnormal position of the macula causes a pseudostrabismus. Most have myopia and some have retinal detachment.
angioedema (AD)	***C1NH*** at 11p11.2-q13.	Signs are non-pitting edema, nausea, and vomiting.
angioid streaks in the retina. MIM 264800. type 1 (AR), type 2 (AR, AD).	Gene. See ***PXE*** at 16p13.1.	Linear cracks in Bruch's membrane can be seen best with idocyanine green angiography. Increased risk of choroidal neovascularization and often subretinal hemorrhages. Their subfoveal neovascularization may be treated by photodynamic therapy with verteporfin. Occur with pseudoxanthoma elasticum (MIM 264800), Grönblad-Strandberg syndrome (MIM 264800), Ehlers-Danlos syndromes, Pagets disease of bone, and with sickle-cell anemia.

angioosteohypertrophy. (S, AD).	***KTW***	Klippel-Trenaunay-Weber, ***KTW*** syndrome (AD). MIM 149000. Some have Kasabach-Merritt hemangioma-thrombocytopenia syndrome, (AD) MIM 141000.
anhidrotic or hypohidrotic ectodermal dysplasia. (XL). MIM 305100.	***ED1*** at Xq12.2-q13.1	Christ-Siemens-Touraine syndrome. Lack sweat glands, have alopecia, dental defects, corneal dystrophy, hyperpigmentation around the eyes, and some are mentally retarded.
type-II. (AD)	***ED2*** at 13q11-q12.1	Clouston hidrotic ectodermal dysplasia, have total alopecia with deafness.
type-III. (AD)	***ED3, EDA3*** at 2q11-q13	Type-III is a milder dysplasia.
Marshall ectodermal dysplasia. (AD)	***COL11A1*** at 1p21	Also have impaired hearing and retinitis pigmentosa.
aniridia-I or irideremia. (AD, S, AR)	***ACP1*** at 2p23-p25, ***ACP2*** at 11p12-p11	See also ***RGS*** at 4q25-q27 and ***RGS3*** at 9q31-q33 for iris hypoplasia. (MIM 106200, 171500).
aniridia-II. (AD). MIM 100200, 106210	***PAX6, AN2*** at 11p13. Encodes a transcription regulatory protein.	May have cerebral malformation, olfactory dysfunction, keratitis, nystagmus, optic nerve hypoplasia, and various amounts of iris tissue deficiency. Mutations in ***PAX6*** can affect the pancreas and lead to diabetes. Deletion here causes ***WAGR*** syndrome. (MIM 194072). Homozygous loss of ***PAX6*** is lethal.
aniridia and absent patella (AD). MIM 106220	Gene	Some have cataracts and glaucoma.
aniridia, partial. (AR). MIM 206750	Gene may be on chromosome 11p.	With unilateral renal agenesis, psychomotor and mental retardation, and congenital glaucoma. Two thirds of aniridia cases are inherited in the AR manner.
aniridia-microcornea. (AD). MIM 106230	Gene	With spontaneously reabsorbed cataract.
Gillespie syndrome. (AR). MIM 206700	Caused by this translocation t(X;11)(p22.32;p12) or possibly by a mutation in ***PAX6*** at 11p13.	Partial aniridia, cerebellar hypoplasia, ataxia, muscular hypotonia, mental retardation, fixed dilated pupils, strands from the iris to the front surface of the lens, congenital cataract. Mostly affects females. Mutations in ***PAX6*** affect the pancreas, can cause diabetes.
ring chromosome 6. (AD, AR). MIM 601237	***ZNF179*** at 17p11.2.	Agenesis of the corpus callosum, hydrocephalus, aniridia, and congenital glaucoma. Some have heart defects, mental retardation, anemia, and seizures. Compare with Smith-Magenis syndrome.(AD) ***SMS*** at 17p 11.2. (MIM 182290).
AEC or Hay-Wells syndrome. (AD). MIM 106260	Mutation in ***p63*** at 3q27 for ectodermally derived tissues.	Mutations can cause abnormal limb development, ectodermal dysplasia, clefting syndrome, ankyloblepharon, and split hand/foot. Ankyloblepharon (fused eyelids), ectodermal defects, cleft lip, pterygium, and keratoconus.
ankyloblepharon, cleft lip/palate. (AD). MIM 106250	Gene	Congenital eyelid fusion. See Hay-Wells syndrome and see trisomy 18. Compare with **CHANDS** syndrome (AR) (MIM 214350) have ankyloblepharon, curly hair, and hypoplastic nails. See also MIM 119500.(AD) with cysts of the lower lip.
ankylosing spondylitis. (S, AD)	***AS, ANS*** at 6p21.3	Marie-Strumpell spondylitis or Pierre-Marie syndrome with rigid spine, back pain, arthralgia, kyphosis, anterior uveitis, and band keratopathy. Have ***HLA-B27.*** (MIM 600169).
anophthalmia-I (XL). MIM 301500	***ANOP1*** at Xq27-q28	Anophthalmia and mental retardation.
anterior segment mesenchymal dysgenesis (AD). MIM 107250.	***ASMD, ASOD*** at 4q28-q31	Have a corneal opacity but no cataract. Compare with Rieger syndrome, gene at 4q25. (MIM 180500).
anterior segment mesenchymal dysgenesis with cataract. (AD, AR)	***RIEG1*** at 4q25, ***FOXC1*** at 6p25, Other genes may be at 13q14 or at 16q24	See the Axenfeld-Rieger syndrome. See the ***RIEG1/PITX*** gene. ***FOXC1*** at 6p25 is a forkhead transcription factor. Compare to the ***ASMD*** type without cataract.. (MIM 107250).
antimongolism syndrome	Partial deletion of chromosome 21.	Retarded growth, heart disease, mental retardation, sclerocornea, and down-slanting lid fissures.
Antley-Bixler syndrome. (S, AR). MIM 207410	A few have a mutation in ***FGFR2*** at 10q25.3-q26	Radio-humeral synostosis, fractures of the long bones, ambiguous genitalia, and proptosis.
anxiety-related personality traits. (AD)	***HTT, SLC6A4*** at 17q11.1-q12.	Hydroxytryptamine transport defect.
Apert syndromes		See acrocephalosyndactyly-I. (MIM 101200).
apnea, postanesthetic. (AD).	***BCHE*** at 3q26.1-q26.2	Butyrylcholinesterase deficiency.

Apolipoproteins. Most apolipoproteins are inherited in the AD manner, but types C-I and C-II are inherited AR. For apolipoprotein cluster-1, the gene ***APOLP1*** is at 11q23 and for cluster-2 ***APOLP2*** maps to 19q13.2.

Apo symbol	Gene	Function	Associated lipoproteins
A-I	***APOA1*** at 11q23	Cofactor for lecithin cholesterol acyl transferase, LCAT.	Chylomicrons, HDL
A-II	***APOA2*** at 1p21-p23	Transport of HDL	Chylomicrons, HDL
A-IV	***APOA4*** at 11q23-q24	Unknown	Chylomicrons, HDL
B-48	***APOB*** at 2p24-p23	Chylomicron transport	Chylomicrons and their remnants and VLDL and IDL
B-100	***APOB*** at 2p24-p23	Ligand for the LDL receptor, transport of VLDL, IDL LDL , and cholesterol.	Chylomicrons and their remnants and VLDL, IDL, and LDL
A-I and C-III	***APOA1*** and ***APOC3*** both at 11q23	Probably linked to ***MNS*** blood group at 4q28-q31 or at 2q14..	An AD combined deficiency. See also ***APOC3*** at 11q23.
C-I	***APOC1*** at 19q13.1 (AR)	Cofactor for LCAT	Chylomicrons, VLDL, IDL, and HDL
C-II	***APOC2*** at 19q13.1 (AR)	Cofactor for LPL	Chylomicrons, VLDL, IDL, and HDL
C-III	***APOC3*** at 11q23	Affects plasma levels of insulin and lipids.	Hyper alphalipoproteinemia.
C-IV	***APOC4*** at 19q13.2	See ***APOC1***, ***APOC2*** and ***APOE***	Associated with VLDL.
D	***APOD*** at 3p14.2, or at 3q26.2-qter	May transport cholesterol esters between lipoproteins	HDL
E	***APOE*** at 19q13.1. (AR).	Ligand for remnant receptors and for LDL receptors. Transports fats. Receptor is ***APOER2*** at 1p34	Chylomicrons and their remnants and VLDL, IDL, and HDL.
F	***APOF, LTIP*** MIM 107760	May have a role in cholesterol transport or esterification.	LDL
G	***APOG***	Unknown	VLDL
H	***APOH*** at 17q23-qter	Beta-2-glycoprotein 1	Chylomicrons, VLDL, and HDL
J	***CLU*** at 8p21-p12	Active in spermatogenesis.	Clusterin. (MIM 185430).
Lp(a)	***LPA*** at 6q27	Abnormal apolipoprotein	LDL and HDL
	ARP1 at 15q26.1-q26.2 (MIM 107773).	Apolipoprotein regulatory protein-1.	Also called ***TFCOUP2***.

Name	Gene	Comments
aqueduct of Sylvius, stenosis. (S, XR, AR).	***LICAM, CAML1, HSAS1*** at Xq28.	See hydrocephalus.
arachnodactyly. (AD). MIM 100700	Gene	Achard syndrome is a connective tissue disorder with broad skull micrognathia, and joint laxity in hands and feet. See Beal syndrome (AD), gene ***FBN2*** at 5q23-q31. (MIM 121050).
arcus senilis, arcus corneae. (AD, AR). MIM 107800.	Gene. Compare with Wilson disease (AR) (MIM 277900).	Can be associated with Alagille syndrome, Alport syndrome, familial hypercholesterolemia, Norum disease, osteogenesis imperfecta, or Tangier disease.(MIM 205400). Not a useful predictor of life expectancy.
argininemia. (AR)	***ARG1*** at 6q23	Have mental retardation and seizures.
arginosuccinaciduria. (AR).	***ASL*** at 7cen-q11.2.	Rough skin, mental retardation, seizures, field defects, and cataracts
Arias syndrome (AR). MIM 271650	***SEMI***	Malignant catatonia. See hyperbilirubinemia. (MIM 143500).
Arnold-Chiari syndrome. types I, II, III,,and IV. (AR). MIM 207950. .	Gene	Malformations of the hindbrain (cerebellar tonsils herniate through the foramen magnum) cause signs like those of Dandy-Walker syndrome, hydrocephalus, spinal cord edema, ataxia, scoliosis, deafness, nystagmus, esotropia, and papilledema. Many have headache and some cough frequently. Type III is severe, the affected children soon die.
arrestin beta-1. (AR). MIM 107940	***ARRB1*** at 11q13	Inhibits **BARK** a beta adrenergic receptor kinase. Gene ***ADRBK1*** is at 11cen-q13.
arrestin beta-2. (AR). MIM 107941	***ARRB2*** at 17p13	Mutation here causes night blindness.
arrestin beta-3, retinal. (XD). MIM 264800	***ARR3, ARRX*** at Xcen-q21	May inactivate rhodopsin.
S-arrestin or S-antigen. (AR). MIM 181031	***SAG*** at 2q37.1	Mutation in the gene for a photoreceptor protein in the retinal rods and pineal gland causes Oguchi-1 disease (AR). (MIM 258100) with night blindness and **ARRP**.
arthrocutaneouveal granulomatosis. (AD). MIM 186580	***ACUG, BLAU*** at 16q12.1-q13.	Blau syndrome with granulomatous synovitis, cranial neuropathy, deafness, and uveitis.

Arthrogryposis may be myopathic, neuropathic, or due to toxic chemicals or drugs that affect connective tissues. Some arthrogryposis results from exogenous factors. Collagen replaces muscle. Amyloplasia is the replacement of skeletal muscle by dense fibrous tissue. Signs include multiple congenital joint contractures. At least 12 arthrogryposis syndromes have been reported including 5 X-linked types, see ***AMCX5*** at Xq23-q27. See also Pena-Shokeir-I syndrome (AR) (MIM 208150) and Marden-Walker syndrome (AR or rarely AD). (MIM 108120, 248700, and 600920).
(Rheumatoid arthritis affects 27/1000 people, average age of onset is 40 years.)

arthrogryposis multiplex congenita. (S, AR) MIM 108110, 208870	***AMC*** or ***AMCD1*** at 5q35	Joint contractures from birth, more common in males. May have ataxia, microcephaly, ophthalmoplegia, cataracts, and glaucoma. Normal intelligence. Rare cases are inherited AD.
arthrogryposis, infantile . (XL).	***AMCX1*** at Xp11.13-q11.2.	Spinal muscular atrophy. Distal arthrogryposis, severe, at multiple sites. Clubbing of the joints.
arthrogryposis-I, distal. (AD, AR, S). MIM 108120, 193700	***DA1, FSS*** at 9p21-q21	Freeman-Sheldon syndrome with congenital contractures and often club foot. See Marden-Walker syndrome. (MIM 108120, 248700).
arthrogryposis, distal. (AR). MIM 208081	Gene. May have mosaic tetrasomy 10p.	With mental retardation, respiratory failure, and a characteristic facies.
arthrogryposis-IIA. (AD, AR) MIM 193700, 208155, 277720.	***FSS*** at 11p15.5. See ***AMCD1*** (MIM 108120)	Freeman-Sheldon, whistling face-windmill vane hand syndrome, cranio-carpo-tarsal dystrophy, camptodactyly, cleft palate, craniofacial abnormalities, distal arthrogryposis, and clubfoot. Enophthalmos, hypertelorism, blepharophimosis, ptosis, esotropia, and down-slanting lid fissures. Compare with Gordon syndrome. (MIM 114300).
arthrogryposis-IIB, distal. (AR, AD). MIM 601680	***DA2B, FSSV, AMCD2B*** at 11p15.5. See also ***TNNI2*** at this locus.	A Freeman-Sheldon variant with skeletal anomalies, contractures of fingers and toes, small mouth, whistling face, and hypertelorism. Some have the Dandy-Walker anomaly, many have ptosis, and some have ophthalmoplegia. See Aase-Smith syndrome-1. ***TINNI1*** is at 1q32, ***TNNI3*** at 19q13,3-q13.4 or at 19q13.4. Note that ***TNNT1*** is at 19q13.3-q13.4, ***TNNT2*** is at 1q32, and ***TNNT3*** is at 11p15.5. A type C traponin has been reported.
arthroophthalmopathy, Stickler-1 (AD). MIM 108300, 120140	***COL2A1*** at 12q13.1-q13.3.	Progressive connective tissue disorder with onset by age three years. Affects 1/10,000. Bony enlargement of the joints, mitral valve prolapse, cleft palate, chorioretinal degeneration, glaucoma, uveitis, cataracts, high myopia, and 57% get retinal detachment. See Kniest dwarfism. (AD) at 12q13.11-q12.2. (MIM 156550).
Stickler-2 (AD). MIM 120290, 184840	***COL11A2*** at 6p21.3	Signs are arthropathy, cleft palate, and deafness. Other genes may be involved.
Stickler-3. (AD, AR). MIM 120280	***COL11A1*** at 1p21	Stickler-Marshall ectodermal dysplasia. The AR type is more severe.
arthrogryposis, neurogenic (AR). MIM 108120	***AMCD1*** at 5q35	Multiplex congenita arthrogryposis is a neurogenic condition with joint contractures and a heart defect.
arthrogryposis with ophthalmoplegia. (AD). MIM 108145	Gene	Oculomelic amyloplasia, limb contractions, limb muscle aplasia, progressive ophthalmoplegia, an abnormal electroretinogram, abnormal macular pigmentation, and retinopathy. Compare to type IIB. (MIM 601680) with limb contractures, limb muscle aplasia, and abnormal macular pigmentation.
arthrogryposis. (AR rarely XR). MIM 208085	***ARC*** activator recruited cofactor.	With renal dysfunction and cholestasis, some have diabetes insipidus, ichthyosis, jaundice, and Fanconi syndrome. Death in infancy. See MIM 210550 for biliary malformation and renal insufficiency
arthropathy, childhood, pseudorheumatoid. (AR)	***PPAC*** at 6q22	Progressive pseudorheumatoid arthropathy.
arthropathy -camptodactyly syndrome (AR). MIM 208250	***JCAP*** at 1q25-q31.	Jacobs syndrome, flexion contractures, arthritis of large joints, and pericarditis.
arylsulfatase B. (AR). MIM 253200.	***ARSB*** at 5q11-q13	Maroteaux-Lamay syndrome with heart disease, deafness, kyphosis, and corneal opacities. See mucopolysaccharidosis VI.
aspartylglucosaminuria MIM 208400	**AGU** at 4q32-q33 or at 4q23-q27.	See mental retardation. Have photosensitivity, acne, psychomotor retardation, and cataract.
Asperger syndrome,. Infantile autism (AR). MIM 209850.	Some have a duplication in the region 15q11-q13. Some have a fragile X mutation	May have hyperlysinemia, mental retardation, and a developmental disorder related to autism of childhood. One had a translocation t(17,18)(p13.3;p11).
asphyxiating thoracic dystrophy. (AR). MIM 208500	***ATD*** may be at 15q13 or on chromosome 12p.	Jeune syndromes (MIM 208509, 208750). Skeletal dysplasia with renal, hepatic, pancreatic, and retinal abnormalities.

asteroid hyalitis. (AD). MIM 182930	Gene	Benson hypertrophy of the sphincter of Oddi with snowball opacities in the vitreous. Rare in myopes. These older patients may have atherosclerosis, hypertension, chronic pancreatitis, diabetes mellitus,hypomagnesemia, retinal telangiectasis, and hyperopia. See Whipple disease. (AR) (MIM 602014). Hypomagnesemia.
asthma, bronchial. (AD, M)	***IGER, APY*** at 11q12-q13, ***BHR1*** at 5q31-q33 for bronchial hyperresponsiveness.	Other genes at 2q33, 5p15, 11p15, 17p11.1-q11.2, 19q13, and 21q21 may be involved. About 1/15 people have some asthma. Average age of onset is 35 years. They are hypersensitive to IgE and have hay fever and eczema. See atopy. ***ADRB2*** for susceptibility may be at 5q32-q34. Compare with: the interleukins ***IL4RA*** at 16p12.1-p11.2 and ***IL13*** at 5q31.1, and ***SCCA1*** at 18q21.3.
astigmatism can be inherited. (AD). MIM 603047	Gene	Most eyes have some with-the-rule astigmatism so need about minus 0.50D cylindrical correction with its axis near 180 degrees. Corneal curvature changes slowly over time adding 0.50D against-the-rule astigmatism, possibly due to lid pressure or to gravity. Corneal toricity can be changed by trauma, by surgery, or by keratoconus.
atherosclerosis susceptibility. (AD). MIM 108725	***ATHS*** at 19p13.1-p13.2 or 19p13.3-p13, or ***LDLR*** at 19p13.2-p13.12.	Atheromas are lipid deposits beneath the intima of large and medium sized arteries. Those affected have more risk of coronary artery disease. There are over 200 ***LDLR*** mutations. See also an AD hypercholesterolemia. (MIM 143890).
Atkins syndrome. (XL). MIM 309530	***MRX1*** at Xp22	Coarse face, macroorchidism, and hypertelorism. See under mental retardation.

Atrophies and **Ataxias, spinocerebellar.** Early-onset types are usually inherited AR and the late-onset types are often inherited AD. AD cerebellar ataxias affect about 0.1% of the population. See also the muscular atrophies, the spinal muscular atrophies, spastic paraplegias, striatonigral degeneration, olivopontocerebellar atrophies, and spinocerebellar degenerations. A multisystem atrophy **OPCA** is responsible for 34% of spinocerebellar degenerations

The gene for ataxin-1 is ***ATX1*** at 6p23. For ataxin-2 the gene is at 12q24. They both have CAG repeats. See Usher syndrome (AR), gene ***USH3*** at 3q21-q25. Most AD **SCA**s are similar to ***SCA6***. Both ***SCA13*** and ***SCA16*** are inherited AD. The gene ***TMP2*** for ataxia with Cogan-type oculomotor apraxia, (AR) maps to 9p13.2-p13.1. Ataxia telangiectasia genes include ***AT1*** at 11q22-q23, and mutations in a gene at 7p14, or 14q12, or 14q32. Some have translocations. Most have expansion of CAG or CTG sequences. ***ATM*** gene is defective in those with ataxia-telangiectasia (MIM 208900). See also ***FRPI*** (MIM 601215). Have more risk of leukemia of the 14q+ type.

Ataxia, with delayed walking, tremor, pyramidal tract signs, and adult-onset dementia (XL) (MIM 301840).

Cerebellar ataxia with skin pigmentation is (AR) (MIM 270750). For sensory/motor neuropathy with ataxia (AD), the gene is ***SMNA*** at 7q22-q32. Spastic ataxia with congenital miosis is AD. May have slurred speech and nystagmus. Behr infantile optic atrophy is AR. Signs are spastic paraplegia, dysarthria, head nodding, mental deficiency, ataxia, horizontal nystagmus, and optic atrophy. Brown-Marie hereditary ataxia syndrome is AR but some are AD. Pyramidal tract paresis, speech difficulty, ophthalmoplegia, nystagmus, strabismus, anisocoria, retinitis pigmentosa, and optic atrophy. Marinesco-Sjogren congenital spinocerebellar ataxia (Mito or AR) with oligophrenia, deafness, nystagmus, strabismus, aniridia, cataracts, and optic atrophy.

NBS1 at 8q21 (AR) (MIM 251260, 602667) is a gene for ataxia-telangiectasia. One variant is the Berlin breakage syndrome for which the gene also maps here. See also ataxia telangiectasia (MIM 208900).

Cerebellar ataxia with posterior polar cataract, deafness, and dementia can be inherited AD. For cerebellar ataxia with spinocerebellar degeneration, progressive external ophthalmoplegia, paralysis of extraocular muscles, ptosis, and retinal degeneration the gene is inherited in the AR manner

For paroxysmal cerebellar ataxia (AD) the gene is at 19p13. (MIM 108500).
See ***CACNL1A6*** a calcium channel gene at 1q25-q31. (MIM 601011).

The ***ATM*** gene is defective in thise with ataxia-telangiectasia (MIM 208900). Mutations in ***FRP1*** (MIM 601215) increase the risk of leukemia of the 14q+ type.

Episodic ataxia (AD), has two subtypes: **EA1** in which the attacks last only for minutes, the gene is ***KCNA1*** (MIM 176260). For **EA2** the gene is on chromosome 19p, and may be the same as ***SCA6***. (AD) at 19p13.2-p13.1.

Gene	How inherited	MIM number	Condition
ATCAY, CLAC at 19p13.3.	AR	601238	Cerebellar ataxia, Cayman type.
PCARP, AXPC1 at 1q32-q31	AR	176250	Biemond's syndrome with posterior column ataxia and retinitis pigmentosa. Some other syndromes bear the Biemond name.
Gene	AR, AD	108650	Brown-Marie hereditary ataxia, pyramidal tract paresis, speech difficulty, nystagmus, strabismus, ophthalmoplegia, anisocoria, miosis, retinitis pigmentosa, and optic atrophy. See Machado-Joseph disease, ***SCA3*** at 14q32.1. (MIM 109150)
CLA1 at 11q14-q21	AR	213200	Cerebellar ataxia-1, cerebelloparenchymal disorder-III.
AEMK at 12p13	AD	160120	Episodic ataxia with myokymia.
FRDA at 9q13-q21	AR, AD	229300	Friedreich spinocerebellar ataxia, the commonest form of AR ataxia, causes about 2% of spinocerebellar degeneration. Affects 1/100,000, onset between ages 5 and 16. Frataxin regulates mitochondrial iron export. Signs include tremor, headache, deafness, cardiomyopathy, nystagmus, and optic atrophy or even glaucoma. Vitamin E provides some help. Most die before age 50.
AVED, TTPA, TTP1 at 8q13.1-q13.3	AR	277460 600415	Friedreich-like ataxia, vitamin E deficiency, and often ARRP. Gene is for alpha-tocopherol-transfer protein. Have GAA repeats.
AGA at 4q32-q33	AR	208400	Mutation in the alpha tocopherol transfer protein gene causes ataxia with vitamin E deficiency.
SCA1, OPCA1, ATX1 at 6p23	AD	164400	Menzel spinocerebellar-1 ataxia with slow conduction time. Ataxin-1 affects the brain stem. Often inherited from the father. Have CAG repeats. Constitutes about 12% of spinocerebellar degenerations. With ***SCA1, SCA2*** or ***SCA3*** many have restless legs. See ***SCA4***.
SCA2, ATX2 at 12q23-q24.1	AD	183090 601517	Spinocerebellar-2 ataxia, ataxin-2, Cuban type, most frequent type with pontine and cerebellar atrophy, CAG triplet repeats, retinal degeneration, pigmentary retinopathy, and ophthalmoplegia. ***OPCA-II*** (AR) is at 12q23-q24.1. (MIM 258300).
Gene	AR	214980	Cholestasis, gall stones, hepatitis, jaundice, pruritus, ataxia, bilateral ptosis, retinal lesions, optic atrophy, and visual disturbances. May relate to Byler disease. (AR). (MIM 211600).
SCA3, MJD1 at 14q32.1	AD	109150	Spinocerebellar-3 ataxia with dysmorphism and an enlarged fourth ventricle. This second most frequent type is also called Brown-Marie ataxia. This Machado-Joseph or Azorean neurodegeneration affects the brain stem causing 2% of spinocerebellar degenerations. Have CAG repeats and degeneration of the external cuneate nucleus. Three subtypes, onset after age 40 with ataxia, tremors, diabetes mellitus, and nystagmus or supranuclear external ophthalmoplegia.
SCA4 at 16q22.1	AD	600223	Spinocerebellar-4 ataxia, myoclonus, and deafness. See ***ATX1*** at 6p23. MIM 164400, 601556. Gene may be on chromosomes 12q, 14q, or 11cen.
SCA5 at 11p11-q11	AD	600224	Spinocerebellar-5 ataxia. Other genes may be on chromosomes 6q, 12q, 14q, or 16q.
SCA6, CACNL1A4 at 19p13.2-p13.1	AD	183086 601011	Spinocerebellar-6 ataxia is a late-onset, cerebellar ataxia with CAG repeats, some have retinitis pigmentosa. Resembles episodic-2 ataxia (MIM 157640) but ***SCA6*** is progressive. .
SCA7, OPCA3 at 3p21.1-p12	AD	164500	Olivopontocerebellar atrophy-III. Spinocerebellar-7 ataxia with cone-rod dystrophy and deafness, gene is ataxin-7. Have CAG triplet repeat expansion. May affect ***CRX*** at 19q13.3. See ***ADCA-II***. (AD). (MIM 164500).
SCA8 at 10q24	AR	271245	Spinocerebellar-8 ataxia, infantile-onset with progressive sensory neuropathy. Have CTA, CTG repeats and external ophthalmoplegia. Compare with ***ADCA-III***. (MIM 183090)
IOSCA may be at 10q23.3-q24.1	AR	271245	Infantile-onset spinocerebellar ataxia, epilepsy and ophthalmoplegia. ***IOSCA*** is ***NOT*** at 10q24.
Gene	XL	301840	Ataxia, delayed walking, tremor, pyramidal tract signs, and adult-onset dementia.
ADCA-I Gene may be ***SCA1*** at 6p23.	AD	183090	Cerebellar signs, extrapyramidal signs, dementia, amyotrophy, and supranuclear ophthalmoplegia but no retinal degeneration. Anticipation occurs. Have CAG repeats. ***SCA2*** is at 12q23-q24.1..
ADCA-II at 3p21.1-p12	AD	164500	Have CAG triplet repeat expansion, cerebellar ataxia, and retinal degeneration. See ***SCA7, OPCA3,*** and ***BBS3.***
ADCA-III at 15q14-q21.3	AD	183090	A pure cerebellar neurological disorder, relatively benign, late-onset, slowly progressive, with CAG repeats. Similar to ***SCA8***. (MIM 271245). See ***OPCA-3*** (AR) at 3p21.1-p12. (MIM 213200).

SCA10 at 22q13-qter	AD	603516	Cerebellar syndrome with seizures, pyramidal signs, cognitive impairment, ATTCT repeats, and ocular dyskinesia.
SCA11 at 2p21.1-p14.1	AD		Early-onset dementia, ataxia, and epilepsy.
SCA12, PPP2R2B at 5q31-q33	AD	117210	Holmes pure cerebellar ataxia makes up about 7.5% of spinocerebellar degenerations. Onset in the 4th decade and slowly progressive. Have tremor and CAG repeats. Some have hypogonadotropic hypogonadism.
SCA13	AD		Have dementia, ataxia, and epilepsy.
SCA14 at 19q13.4-qter.	AD		Have porphyria, ataxia, and mental retardation.
SCA16 at 8q22.1-q24.1	AD		
SCA17	AD		Gene for cerebellar ataxia with CAG repeats. Huntington-like disease TBP gene disease patients have repeats in the TATA-binding protein. Not a common cause of parkinsonism.
SCA19 at 1p21-q21	AD		Relatively mild ataxia.
SCA21 at 7p21.3-p15.1			Have a slowly progressive gait and limb ataxia.
SCA22 at 1p21-q23	AD		Spinocerebellar ataxia.
ASAT at Xq13	XL	301310	3-methylglutaconicaciduria type 3. Have spinocerebellar ataxia with anemia.
MGA3 at 19q13.2-q13.3	AR	258501	Spinocerebellar ataxia with optic atrophy and chorea..
Gene	AD	183100	Spinocerebellar atrophy with pupillary paralysis. Pupil does not respond to light or to convergence but does constrict with accommodation.
Gene	AR	271310	Spinocerebellar degeneration, onset in 2 year old, mental retardation, muscle abnormalities, ataxia, corneal dystrophy, corneal opacification, congenital cataracts, and myopia.
Gene	XL	301840	Ataxia, delayed walking, tremor, pyramidal tract signs, and adult-onset dementia.
HOOE	AD	117300	Cholesterol accumulation in the brain causes cerebellar ataxia, deafness, dementia, posterior polar cataract, retinal neovascularization, and glaucoma. Die in their 4th or 5th decade.
Gene	AR		Cerebellar ataxia with spinocerebellar degeneration, progressive external ophthalmoplegia, ptosis, and retinal degeneration.
LGMD2E at 14q12 ***NTRK4*** at 6p21	AR	600900 601312	See limb-girdle dystrophy under muscular dystrophy. A receptor for tyrosine kinase.
ADR	AR	208850	Infancy-onset of ataxia, progressive sensorineural deafness, and mental retardation. Some have red hair. MIM 266300. Compare with Richards-Rundle syndrome. (MIM 245100.)
DRPLA at 12pter-p12	AD	125370	Dentat orubropallidoluysian syndrome with expanded ribonucleotide CAG repeats. Causes 2.5% of spinocerebellar degenerations.
AT1, ATA, ATC, ATE, ATM at 11q23	AR, XL, S	208900	The Louis-Bar syndrome, with ataxia, microcephaly, cataract, and telangiectasia. Other genes that may be involved are at 7p14, 7q35, 14q12, and 14q32. Compare with: ***FRP1, ATR***. (MIM 601215).
FRP1, ATR at 3q22-q24		601215	Ataxia with telangiectasia. ***FRAP*** related protein-1. ***ATR*** regulates p53. See also ***MMP10*** at 11q22.3. (MIM 185260).
SBMA, KD, SMAX1 at Xq12.	XR	313200	Kennedy spinobulbar muscular atrophy with increased CAG repeats.
H4F5, SMAM1 at 5q13	AR	603011 600354	Spinal muscular atrophy related genes for types ***SMA1*** to ***SMA3***. Often have deletions from ***SMN1*** at 5q13. (AD, AR)
MCDC1 at 16q22	AR	271310	Spinocerebellar degeneration with congenital macular corneal dystrophy.
NARP. Neuronal activity regulated pentraxin.	Mito, AR	551500 516060	Point mutation T8993G in the ATPase-6 gene of the mitochondrial DNA causes neuropathy, dementia, ataxia, seizures, muscle weakness, and retinitis pigmentosa. See Leigh syndrome, gene ***MTATP6*** at 8527-9702. (MIM 256000).
ARTS at Xq21.33-q24	XR	301835	ARTS syndrome with tetraplegia, ataxia, weakness, deafness, mental retardation, optic atrophy, loss of vision, and early death.
Gene	XR	301790	Spinocerebellar ataxia, deafness, esotropia, and optic atrophy. Death in late childhood.
Gene at 9q33.3-q34.3	AD	183050	Spinocerebellar ataxia with cerebellar atrophy, peripheral neuropathy, and muscular rigidity.
RRS	AR	245100	Richards-Rundle syndrome, with ataxia, deafness, mental retardation, ketoaciduria, and some have genital hypoplasia. See Roussy-Levy syndrome. (MIM 180800) and ***ADR*** (MIM 208850).
May have a mutation in ***PMP22*** at 17p11.2-p12..	AD	180800	Roussy-Levy syndrome with areflexic dystasia, claw-foot, hand tremor, weakness, and absent tendon jerks. Compare with ***CMT-1A*** and ***HNPP*** (MIM 162500).
Gene	AR	212710	Polyneuropathy, congenital cataract, later develop ataxia, deafnes s, and mild mental retardation. See **HSAN-IV.** (MIM 256800). Compare with **ADR** (AR) which manifests in infancy. (MIM 208850).

PAP, MSA	AD	146500	Shy-Drager multisystem atrophy, adult-onset causes about 7% of spinocerebellar degenerations. Signs are orthostatic hypotension, ataxia, tremor, progressive autonomic failure, and incontinence, but normal intellect. Compare with Shy-Gonatas syndrome.(AR). (MIM 255140).
Gene	AR	271250	Spinocerebellar ataxia, blindness, deafness, cochlear degeneration. Compare with Refsum syndrome.(MIM 266500, 602026, 600964).
Gene	AR	271320	Spinocerebellar degeneration, congenital, with spastic ataxia, cataracts, myopia, macular corneal dystrophy, and normal intelligence.
Gene	AD	158500	Ataxia, muscular atrophy, diabetes mellitus, and retinitis pigmentosa. Compare with Refsum syndrome.
Gene	(XL)	301840	Deficiency of the luteinizing releasing hormone ***LHRH*** (MIM 157260) Ataxia, delayed walking, tremor, pyramidal tract signs, and adult-onset dementia.
Gene	AR	212840	Deficiency of the leuteinizing releasing hormone ***LRHR*** causes cerebellar ataxia, hypogonadotropic hypogonadism, and chorioretinal dystrophy. Compare with: MIM 215470 (AR) with chorioretinal dystrophy..
SMN1 at 5q13.	AR, AD, XL	158600 253400	Juvenile muscular atrophy, Kugelberg-Welander syndrome, onset in late childhood of a progressive atrophy with elevated serum creatine kinase, affects legs first, then arms, ptosis, ophthalmoplegia, and exotropia. Compare with: ***SMA3*** (AD, AR, XL), (MIM 253400).
HMN2 at 12q24.3	AD	158590	Distal spinal atrophy. The neuroophthalmological involvement is motor. See ***HDMN5*** on chromosome 7p and ***BDC*** at 12q24. (AD) (MIM 113100).
SMS, NPHP1 at 2q13	AR	266920 256100	Saldino-Mainzer, conorenal syndrome with cerebellar ataxia, chronic renal failure, cone-shaped epiphyses of the hands, Leber's amaurosis congenita, and retinitis pigmentosa. Compare with Loken-Senior syndrome, renal dysplasia and retinal aplasia. (MIM 266900).

Name	Gene	Comments
atrophia areata (S, AD). MIM 108985	***AA*** at 11p15	With peripapillary chorioretinal degeneration.
autism, susceptibility (AR). MIM 209850. Twenty genes may be involved.	***AUT*** may be at 7q32.3-q33. Some have duplications in 15q11.2 or in 17p11 or in chromosomes 5, 8 or 19, or duplication of 15q11-q13, or mutations in ***ARX*** at Xp22.1-p21.3 or this translocation t(17;19)(p13.3;p11). Some have partial trisomy 6p with duplications from 6p21 to 6p25-pter.	This developmental disorder is more often inherited from the father, affects 1/2500. Affects 4 times more males than females. Reduced adenine deaminase activity, low birth weight, mental and developmental retardation, problems with social interaction, or communication, and show repetitive patterns of interest or behavior, and morbid self- absorption, often have other disorders. About 75% are mentally retarded. Seems to show a linkage with HLA-DR4 and DR13. ***ARX*** mutations can cause myoclonic epilepsy and mental retardation. ***XMESID*** is at Xp11.2-p22.2 Mutations in ***ISSX*** (MIM 308350) see West syndrome, cause infantile spasms, and mental retardation, many die in their first decade. Those with Partington syndrome, gene ***MRXS1,*** also may have mutations in ***ARX.*** (MIM 309510). Have mental retardation. See also adenylosuccinase deficiency (AR), ***ANADSL*** at 22q13.1, Rett syndrome (MIM 312950), Sotos cerebral gigantism (MIM 117550), and Asperger syndrome (MIM 209850).
Asperger infantile autism. (AR). MIM 209850	One had a translocation t(17;19)(p13.3;p11)	Some may depend on a fragile X mutation.
Austin variant of Heinz body anemia	Gene	See Heinz body anemia (MIM 141900). Compare with ***HBA1*** at 16p13.3-p13.11 (MIM 141800), and beta globulin at 11p15.4-p15.5 (MIM 141900).
Autoimmunity a misguided defense mechanism, is mostly inherited AD. See alopecia areata (MIM 104000), autoimmune hemolytic anemia (MIM 205700), hypoadrenocorticism with hypothyroidism, pernicious anemia (MIM 170900), Schmidt syndrome (MIM 269200), Sjögren syndrome (MIM 270150), systemic lupus erythematosus (MIM 152700), thyroid autoantibodies, Addison disease, and diabetes mellitus.		
autoimmune polyglandular disease-I (AR). MIM 240300	***AIRE-1*** at 21q22.3	An autoimmune regulator. Mutation causes candidiasis, ectodermal dystrophy, and keratoconjunctivitis. See also at this locus ***APECED*** for autoimmune-polyendocrine-candidiasis-ectodermal dysplasia. Can have an autoimmune reaction with arthritis and alopecia areata.
autoimmune syndrome-II. (AR, AD, M)	May have a mutation in ***AIRE-1*** at 21q22.3.	See Schmidt syndrome (PGA-II) with diabetes mellitus, Addison disease, chronic pulmonary disease, anemia, myxedema, cataracts, and band keratopathy.
autonomic nervous system dysfunction. (AD)	***DRDA*** at 11p15.5	This is only one of several genes for autonomic nervous system dysfunction.
AWTA syndrome		See Wilms tumor.

Axenfeld-Rieger anomaly (AD). May have an atrial septal defect with a sensorineural hearing loss and partially absent eye muscles. Compare with iridocorneal dysgenesis, goniodysgenesis, anterior segment mesenchymal dysgenesis, anterior chamber cleavage syndrome, ring-like opacity deep in the cornea, and the Reese-Ellsworth syndrome. (MIM 141900).

The Axenfeld anomaly (AD) includes posterior embryotoxon, adhesion of the Schwalbe ring to the base of the iris, a defective gonial angle and trabecular region, and often glaucoma.

The Rieger anomaly consists of posterior embryotoxon, mesodermal dysgenesis of the anterior segment, hypoplasia of the anterior layers of the iris and trabecular meshwork, and often glaucoma.

Axenfeld-Rieger syndrome. (AD, AR, S) MIM 109120, 602482	***FOXC1, FKHL7*** at 6p25, ***RIEG1/PITX2*** at 4q25, ***ASMD*** at 4q28-q31, ***RIEG2*** at 13q14, or a gene at 16q24.	Iridogoniodysgenesis with somatic anomalies, arthritis, alopecia, stenosis, mild deafness, dental anomalies, and facial anomalies. Ocular effects are often bilateral, iris hypoplasia, sclerocornea, glaucoma, and a persistent pupillary membrane. Compare with: Peters' anomaly. A mutation in ***PAX6*** was the cause in one family.
Axenfeld-Schurenberg syndrome.	Gene	Cyclic oculomotor paralysis is often unilateral, affected eye is abducted, has a small fixed pupil, and periodic oculomotor paralysis.
Ayazi syndrome (XR). MIM 303110	***REP1, CHM*** at Xp21.1-p11.4	A deletion from this gene causes obesity, deafness, and choroidal degeneration.

B.

Baller-Gerold syndrome. (AR). MIM 218600	***BGS*** One had a mutation in ***TWIST*** at 7p22-p21.	Craniosynostosis, oxycephaly, CNS anomalies, short stature, imperforate anus, microcephaly, radial aplasia, and thumb hypoplasia. Compare with these syndromes: Roberts (MIM 268300), Rothmund-Thomson (MIM 268400), and VACTERL (MIM 276950, 319360, 314370).
Bamatter syndrome. (XL)	See progeria.	Precocious aging, osteoporosis, stunted growth, microphthalmia, glaucoma, and corneal opacities.
Bannayan-Zonana syndrome (AD). MIM 153480	***PTEN*** at 10q23.3	Signs include macrocephaly, seizures, lipomas, and hemangiomas. ***PTEN*** is a tumor suppressor.
Baraitser-Winter syndrome. (AR, XL). MIM 243310	Gene may be at 2q12-q14	Macrocephaly, obesity, mental retardation, hypertelorism, ptosis, iris colobomas, and down-slanting lid fissures. Compare with Noonan syndrome. (MIM 163950). Note ***PAX 8*** maps to 2q12-q14. (MIM 167415).
Bardet-Biedl syndrome (AR). MIM 209901	***BBS1*** at 11q13	***BBS1*** constitutes 40% of Bardet-Biedl cases. They have mental retardation, postaxial polydactyly, obesity, hypogonadism, severe renal impairment, speech disorders, nystagmus in 50%, rod-cone dystrophy, and pigmentary retinopathy. Average age at diagnosis was 9 years. See ***SCA5*** at 11p11-q11.
(AR). MIM 209900	***BBS2*** at 16q21 and ***KIFC3*** at 16q13-q21.	Make up about 25% of Bardet-Biedl cases, and have diabetes mellitus, and cardiac and kidney anomalies.
(AR). MIM 600151	***BBS3*** at 3p13-p12	Have signs similar to those of ***BBS1***.
(AR). MIM 600374	***BBS4, MYO9A*** at 15q22.3-q23	Obesity. They constitute about 25% of Bardet-Biedl cases.
(AR)	***BBS5*** at 2q31	Note that ***MYO3B*** maps to 2q31.1-q31.2.
McKusick-Kaufman syndrome (AR). MIM 236700	***MKKS, BBS6*** at 20p12	Affects the chaperonin molecule. A Bardet-Biedl-like syndrome in very young children, with obesity, hydrometrocolpos, postaxial polydactyly, heart disease, vaginal atresia, renal malformation, and retinal dystrophy, but a fairly good prognosis. Compare with Pallister-Hall syndrome. ***PHS*** (AD) (MIM 146510).
Barnard-Scholz syndrome. (XL). MIM 311000	***OPEM***	Have muscle weakness, external ophthalmoplegia, ptosis, choroidal degeneration, retinitis pigmentosa, and myopia. Compare with Kearns-Sayre syndrome (MIM 530000), ophthalmoplegia with retinal degeneration.
Bartsocas-Papas syndrome (AR). MIM 263650	***BPS***	Multiple lethal popliteal pterygia, ankyloblepharon, cleft lip/palate, filiform bands between the jaws, syndactyly, lack eyebrows and eyelashes, and have other anomalies. Most die in early childhood. See other pterygia syndromes e.g. at MIM 119500, 265000.
Bartter syndrome (AR)	***BSND*** at 1p31	Have an infantile Bartter syndrome with deafness.
Bartter syndrome-I (AR). MIM 600839	***SLC12A1, NKCC2*** at 15q15-q21.1	Signs include hypokalemic metabolic alkalosis and some are deaf and some have tyrosinase-negative oculocutaneous albinism.

Bartter syndrome - II (AR). MIM 600359	***KCNJ1, ROMK1*** at 11q24	Antenatal Bartter syndrome with renal tubular alkalosis, and systemic symptoms.
Bartter syndrome - III (AR). MIM 602023	***CLCNKB*** at 1p36	Renal salt-wasting disease. See other salt-wasting diseases.
Gitelman variant of Bartter syndrome. (AR). MIM 263800	***SLC12A3*** at 16q13	The gene is for a thiazide-sensitive NaCl co-transporter. Mutation causes hypokalemia, hypomagnesemia, metabolic alkalosis, hypocalciuria, arthralgia, and sclerochoroidal calcification.
basal-cell nevus. (S, AD). MIM 109400, 601309	***NBCCS, BCNS, PTCH*** at 9q22.3-q31	See Gorlin-Goltz syndrome. [Not to be confused with Goltz-Gorlin focal dermal hypoplasia (XD) with its gene ***DHOF*** at Xp22.31.]
basal-cell carcinoma		See under cancer.
Bassen-Kornzweig syndrome		See abetalipoproteinemia. (MIM 107730, 200100).
Batten-Mayou syndrome		See the ceroid lipofuscinoses.
Bazex syndrome		See under cancer. MIM 301805.
Bazzana syndrome Beal syndrome. (AD)	Gene ***FBN2, CCA*** at 5q23-q31	Angiospastic ophthalmo-auricular syndrome, otosclerosis, deafness, tortuous retinal vessels, and concentric constriction of the visual field. Contractural arachnodactyly, kyphoscoliosis, and ocular complications.
Beare-Stevenson syndrome. (AD).	***FGFR2*** at 10q25.3-q26	Craniosynostosis, anogenital anomalies, and ear defects. See cutis gyrata syndrome, under skin.
Beckwith-Wiedemann syndrome (AD, S). MIM 130650, 192500, 603240, 602631	***BWS, CDKN1C*** at 11p15.5. See also ***p57, KIP2*** at 11p15.5.	Duplication causes gigantism, hepatomegaly, hypoglycemia, adrenal carcinoma, nephroblastoma, and Wilms tumor. For region 1A the gene is ***BWR1A*** at 11p15.5. (MIM 602631). Genes such as ***UPD*** for uniparental disomy are critical for renal development. (MIM 305650).
bedwetting		After 7 years of age. See enuresis, nocturnal.
Behçet syndrome. MIM 109650	If not Mendelian, may be viral. May relate to ***MICA*** at 6p21.3. (MIM 600169).	Oculobuccogenital syndrome with oral ulcers, skin lesions, genital ulceration, systemic vasculitis, keratoconjunctivitis, uveitis, hemorrhages, and optic atrophy. Has been called Gilbert retinal syndrome. (MIM 191740).
Bencze hemifacial hyperplasia syndrome. (AD). MIM 141350	***HFH`***	Abnormal growth of facial skeleton, hemifacial hyperplasia, facial asymmetry (left side prominent), cleft palate, strabismus (esotropia), and amblyopia. For facial asymmetry see (MIM 133900).
Bernheimer-Seitelberger gangliosidosis. (AR). MIM 272750	***GM2A*** at 5q31.3-q33.1	A Tay-Sachs variant with dementia, seizures, paralyses, a cherry-red macula, and blindness. See Tay-Sachs gangliosidosis. **GM2** type 1.(MIM 272750).
Best macular dystrophy. (AD, S). MIM 153700	***VMD2*** at 11q13	Juvenile-onset macular dystrophy, but can have onset at age 45. ***VMD1*** for vitelliform macular dystrophy (AD) may be at 8q24.3. (MIM 153840).
beta galactosidase deficiency. (AR). MIM 230500	***NEU*** at 6p21.3	Neuraminidase deficiency. See mucopolysaccharidosis-IVB, (MIM 263010).
beta lipoprotein deficiency	Failure of a transport protein .	Degeneration of cerebellar tracts. May have nystagmus, night blindness, and pigmentary degeneration of the retina. Treat with vitamins A and E.
Bethlem myopathy. (AD). MIM 158810	***COL6A1*** and ***COL6A2*** at 21q22.3, ***SLC10A2*** at 13q33	A congenital, benign, muscular dystrophy. See also ***COL6A3*** at 2q37. (MIM 120250) in which some have Bethlem myopathy.
Bieber syndrome. (XR). MIM 312190.	Gene	Agenesis of the corpus callosum, microcephaly, hydrocephalus, radial aplasia, mental retardation, hypospadias, anogenital anomalies, microphthalmia, pannus, cataracts, ptosis, and retinal dysplasia.
Biemond syndromes		With these hypophyseal infantilism syndromes get night-blindness.
Bietti crystalline tapetoretinal degeneration. (AR). MIM 210370	***BCD4*** at 4q35-qter	Panchorioretinal atrophy with lipid inclusions, marginal, crystalline corneal dystrophy, retinitis punctata albescens, and progressive night blindness.
biliary atresia. (AR, M). MIM 210500	***EHBA***	Incidence 1/20,000. Also have renal malformations, and right ventricular hypertrophy. Need surgery in first 2 months of life.
Bing-Neel macroglobulinemia	Gene	See under blood dyscrasias.
biphosphoglycerate mutase deficiency (AR)	***BPGM*** at 7q22-q34	Have hemolytic anemia.

bipolar affective disorder (AR). MIM 125480	***BPAD, MFAD1, MD1*** at 18q22-q23	Other responsible genes may be on chromosomes 4p, 5q, 11p, 13, 15, 18, 21q, 22q, and for an XL variety the gene is on Xq. Affects 1/100, average age of onset is 30. Lithium is used to treat but 30% do not respond to lithium.
Björnstad syndrome	Gene	See under hair.
Blatt syndrome. (AD). MIM 254195	***GNAI2*** at 3p21	Malformation of facial bones, myasthenia, mental retardation, hypertelorism, distichiasis, microphthalmia, anisometropia, and many lack Meibomian glands.
Blau or Jabs syndrome (AD). MIM 186580	***ACUG*** at 16p12-q21.	Sixth nerve palsy, granulomatous synovitis, deafness, skin rash, vasculitis, and uveitis.
blepharo-naso-facial malformation syndrome. (AD). MIM 110050	May have a mutation in ***PAX3*** at 2q35.	Mask-like face, weak facial muscles, mental retardation, telecanthus, and obstructed lacrimal ducts. See MIM 193500. Waardenberg syndrome-1.(AD) at 2q35.
blepharophimosis, ptosis, epicanthus inversus and, telecanthus syndrome. (AD, S)	***FOXL2*** at 3q23	This forkhead transcription factor is responsible for most cases of ***BPES1*** at 3q23 and ***BPES2*** on chrokmosome 7p (MIM 601649). However some do not have a genetic defect in the ***FOXL2*** gene. See ***FOXL3*** ???????????
blepharophimosis, ptosis, ectopia lentis, and myopia. (AD). MIM 110100	***BPES1*** at 3q23. See ***FOXL2*** at 3q23	Their connective tissue defect causes congenital ptosis, premature ovarian failure, and female infertility. With ***BPES2*** at 7p21-p13 they do **not** have ovarian failure.
blepharophimosis, epicanthus inversus, and ptosis-2. (AD)	***FOXL2*** at 3q23	May affect the eyes only. Gene was also reported to be at 7p21-p13.
ptosis (AD). MIM 178300	***PTOS1*** at 1p34.1-p32	Also called blepharoptosis.
blepharospasm, essential. (S, AD). MIM 117700.	***CP*** at 3q21-q24	The oromandibular dystonia is Meige syndrome. The gene is for ceruloplasmin Their dry eyes often recover spontaneously. See Wilson disease (MIM 277900) and ***OFD3***. (MIM 258850).
Bloch-Sulzberger syndrome, (formerly **IP1**) See hypomelanosis of Ito. (XD). MIM 308300,146150	***NEMO*** (IKK gamma) at Xq28 is a regulatory, critical component of the NF-kappa B signalling pathway. The IKK complex consists of IKK alpha, beta, and gamma, (***NEMO***).	With sporadic incontinentia pigmenti the skin has swirling lines or vesicles, most have dental and ocular anomalies, retrolental fibroplasia, and 10% have a neurological deficit. Genes may be ***IP1*** and ***ITO*** at Xp11. With incontinentia pigmenti achromians some have this translocation t(X;5)(p11.2;p35.2). Signs are mental retardation, seizures, peg-shaped teeth, iris colobomas, cataract, and retinal vascular changes. For familial incontinentia pigmenti (XD) the gene is ***IP2*** at Xq28. Microcephaly, mental retardation, quadriplegia, and pigmentary changes that tend to disappear by age 20. This mutation is usually lethal in males.

Blood Dyscrasias and **Coagulation Disorders** See also the agammaglobulinemias, anemias, leukemias, and lymphomas. Intracranial hemorrhage is the third most common cause of cerebrovascular disease.

The gene ***ASAT*** at Xq13 for sideroblastic anemia with spinocerebellar ataxia is inherited XL. (MIM 301310).

Name	Gene	Comments
Abelson leukemia (AD). MIM 189980	***ABL1*** at 9q34.1	Murine leukemia.
Addison anemia (AD, AR, XL). MIM 202200, 240200, 240300, 300250	Gene. May have mutations in ***AIRE*** at 21q22.3	One of the polyglandular autoimmune diseases. T-cell destruction of adrenocortical cells. Have antibodies against the enzymes involved in steroid synthesis. Adrenocortical insufficiency with skin and mucous membrane hyperpigmentation, neonatal cyanosis, progressive megaloblastic anemia, glomerulosclerosis, vascular collapse, glomerulosclerosis, gut disturbances, sleep disturbances, seizures, and weight loss. (MIM 202200, 240300, and 300254). Many of these patients have B_{12} deficiency or candidiasis.
agammaglobulinemia (XR). MIM 300300	***BTK, AGMX1, XLA*** at Xq21.3-q22	Bruton agammaglobulinemia. Their tyrosine kinase deficiency also causes an arthritis-like syndrome in these boys. See immunodeficiency.
antithrombin-III deficiency (AD)	***AT3*** at 1q23-q25	Signs are thrombosis and hypercoagulability. See acute lymphatic leukemia.
alpha dysfibrinogenemia (AD).	***FGA*** at 4q31	Have a bleeding diathesis or recurrent thrombosis and renal amyloidosis.
The genes for the **B-cell lymphomas** include: ***BCL1*** may be at 11q13, ***BCL2*** (AD) at 18q21.33, ***BCL3*** at 19q13.1, ***BCL5*** (AD) at 17q22, ***BCL6*** at 3q27, ***BCL7*** and ***BCL7A*** are both at 12q24.1, ***BCL8*** at 15q11-q13, and ***BCL9*** at 1q21. See also cancer.		
Bernard-Soulier clotting disorder, type A. (AR)	***GP1BA*** at 17pter-p12	This giant platelet syndrome causes a bleeding tendency.
type B. (AR)	***GP1BB*** at 22q11.2	A deletion here causes a bleeding tendency.

type C. MIM 173515 See also: ***GPIBB*** MIM 138720, ***GPIBA*** MIM 231200	***GPIX*** at 3q21 is a subunit of the gene ***Ib-IX-V*** for the von Willebrand receptor.	Mutation in the glycoprotein gene ***GP9*** causes an atypical Bernard-Soulier syndrome. The pseudo von Willebrand condition is due to a disorder affecting the receptor. von Willebrand patients (AD, AR) (MIM 193400, 277480) have a VIIIR defect (AD), low antihemophilic globulin (AHC), and prolonged bleeding time.
beta dysfibrinogenemia. (AD).	***FGB*** at 4q31	***FGG*** for gamma dysfibrinogenemia is also here.
Bing-Neel macrolobulinemia	Gene	Cerebral lymphocytic proliferation, CNS infiltrated by malignant cells. Excess production of gamma M globulin causes blood sludging, with anemia, CNS symptoms, strokes, splenomegaly, EOM paralyses, ptosis, chorioretinitis, dilated retinal veins, and glaucoma. Seems to be a variation of Waldenstrom macroglobulinemia (AD) which is a B-cell lymphoma that produces monoclonal IgM. (MIM 153600).
bleeding diathesis MIM 600998	***GNAQ*** at 9q21, and a pseudogene at 2q14.3-q21	Deficient in guanine nucleotide-binding protein.
bleeding diathesis MIM 188070	***TBXA2R*** at 19p13.3	Defective thromboxane A2 receptor. Thromboxane facilitates platelet aggregation.
Bonnett-deChaume-Blanc syndrome	Gene	Arteriovenous aneurysm of retina and midbrain. See von Hippel-Lindau disease (MIM 193300), and Wyburn-Mason syndrome gene at 3p26-p25 (MIM 193300).
cyclic neutropenia MIM 130130	***ELA2*** at 19p13.3	Mutations affecting the gene encoding neutrophil elastase increase the risk of bacterial infections.
Diamond-Blackfan syndrome (AR, AD). MIM 205900	***DBA*** at 19q13.2	Red cell aplasia, anemia, mental retardation, and may get osteogenic sarcoma.
Duffy blood group. (AD).	***Fy*** at 1q21-q22.	May have an anti-malarial role.
Epstein syndrome. (AD). MIM 153650	***MYH9*** at 22q12.3-q13.2.	Macrothrombocytopenia, nephritis, Dohle-like leukocyte inclusions, deafness, and cataracts. Alport syndrome, deafness, and prolonged bleeding time. See MIM 153640 for the Fechtner syndrome and for the Sebastian platelet syndrome, both are inherited AD. See also the May-Hegglin anomaly (AD) (MIM 155100), and see Epstein-Barr viral infections.
factor H deficiency. (AD). MIM 134370	***HF1, CFH, HUS*** at 1q32. ***FHR2*** at 1q31-q32.1	Lack of this complement factor causes thrombocytopenia, hemolytic anemia, renal failure, and recurrent meningococcal disease.
factor I, fibrinogen deficiency of α, β, and γ subunits. (AD, AR).	***FGA, FGB***, and ***GC*** all at 4q31.	Recurrent thromboses.
factor II, prothrombin deficiency. (AR). MIM 176930	***F2*** at 11p11-q12	The gene ***F2R*** for the thrombin receptor is at 5q13. Dysprothrombinemia is AD.
factor III, coagulation factor . (AD).	***F3, TFA*** at 1p22-p21	Tissue thromboplastin is a potent pro-coagulant.
factor V, proaccelerin, labile factor deficiency. (AR). MIM 227400	***F5*** at 1q23	This deficiency causes Owren disease, parahemophilia. See also factor V Quebec.
factor V and factor VIII, deficiency. (AR)	***MCFD1, LMAN1*** at 18q21.3-q22	Multiple coagulation factor deficiency.
coagulation factor VII, proconvertin deficiency. (AR)	***F7*** at 13q34. (See also ***F10*** at 13q34.)	Bleeding diathesis. See DeGrouchy syndrome. (MIM 600624).
factor VII, regulator. MIM 134450	***F7R, F7E*** at 8p23.2-p23.1.	Regulates coagulation factor VII.
factor VIII, (AD, AR). MIM 193400	***VWF, F8VW*** at 12pter-p12, ***GP1BA*** at 17pter-p12	This platelet dysfunction causes von Willebrand disease the most common inherited bleeding disorder. Five AD (I, IIA, IIB, IID, and IIE), two AR (IIC, and III), and also an XD subtype occur. Signs include GI, urinary, and uterine hemorrhages. Receptor is ***Ib-1X-V.***
factors VIIIa and VIIIb. (XL).	***F8A*** and ***F8B*** at Xq28	Classical hemophilia.

factor VIIIc, antihemophilic factor deficiency. (XR)	***F8C, HEMA*** at Xq28	Mutation here causes hemophilia A.
factor IX, plasma thromboplastic component. (XR).)	***F9, HEMB*** at Xq27.1-q27.2	Deficiency of this coagulation factor, Christmas factor, causes hemophilia B.
factor X, deficiency. (AR).	***F10*** at 13q34. (See also ***F7.***)	Stuart-Prower factor deficiency causes a bleeding tendency.
factor XI, plasma thromboplastin antecedent deficiency. (AR). MIM 264900.	***F11*** at 4q35	Hemophilia C, Plasma thromboplastin antecedent deficiency, Rosenthal syndrome with minor bleeding episodes.
factor XII, deficiency. (AR).	***F12, HAF*** at 5q33-qter	Hageman factor deficiency causes no symptoms.
factor XIIIA, fibrin stabilizing deficiency. (AD).	***F13A1, F13A*** at 6p25-p24	Bleeding diathesis. Note ***F13A2*** and ***F13A3 are*** also at 6p25-p24..
factor XIIIB, fibrin stabilizing deficiency. (AD).	***F13B*** at 1q31.2-q32.1	Bleeding diathesis. B polypeptide.
hemangioma, capillary. (AD).	***HEMC*** at 5q31-q33	***HCLS1*** at 3q13 is a substrate for protein kinases.
hemochromatosis. (AR, S, AD).	***HFE*** at 6p21.3-p12	Heart failure, diabetes mellitus, and arthropathy.
hemorrhagic tendency. (AD). MIM 601841	***PC1, PLANH3*** at 14q32.1 ***P1, AAT*** at 14q32.1. ***PAI1, PLANH1*** at 7q22.1-q22.3, ***F5*** at 1q23.	A protein C inhibitor. A plasminogen activator inhibitor-3.
coagulation factor-II. MIM 187930	***F2R, CF2R, PAR1*** at 5q13.	A thrombin receptor. See ***F2*** (MIM 176930) and ***F2RL***.
hemoglobins alpha, gamma, and epsilon. . . MIM 141800.	***HBA1*** in the region 16p13.33 to 16p13.11.	An alpha globin cluster is at 16pter-p13.3. Beta ***HBB*** is at 11p15.5. ***HBD*** is for the delta locus. Theta is ***HBE1*** and gamma is ***HBQ1***.
methhemoglobinopathy. (AR)	***CYB5*** at 18q23, ***DIA1*** (MIM 250800) , ***DIA2*** (MIM 125370), ***DIA3*** (MIM 125880), ***DIA4*** (MIM 125860), at 16q22.1	Methhemoglobinemia, cyanosis. ***DIA1*** (AR) is at 22q13.31-qter ***DIA2*** is on chromosome 7. Note some are inherited in the AD manner.
Heinz body anemia. (AD, AR). MIM 141800	***HBA1*** at 16p13.3-p13.11, ***HBB*** at 11p15.4-p15.5	Congenital alpha thalassemia, polycythemia. See Reese-Ellsworth syndrome. (MIM 141900). For the Austin variant see MIM 141900.
hemoglobin H disease. (AD)	***HBA2*** at 16pter-p13.3	Alpha thalassemia. Many variants.
hemorrhagic telangiectasia-I (AD). MIM 187300	***HHT1, ORW-I*** at 9q33-q34.1	Osler-Rendu-Weber syndrome-I, congenital telangiectasis. ***ENG*** for endoglin is at 9q34.1. (MIM 131195).
hemorrhagic telangiectasia-II. (AD). MIM 600376	***ALK1, ACVRL1*** at 12q13 ***HHT2***, ***ORW-II*** at 3p22.	Causes Osler-Rendu-Weber syndrome-II.
telangiectasia-III. (AR) MIM 601101	***HHT3.***	Osler-Rendu-Weber-III with liver involvement.
hereditary persistence of fetal hemoglobin (XL). MIM 305371	***GATA1, GF1, NFE1*** at Xp21-p11, ***FCPX, PCP*** at Xp22.2.	Anemia, decreased gamma globulin expression.
hereditary persistence of fetal hemoglobin. (AD)	***HBG1, HBG2, HBGR*** at 11p15.5	Decreased gammaglobulin expression, anemia.
hereditary persistence of fetal hemoglobin, heterocellular. (AD)	***HPFH2*** at 7q36	This is an Indian type. (MIM 142335). The gene ***FCP*** for another (AD) heterocellular type is at 6q22.3-q23.1. (MIM 142470).
hereditary persistence of alpha hemoglobin. (AD)	***AFP, HPAFP*** at 4q11-q21	Ataxia-telangiectasia.
hetero-hemoglobin. (XR).	***FCP1, FCPX*** at Xp22.2.	Mutation causes hereditary persistence of fetal hemoglobin.
Kell blood group. (AD). MIM 110900	***KEL*** at 7q33-q35	Other mutations can be involved. See hyperreflexia. The oncogene ***TIM*** (MIM 600888) also maps here.
MNS blood group MIM 111300	Gene may be at 2q14 or at 4q28-q31.	Glycophorin gene family.

plasminogen activator deficiency. (AD)	***PLAT,TPA*** at 8p12-q11.2, ***PLAU, UKP*** at 10q24-qter	Thromboembolic disease.
plasminogen activator inhibitor-I. (AD)	***PAI1, PLANH1*** at 7q21.1-q22.3.	A product of the endothelial cells. Mutation causes a bleeding tendency.
plasminogen activator inhibitor-II. (AD).	***PAI2, PLANH2*** at 18q21.2-q22.	Produced by the placenta, monocytes, and macrophages.
plasminogen activator inhibitor alpha-II. (AR)	***PL1*** at 17pter-p12	Placental thrombin inhibitor.
plasminogen activator receptor. (AD)	***PLAUR, URKR*** at 19q13	Regulates surface plasminogen activity.
plasminogen deficiency, types I and II. (AD)	***PLG*** at 6q26	Have deep venous thromboses and retinal thromboses.
platelet disorder. (AD)	***FPDMM*** at 21q22.1-q22.2	With associated myeloid malignancy. See also von Willebrand disease. Three subtypes with prolonged bleeding time. ***VWF*** (MIM 193400). See MIM 277480 for a recessive von Willebrand form.
protein C. (AD)	***PROC*** at 2q13-q14	Inactivates coagulation factors Va and VIIIa.
protein S deficiency. (AD)	***PROS1*** and ***PROS2*** at 3p11.1-q11.2	Recurrent venous thromboses.
Shwachman-Diamond syndrome (AR). MIM 260400	***SBDS*** at 7q11. Some have other genetic abnormalities.	Pancreatic insufficiency manifesting in infancy, bone marrow dysfunction, dwarfism, severe neutropenia, aplastic anemia, immunodeficiency, and more risk of leukemia.
spherocytosis type I. (AD)	***SPTB*** at 14q23-q24.2.	Gene is spectrin, mutation causes hemolytic anemia, and jaundice. For choreoacanthocytosis (AR) see ***CHAC*** at 9q21 MIM 200150.
spherocytosis type II. (AD).	***ANK1, SPH2*** at 8p11.2-p11.1.	Gene is ankyrin. Mutation causes iron overload anemia.
Japanese spherocytosis. (AR).	***EPB42*** at 15q15, ***SLCA1*** at 17q21-q22.	Hemolytic anemia. Possibly ***SPTA1*** at 1q21 and ***EKV*** at 1p36.2-p34 are involved.
spherocytosis. (AR)	***LOR*** at 1q21	The gene product is loricrin.
Thalassemias are mostly inherited AD. The person with Mediterranean or Cooley hypochromic anemia (AD) may be mentally retarded.		
alpha thalassemia. (AD)	***HBA1*** and ***HBA2*** at 16p13.3-p13.11.	Heinz body alpha anemia, jaundice, and cyanosis.
alpha thalassemia. (AD)	***HBHR, ATR1*** at 16p13.3	Microcephaly with mental retardation. Hemoglobin H disease.
beta thalassemia. (AD). MIM 141900	***HBB*** at 11p15	Heinz body sickle-cell anemia. See ***HBA*** (MIM 141800).
delta thalassemia. (AD). (MIM 142000).	***HBD*** at 11p15.	Hemoglobin Lepore and other types.
thalassemia. (XL)	***ATRX, ATR2*** at Xq13	Severe psychomotor retardation.
Thrombocytopenias. Those affected have fewer platelets and have anemia.		
thrombocytopenia. (AD)	***TCPT*** at 11q23	Deletion causes Paris-Trousseau thrombocytopenia.
thrombocytopenia. (AR, AD).	***GP2B, ITGA2B, CD41B*** at 7q21.32	Glanzmann-Naegeli type, abnormal platelets, thrombasthenia, and a bleeding tendency.
thrombocytopenia. (XR)	***IMD2,WAS,THC*** at Xp11.23-p11.22.	Wiskott-Aldrich syndrome with eczema, immune deficiency, bloody diarrhea, and early death.
thrombocytopenia. (AD)	***ITGB3, GP3A*** at 17q21.1-q21.3	Glanzmann thrombasthenia, the platelet glycoprotein deficiency, results in early bruising and bleeding.
macro type. (AD)	***CD36*** at 7q11.2	Platelet collagen receptor.
thromboangiitis obliterans. (AR). MIM 211480.	Deficient in **HLA-B12**. Gene	Buerger autoimmune disease with Raynaud's phenomenon, hyperhidrosis, and digital ulcers. Occurs especially in young male smokers. Associated with **HLA-DRB1**.
thrombophilia. (AD, AR). MIM 173360	***HGR*** at 3q28-q29, ***PLANH1*** at 7q22.1-q22, ***AT3*** at 1q23-q25, ***PLG*** at 6q26, ***PROC*** at 2q13-q14, ***HFC, HC2*** at 22q11	Can inhibit a plasminogen activator and cause protein C deficiency, and other blood anomalies.

Bloom syndrome (AR). MIM 210900	***BLM*** at 15q26.1, is a ***RECQ*** helicase.	Helicases function at the interface between DNA replication and DNA repair. They help to maintain genetic stability. The abnormally small child has multiple anomalies and is very sensitive to sulight. Bloom dwarfism with facial telangiectasia mostly affects males. Have a predisposition to diabetes, cancer, immunodeficiency and leukemia.. an also act as a cancer suppressor.
blue cone pigment		Tritanopia. See color vision.
blue sclera syndrome. (AR). MIM 229200 Sometimes called the van der Heave syndrome	Gene	Have joint hyperextensibility, red hair, a brittle cornea that can perforate, (fragilitas oculi), keratoconus, and some are deaf. Compare with these syndromes: Ehlers-Danlos type VIB (MIM 229200), osteogenesis imperfecta (several subtypes), Marfan (MIM 154700), van der Hoeve (AD), and Hallermann-Streiff (MIM 234100).
body mass index	Genes may be at: 5q14-q21, 8q23-q24, 10p15, and 14q11.	Based on the relation between the person's height and weight.
Boeck sarcoidosis MIM 181000	Some familial predisposition.	Besnier-Boeck-Schauman sarcoidosis. Lymphadenopathy, bone lesions, cirrhosis, lacrimal gland adenopathy, keratitis sicca, glaucoma, and optic atrophy.
bone dysplasia with medullary fibrosarcoma (AD).	***BDMF*** at 9p22-p21	Malignant fibrous histiocytoma causes skeletal dysplasia.
Bonnett-DeChaume-Blanc syndrome	Gene	Arteriovenous aneurysms of midbrain and retina. Compare with these syndromes:: Wyburn-Mason (MIM193300) and von Hippel-Lindau (MIM 193300).
Bornholm myopia-1. (XL)	***MYP1, BED*** at Xq28	Superior intelligence, severe myopia, and detached retina. With ***MYP2*** have severe myopia (AD) at 18p11.31. MIM 160700.
Bowen syndrome of multiple malformations. (AR). MIM 211200	Gene at 9q22.3.	Heart defects, agenesis of the corpus callosum, congenital glaucoma, and early death. Compare with the cerebrohepatorenal syndrome (MIM 214100).
Bowen-Armstrong syndrome. (AR). MIM 225000	Gene	Ectodermal dysplasia, mental retardation, renal anomaly, hand and foot deformity, and cleft lip/palate. May relate to the AEC syndrome with ankyloblepharon, ectodermal defects, and cleft lip/palate. (MIM 106260).
Bowen-Conradi syndrome. (AR). MIM 211180	Gene	This mainly Hutterite syndrome occurs in 1/355 liveborn and includes low birth weight, microcephaly, joint deformities, hypospadias, and death in their first year.
Brachmann or Cornelia DeLange syndrome. (AR). MIM 122470	***CDL1*** at 3q26.3	Growth retardation, motor disturbances, mental retardation, ptosis, nystagmus, strabismus, down-slanting lid fissures, and high myopia.
brachydactyly type A1 MIM 112500	***CBG*** at 14q31-q32.1	A corticosteroid-binding globulin. Type A2 (MIM 112600), type A3 (MIM 112700), and type A4 (MIM 112800).
brachydactyly, type B. (AD). MIM 120400	***ROR2*** at 9q22	Also have renal agenesis, and macular colobomas. Compare with: Sorsby macular coloboma and Robinow syndrome (MIM 268310).
brachydactyly, type C. (AD). MIM 113100, 601146	***BDC*** at 12q24, ***CDMP1*** at 20q11.2	Abnormalities of the fingers. Haws type. See Grebe chondrodysplasia. (MIM 200700).
brachydactyly, type E. (AD). MIM 113300	***BDE*** at 27	Brachydactyly.
brachydactyly with mental retardation. (AD)	***BDMR*** at 2q37	Often the cause is a deletion here.
bradykinin receptors	***BDKRB1*** at 14q32.1-q32.2	***BDKRB2*** has been mapped to 14q32-q32.2.
brain-fat-bone disease. (AR).	***PLOSL*** at 19q13.1	Polycystic membranous osteodysplasia with leukoencephalopathy.
branchiootorenal syndrome. (AD)	***EYA1, BOR*** at 8q13.3	Deletion causes Melnick-Fraser syndrome with deafness and preauricular pits. Compare with Okihiro syndrome. (MIM 126800).
bronchial asthma, (can be AD)	***BHR1*** at 5q31-q33	Genes on other chromosomes may be involved. Seasonal wheezing, sneezing, rhinitis, and allergic reactions.
Brown or Jaensch-Brown inferior oblique pseudopalsy syndrome	May be AD or AR but some are not inherited.	Was called superior oblique tendon sheath syndrome. Have bilateral ptosis, are unable to elevate the eyes. Corticosteroids can be helpful .for treating acquired cases of painful ophthalmoplegia

Brugada syndrome. (AD). MIM 601144	***SCN5A*** at 3p24-p21	Affects about 1/10,000. Cardiac disease, ventricular fibrillation, right bundle branch block. Potentially lethal. See Jervell-Lange-Nielson syndrome. ***LQT3.*** (MIM 600163).
Brunner syndrome. (XL).	***MAOA*** at Xp11.4-p11.23	Monoamine oxidase deficiency.
Bruton agammaglobulinemia (XL). MIM 300300.	***BTK, ATK*** at Xq21.3-q22	Fail to produce mature B cells, lack plasma cells, frequent bacterial infections but resist viral infections, have a rheumatic fever-like syndrome.
bullous pemphigoid, antigen-1. (AD)	***BPAG1*** at 6p12-p11	Neurodegeneration. Gene is dystonin. See also ***BPAG2, COL17*** at 10q24.3. (MIM 113811).
bull's eye maculopathy. (AD, XL). MIM 179605	***peripherin/RDS, RP7*** at 6p21.1-cen	Compare with butterfly dystrophy, retinitis pigmentosa, pattern dystrophy, and fundus flavimaculatus.
Bürger-Grütz hyperlipoproteinemia-1a. (AR). MIM 238600	***LPL, LIPD*** at 8p22	Hyperchylomicronemia. Compare with hypercholesterolemia-1a. (MIM 107730, 138491).
butterfly dystrophy. (AD).	***RDS, RP7*** at 6p21.1-cen.	See also bull's eye maculopathy, pattern dystrophy, and fundus flavimaculatus.
Byler disease. (AR MIM 211600, 601847, 602397, 603201.	***PFIC1*** at 18q21, (MIM 602397), ***PFIC2*** at 2q24. (MIM 601847), Some have mutations in ***BSEP*** (MIM 603201) a bile salt export pump.	Depends on an ABC transporter (ATP-binding cassette) of which there are at least 50. Affects 1/90,000. With this type of progressive cholestasis, some are deaf, and many have retinal lesions. Also causes Greenland intrahepatic cholestasis with onset soon after birth. See also ***PGY3*** (MIM 171060). P-glycoproteins are overproduced by cancer cells and cause multidrug resistance.

C.

The **cadherins** are calcium-dependent trans-membrane glycoproteins responsible for the physical adhesion of epithelial cells. They are important in neural cell development. Cadherins are needed for normal cell functions and probably protect against cancer. The catenins regulate the function of the cadherins.

The cadherins include ***CDH1*** at 16q22.1 (AD). This uvomorulin is an E-cadherin, (MIM 192090), ***CDH2*** is at 18q11.2 (AD). This N-cadherin has a neural role, (MIM 114020), ***CDH3*** at 16q21-q22.1 is called P-cadherin, (MIM 603006) , ***CDH4*** in nervous tissue,(MIM 603006), ***CDH5*** at 16q21-q22.1, (MIM 601120), ***CDH6*** (MIM 603007), ***CDH7*** is at 18q22-q23 (603016), ***CDH8*** is at 16q21-q22.1 (MIM 603008), ***CDH11*** an OB-cadherin, an osteoblast is at 5p14-p13, (MIM 600023), ***CDH12*** for N-cadherin 2, is at 5p14-p13 (MIM 600562), ***CDH13*** H-cadherin, heart is at 16q24, (MIM 601364), ***CDH15*** for M-cadherin is at 16q24.3 myotubule, (MIM 114019), r ***CDH16*** at 15q21-q22 or at 8q22.11, (MIM 603118), ***CDH17*** at 8q22.1 (MIM 603017), ***CDH18*** formerly called ***CDH14***, (MIM 603019), ***CDH16*** may be at 8q22.1, ***CDH19*** (MIM 603057), ***CDH20*** (MIM 603058) and ***CDH21*** (MIM 603059).

See also the desmogleins ***DSG1*** (MIM 125670), ***DSG2*** (MIM 125671), and ***DSG3*** (MIM 169615). all at 18q12

At least eleven genes are recognized as **calcium channel genes**. Examples include: ***CACNB1*** , **CACNB2,** and ***CACNB3***, etc. See channelopathy.

encode the calcineurin A subunit. (AD, AR) MIM 121400, 217300	***CNA1*** at 12q21, ***CNA2*** is at 12q22.	Calcineurin has a catalytic subunit and a regulatory subunit. See cornea plana.
calmodulin is a calcium binder and modulates the calcium channel signal	***CALM1*** at 14q24-q31, ***CALM2*** at 2p21.3-p21.1, ***CALM3*** at 19q13.2-q13.3	Nearly 20 subtypes of these calcium modulated proteins are known. (MIM 114180, 114182, and 114183). See cornea plana. Pseudogenes have also been found.
camptomelic or campomelic dysplasia-1. (AR)	***CMD1, SRA1*** at 17q24.3-q25.1	Congenital muscular dystrophy with severe central nervous system disorders.
Canavan disease (AR). MIM 271900	***ASPA*** at 17pter-p13	Deficiency of aspartocyclase allows N-acetylaspartic acid to accumulate. Get van Bogaert-Bertrand spongy degeneration of the white matter with mental retardation, megalencephaly, atonia of neck muscles, nystagmus, strabismus, optic atrophy, blindness, and usually death by 18 months of age. Compare with Alexander disease.(AD, AR) ***GFAP*** at 11q21-q23, (MIM 203450)

Cancer. One person a minute dies of cancer in USA.. More than 30 oncogenes have been recognized. More than 70% of cancers arise in epithelial cells and almost 60% occur in people over 65 years of age. Mutations are more likely to occur in the paternally-derived chromosome in the following diseases: Wilms tumor, bilateral retinoblastoma, osteosarcoma, embryonal rhabdomyosarcomas, and neurofibromatosis-1.

A gene for tumor susceptibility is at 11p15.2-p15.1. Multiple tumor-associated genes ***MTACR1*** map in the region 11p15.5. (MIM 194071). See Wilms tumor type 2. See these tumor-promoting oncogenes: ***ras, myc***, ***erbB2,*** and ***bcl-2***. See also the Lynch genes ***LCFS1*** at 2p16-p15 and ***LCFS2*** at 18q11-q12. Probably genes acting as apoptosis inhibitors such as ***APl1*** and ***APl2*** both at 11q22-q23 have a role. Many deletions can cause cancer.

As tumors progress they show more genetic alterations, especially loss of heterogeneity at 10q23. LOH occurs in 70% of glioblastomas. Gene amplification is common in some cancers: see for example ***ERBB1*** at 7p12.3-p12.1, ***ERBB2*** at 17q21.1, ***MYC*** at 8q24.12-q24.13, and ***cyclin D1*** at 11q13. Three oncogenes work together ***MYC, BCL2***, and ***RAS***.

Genes for suppression of tumorigenicity-7, breast, are: type-I at 7q31.1, type-2 at 11p14.3-p12, type-5 at 11p15, and type-6 at 11p11.2. The tumor suppressor gene ***PTEN*** is at 10q23. The gene ***TP53*** at 17p13.1-p12, a tumor suppressor, this promoter of apoptosis is mutated in half of human cancers. Related genes are ***p63*** formerly called ***NBP*** that regulates ***p53***. Also related is ***p73***. Decreased expression of ***p73*** protein and increased expression of ***p63*** protein have a role in pancreatic adenocarcinoma. A mutation in the ***p63*** gene is responsible for the AEC or Hay-Wells syndrome (AD). Other tumor suppressor genes are ***Rb, DRTF1*** (MIM 189902), ***p21***, ***CDKN1A*** (MIM 116899), and ***p16, CDKN2A*** (MIM 600160). The gene ***THW*** on chromosome 6q appears to have a suppressor role in melanoma metastasis and in other tumors. See also Bloom syndrome (AR) ***BLM*** at 15q26.1 (MIM 210900).

Certain genes play a role in tumor necrosis, for example ***TNFA1P1*** at 17q22-q23 or other deletions from chromosome 17. Tamoxifen is used in treating cancers, it induces apoptosis.

Name	Gene	Comments
acoustic neuroma. (AD) adrenocortical carcinoma. (AR).	***NF2*** at 22q12.2 ***ADCR, MTACR1, WT2*** at 11p15.5.	Deletion causes bilateral neuromas. A rare childhood tumor.
adenomatous polyposis coli. (AD).	***APC, FPC*** at 5q21-q22	See Gardner (MIM 175100) and Turcot (MIM 276300) syndromes.
anal canal carcinoma. (AD). MIM 105580.	***ANC*** at 11q22-qter and at 3p22	Squamous carcinoma results from deletions at either locus.
ataxia-telangiectasia (AD, AR, S). MIM 208900.	***ATM, AT1*** at 11q23	Louis-Bar syndrome. More than 40 mutations have been identified.
basal-cell carcinoma. (S, AD).	***RASA1, GAP*** at 5q13.3	And deletions from ***NBCCS*** at 9q22.3-q31 or from ***MSSE, ESS1*** at 9q31 or from ***PTCH*** (MIM 601309). Lesions are likely to occur on the lower lid.
basal cell carcinoma. (AD). MIM 601309	***PTCH*** at 9q22.3 or at 9q31.	**NBCCS**. Nevoid basal cell carcinomas with skeletal anomalies, and jaw cysts. See Gorlin-Goltz syndrome.(MIM 109400)
basal-cell nevus (AD). MIM 109400	***NBCCS, BCNS*** at 9q22.3-q31	Gorlin-Goltz syndrome (MIM 109400) with mental retardation, glaucoma, scoliosis, and iris colobomas. Skin lesions usually appear in childhood. They may have hypertelorism, strabismus, cataracts, and colobomas of the optic nerve.
Bazex syndrome. (XD). MIM 301805	***BZX*** at Xq24-q27	Carcinomas of the face appear about age 20 and marks appear on the skin of the back of the hands and elbows.
B-cell lymphoma	***BCL1*** may be at 11q13, ***BCL2*** (AD) at 18q21.33, ***BCL3*** at 19q13.1, ***BCL5*** (AD) at 17q22, ***BCL6*** at 3q27, ***BCL7*** and ***BCL7a*** at 12q24.1, ***BCL8*** at 15q11-q13, ***BCL9*** at 1q21.	See the lymphomas, many of these types are inherited in the AD manner.
Beckwith-Widemann syndrome. (S, AD). MIM 130650, 602631.	***BWS, BWR1A*** at 11p15.5	Duplication causes exomphalos-macroglossia-gigantism, coarse features, adrenal carcinoma, and cardiomyopathy.
Besnier-Boeck-Schauman sarcoidosis. (MIM 181000)	Mostly non-genetic.	Also have cirrhosis and keratitis sicca.
bicornate uterus. (AD). MIM 192000	Gene	Incidence 1/1000 females. May have other uterine anomalies.
BK mole or dysplastic nevus syndrome MIM 155600	***CMM1*** at 1p36, ***CMM2*** at 9p21, ***CMM3*** at 6q22-q23 and probably other genes.	Large moles, may get cutaneous malignant melanomas, possible metastasis to choroid, as well as nevi in conjunctiva or iris. See also ***MG50*** at 2p25.3 (MIM 600134) and ***CDK4*** at 12q13-q14 (MIM 123829).

bladder cancer (AD). MIM 109800	***HRAS*** at 11p15.5-p15.1, ***RASK2*** at12p12.1, ***RB1*** at 3q14.	***RASK2*** has a role in many cancers including lung cancer and breast cancer.
Bloom syndrome (AR). MIM 210900	***BLM, BS*** at 15q26.1	The abnormally small child has multiple anomalies and is very sensitive to sunlight. Tend to develop solid tumors, immuno deficiency, and leukemia.
blue rubber bleb nevus syndrome. (S, AD). MIM 112200	***BRBNS*** may be on chromosome 9p.	Bean syndrome with hemangiomas anywhere on the body, especially in the GI tract, and profuse sweating, some have epilepsy, anemia, and may have ocular lesions too. See ***VMCM*** (MIM 600195) for familial venous malformation.
bone dysplasia with medullary fibrosarcoma. (AD).	***BDMF*** at 9p22-p21	Minimum trauma produces bone lesions.
Bonnet deChaume-Blanc syndrome	Gene	Arteriovenous aneurysms of midbrain and retina. Compare with these syndromes: von Hippel-Lindau (AD) at 3p26-p25 (MIM 193300). and Wyburn-Mason .(MIM 193300). See ***RCC1*** for renal cell carcinoma at 3p14.2 (MIM 144700), and ***RCC2*** (MIM 179760) and ***RCC3*** (MIM 179770).
Bowen disease, *carcinoma in situ*	Gene	Carcinoma *in situ*. Squamous cell carcinomas of skin, conjunctiva, and cornea..
brain tumors	***DMBT1*** at 10q25.3-q26.1. Brain tumors can be associated with:: ***EGFR*** at 7p12.3-p12.1**,** ***CDK4*** at 12q13-q14, ***CDKN2A*** at 9p13-p22, ***TP53*** at 17p13.1- p12, ***NF2*** at 22q12.2, ***PTEN*** at 10q23.3..	Deletions from this tumor suppressor can cause brain tumor, medulloblastomas, gliomas, and lung cancer. Gene product is hensin. Medulloblastomas often have deletions from genes at 10q25.3, 11p13 to 11p15.5, and 16q24.1-q24.3. Loss of heterozygosity. See ***DMBT1*** for malignant brain tumors (MIM 601969). See also the gliomas.
breast cancer, susceptibility. (AD) .	***BRCA2*** at 13q12.3. ***BTAK, STK15*** at 20q13 is the gene for serine/protein kinase. ***MYBL2*** at 20q13.1 is the avian myeloblastosis viral oncogene homolog-like-2. ***ZNF2*** at Xp22.11-p11.23 is for a zinc finger protein. Some have losses from genes on 10q, 11p, or 16q.	Breast cancer is the most common malignancy in women. Breast cancer affects 1/9 women and kills 1/20. Average age of onset is 65 years. Most breast cancers over-express ***cyclin D1,*** a component of the cell cycle mechanism. The ***cyclin D1*** oncogene is ***PRAD1, CCND1*** at 11q13-q13.4. Among those with breast cancer ***BTAK*** is amplified in 21%, ***MYBL2*** in 17%, and ***ZNF2*** in 12.5%. The gene ***AIB1*** on chromosome 20q is amplified in some breast cancers. (MIM 601937).
breast cancer. (S, AD, AR).	***BRCA1*** at 17q21	Early-onset breast cancer, and deletion causes ovarian cancer.
(AD)	***BRCA2*** at 13q12.3	For an early-onset cancer and for early-onset male breast cancer.
(AR)	***BRCA3*** at 8p12-p22.	Or this translocation t(11;22)(q23;q11).
(AD)	***ESR1*** at 6q25.1	An estrogen receptor gene. See also ***ESR2*** at 14q22-q24.
(AD)	***TP53*** at 17p13.1-p12 or at 17p13.3	***TP53*** is a breast cancer regulator, a suppressor. Gene ***BCPR*** at 17p13.3 regulates ***TP53***. (MIM 191170) ***p53*** is the most frequently mutated gene in cancers.
(AD)	***BCL1, PRAD1*** at 11q13.3	Parathyroid adenomas.
(AD). (MIM 113710)	***TFF1, BCEI*** at 21q22.3	Trefoil factor-I is expressed only in breast cancer. Trefoil factor-2 gene is ***TFF2*** at 21q22.3. (MIM 182590) and ***TTF3*** (MIM 600633).
(AD)	***KRAS2, RASK2*** at 12p12.1	Cancer of lung, breast, bladder, and pancreas.
(AD)	***TKR1, ERBB2*** at 17q21.1	Leukemia and breast tumors. See ***ERBB1*** at 7p12.3-p12.1. May relate to ***EGFR*** at 7p12.3-p12.1 or at 7p13-q22. (MIM 131550).
(AD)	***HER2, NGL*** at 17q12-q21	Is the most frequently amplified oncogene in breast tumors. Is associated with a poor survival in breast cancer. See ***NEU*** at 6p21.3 for neuraminidase deficiency.
(AD)	***FGR*** at 1p36.3-p36.2	This oncogene was called ***VFGR.***
(AD, S)	***BWS, BWR1A*** at 11p15.5	Beckwith-Wiedemann syndrome.
(AR)	***TSG101*** at 11p15.2-p15.1	A gene for tumor susceptibility.
tumor necrosis factor. (AD). MIM 601728	***PTEN*** at 10q23.3	Deletion here allows many tumors to grow. See for example Cowden disease (AD) (MIM 158350) with multiple hamartomas and seizures.
(AD)	***FHIT*** at 3p14.2	Deletion here causes esophageal, stomach, colon, and other cancers.
(AD)	***PHB*** at 17q21	Deletion of prohibitin allows cancer to grow.

allows steroid-dependent cancers to develop. . MIM 601937	***SRC3, AIB1*** at 20q12-q13.2	This steroid receptor activator has a role in many cancers including breast cancer.
lobular breast cancer. (AD).	***CDH1*** at 16q22.1	See cadherin. The catenins regulate the function of the cadherins.
AMC syndrome (AR). MIM 208870	***ATA*** at 11q23	Mutation causes ataxia, microcephaly, cataract, nystagmus, mental retardation, and may influence breast cancer.
breast cancer, ductal, suppressor-I. (AR)	***BRCD1*** at 13q14.1.	Some have deletions from another (AR) suppressor ***BRCD2*** at 1p36. See also the melanoma genes.
breast carcinoma inhibitor.	***BMRS1*** at 11q13.1-q13.2	A metastasis suppressor.
breast cancer metastasis. MIM 156490.	***NM23, NME1*** at 17q213	Can inhibit metastasis. Related genes are ***NME2*** and ***NM23-H2*** at 17q21.3, as well as ***NME3*** and ***NME4*** at 16p13.3. See MIM 156491, 601817, and 601818.
breast cancer suppressor. (AD).	***BCPR*** at 17p13.3.	This suppressor regulates ***TP53*** at 17p13.1-p12.
breast tumorigenicity suppressor-7. MIM 600833	***TSG7*** at 7q31.1	The gene caveolin-I, ***CAV-1*** at 7q31, has a role in ovarian carcinoma. Other suppressors exist. Including ***CAV-2*** and ***CAV-3.*** Amoxifen can reduce the risk of ER-positive breast cancer.
breast cancer, male. (XL or AD).	***AR, KD, DHTR, SBMA, TFM*** at Xq12.	Also ***BCRA2*** at 13q12.3. (MIM 600185).
cancer associated retinopathy. (AR). MIM 179618	***RCV1*** at 17p13.1.	**CAR** syndrome may be an immune reaction to cancer, Have antiretinal antibodies and progressive retinal degeneration, scotomas, and loss of vision.
carcinoid tumor of the lung. (AD). MIM 131100	***MEN1*** at 11q13	Multiple endocrine neoplasia.
Carney complex. (AD). MIM 160980	***CNC1*** at 17q22-q24, ***CNC2*** at 2p16 but not all show this linkage.	Multiple endocrine neoplasia. Atrial myxoma, adrenocortical carcinoma, nasopharyngeal schwannoma, Cushing disease, spotty skin and labial pigmentation. See the McCune-Albright syndrome. (MIM 174800).
cervical carcinoma (AD). MIM 191181, 601153 Is best detected by a Pap smear.	***ST3*** at 11q13-q13.4, ***FHIT*** at 3p14.2. With cervical cancer aneuploidy of chromosome 13 occurs early.	Deletions from these genes can cause cervical carcinoma. A suppressor gene maps to 11q22-q24. The gene ***HTS1*** at 11p15 is a HeLa tumor suppressor. If cancer has spread to the lymph nodes, detect by PET (positron emission tomography). Five-year survival rate when lymph nodes are affected is 45%. Treatment by hysterectomy gives a 5-year survival rate of 90%.
chondrosarcoma. (AD)	***EXT1*** at 8q24.1-q24.13	This translocation t(9;22)(q31;q25) is also a common cause.
chondrosarcoma, myxoid. MIM 600542.	***CSMF*** at 9q22	Extra-skeletal chondrosarcoma.
colon cancer, non-polyposis, type 1. (AD)	***COCA1, FCC1, MSH1, MSH2,*** at 2p16, ***DRCA, CLD*** at 7q22-q31.1	***MSH2*** accounts for 60% of non-polyposis colon cancer. See Muir-Torre (AD) (MIM 158320) have sebaceous tumors with internal malignancy, often colorectal cancer. Relates to Lynch cancer family-II. (MIM 114400). See also ***MLH1*** (AD) at 3p23-p21.3. (MIM 120436).
colon cancer, type 2. (AD)	***COCA2, FCC2*** at 3p23-p21.3	Accounts for 30% of non-polyposis colon cancer.
other types of colon cancer. (AD)	***TGFBR2*** at 3p21.3, ***PTPG1*** at 7q11.23	Or deletions from ***FHIT*** at 3p14.2.
colon cancer. (AD)	***DRA*** at 7q22-q31.1, ***TRK*** at 1q23-q24, ***DCC, GS*** at 18q21.3, ***KRAS2*** at 12p12.1	Colon cancer affects 12/10,000 people, average age of onset is 70 years . Or a deletion from ***MLH1*** at 3p23-p21.3. (MIM 120436).
colorectal cancer. (S, AD)	***COCA2, SCLC1*** at 3p23-p21.3, ***APC, MCC, GS, FPC*** at 5q21-q22, ***DR*** at 7q22-q31.1, ***MSH*** at 6q24, ***NRAS*** at 1p13.2, ***BCPR*** at 17p13.3, ***BAX*** at 19q13.3, ***TP53*** at 17p13.1-p12, ***KRAS2, RASK2*** at 12p12.1, ***CTNNB1*** at 3p22-p21.3.	Colorectal cancer kills about 57,000 people a year in USA. Deletion from the gene ***DCC*** at 18q21.3 causes colorectal carcinoma. Some have gains of chromosomes 7, 8, or 20 or have a loss of chromosome 18. Other genes are ***MADH4/SMAD4*** (MIM 600993) and ***TGFBR2***. (MIM 190182). Among those with sebaceous skin tumors with or without keratoacanthomas half have colorectal cancer.

colorectal cancer, non-polyposis. (AD)	***COCA1, FCC1, MSH2*** at 2p16 ***CFS2*** at 18q11-q12, ***PMS1*** at 2q31-q33, ***TGFBR2*** at 3p21.3, ***PMS2*** at 7p22, ***COCA2*** at 3p23-p21.3.	Type 1 ***M SH2*** at 2p16, HNPCC1. Type 2 ***MLH1*** at 3p23-p21.3, HNPCC2 Type 3 ***PMS1*** at 2q31-q33, HNPCC3. Type 4 ***PMS2*** at 7p22, HNPCC4 Type 5 ***M SH6, GTBP*** , HNPCC5.
connective tissue and other tumors (AD)	***MDM2*** at 12q14.3-q15	Binds to the tumor suppressor ***p53***.
craniopharyngioma. XL type. MI M 312000 AR type. MIM 262600..	Mostly non-genetic, only rarely AR or XL.	A congenital tumor with hydrocephalus, paresis of CNIII and CNVI, diplopia, nystagmus, and field defects. Tends to be associated with pituitary dwarfism.
Denys-Drash syndrome.		See Wilms tumors.
endometrial carcinoma . MIM 602084	***DEC*** at 10q23-q26, ***CDH1*** at 16q22.1, ***MSH3*** at 5q11-q12, ***PTEN, MMAC1*** at 10q23.3	Deletions from these genes are responsible. There are about 20 cadherins, calcium-dependent cell adhesion proteins, epithelial. They affect neural development. A common sign is bleeding. The Ecadherin gene has a role, when methylated this tumor has invasive capacity.
epithelioma, squamous.(AD).	***EDD1*** at 19p13	See also ***ESS1*** at 9q31 and ***PIN1*** at 19p13.
esophageal cancer. (AD). MIM 601153	***FHIT*** at 3p14.2, ***TP53*** at 17p13.1-p12, ***RB1*** at 13q14. Possibly genes at 3q21.3, 9p22, and 9q31. See ***CREST*** syndrome when the esophagus is involved.	A deletion can cause renal cell carcinomas, and colon cancers. Amplification of DNA in the region 18p11.3 relates to esophageal squamous cell carcinoma. Other genes are ***YES1*** (MIM 164880), ***TYMS*** (MIM 188350), ***HEC*** (MIM 600559), and ***TGIF*** (MIM 602630).
esophageal cancer with tylosis. (AD)	***TOC, TEC*** at 17q24	Oral leukoplakia, esophageal cancer, and palmoplantar keratoderma.
palmoplantar keratoderma. (AD)	***KRT9*** at 17q21.1-q21.2	For Bothnian keratosis palmoplantaris the gene ***PPKB*** is at 12q11-q13.
Ewing sarcoma (AD). MIM 133450	***EWSR1, EWS*** at 22q12. or this translocation t(11;22)(q24;q12). The proto-oncogene ***FLI1*** at 11q24 may have a role.	A highly metastatic round-cell tumor of bone, more frequent in males age 10 to 25 years.
fibrosarcoma, infantile MIM 191316	Fusion of ***ETV6*** at 12p13 and ***NTRK3*** at 15q25.	Sometimes classified as a malignant fibrous histiocytoma but has a relatively good prognosis and low rate of metastasis.
Gardner syndrome. (AD). MIM 175100	***APC, GS, FPC*** at 5q21-q22	Deletions here cause adenomatous polyposis coli. Compare with: Turcot syndrome for which the genes are ***APC*** at 5q21-q22. (MIM 175100), ***MLH1*** (MIM 120436), or ***PMS2*** (MIM 600259).
gastric cancer, familial. (AD)	***CDH1, UVO*** at 16q22.1	Cadherin-1.
glioblastoma multiforme. . (AD).	***GMB*** at 10q25.1-qter, ***ANOVA*** at 19q13.3	Loss of a tumor suppressor.
Gliomas may develop along several pathways. Anomalies in genes on chromosome 7, or 10 or 17 relate to glioma. The ***FGFR*** gene (MIM 131550) is amplified in 40% of malignant gliomas. Pathway 1 for WHO grade 1, loss of heterozygosity in 17q unmasks mutations in ***NF1*** (MIM 162200). Pathway 2 loss of heterozygosity in 17p unmasks mutations in ***p53*** and leads to astrocytoma-2. Similarly loss of heterozygosity in 13q unmasks mutations in ***RB1***. Loss of heterozygosity in 19q unmasks mutations in ***p16***. Loss of heterozygosity in 9p unmasks mutations in ***p15.*** See ***DMBT1*** at 10q25.3-q26.1 for malignant brain tumors. (MIM 601969).		
glioma. (AD, AR)	***PDGFA*** at 7p22, ***PDGFB*** at 22q13.1, ***NEU*** at 6p21.3, ***NF2*** at 22q12.2, ***erbB2*** at 17q21.1	Gliomas are derived from cells of the brain, pineal gland, pituitary gland, or retina. Some have deletions from ***PTEN***, ***MMAC1*** at 10q23.3. See also ***GLG1*** at 15q22-q23, ***DMBT1*** at 10q25.3-q26.1, and see MIM 137800 for gliomas of the brain
malignant gliomas, astrocytomas, type 3 . MIM 137800.	Depend on multiple genetic changes including mutations in ***p53*** and in the retinoblastoma cell cycle regulatory pathway.	The glioma amplified sequence41 is at 12q13-q15. See ***ART4*** at 12q13.2-q13.3 for a bacterial toxin. (MIM 603087) Involved genes may also be on chromosomes 9p, 10q, and 19q.
glioma associated oncogene homolog MIM 165220	***GLI1*** at 12q13.2-q13.3	One of the Kruppel family of zinc finger proteins. Kruppel means cripple or dwarf.
Gorlin-Goltz syndrome. (AD). MIM 109400	***NBCCS, BCNS, PTCH*** at 9q22.3-q31, ***ESS1*** at 9q31, ***PIN1*** at 19p13, ***PIN1L*** at 1p31.	Multiple basal cell carcinomas, medulloblastoma, ovarian fibromas, and other defects. Genes for two AR cancer-producing syndromes also map here, ***XPAC*** (MIM 278700) for xeroderma pigmentosum and ***FANCC*** at 9q22.3-q31 for Fanconi anemia group C. (MIM 227645).

hepatocellular carcinoma. (AD)	***HVBS1*** at 11p14-p13, ***LCO*** at 2q14-q21, ***MPR1*** at 6q26, ***HVB56*** at 4q32.1 ***TP53*** at 17p13.1-p12, ***LPSA*** at 19p13.2-q13.3.	Liver cancer can relate to HBV and HCV viral infections.
humoral hypercalcemia of malignancy (AD)	***PTHLH*** at 12p12.1-p11.2	A parathyroid-like hormone acts here. Hypercalcemia is a common complication of lung cancer.
Kaposi sarcoma (AD). MIM 148000	Rarely familial. Gene? Often seen in AIDS patients and homosexual men.	Have red-purple vascular sarcomas especially on the legs and have limb edema. Occurs more often in men than in women Can affect the conjunctiva. See also herpesvirus 8.
kidney cancer		See under kidney.
leiomyomata (AD). MIM 150800	***MCUL1*** at 1q42.3-q43 for cutaneous leiomyomata and for uterine fibroids.	Leiomyomata are the most common gynecological tumors in women of child-bearing age. The connexin gene Cx43 (***GJA1*** at 6q14-q24.1) is often involved in uterine leiomyomata.
Li-Fraumeni cancer family syndrome. (AD). MIM 151623	***p53, TP53*** at 17p13.1-p12 See also MIM 113721, 191170.	Deletion causes many different cancers. The gene for a related protein kinase inhibitor is ***p58*** at 1p36. (MIM 176873, 601184) . It is related to ***p34***..
lipoma. (AD)	***BABL, LIPO*** at 12q13	Benign lipomas. See ***LPP*** at 3q28, ***HMGIY*** at 6p21, and for Allgrove syndrome (AR) ***AAA*** at 12q13.
liposarcoma (AD). MIM 164953	***LPSA, D19S38IE*** at 19p13.2-q13.3. Other genes are at 1q42.3-q43, or 12q13-q14, or on chromosomes 6, 7, or 14.	An aggressive malignant neoplasm. Oncogene liposarcoma. See ***GLI1*** at 12q13.2-q13.3.
liposarcoma, myxoid type (AD)	***DDIT3, CHOP10, GADD153*** at 12q13.3	Liposarcoma.
liver cancer oncogene (AD). MIM 165320	***LCO*** at 2q14-q21	One of the oncogenes.
lung cancer, small-cell type. (AD)	***SCLC1, COCA2*** at 3p23-p21.3, ***FHIT*** at 3p14.2, ***VHL*** at 3p26-p25	Deletions from these genes cause this oat-cell type cancer. The retinoblastoma tumor suppressor gene ***RB1*** is mutated in 90% of small-cell lung cancers. ***TP53*** is deleted in 90% of small-cell lung cancers and in 50% of non-small-cell lung cancers.
lung cancer. (AD)	***SLC, SCYA21*** at 9p13, ***L-myc*** or ***TAL1*** at 1p32, ***myc*** at 8q24.12-q24.13, ***NMYC*** at 2p23-p24, ***SSTR2*** at 17q24, ***erbA*** at 7q21-q22, ***KRAS2, RASK2*** at 12p12.1.	Defects in ***RB1*** at 13q14 or a translocation can also be responsible. The gene ***p16*** at 9p21 is mutated in more than 50% of non-small-cell lung cancers. Non-small-cell lung cancer (NSCLC) is the leading cause of cancer death in the world.
lung carcinoma, squamous cell type. (AR, AD)	***BCHE, SLC2A2*** (AR) at 3q26.1-q26.3, ***ENO1*** (AD) at 1pter-p36.13, ***PAX7*** (AR) at 1p36.	***BCHE*** is amplified in these carcinomas. ***ENO1*** codes for enolase, a tumor suppressor. ***PAX7*** (AR) codes for a transcription factor. (MIM 167410).
Lynch-1 cancer family syndrome (AD). MIM 114500	***LCFS1*** at 2p16-p15	Deletion here causes multiple neoplasms but especially colon cancer.
Lynch-2 cancer family syndrome (AD). MIM 114400	***LCFS2*** at 18q11-q12	Deletion leads to cancer especially in the right colon. See ***MSH2*** (MIM 120436) and see Muir-Torre syndrome. (MIM 120433, 120435, and 158320.)
medulloblastoma. (AD).	***MDB*** at 17p13.1-p12, ***DMBT1*** at 10q25.3-q26.1	A common posterior fossa tumor in children. For a neurotrophic tyrosine kinase receptor see ***NTRK3*** at 15q25 (MIM 191316).
melanomas. (AD, S) dysplastic nevi	***CMM1, MLM, DNS*** at 1p36, ***MLM2, CMM2, CDKN2A*** at 9p21 or at 9p13-p22, ***MG50*** at 2p25.3, ***CMM3*** at 6q22-q23, ***CDK2*** at 5p13, ***CDK6*** at 7q21- q22, ***SKP1A*** at 7q11.2, ***SKP1B*** at 12p12.	For melanoma-1 the gene is ***CDKN2A, TP16, p16***$^{(INK4)}$ at 9p13-p22. For melanoma-2 ***CDK4, CDKN1B*** is at 12p12.3. Deletions from any of these genes or from certain other genes such as the tumor suppressor ***AIM1*** at 6q21 can lead to a melanoma. For the cutaneous malignant melanoma, BK mole, dysplastic nevus syndrome the gene is ***CMM1*** at1p36. Another melanoma gene has been mapped to 2p25.3, but see ***MG50***.. The melanotransferrin for the melanoma associated antigen ***p97*** is at 3q28-q29. (MIM 155750). Final agreement on some of these names is yet to be reached.

melanoma inhibitory activity. MIM 601340.	***MIA*** at 19q13.32-q13.33	Modulates cancer growth.
meningiomas. (AD)	***NF2*** at 22q12.2, ***PDGFB, SIS*** at 22q13.1, ***MGM*** at 22q12.3-qter.	Most are associated with mutations in ***NF2***, the gene for neurofibromatosis-II.
metastasis suppression MIM 156490, 156491 601817, 601818.	***NM23, NME1*** at 17q21.3. ***NME2*** at 17q21.3, ***NME3*** and ***NME4*** at 16p13.3.	***NME1*** Inhibits metastasis by breast, melanoma, and other cancers including head and neck squamous carcinomas.
Muir-Torre cancer family syndrome (AD). MIM 158320	***MLH1*** at 3p23-p21.3, (MIM 120433) ***MSH2*** at 2p16. (MIM 120435)	Sebaceous skin tumors often with non-polyposis colon cancer. Nearly half have colorectal cancer. See Lynch-2 cancer family syndrome. (MIM 114400). Other skin polyposis syndromes are Peutz-Jeghers (MIM 175200, 602216), and Gardner (MIM 175100)..
mutiple endocrine neoplasia type-1 (AD). MIM 131100	***MEN1*** at 11q13	Deletion causes many cancers. gene product is menin. See Wermer and Zollinger-Ellison syndromes. (MIM 131100).
types-IIA and IIB (AD, S). MIM 171400	***RET, MEN2A*** at 10q11.2	This protooncogene codes for a tyrosine kinase. Mutations in ***RET*** have been found in 25% to 80% of sporadic medullary thyroid carcinomas.
type-III (AD). MIM 162300.	***RET, MEN2A*** at 10q11.2. (***MTC*** and ***MEN2B*** also map here.).	***MEN2B*** mutations can cause congenital megacolon, medullary carcinoma of the thyroid, and later pheochromocytoma.
multiple exostoses, multiple osteo-chondromatosis. (AD). MIM 133700, 133701, 600209.	***EXT1*** at 8q24.1 or 8q23-q24, ***EXT2*** at 11p12-p11 or 11p11-p13 ***EXT3*** on chromosome 19p, ***EXT4*** at 1p36.1	***EXT1*** and ***EXT2*** account for over 90% of cases. ***EXT1*** can act as a tumor suppressor but all these tumors carry a risk of malignant transformation. See also ***EXTR1*** at 8p21 and ***EXTR2*** at 1p21. Compare with the Langer-Giedion syndrome. (MIM 150230).
multiple myeloma. MIM 254500	***MUM1, IRF4*** at 6p25-p23. About 20% have this translocation t(4;14)(p16.3;q32). Some have a mutation in ***cyclin D3*** at 6p21 or in ***MMSET*** at 16q23..	This malignancy of plasma cells leads to deregulation of the gene for fibroblast growth factor receptor ***FGFR3*** at 4p16.3. Kahler disease. Associated conditions can be Crouzon syndrome and Beare-Stevenson syndrome with mutations in ***FGFR2*** and ***FGFR3.*** Those with a deletion from ***DBM*** at 13q14 have a poorer prognosis
multiple tumor associated chromosome region 1 . (AR, AD) nasopharyngeal carcinoma. (AD)	***MTACR1, WT2*** at 11p15.5 ***TP53, p53*** at 17p13.1-p12	Wilms tumor. (MIM 194071). ***TP53*** ia a cell cycle regulator in many different cancers.
nephroblastoma . (AD)	***NOV*** at 8q24.1	Oncogene. Some have a deletion from a gene at 11p15.5.
neuroblastoma. (AR). MIM 256700 (The older symbols were ***NBS*** and ***SRC2.***)	***NB, VFGR, NBS, SRC2*** at 1p36-p34, ***LOH*** at 7q31.1, ***NMYC, MYCN*** at 2p23-p24, ***NRAS*** at 1p13.2, ***TP73*** at 1p36, ***NME1*** at 17q21.3.	May have double minute chromosomes or deletions from 1p36.2-p36.1, 5q36.13, 11q23, 14q32-qter, or 16p12-p13 for a predisposition to neuroblastoma. Band 1p35-p36 contains two neuroblastoma suppressor loci.
neuroblastoma, infraorbital	Gene	Hutchinson syndrome, metastatic hematogenous dissemination of a primary tumor in a child under age 6, severe anemia, exophthalmos, EOM palsy, choroidal metastasis, optic atrophy, and has a poor prognosis.
neuroepithelioma (AD).	A translocation t(11;22)(q24;q12).	
neurofibromatosis-I. (AD). MIM 162200	***NF1*** at 17q11.2	Von Recklinghausen or Watson syndrome. Peripheral type. May have an optic nerve glioma.
neurofibromatosis-II. AD, S). MIM 101000	***NF2*** at 22q12.2	Central type. Deletion here causes an acoustic neuroma.
neurofibromatosis-III. (AD). MIM 162260, 162220	***NF3A*** on chromosome 12. ***NF3B*** for the intestinal type.	Mixed Riccardi type. Bilateral acoustic neuromas, no Lisch nodules on irides.
neurofibromatosis-IV (AD). MIM 162270	Gene.	With this Riccardi type they have no Lisch nodules on the irides.
neurofibromatoses - types V and VI	Genes.	Have been reported.

nevoid basal cell carcinoma syndrome. (AD). MIM 109400	***NBCCS, BCNS*** at 9q22.3-q31	Gorlin-Goltz syndrome. May have a medulloblastoma. See also ***PTCH*** at 9q22.3. (MIM 601309).
nevus of Ota, oculodermal melanocytosis. (AD). MIM 117350.	Gene. See Wadia-Swami syndrome with sbw eye movements. For the AD type see MIM 117350 and for the rare AR type see MIM 271322.	Congenital periorbital brown or slate-grey skin pigmentation, usually unilateral, in area supplied by first and second divisions of the trigeminal nerve. Affects more females than males. Can treat with cryotherapy or by Q-switched alexandrite laser. A mongolian spot in the sacral area disappears after puberty
nevus sebaceus of Jadassohn. (AD ?). MIM 163200	***JNP, NSJ*** or ***LNSS*** Posssibly not Mendelian.	Paracrinopathy. Linear hamartoma nevi on face and scalp, alopecia, seizures, mental retardation, proptosis, eyelid coloboma, nystagmus, and corneal vascularization. May develop osseous and cartilaginous choristomas.
oncogene. MIM 164940.	***FGR*** at 1p36.2-p36.1	Was called ***SRC2***. There are many oncogenes.
oral cancer-1. MIM 602198	***DOC1*** at 12q24.31	Deleted in oral cancer.
osteosarcoma. (AD)	***RB1*** at 13q14, ***TP53*** at 17p13.1-p12	Deletions from either gene can be responsible
ovarian cancer. (AD)	***BRCA1*** at 17q21, ***OVC*** at 9p24, ***OVCS*** at 6q26-q27, ***AKT2*** at 19q13.1-q13.2.	Deletions from any of these genes can be responsible. Some show amplification in the chromosomal region 20q12-q13. See genes ***AIB1*** at 20q12 and ***PTPN1*** at 20q13.1. In 60% of cases they have abnormal nucleotide excision repair factors (NER).
ovarian carcinoma. (AD)	***UVO, CDH1*** at 16q22.1	And can cause endometrial carcinoma.
ovarian cancer with colorectal non-polyposis cancer. (AD).	***MSH2*** at 2p16	***OGR1*** at 14q31 (MIM 601404) is the gene for a receptor for ovarian cancer G protein.
palmoplantar keratoderma (AD).	***FPPK*** at 17q21.1-q 21.2	Some have esophageal cancer but keratoderma can also occur with other cancers.
Cancer of the pancreas kills more than 24,000 people a year in USA, and is the fifth leading cause of cancer death. Most die within a few months after diagnosis, fewer than 5% live for 5 years. Mutations in the following genes increase the risk of pancreatic cancer: ***hMSH2, hMLH1, hPMS1, hPMS2, LKB1/STK1,*** and ***PRSS1***. Pancreatic suppressor genes are: ***INKA4, Tp53, SMAD4, MAP2K4, MADH4, ACVRIB,*** and ***BRCA2.*** The gene ***CDKNA2*** is a cyclin-dependent kinase inhibitor ***p16*** that promotes cell cycle arrest. For pancreatic acinar carcinoma the genes may be ***CDKN2*** at 9p21 or ***MADH4*** .at 18q21.1. The gene ***PSCPT*** at is for a solid and cystic pancreatic tumor. When this tumor is removed the prognosis for the patient is good.		
pancreatic cancer susceptibility. (AD). MIM 260350, 600160, 600993.	Gene at 4q32-q34. See also ***CDKN2*** at 13q12.3, and ***MADH4***. (MIM 600993).	Most are AD. See MIM 260350, 167780, 190070, 191170. Smoking increases the risk. Tumor suppressors at 6p22 and at 6q23-q24 can affect the progression of endocrine pancreatic cancer.
pancreatic cancer. (AD)	***TP53*** at 17p13.1-p12	Is regulated by ***BCPR*** at 17p13.3. ***PETS1*** at 3p25 is a pancreatic tumor suppressor.
pancreatic ductal carcinoma. (AD). MIM 260350	***CMM2, P16-INK4, TP16*** at 9p13-p22, ***ARP*** at 3p21.1, ***ST3*** at 11q13-q13.4, ***BRCA2*** at 13q12.3.	Deletion from or mutation of any of these genes can be responsible. Most die within six months. Mutations in ***BRCA2*** are found in 17% of cases. See also ***SMAD4*** at 18q21.1 (MIM 600993),. It relates to ***TGFB1***. (MIM 190180). Other transforming growth factors are ***TGFB2*** (MIM 190220), and ***TGFB3*** (MIM 190230).
pancreatic carcinoma (AD). MIM 600160	***TP53*** at 17p13.1-p12, ***KRAS2***, ***RASK2*** at 12p12.1, ***CDKN2*** at 13q12.3, ***BRCA2*** at 13q12.3.	The gene ***PETS1*** at 3p25 suppresses pancreatic endocrine tumors. ***KRAS2*** (MIM 190070) is mutated in 85% of pancreatic carcinomas, and in non-small-cell lung cancers but is not mutated in small-cell lung cancers. Mutations in ***p53*** (MIM 191170) are seen in 50% of pancreatic carcinomas.
pancreatic carcinoma. MIM 600993	***MADH4*** at 18q21.1	Deletion of this tumor suppressor can cause pancreatic carcinoma. Some pancreatic carcinomas depend on deletion of ***DCC*** or ***PPC*** which map in this vicinity. Or loss of the tumor suppressor ***DPC4***. (MIM 120470, 600993).
papillary renal cell carcinoma. MIM 312390, 179755.	***RCCP2, PRCC*** may be translocation related t(X;1)(p11.2;q21.2)	See under kidney.
paraganglioma. (AD)	***PGL, CBT1*** at 11q23	Carotid body tumor.
paraneoplastic syndromes.. (AD).	***PTHLH*** at 12p12.1-p11.2	Humoral hypercalcemia of malignancy.

paraneoplastic sensory neuropathy. (AD)	***HUD, PNEM*** at 1p34	Often with small-cell lung cancer.
parathyroid adenomatosis. (AD). MIM 163461.	***CCND1, PRAD1*** at 11q13-q13.4	This ***cyclin D1*** oncogene is overexpressed in parathyroid tumors. In parathyroid adenomas the gene ***MEN1*** at 11q13 is mutated. Note ***ST3*** also maps here.
pheochromocytomas (AD). MIM 171300, 171350, 171420	***PCHC*** on chromosome 1p, or ***RET*** at 10q11.2, or a deletion from the tumor suppressor ***VHL*** at 3p26-p25	Deletions from these genes or from many others can be responsible for tumor of the adrenal medulla. A pheochromocytoma secretes catecholamines and causes severe hypertension, heart failure and cataracts.
pituitary tumor. (AD)	***PRKCA, PKCA*** at 17q22-q23.2, ***MEN1*** at 11q13	Is an invasive pituitary tumor.
polyposis, juvenile, intestinal. (AD)	***PJI*** at 10q22.3-q24.1	Deletions from this suppressor gene.
polyposis coli, adenomatous. (AD)	***APC, FPC*** at 5q21-q22	Gardner syndrome. (MIM 175100).
Prostate cancer is the most common malignancy In North American men and the second most common cause of cancer death.		
prostate cancer susceptibility. (XL)	***HPCX*** at Xq27-q28.	Recurrent chromosomal break points in prostate cancer cell-lines are at 5q11, 8p11, and 10q22.
prostate cancer (AD). MIM 176807	***PRCA1, HPC1*** at 1q24-q25, ***PRCA2, HPC2*** at 1q42.2-q43, , ***BRCA1*** at 17q21, ***MXI1*** at 10q25, ***AR, DHTR, SBMA*** at Xq12, ***KAI1, CD82*** at 11p12.	Some have a deletion from ***nm23*** at 17q22 or from ***PTEN***, ***MMAC1*** at 10q23.3 (MIM 601728) Mutations in ***PTEN*** have been reported in Cowden disease (MIM 158350), Bannayan-Riley-Ruvalcaba disease, (AD) (MIM 153480), and with the Proteus syndrome. (MIM 176920)
prostate adenocarcinoma-I MIM 601188	***PAC1*** at 10pter-q11 mediates tumor suppression and apoptosis of prostate cancer.	Genes for prostate adenocarcinomas are also at 6q21-q23 and at 6q25-q27. For inflammatory atrophy of the prostate the gene for COX-2 is ***PTGS2*** at 1q25.2-q25.3.
prostate cancer metastasis . MIM 156490.	***NM23*** at 17q21.3	A metastasis inhibition factor. See also ***NME2, NME3***, and ***NME4***.
prostate cancer metastasis. (AD)	***PCM1*** at 8p21.3-p22	Can combine with ***RET*** at 10q11.2 (MIM 164761).
prostate cancer suppressor	***N33*** at 8p22. See also ***C13*** at 13q12-q14, ***ANX7*** at 10q21, ***ST7*** at 7q3, ***DNMT*** at 10p15.1.	***KAI1*****, CD82** is an antimetastasis gene at 11p11.2**.** (MIM 600623).
purpura, thrombotic thrombocytopenic. (AD, AR) MIM 134370, 274150	Gene may be ***CFH*** at 1q32	See complement factor H. (MIM 134370). For purpura simplex (AD) see MIM 179000.
purpura thrombocytopenic (AD). MIM 188030	***ITP***	An autoimmune condition. A deficiency of ***ADAMTS13*** that cleaves von Willebrand factor leads to formation of microthrombi. Treat with dexamethasone or splenectomy.
renal cell carcinomas (MIM 144700)	***RCC1*** at 3p14.2	See under kidney and under cancer. See also ***RCC2*** (MIM 179760) and ***RCC3*** (MIM 179770).
retinoblastoma (C, AD). MIM 180200	***RB1*** at 13q14 acts like a recessive because both genes must be abnormal for the tumor to be malignant. Rarely a translocation is involved.	All bilateral and 10% to 20% of unilateral retinoblastomas are hereditary. Look for a white reflex in the pupil of a child a few months old. Mutations in ***RB1*** cause other cancers too. A trilateral retinoblastoma includes bilateral retinoblastomas, and a mid-line CNS tumor, often a pinealoma.
retinoblastoma-like tumor. (AD). MIM 116957	***CP107, RBL1*** at 20q11.2	See also ***RBL2*** at 16q 12.2 (MIM 180203).
rhabdomyosarcoma. (AR)	***RMS1*** at 11p15.5, ***WT2*** at 11p15.5, ***RB1*** at 13q14	Deletions from these genes can cause rhabdomyosarcomas.
rhabdomyosarcoma. (AD)	***PAX3, WS1, HUP2*** at 2q35, ***RMS1*** at 11p15.5, ***PAX7*** at 1p36, ***BWR1A*** at 11p15.5, and a gene on chromosome Xp.	Although rare a rhabdomyosarcoma is the most common primary orbital tumor in childhood. Fusion of two genes can be responsible.
rhabdomyosarcoma, alveolar. (AD)	***FKHR*** at 13q14.1, ***PAX3*** at 2q35, ***PAX7*** at 1p36	Often have a translocation. t(2;13)(q35;q14). A pseudogene is at 5q35.2-q36.3.

rhabdoid tumors. (AD). MIM 601607	***RDT*** at 22q11, ***SNF5/INI1*** at 22q11.23 is a tumor suppressor gene.	Deletion here is the usual cause of these highly malignant tumors in children under 2 years of age.
salivarygland adenoma. (AD)	***SGPA, PSA*** at 8q12.5	Benign pleomorphic adenomas.
salivary gland adenoid cystic carcinoma. MIM 217990	***ACC*** at 6q23-q25	Agenesis of the corpus callosum and recurrent bronchopneumonia. Note this is the location of ***EPM2*** for ***MELF*** Lafora epilepsy.
sarcoma, synovial. (XR)	***SSRC, RCCP2, SSXT, SSX1, SSX2*** all at Xp11.2, ***INT-1*** at 12pter-q14, ***BCL2*** at 18q21.33, ***SAS*** at 12q13-q14	The gene ***PXN*** is for paxillin. The Rous sarcoma gene is at 12q24. Gene ***SRC*** at 20q11.2 is for a proto-oncogene. (MIM 190090). .
schwannoma. (AD, S)	***NF2*** at 22q12.2, ***ERBB2*** at 17q21.1, ***AREG*** at 4q13-q14	Amphiregulin is an epidermal growth factor. See also ***PCHC*** for pheochromocytomas.
skin cancer, non-melanoma.	Deletion from a gene at 9q22.3 but some have a mitochondrial anomaly.	See under cancer.
Smith-Magenis syndrome (AD). MIM 182290	***SMCR*** at 17p11.2	Deletion here allows many kinds of cancer to develop.
spastic quadriplegia, & mental retardation . (AR). MIM 270950	Gene	May also have tumors, deafness, mental retardation, trouble sleeping, exotropia, nystagmus, ptosis, miosis, and retinitis pigmentosa.
squamous epithelioma. (AD).	***ESS1*** at 9q31.	Squamous cell carcinoma.
squamous cell carcinoma, antigen 1. MIM 600517, 600518.	***SCCA1*** at 18q21.3	For antigen 2 the gene is ***SCCA2*** at the same locus. These genes of the serpin family allow tumor cells to survive by protecting them against TNF alpha-induced apoptosis. See also psoriasis, several genes.
stomach or gastric cancer. (AD)..	***APC, GS, FPC*** at 5q21-q22	This cancer can also be caused by a deletion from ***FHIT*** at 3p14.2. (MIM 601153).
suppressor of tumorgenicity-2. MIM 185440	***ST2*** at 11p14.3-p12	***ST2*** is a member of the interleukin-1 receptor family. See cervical cancer. See HeLa cell line.
suppressor of tumorgenicity-3. MIM 191181.	***ST3*** at 11q22-q24, or at 11q13-q13.4, or at 11q12-q13	HeLa cell type. See cervical carcinoma. The gene for tumor suppressor-5 is ***HTS1*** at 11p15.
testicular cancer. (AR). MIM 273300	***GCT*** at 12q22-q24	Deletion here causes this germ-cell tumor.
thyroid cancer, predisposition to. (AD)	***TRKA*** at 1q32-q41, ***TSHR*** at 14q31, ***PTEN*** at 10q23.3	A tyrosine kinase receptor. Thyroid stimulating hormone receptor. A regulator in the cytoplasm and nucleus of neurons.
thyroid medullary carcinoma. (AD) .	***RET, MEN2A, MEN2B*** at 10q11.2, ***TPR*** at 1q25, ***TFG*** at 3q11-q12.	Pheochromocytoma, nodular goitre, and neuromas of nasal, laryngeal, and conjunctival tissues. Mutations in ***RET*** can occur with Hirschsprung aganglionic megacolon. One gene for Hirschsprung disease is ***GDNF*** at 5p13.1-p12.
thyroid non-medullary cancer. (NMTC).	***MNG1*** at 14q32, ***TCO1*** at 19q13.2, ***fPTC*** at 1p21.	For multinodular goitre. ***MNG1*** and ***fPTC*** act with ***TCO*** at 19q13.2. These patients have cell oxyphilia. This cancer is more aggressive and often multifocal.
thyroid papillary carcinoma. (AD).	***D10S170, TST1, PTC, TPC*** at 10q11-q12, ***PTEN*** at 10q23.3..	Alpha-induced endothelial primary response gene.
tuberous sclerosis. (S, AD) MIM 191100, 191092.	***TSC1*** at 9q32-q34, ***TSC2*** at 16p13.3	Deletions from either of these genes cause Bourneville disease with tuberous sclerosis, renal cysts, and retinal tumors.
tumor necrosis factor, alpha-induced protein-1.	***TNFAIP1*** at 17q22-q23	Endothelial. See ***TNFAIP6***. (MIM 600410) on chromosome 2.
tumor necrosis factor, (cachectin). (AD). MIM 191160	***TNF, TNFA, TNFB*** at 6p21.3-p21.1	Hemorrhagic tumor necrosis. ***TNFB2*** may be associated with migraine without an aura.
tumor necrosis factor receptor-2	***TNFR2*** at 1p36.3-p36.2	See also ***TNFR1*** at 12p13 on T and B cells.

tumor suppressor genes. (AD).	***TP53*** at 17p13.1-p12, ***MLH1*** at 3p23-p21.3.	The gene ***p53, TP53*** is a cell cycle regulator.
Turcot syndrome (AD, AR). MIM 276300	***APC***, ***FPC*** at 5q21-q22, ***MLH1*** (MIM 120436), ***PMS2*** (MIM 600259).	Deletions cause a medulloblastoma or a glioblastoma. Tumors of the CNS and polyposis of the colon. Compare with Gardner syndrome. (MIM 175100).
tylosis with esophageal cancer. (AD).	***TOC, TEC*** at 17q24	Oral leukoplakia and palmoplantar keratoderma.
cervical cancer MIM 185440	***ST2*** at 11p14.3-p12	This gene acts as a cancer suppressor.
cervical cancer. MIM 191181	***ST3*** at 11q22-q24, or at 11q13-q13.4, or at 11q12-q13	Deletion from this tumor suppressor gene causes cervical cancer. Loss of ***TP53*** relates to cancers in various parts of the body. Note ***HPV16***. Integrations tend to occur with ***FRA13C*** at 13q23, with ***FRA3B*** at 3p14.2, and with ***FRA17B*** at 17q23.
uveal melanomas. (AD). MIM 156490	***nm23*** at 17q21.3	Deletion here causes the most common primary intraocular malignancy.
von Hippel-Lindau syndrome. (S, AD) MIM 193300	***VHL*** at 3p26-p25	Deletion causes angiomas, renal cysts, renal carcinomas, and hypertension.
von Hippel-Lindau binding factor MIM 300133.	***VBP1*** at Xq28	***VBP1*** transports ***VHL*** into the nucleus.
Wilms tumor		See Wilms tumors and ***WAGR***. (MIM 194072).
CAMAK syndrome. (AR). MIM 212540	Gene	Low birth weight, microcephaly, arthrogryposis, curved spine, stiff joints, mental retardation, and cataracts soon after birth.
CAMFAK syndrome. (AR). MIM 212540	Gene	Neurological disease with demyelination, microcephaly, severe mental retardation, failure to thrive, kyphoscoliosis, spasticity, hip dislocation, and congenital cataracts. The CAMFAK syndrome resembles these syndromes:early-onset Cockayne, Pena-Shokeir (AR), and Martsolf (MIM 212720).
Canavan disease (AR) MIM 271900	***ASPA*** at 17pter-p13 May have ***ACY2*** deficiency in non-Jewish patients.	Aspartoacylase deficiency, excrete excessive N-acetylaspartic acid in urine. Spongy degeneration of CNS white matter. May be congenital, infantile or a late-onset type. Atonia of neck muscles, and blindness. Severe mental retardation. Death in early childhood. Mostly affects Jewish patients..
Carbohydrate deficient glycoprotein syndromes are now called **disorders of glycosylation**. They have a major effect on the central nervous system. ***CDGS-Ia*** is the most common carbohydrate deficient glycoprotein syndrome. Signs include mental retardation, epilepsy, cerebellar ataxia, polyneuropathy, strabismus, and retinitis pigmentosa.		
carbohydrate deficient glycoprotein syndrome-1a. (AR, XL). MIM 601785, 212065	***PMM2, CDGS-Ia*** at 16p13.3-p13.2. ***PMM1*** is at 22q13.	Jaeken syndrome. Mutation in the gene for phosphomannomutase deficiency causes multi-system disorders involving major vessels, developmental delay, hypotonia, cerebellar hypoplasia, ataxia, peripheral demyelination, stroke-like episodes, alternating internal strabismus (esotropia), and myopia.
carbohydrate deficient glycoprotein syndrome- 1b (AR). MIM 602579	***MPI, PMI1***, ***CDGS-Ib*** at 15q22-qter.	Reduced polyprenol reductase and a mannosephosphate deficiency. Have liver disease, enteropathy, and hypoglycemia without neurologic involvement.
CDGS syndrome-1c	***CDGS-Ic***	Mild psychomotor retardation and seizures.
CDG-1i	Gene	Has been identified.
glycoprotein syndrome-III (AR). MIM 212067.	***CDGS-III***	Infantile spasms and pigmentary skin changes with psychomotor delay and growth retardation.
glycoprotein syndrome-IV. (AR). MIM 601110	***CDGS-IV***	Microcephaly, intractable seizures, iris coloboma, and optic atrophy.
carbonic anhydrase deficiency. (AD). MIM 114800	***CA1, CA2***, and ***CA3*** all map to 8q22-q13	Types I, II, and III encode soluble metalloenzymes of physiological importance. ***CA2*** (MIM 259730).
carbonic anhydrase deficiency type IV MIM 114760	***CA4*** at 17q23	Membrane bound. Facilitate transport of CO_2 and bicarbonate as well as iron and fluid transport.
type V. (AD). MIM 114761	***CA5*** at 16q24.3	Mitochondrial.

type VI. (AD). MIM 114780	***CA6*** at 1p36.33-p36.22	In saliva.
type VII. (AD). MIM 114770	***CA7*** at 16q21-q23	In salivary glands.
type VIII. MIM 114815	***CA8*** at 8q11-q12	Binds zinc.

Cardiac Anomalies. See cardiomyopathy and related problems. Estimate that in USA 700 infants a year are born with a deletion from a gene at 22q11.2 which causes cardiac defects.

A hypoplastic left heart depends on the gene ***JAM3*** at 11q24. Malfunctioning ion channels impair ventricular repolarization and cause ventricular tachyarrhythmia. Ventricular tachycardia is called torsade de pointes. Potentially lethal inherited disorders of cardiac conduction are: Brugada syndrome and the long QT syndrome. Each affects about 1/10,000.

Name	Gene	Comments
atrial septal defect. (S, AD).	***ASD1*** ***ASD2***	Incidence 1/1500 live births. The secundum type ***ASD2*** with brachydactyly (AD) maps to 6p21.3. (MIM 108800, 113301).
atrioventricular canal defect-I. (AD).	***AVSD, AVCD*** at 21q22.	An atrial septal defect of the secundum type is mostly sporadic but some depend on the AD genes ***ASD1*** and ***ASD2***.
atrioventricular septal defect. (AR, AD). MIM 600123.	Gene at 3p25 just outside the ***TIMP4*** locus.	Deletions here cause low birth weight, micrognathia, anal and radial defects, telecanthus, convergent strabismus, and ptosis. Mutations in ***CRELD1*** are associated with atrioventricular septal defects. Possibly the gene ***AVSD2*** is at 3p25. A gene for mental retardation also maps here.
mitral valve prolapse (AD). MIM 157700	***MVP*** Some have a conduction defect. (MIM 108900).	Barlow syndrome.affects 6% of young adults. Mitral valve prolapse can be relatively benign, they may show cleft palate and occlusion of retinal vessels. The ***FBN*** gene for fibrillin at 15q21.1 (MIM 134797), may be involved. With Marfan syndrome. (MIM 154700) more than 12% have a prolapsed mitral valve.
bicuspid aortic valve. (S, but 25% are AD) MIM 109730	Gene	Incidence 1/100, hypoplastic left heart, affects more males than females. Affects 25% of those with Turner syndrome. (MIM 312760).
coarctation of aorta. (M, AD). MIM 120000	Gene	Incidence 1/2500. Hypoplastic left heart. Seen in 10% of those with Turner syndrome.
myocardial infarction, susceptibility. (AD) MIM 106180	***DCPI, ACE1*** at 17q23	This gene is an important regulator of blood pressure.
coronary artery disease, susceptibility. (M) MIM 152200	***LPA*** at 6q27	Have elevated levels of Lp(a) and an increased risk of atherosclerosis.
conotruncal heart malformation (AR). MIM 217095	***CTHM*** at 22q11.2	Often have a deletion from this site. See ***CATCH-22*** at 22q11.2. This group of disorders includes: the DiGeorge velocardiofacial syndrome. ***DGS1*** at 22q11.2. (MIM 188400), velocardiofacial syndrome ***VCFS*** (MIM 192430), conotrunkal anomalies, face syndrome ***CTAFS,*** and some conotrunkal cardiac defects (MIM 217095).
endocardial fibroelastosis-II. (XR)	***EFE2, BTHS*** at Xq28	Pulmonary hypertension, cyanosis.
fibromuscular dysplasia of arteries. (AD)	***COL3A1*** at 2q32.2	Mutations here cause a wide spectrum of diseases. (MIM 120180).
heart hand, Holt-Oram syndrome. (AD). MIM 142900	***HOS1*** at 12q21.3-q22	Atrial septal defect, pulmonary hypertension.
heart block, progressive familial-I . (AD). MIM 113900	***HB1, PFHB1*** at 19q13.2-q13.3	Familial bundle branch block, type 1 is progressive,.
hemangioma, capillary hereditary. (AD)	***HEMC*** at 5q31-q33	Capillary hemangiomas are the most common tumors of infancy.
hematuria, familial benign.. (AD)	***COL4A4*** at 2q36-q37	See type 2 Alport syndrome.(AR). (MIM 203780).
hemorrhagic telangiectasia (AD)	***ORW, HHT1*** at 9q33-q34.1, ***HHT2, ORW-II*** at 3p22, ***CVRL1*** at 12q13.	Mutation in ***ENG*** at 9q34.1 for endoglin can cause Osler-Rendu-Weber disease. See also ***ORW-III*** and ***HHT3.*** (MIM 601101).
patent ductus arteriosus. (S, AD, AR). MIM 169100	***PDA***	Incidence 1/1200 in term infants. Have down-slanting lid-fissures. A potential cause is maternal rubella. See **CHAR** syndrome (MIM 169100) and other syndromes.

tetralogy of Fallot. (AD, some AR) MIM 187500	***TOF.*** Some have a deletion from 22q11	Incidence 1/2000. Preauricular ear pits, fifth finger clinodactyly, and prominent eyes. Some have glaucoma (MIM 187501). Compare with Goldenhar syndrome. (MIM 164210)
transposition of the great arteries. (S)	***CTHM*** often with deletions from 22q11.2.	Incidence 1/3500. Conotrunkal heart malformations.
ventricular septal defect.. (S, AD, AR)	Gene may be at Xq25.2.	Incidence 1/800 live births. For a ventricular septal defect the gene may be at Xq25-q26 MIM 306955.

Long QT interval (AD, AR, S), or **Romano-Ward syndrome** (AD). May have ventricular tachyarrhythmia, torsade de pointes, which can cause syncope or cardiac arrest. The rare **Jervell and Lange-Nielson** (JLNS) or **surdocardiac syndrome** (AR) gene ***KCNE1,*** (MIM 220400) with marked QT prolongation and sensorineural deafness occurs when a child inherits mutant alleles from both parents. Risk is increased if patient is on an anti-psychotic drug or has diabetes. See also MIM 600163 for a sodium channel.

LQT1. (AD). MIM 192500	***KCNQ1, KVLQT1*** at 11p15.5 codes for a potassium channel.	With LQT1 or LQT2 the patient is more likely to have a cardiac event especially during exercise.
LQT2. (AD). MIM 152427	***KCNE2, HERG*** at 7q35-q36 codes for a potassium channel.	Affects potassium channels and this predisposes the patient to arrhythmia and sudden death. See also ***KCNE1*** (MIM 176261).
LQT3. (AD). MIM 600163.	***SCN5A*** at 3p24-p21 codes for a cardiac sodium channel.	With LQT3, Brugada syndrome, the risk of death is higher.
LQT4. (AD). MIM 600919.	***LQT4*** at 4q25-q27	With sinus bradycardia.
LQT5. (AD). MIM 176261.	***KCNE1*** at 21q22.1-q22.2	Rare. Compare with ***KCNE2***. (MIM 152427). The ***ISK*** gene controls a potassium channel. (MIM 176261).
LQT6. (AD)	Gene	May relate to hyperthyroidism. See MIM 176261.
LQT7. (AD). MIM 600681	***KCNJ2*** at 17q23 encodes Kir2.1 an inward-rectifying potassium current.	Andersen syndrome with ventricular arrhythmia, periodic paralysis, and dysmorphic features.

Cardiomyopathy, cardiovascular defects, and related inherited problems. Mutations in 9 genes ***MYH7, TNNT2, TPM1, MYBPC3, MYL3, MYL2, TNN13, CACT,*** and ***DCM*** . can cause hereditary hypertrophic cardiomyopathy (HCM). Dilated cardiomyopathy (DCM) in adults can be due to mutations in ***CACT, DES*** or ***DMD***.

Hypertrophic cardiomyopathy (AD) affects about 1/500. Have a mutation in the sarcomere protein.

Mutations in the methylenetetrahydrofolate reductase (AR) gene ***MTHFR*** at 1p36.3 increase the risk of thromboembolism. (MIM 236250).

For the (XR) cardiac valvular dysplasia that affects males the gene is ***CVD1*** at Xq28.

The gap junction proteins affect cardiac conduction. ***Cx43*** has a role in cardiomyopathy.

Name	Gene	Comments
cardio-fascio-cutaneous syndrome (AD). MIM 115150	***CFC*** at 12q14	Congenital heart defect, mental retardation, and nystagmus. See Noonan syndrome. (MIM 163950).
cardiomyopathy, hypertrophic (AD, AR, Mito) MIM 192600, 115195, ---- *++++++++++++++++++++++++ 115196.	***CMH1, MYH7*** at 14q12, ***CMH2***,***TNNT2*** at 1q32, ***CMH3*** at 15q22.1 , ***CMH4*** at 11p13-q13, ***TNN13*** at 19q13.4, ***CMPD2*** at 1q32, ***ACT2*** at 15q14, ***CMH6*** at 7q3.	For Wolff-Parkinson-White syndrome (AD) one gene is ***CMH6*** at 7q3 but other genes can be involved. ***ACTC*** at 15q14 is the gene for an idiopathic cardiomyopathy. ***CMH1*** (MIM 192600), ***CMH2*** (MIM 115195), ***CMH3*** (MIM 115196), ***CMH4*** (MIM 600950),
with mid-left-ventricular defect.	***MYL1*** at 2q32.1-qter. ***MYL2*** at 12q23-q25.3.	Regulates myosin activity in smooth muscles.
with mid-ventricular chamber defect	***MYL3*** at 3p21.1-p22, ***MYL4*** on chromosome 17q (MIM 160770).	The myosin molecule has two heavy chains and four light chains. ***MYL5, MYL6***, and ***MYL7*** have also been reported.
cardiomyopathy, dilated. (XL)	***DMD, BMD*** at Xp21.2, ***TAZ, EFE2, CMD3A*** at Xq28	Muscular dystrophy. Death in early infancy. See Oregon eye disease, tyrosinemia-II. (AR). (MIM 276600).
cardiomyopathy, dilated. (AD)	***CMD1A*** at 1p11-q11, ***CMD1B*** at 9q13, ***CMD1C*** at 10q21-q23, ***CMD1D*** at 1q32, ***CMD1E*** at 3p25-p22, ***CMD1F*** at 6q23	Causes congestive heart failure. A recessive form also occurs.

cardiomyopathy with cataract. (AD). MIM 600958	***CMH4*** at 11p13-q13 and genes on chromosomes 1, 4, or 15, and at least one more gene.	***CMH4, MYBPC3*** is a myosin-binding protein C, cardiac. Familial hypertrophic cardiomyopathy.
cardiomyopathy. (Mito).	***MTTQ*** at 4329-4400 ***MTTL1*** at 3230-3304.	***MTTQ*** is for glutamine. ***MTTL1*** is for leucine. Have noninsulin dependent diabetes, maternally transmitted.
supravalvular aortic stenosis. (AD)	***ELN*** at 7q11.2	Gene is elastin. Williams-Beuren syndrome. ***WBS*** at 7q11.2 (MIM 194050).
atherosclerosis, susceptibility. (AD)	***CLU, CLI, SGP2, TRPMN2*** at 8p21-12, ***ATHS, ALP*** at 19p13.3-13.2	Gene is clusterin, apolipoprotein J.
aneurysm, familial. (AD).	***COL3A1*** at 2q32.2	More likely in males**.**
arrhythmogenic right ventricular dysplasia. (AD)	***ARVD1*** at 14q23-q24, ***ARVD2*** at 1q42-q43, ***ARVD3*** at 14q12-q22, ***ARVD4*** at 2q32.1-q32.3, and a gene on chromosome 10.	Affects about 1/15,000. With the degeneration of the myocardium they may have arrhythmia, a dilated right ventricle, and anterior polar cataract.
atrial fibrillation. (AD)	***ACTA2*** at 10q23.3, ***CSX*** at 5q35	In vascular smooth muscle.
atrial septal defect. (AD, M, S)	***ASD2*** at 6p21.3 MIM 108800, 113301.	Secundum type with brachydactyly. See ***ASD1.*** (MIM 108800) Active in several related conditions.
atrioventricular canal defect-I. (AD)	***AVSD*** at 21q22, ***AVCD*** at 1p31-p21	Congestive heart failure. A deletion from 3p25-pter near the ***TIMP4*** locus can cause an atrioventricular septal defect. See Down syndrome (MIM 190685) and the Ivemark syndrome. (AR) (MIM 263200).
carnatine deficiency (AR). MIM 212140, 603377	Gene ***SLC22A5*** encodes a carnatine transporter ***OCTN2.*** The gene is near 5q31.1.	Defective plasma membrane uptake of carnatine. Reye syndrome with progressive cardiomyopathy, skeletal myopathy, hypoglycemia, and hyperammonemia.
periarteritis nodosa, polyarteritis nodosa. (AD). MIM 109100	***PAN.*** See ***SCA6*** at 19p13.2-p13.1 Some autoimmune diseases are mitochondrial**.**	Kussmaul disease is a necrotizing angiitis with nodules along small and medium size arteries. The tumor-like lesions in this autoimmune disease have a benign clinical course but can cause duodenal necrosis. Mostly seen in males ages 20 to 40, GI disorders, hypertension, ptosis, corneal ulcers, uveitis, cataract, optic atrophy, and retinal detachment. See Churg-Strauss syndrome.
cerebral arteriopathy. (AD). MIM 600142, 600276	***CADASIL*** See ***Notch-3*** at 19p13.2-p13.1 or at 1p13-p-p11.	The ***Notch-3*** gene (MIM 600276) seems to affect ***CASIL*** (MIM 125310) which causes multi-infarct dementia. Onset after age 50, signs are subcortical infarcts, leukoencephalopathy, about 80% have dementia, 40% have depression, and 30% have migraine with an aura. Paroxysmal cerebellar ataxia (MIM 108500) and familial hemiplegic migraine MHP1 (MIM 141500) also map to 19p13. See ***Notch-2*** (MIM 600275).
congenital complete heart block. (AR). MIM 234700	Gene	Incidence 1/22,000 live births. Lack an atrioventricular node. Some have antibodies against calreticulin. Some of their mothers have systemic lupus erythematosus, (MIM 152700).
congenital heart defect. MIM 602118	May have a deletion from the 22q11 region.	Nieden syndrome, onset from birth, telangiectasia and pigmentation of the skin, deafness, sparse eyebrows, bilateral cataracts, and glaucoma. Some have diabetes mellitus.
congenital heart disease. MIM 602118.	***CHD*** at 3p25-pter	Deletion here causes low birth weight, mental retardation, micrognathia, telecanthus, and ptosis. About 1/3 of these patients have congenital heart disease, most often an atrioventricular septal defect.
cardiac valvular dysplasia-I. (XR)	***CVD1*** at Xq28	Congenital congestive heart failure.
cardio-facio-cutaneous syndrome. (AD). MIM 115150.	***CFC*** at 12q24	Congenital heart defect, mental retardation, and nystagmus. See Noonan syndrome. (MIM 163950), a male Turner syndrome.
Carney myxoma-endocrine complex. (AD). MIM 160980	***CNC*** at 2p16 and ***PRKAR1A*** at 17q22-q24 for the regulatory unit.	Atrial myxomas, pigmented skin lesions, pituitary adenoma, endocrine overactivity, Cushing syndrome, and acromegaly.

carpal tunnel or Leri syndrome. (S, AD). MIM 115430, 176300	***CTS1, TTR*** at 18q11.2-q12.2	Constrictive median neuropathy with onset at an early age, vitamin B_6 deficiency. Affects 3% of the population and is the commonest peripheral entrapment neuropathy in humans. Dwarfism, joint deformities, microphthalmia, EOM paralyses, corneal clouding, and cataract. Responsive to pyridoxine.
Carpenter syndrome. AR). MIM 201000	***FGFR2*** at 10q25.3-q26.	Pfeiffer (MIM 101600), Summitt (MIM 272350), and Goodman (MIM 201020) syndromes are similar. Compare with these syndromes: acrocephalopolysyndactyly-II (AD) (MIM 201000), and Beare-Stevenson .(AD) (MIM 123790).
fibroblast growth factor receptor (AD). MIM 134934	***FGFR3*** at 4p16.3	Mutation here causes dwarfism, craniosynostosis, and signs similar to those of mutations in the ***TWIST*** gene at 7p22-p21. ***FGFR3*** is a negative regulator of bone growth. See also Crouzon syndrome with acanthosis nigricans and the Beare-Stevenson syndrome. Mutations in ***FGFR3*** are seen in several cancers including bladder carcinoma. See also fibroblast growth factor 9, gene ***FGF9*** at 13q11-q12.
cartilage-hair hypoplasia. (AR)	***CHH*** at 9p13	Dwarfism, Hirschsprung disease, and anal stenosis.
catalase deficiency. (AD).	***CAT*** at 11p13	Acatalasemia.
cat-eye or Schmid-Fraccaro syndrome. (C, S, AD). MIM 115470	***CES, CECR1*** at 22q11	Partial trisomy G causes mild mental retardation, heart anomalies, anal atresia, ear malformation, microphthalmia, iris colobomas, and cataract.
mitral valve prolapse. (AD). MIM 157700	***MVP***	Barlow syndrome is the most common cardiac disorder. It affects about 6% of young adults.. May have a fibrillin mutation, gene ***FBN1*** at 15q21.1. (MIM 134797). See Marfan syndrome. (MIM 134797, 154700, 154705).
myocardial infarction susceptibility. (AD)	***DCP1, ACE1*** at 17q23. (MIM 106180)	Helps to regulate blood pressure.
Pfeiffer syndrome. (AD). MIM 101600.	***FGFR1*** at 8p11.2-p11.1.	Gene is for a fibroblast growth factor receptor. See also Apert syndrome. (MIM 101200).
Williams-Beuren syndrome (S). MIM 194050	A contiguous gene region at 7q11.23.	Lack an elastin gene (MIM 130180). Supravalvular aortic stenosis, hypercalcemia, thin, short stature, hoarse voice, and some mental retardation.

Cataracts occur in several endocrine and metabolic disorders including diabetes and in many inherited syndromes. Cataracts commonly develop in the elderly. Anomalies of lens development or uncontrolled cell division can result in the scattering of light. Cataracts can also be caused by trauma, by exposure to radiant energy, and by some drugs. People living in desert regions can develop thickening of the bronchial walls and cataracts, often of the posterior subcapsular type.

Mutations in genes at more than 30 loci can cause ASD cataracts. Other cataracts are inherited in the AR and XL manner. Even in one family the type of cataract that appears can differ between individuals.

Another group of cataracts have aberrations of the lens crystallins (alpha, beta, gamma) or even of the intracellular environment causing the crystallins to aggregate instead of their usual orderly arrangement. The gamma crystallin duster is at 2q33-q35. The crystallins constitute over 80% of the soluble protein in the lens. Eleven major soluble proteins have been identified in the young human lens. See ***ARF3*** at 12q13. The gap junction proteins ***GJA3*** and ***GJA8*** have a role in cataract.

Congenital cataract (AD) may depend on a translocation between 3p26.2 and 4p15. Cataract and microcornea with myopia constitute Peters anomaly, an AD syndrome. See ***FOXC1*** at 6p25. Trisomies 8, 13, 18, 21, and 22 tend to cause cataract. Presenile cataracts with foveal hypoplasia constitute an AD syndrome. Some also have nystagmus and corneal pannus. A congenital cortical cataract (AR) occurs in some people with ichthyosis. In one AR syndrome cataracts accompany microphthalmia, miosis, and nystagmus. See MIM 212550.

CPP on chromosome 1 is the gene for an AD posterior polar cataract with choroideremia, and myopia. (MIM 116600).

Patients with Wilson disease may first present with decreased vision and cataract. Cataracts can also occur with Cohen syndrome, Degos disease, diabetes mellitus, and Dubowitz syndrome. A gene for open calvarial sutures and sutural cataracts has been mapped to 14q13-q21. ***GALK1*** (AR) is at 17q24 (MIM 230200) galactosemia-2 and juvenile cataracts. ***GALK2*** is on chromosome 15 (MIM 137029).

See also ***CAMFAK*** (AR) (MIM 212540), ***CAMAK*** (MIM 212540), and (MIM 212710).

See Hejtmancik JF. The genetics of cataract: our vision becomes clearer. Am J Hum Genet 1998;62:520-525

Gene	How inherited	MIM number	Comments
CTAA1, CAP at 14q24-qter	AD, AR, XR	115650 116200 123660	Anterior polar-1, congenital cataract. Other possible genes are ***CZP1*** at 1q21-q25, and ***CRYGA*** (AD) at 2q33-q35.
CTAA2 at 17p13	AD	601202	Anterior polar-2, congenital cataract.
CCT at Xp22.3-p21.1	XR	302200	Congenital total cataract with posterior sutural opacities in heterozygotes. Cataracts progress faster in males. Some are mentally retarded. Heterozygous females have sutural opacities. See also a cataract-dental syndrome (MIM 302350) and see ***PCC*** at 2q33-q35 (MIM 601286) with opacities between the fetal nucleus and the lens cortex. For a liver cell adhesion molecule the gene is ***LCAM*** (MIM 152423).
CC at 3p26.2	AD	116700	Congenital total cataract. Gene may be at 4p15.
CKMT1, SORD1 at 15q15	AD	182500	Congenital cataract.
Gene			Andogsky syndrome with atopic dermatitis, nephropathy, keratoconjunctivitis, and dense subcapsular cataracts, unilateral or bilateral, that progress to complete opacification.
Gene	AD		Deafness, syndactyly, nystagmus, microcornea, keratoconus, microphakia, abnormal irides, shallow anterior chamber, congenital glaucoma, and congenital cataracts.
Gene	AD	123050	Oxycephaly (tower skull), craniostenosis, osteopetrosis, dwarfing, nasal abnormalities, keratoconus, and congenital cataracts.
GALK1 at 17q24	AR	230200	Congenital or juvenile galactokinase deficiency, galactosemia with deafness, microphthalmia or keratoconus, retinitis pigmentosa, and juvenile cortical cataracts. Need to eliminate lactose and galactose from their diet. ***GALK2*** for juvenile cataracts is on chromosome 15. (MIM 137029). See also von Reuss syndrome.
Gene	AR		Facial dysmorphism, motor neuropathy syndrome, strabismus, nystagmus, ptosis, microcornea, and congenital cataracts.
Gene	AD	116150	Cataract, microcornea, and myopia. Compare with Peters anomaly (AD, AR) (MIM 116150, 261540).
PITX3 at 10q25 ***ZNF23*** at 16q22	AD AD	602669 194527	Congenital cataract with anterior segment mesenchymal dysgenesis. Congenital, posterior polar, progressive cataract. Can also be caused by a mutation in a gene on chromosome 1p. Genes for other cataracts map near haptoglobulin at 16q22.
ZNF237 at 13q11-q12			A member of the ***MYM*** gene family. Genes for other cataracts map near haptoglobulin at 16q22. Note ***FGF9*** also maps here. Note that ***CZP***, ***CZP2*** and **CZP3** are on chromosome 13.
CAM, CTM at 16q22.1	AD	116800	Congenital, zonular, progressive, anterior nuclear, polar, Marner cataract. Linked to haptoglobin at 16q22. Compare with ***CCV***.
CTPA, CPP at 1pter-p36.1.	AD	116600	Congenital, progressive, posterior polar, total cataract, choroideremia, and myopia. Compare with Volkmann cataract. (MIM 115665).
CCV at 1p36.	AD	115665	Congenital, zonular, pulverulent, Volkmann cataract. Progressive central and zonular with a sutural component. Compare with ***CPP*** (MIM 116600) for a usually AD congenital posterior polar cataract with choroideremia and myopia.
CATM at 16p13.3	AD, AR	156850	Congenital total cataract with microphthalmia.
CCT may be at Xp22.3-p21.1	XL	302200	Congenital total cataract with posterior sutural opacities in heterozygotes. Cataracts progress faster in males. Some are mentally retarded. The heterozygous females have suture cataracts. See also MIM 302350.
CCA1, CRYBB1 at 17q24	AD	115660	Cerulean-1, blue-dot cataract, nuclear and cortical, congenital.
CCA2, CRYBB2 at 22q11.2-q12.2	AD	601547 123620	Cerulean-2 blue-dot cataract. Also has a role in malignant rhabdoid tumors. ***CRYBB2*** for beta2 crystallin maps here. Genes for other beta crystallins ***CRYBB2P1*** and ***CRYBA4*** (at 22q11.2-q13.1) also map in this vicinity. ***CRYBB3*** is for crystallin beta-3, (MIM 123630).
CCFDN in the 18qter-region..			Congenital cataract, facial dysmorphism, and neuropathy. Compare with Marinesco-Sjögren syndrome (AR) (MIM 248800).
Gene	AD	116300	A diffuse nuclear nonprogressive cataract.
CRYAA, CRYA1 at 21q22.3.	AD, AR, XR	123580	Congenital zonular, nuclear, crystalline cataract. See ***ADCC-2*** at 21q22.3. ***ADCC-1*** is at 11p15.5.

CAE1, CZP1, GJA8, CZNP at 1q21-q25	AD	116200 600897	Coppock, Doyne discoid, congenital, zonular, pulverulent-1, embryonic nuclear, polymorphic, stationary cataract. Duffy-linked. Coppock cataract is limited to the fetal nucleus of the lens. This is close to the gene ***CJA8*** at 1q21 for connexin 50. (MIM 600897).
CZP at 13q11-q12	AD	601885	Zonular pulverulent cataract.
CZP2 at 13q11-q12.	AD	601885	Zonular, pulverulent-2 cataract. Another AD type has its gene ***CTAA1*** at 2q33-q35 but see ***PCC*** and ***CCP*** (AD) with congenital opacities between the fetal nucleus and the lens cortex. (MIM 601286). Note the ***ZNF237*** gene maps here and so does ***FGF9***.
CZP3, CAE3, GJA3, CX46 at 13q11-q12	AD	601885	Zonular, pulverulent-3 cataract. See also the connexin 46 gene. For a (usually AD) pulverulent nuclear cataract see MIM 212600.
CCZS-LSB at 17q11-q12	AD, AR	600881	Congenital, zonular, lamellar cataract with sutural opacities. This gene is near the beta A3 crystallin gene. (MIM 123630)
CRYBA1 at 17q11.1-q12.	AD	123610	Congenital zonular cataract with sutural opacities. ***CCZS. CRYBA4*** maps to 22q11.2-q13.1. (MIM 126631). ***CRYBB2*** (MIM 123620) and ***CRYBB3*** for crystallin beta-3 (MIM 123630).
PAX6 at 11p13	AD	106210	Congenital, zonular cataract with late-onset corneal dystrophy.
CRYGA, CRYA1, CCL at 2q33-q35	AD	123660	Congenital, embryonic, variable, nuclear, lamellar, aculeiform, Coppock-like cataract. Gamma crystallin is involved.
CRYGD at 2q33-q35	AD	115700 123690	Punctate, progressive, crystalline, aculeiform, or frosted cataract, may be described as pulverulent, see ***CZP2.***
CRYG1, PCC, CCP at 2q33-q35	AD, AR, XR	601286	Congenital, polymorphic, nonnuclear cataract. Opacity between the fetal nucleeus and the lens cortex. ***LCAM*** (MIM 152423) is the gene for a liver cell adhesion molecule.
FTL at 19q13.3-q13.4	AD	134790	Cataract with hyperferritinemia.
CMH4 at 11p13-q13	AD	115197 600958	Cardiomyopathy, pulmonary stenosis, with congenital cataracts, hyperplastic primary vitreous, aniridia, colobomas, nystagmus, strabismus, keratoconus, and myopia. See Sanger syndrome (AR), (MIM 212350).
NHS at Xp22.3-p22.1	XR	302350	Nance-Horan, the cataract-dental syndrome. Affected males have nuclear cataract and often microcornea. Carrier females have Y-sutural cataracts and small corneas but their vision is only slightly reduced.
CAHMR	AR	211770	Congenital hypertrichosis, mental retardation, and lamellar cataracts.
HEC	Genetic or viral	600559	Congenital hydrocephalus, endocardial fibroelastosis, and congenital cataracts. Death in infancy. Compare with Walker-Warburg syndrome (AR), ***WWS*** at 9q31-q33. (MIM 236670).
Gene	AR	212550	Cataract, microphthalmia, nystagmus, and miosis.
Gene	AD	116300	Cataract, nuclear diffuse, non-progressive.
Gene	AD	116150	Congenital cataract begins as posterior polar, microcornea, abnormal irides, nystagmus, glaucoma, and myopia.
Gene	XL, AD, AR	302300 156850 212550	Congenital cataract, with microcornea or slight microphthalmia. Compare with Nance-Horan cataract-dental syndrome. (XL). Gene on chromosome Xp. (MIM 302350).
Gene	S, XR, AR	601372	With posterior subcapsular or cupuliform cataract some have chorea.
Gene	AD	115900	Floriform congenital cataract often with lenticonus or aniridia. Koby syndrome includes floriform cataract.
Gene	Mito	160550	Myopathy, facial weakness, progressive ophthalmoplegia, early-onset cataract, and weak inferior oblique muscle.
Gene	AD, AR	212500	Hutterite or Japanese congenital or juvenile cataract, with congenital deafness, Usher syndrome, and retinitis pigmentosa. Compare with galactokinase deficiency (MIM 230200), and epimerase deficiency (MIM 230350).
Gene	AR	218900	Crome encephalopathy, short stature, seizures, epilepsy, mental retardation, renal tubular necrosis, and congenital cataracts. Most die before 9 months of age. Compare with MIM 248800, 309900.
Gene	AR		McKusick-Weiblaecher syndrome with leg deformity or absence, imperforate anus, partial paralysis of CNIII, and congenital cataracts.
Gene	AR, Mito	212350	Sengers syndrome, congenital cataracts, hypertrophic cardiomyopathy, ventricular septal defect, muscular weakness, pulmonary stenosis, hyperplastic primary vitreous, aniridia, nystagmus, strabismus, and keratoconus. Compare with MIM 160550, 251950, 255125. Some have a deficiency of ***ANT1*** at 4q35 (MIM 103220).
Gene	AD	115800	Crystalline coralliform cataracts with fine crystals in the axial portion of the lens. Can also have aculeiform type cataracts.
One patient had trisomy 17.	AR	212720	Martsolf syndrome with microcephaly, severe mental retardation, short stature, hypogonadism, heart failure, and cataract.

Gene	AR	212710	Congenital cataract with polyneuropathy, ataxia, late-onset deafness, and mild mental retardation. (With ***ADR***. (MIM 208850) the hearing loss and ataxia manifest in infancy.)
Gene	AD but some AR	212700	Central pulverulent cataract. Total nuclear cataract.
UFD1L at 22q11.2.		188400 601754	A deletion from ***UFD1L*** causes **CATCH-22** with many developmental defects, see DiGeorge syndrome (MIM 188400), velocardiofacial syndrome.***VCFS*** (MIM 192430), conotrunkal anomaly **CTAFS** (MIM 601755), and some have conotrunkal cardiac defects (MIM 217095.

Catenins are adhesion-associated proteins of which eighteen subtypes have been identified. The catenins regulate the function of the cadherins. Examples are: ***CTNNA1*** at 5q31 for alpha 1, (MIM 116805), ***CTNNA2*** at 2p12-p11.1 for alpha 2, (MIM 114025), ***CTNNB1*** at 3p22 for beta 1, (MIM 116806), ***CTNND1*** at 11q11 for delta 1, (MIM 601045), and ***CTNND2*** at 5p15.2-p15.3 for delta 2, (MIM 123450)
A pseudogene is at 5q22.

Cathepsins are proteases. More than a dozen cathepsin subtypes have been reported. Some have a role in tumor development. Cathepsin B is at MIM 116810, the gene for cathepsin C is ***CTSH*** at 11q14.1-q14.3. (MIM 602365), cathepsin H at 15q24-q25 (MIM 116880), cathepsin S at (MIM 116845), cathepsin W (MIM 602364), and cathepsin Z (MIM 603169).

Name	Gene	Comments
celiac disease, predisposition MIM 123890.	***CTLA4*** at 2q33-q34	See also MIM 212750. Reported to increase susceptibility to diabetes mellitus and to Graves disease and celiac disease. Gene is close to ***CD28*** for T-cell antigens
celiac disease (AR or ?). MIM 212750	***MICA, GSE, MICB*** at 6p21.3. MHC class 1 related.	Epithelium of small intestine becomes infiltrated with CD8(+) T cells. They lose bone mass, have weaker bones, anemia, and diarrhea. Risk to a first degree relative of an affected is about 10%. ***MICA*** may relate to Behçet syndrome. (MIM 109650).
Cell cycle genes include: ***CCNB1*** at 5q12 and ***CDC25C*** at 5q31. MIM 123836, 157680.		
central areolar choroidal dystrophy (often AD). MIM 215500	***CACD*** at 17p13	Hyperpigmentation in the macula is sometimes inherited in the XL manner. This condition resembles North Carolina macular dystrophy. Some have a mutation in ***RP7*** at 6p21.1-cen. (MIM 179605).
central core disease of muscle. (AD)	***RYR1, MHS, CCO*** at 19q12-q13.2, ***MYH7,CMH1*** at 14q12	Progressive muscle weakness. Increased urinary creatine.
central serous retinopathy. (AD)	***CFH*** at 1q32	Complement factor H. See ***FHR2*** at 1q31.2-q32.1
cerebellar degeneration autoantigens. (XL, AD)	***CDR1*** at Xq24-q27, ***CDR2*** at 16p13.1-p12, ***CDR3*** at 17q25	(17q25 is also the site of ***GCGR,*** a glucagon receptor)
cerebellar vermis aplasia. (AD) MIM 117360	***ACV***	Non-progressive ataxia and nystagmus. Relates to these syndromes, Dandy-Walker malformation, Senior-Loken, COACH, and possibly to familial juvenile nephronophthisis. Anima syndrome may belong with ACV.
cerebelloparenchymal atrophy	***CPD*** at 17p11.1-q11.2	B-type carboxypeptidase functions in the membrane of mammalian cells. Five subtypes.
(AD). MIM 117400	***CPD1***	Cerebello-olivary atrophy with onset in fifth decade, ataxia, speech difficulty, and progressive dementia.
(AR). MIM 213100	***CPD2***	Onset in 4th or 5th decade, ataxia, speech disturbances, and some have seizures.
(AR). MIM 213200	***CPD3, CLA1*** may be at 11q14- q21.	Congenital cerebellar ataxia, mental retardation, speech disturbance, and some have albinism. Note ***TYR*** is at 11q14-q21.
(AR). MIM 213300	***CPD4*** may be close to 17p11.2-p12, or at 9p34.	Joubert syndrome, cerebellar vermis agenesis, with Dandy-Walker malformation, renal cysts, abnormal breathing pattern, hypotonia, tremor, ataxia, coloboma of the optic nerve, abnormal eye movements, and retinal dystrophy.
(AR). MIM 213400	***CPD5***	Spinodentate atrophy with loss of fibers from the superior cerebellar peduncle, ataxia, and myoclonic jerks.
cerebral arteriopathy with subcortical infarcts. (AR, AD) MIM 125310, .600142	***CADASIL, CASIL*** at 19p13.2-p13.1	Multi-infarct dementia, relapsing strokes, depression, motor disability, and seizures.
cerebral cavernous malformations-1. (AD)	***CCM1*** at 7q11.2-q21, ***CCM2*** at 7p15-p13, ***CCM3*** at 3q25.2-q27	Have seizures, retinal angiomas, and sudden death..

cerebral gigantism. (S, AD). MIM 117550	***NSD1*** at 5q35, or at 3p21, or at 15q22. .	Sotos syndrome, disturbance of the diencephalon, large skull, mental retardation, congenital heart defect, incoordination, scoliosis, down-slanting lid fissures, nystagmus, strabismus, iris hypoplasia, cataracts, glaucoma, and high hyperopia. See Russell syndrome. Compare with Nevo syndrome (AR) (MIM 601451). Increased growth, kyphosis, hypotonia, and hyperbilirubinemia. (MIM 143500).
cerebro-hepato-renal syndromes.		See the Zellweger syndromes (MIM 214100) and the Smith-Lemli-Opitz syndromes. (MIM 270400).
cerebro-oculo-facial-skeletal, **COFS** syndrome. (AR). MIM 214150	***NLS*** at 1q23 or 16q13. May have mutations in: ***XPG***, ***CSB*** , ***XPD,*** (AD), and possibly in ***PP1B*** on chromosome 15 or ***XPB*** (AD) for complementation group B xeroderma pigmentosum.	Pena-Shokeir-II syndrome. (AR) (MIM 214150). Signs are microcephaly, a rapidly progressive neurological disorder, severe mental retardation, intracranial calcification, deafness, cataracts. Death before age 3 years. May relate to Cockayne syndrome and to xeroderma pigmentosum. Compare with Pena-Shokeir-I syndrome (AR) (MIM 208150) with fetal akinesia, motor neuropathy, cardiac hypoplasia, camptodactyly, and cleft palate. Are hypersensitive to UV radiation or DNA repair abnormalities. ***XPD*** is ***ERCC2*** at 19q13.2-q13.3, ***XPB*** is ***ERCC3*** at 2q23-qter, ***XPG*** is ***ERCC5*** at 13q32.3-q33.1, and ***CSB*** is ***ERCC6*** at 10q11-q21***.***
cerebroretinal angiomatosis. (AD). MIM 193300	***VHL*** at 3p26-p25	von Hippel-Lindau syndrome (MIM 193300) with renal cancer, pancreatic carcinoma, and hypertension. ***VBP1*** at Xq28, (MIM 300133) is a binding protein that works with ***VHL***.
cerebroretinal arteriovenous aneurysm syndrome. (AD).	Possibly not hereditary.	Bonnet-De Chaume-Blanc or Wyburn-Mason syndrome. Hydrocephalus, midbrain aneurysm, dizziness, slow speech, exophthalmos, ptosis, strabismus, nystagmus, anisocoria, papilledema, and some ophthalmoplegia. May relate to von Hippel-Lindau syndrome (MIM 193300).
cerebroretinal vaasculopathy (AD). MIM 192315	Gene at 3p21.1-p21.3	Frontoparietal lobe pseudotumor and retinal capillary abnormalities, CNS degeneration, leukodystrophy, headaches, seizures, loss of memory, lupus erythematosus, skin lesions. Have more risk of stroke. Can simulate a brain tumor. MIM 180000. Occlusion of branch retinal veins, retinal hemorrhages, retinal ischemia, and reduced vision. Tortuosity of retinal vessels (AD) may lead to retinal hemorrhages.
cerebrotendinous xanthomatosis (AR). MIM 213700	***CYP27, CTX*** at 2q33-qter	Hagberg-Santavuori syndrome. Signs are mental retardation, atherosclerosis, jaundice, ataxia, and juvenile cataracts.
cerebrovascular disease, occlusive (AD)	***AACT*** at 14q31-q32.3.	Chronic active hepatitis..

Ceroid lipofuscinoses, neuronal are AR degenerative diseases and the most common neurogenetic encephalopathies of childhood. Affect as many as 1/12,500 liveborn. Ceroid lipopigment accumulates in lysozymes of neurons and other cells. Most have progressive cerebral and ocular dysfunction, seizures, and premature death. The adult form can be inherited AR or AD. Eight subtypes have been identified. See also epilepsy. Cathepsin H gene ***CTSH*** at 15q24-q25 is deficient in about 25% of cases. (MIM 116820). Some are deficient in phospholipase A. (MIM 600522).

Name	Gene	Comments
ceroid lipofuscinosis, neuronal-1, infantile. (AR). MIM 256730	***CLN1*** at 1p32	Santavuori-Halitia type. Encodes palmitoyl protein thioesterase-I (PPTI). Store excessive cholesterol, have cerebral cholinesterinosis. Onset about age 1 year. Microcephaly, psychomotor deterioration, ataxia, mental retardation, optic atrophy, nystagmus, exotropia, blind in infancy. Death before age 10.
late infantile. (AR). MIM 204500	***CLN2*** at 11p15.5 but this is questioned.	Jansky-Bielshowsky lipofuscinosis. Gene encodes tripetidyl peptidase-I (TPPI). Deficiency of lysosomal tripetidyl peptidase-I (LINCL). Rapidly fatal, neuronal atrophy, mental retardation, and ataxia but no optic atrophy.
juvenile. (AR). MIM 204200	***CLN3, JNCL*** at 16p12.1-p11.2 Has anti-apoptosis activity. ***CLN3*** is regulated by ***AZF1*** at Yq11.23. (MIM 415000), a glucose-dependent transcription factor.	Accumulate autofluorescent hydrophobic material in the lysosomes. Spielmeyer-Sjögren-Vogt-Batten disease is the most common neurodegenerative disease of childhood. More than 30 mutations occur in the gene battenin. The gene product CLN3p is a membrane protein. In this macular type after 4 years of age they have juvenile-onset ceroid lipofuscinosis and early-onset ARRP. Spielmeyer-Vogt syndrome is a peripheral type of amaurotic idiocy with vacuolation of lymphocytes. Norman and Wood described a congenital lipofuscinosis with a gene ***PPT*** at 16p12 or at 1p32. (MIM 600722).

neuronal. adult (AR, AD). MIM 162350, 204300.	***CLN4*** gene locus not known.	May be called Kufs-Hallervorden, Hallervorden-Spatz, or Parry lipofuscinosis. Parry type is AD (MIM 162350). A GM2 gangliosidosis, deficient in hexosaminidase, an adult-onset (about age 31) lipofuscinosis in which ceroid lipofuscin is stored in the CNS, liver, heart muscle, and retina. Progressive dementia, seizures, myoclonic jerks, postural deterioration, progressive gait disturbance, and visual loss. Death within 20 years of onset. See Boehme syndrome (AD), (MIM 162350). (Note there is a Parry type of goitre.)
late infantile (AR). MIM 256731	***CLN5*** at 13q31-q32. Interacts with ***CLN2*** and ***CLN3***..	Four mutations are known. Late infantile lipofuscinosis (onset age 4 to 7 years) with mental retardation, sleep disturbance, ataxia, myoclonic epilepsy, and visual failure. For a Finnish variant see MIM 600143.
late infantile or early juvenile (AR) MIM 601780	***CLN6*** at 15q22-q23	Early juvenile neuronal lipofuscinosis, a non-Finnish variant, amaurotic idiocy with motor clumsiness begins about age 5. Signs of Batten disease are mental retardation, ataxia, epilepsy, and failing vision.
late infantile lipofuscinosis.	***CLN7, LINCL*** may be at 14.3-q15 or at 8p23.	For this late infantile, Turkish variant the gene may be allelic to ***CLN8***.
(AR). MIM 600143	***CLN8, EPMR, NES*** at 8pter-p22	Northern epilepsy with progressive mental retardation has its onset in the child between 5 and 10 years of age.
ceruloplasmin. (AD). MIM 117700	***CP*** at 3q21-q24	Have ataxia, tremor, and retinal degeneration as well as dry eyes but this may recover spontaneously. Compare with Wilson disease (AR) (MIM 277900) and Meige syndrome ***CPP*** at 3q21-q24.
cervico-oculo-acoustic or Wildervanck syndrome (XD, M). MIM 314600	Gene	Generally affects only females. Have the Klippel-Feil anomaly (fused cervical vertebrae) (MIM 148900), congenital deafness, microcephaly, mental retardation, and Duane syndrome (abducens palsy with retractio bulbi). (MIM 126800),
CHANDS syndrome. (AR). MIM 214350	Gene	Curly hair, ankyloblepharon (fused eyelids), and nail dysplasia. Some have ataxia.
Channelopathy genes encode ion channels. One gene (of 11 or so) for a calcium channel is ***CACNA1A***, or ***CACNL1A4*** (MIM 601011), and one gene (of 10 or more) for a sodium channel is ***SCN1A*** (MIM 182389), and one gene (of 30 or more) for a potassium channel is ***KCNK2*** (MIM 603219). Some channelopathy-related diseases are: Brugada syndrome due to mutation in a sodium channel gene, familial atrial fibrillation (gene at 10q32), long QT syndromes, due to genes encoding sodium or potassium channels, and polymorphic ventricular tachycardia due to a defective ryanodine receptor.		
CHAR syndrome (AD). MIM 126830	Gene	Patent ductus arteriosus, duckbill lips, long philtrum, downslanting palpebral fissures, some have polydactyly, fifth finger clinodactyly, and ptosis. Can be the result of maternal rubella.

Charcot-Marie-Tooth Neuropathy. Peroneal muscular atrophy with onset between the ages of 5 and 15. Peroneal means pertaining to the fibula or the outer side of the leg. See also the atrophies. ***CMT-I*** is the commonest hereditary neurological disease in humans. At least 12 loci may be involved. Compare with the hereditary motor and sensory neuropathies and the Déjérine-Sottas syndrome. (AD, AR).

Charcot-Marie-Tooth neuropathy can accompany these AD conditions: deafness, ptosis, parkinsonism, Guadalajara syndrome, Friedreich ataxia (some are deaf), and a demyelinating disease. See also ***EGR2*** at 10q21.1-q22.1 (AD, AR) and familial amyotrophic neuralgia (AD) with brachial plexus neuropathy, gene ***NAPB*** at 17q24-q25.

A form of CMT called ***CMTAR*** has its gene at 8q24 and for a neuronal type D, the gene maps to 7p14.

CMTX depends on mutations in the ***GJB1*** gene (Cx32) at Xq13. At least six mutations have been reported. May have deafness or other CNS involvement.

Gene	How inherited	MIM number	Comments
CMT at 15q13-q15 or a deletion from ***OXAIL*** at 4q11.2.	AR	218000	Agenesis of the corpus callosum and sensorimotor neuropathy. See ***ACCPN*** (MIM 218000) and see cytochrome oxidase MIM 123997)..
CMT-IA at 17p11.2-p12	AD	118220 601097	With this demyelinating neurological disease some have duplication of 17p11.2-p12, a few have a point mutation in the peripheral myelin protein 22 gene ***PMP22.*** Some with ***CMT-IA*** have mutations in ***MPZ*** or in ***GJB1*** a gap junction protein (Cx32) or in ***ERG2/Krox-20*** an early growth response transcription factor at 10q21.1-q22.1 (AD, AR). Have slow nerve conduction. Compaare with: ***HMSN-IA, HMSN-III***, and Déjérine-Sottas syndrome (AD, AR) (MIM 145900) and the Roussy-Levy syndrome. (AD) (MIM 180800).
HNPP at 17p11.2-p12	AD	162500	A deletion causes reduced expression of the ***PMP22*** gene. Hereditary, recurrent neuropathy, liability to pressure palsies, episodic, demyelinating, neuropathy.

CMT-IB, MPZ, PO at 1q21.1-q23.3 or 17p12-p11.2.	AD	118210 118200 159440	Point mutation in ***MPZ*** causes a demyelinating neuropathy. With ***CMT-IB*** they have slow nerve conduction. Linkage to the Duffy blood group. See also ***PMP22*** at 17p11.2-p12. An AR type has been linked to a gene at 8q21.2-q13. Deletion from ***HMSN-IB***. (AD). (MIM 118200). See Déjérine-Sottas syndromes. (MIM 145900, 159440, 601097).
CMT-IC	AD	601098	Patients with ***CMT-IC*** have slow nerve conduction.
CMT-ID at 10q21.1-q22.1	AD		See ***EGR2*** (AD, AR) at 10q21.1-q22.1.
CMT-II at 1q21.2-q21.3	AR		Some with type 2 (axonal, neuronal) have onset later in life, mutations in ***MPZ*** at 1q21.1-q23.3 or in ***GJB1*** at Xq13. See ***HMSN-1B***. (AD).(MIM 118200).
CMT-IIA at 1p35-p36	AD, AR, XL	118210 145900	With ***CMT-IIA*** (axonal) they have motor and sensory neuropathy. See ***HMSN-IIA*** at 1p36-p35. (MIM 118210, 145900).
CMT-IIB at 3q13-q22	AD	600882	***CMT-IIB*** may be on chromosome 3p. Neuronal type B. See ***HMSN-P*** (MIM 162375) and see type D.
CMT-IIC at 5q23-q24	AD	158580 158588	***CMT-IIC*** is demyelinating with muscular atrophy, vocal cord paralysis, and some are deaf. See ***HMSN-IIC.*** (MIM 158580).
CMT-IID at 7p14	AD	601472	They have ***CMT***, neuronal type D. See ***CMT-IIB***. (MIM 600882).
CMT-IIE, NEFL, NF-L at 8p21	AD	162280	***CMT-IIE.*** Neurofilament, light.
CMT-IIX at Xq24-q26	XL		With deafness and mental retardation. (Note ***ANT2*** also maps here. MIM 300150).
MPZ, CMT-III at 1q21.1-q23.3.	AD, AR	145900 601097	Déjérine-Sottas syndrome. ***MPZ*** is also referred to as myelin protein zero. Some have mutations in ***PMP22*** at 17p11.2-p12. Severe infantile-onset demyelinating polyneuropathy. ***HMSN-III***.(MIM 145900, 159440, 501097). Clinically resembles ***CMT-I.*** Gene can suppress prostate cancer.
CMT-IVA at 8q13-q21.1, or at 8q21.1.	AD, AR, XL	214400	***CMT-IVA*** a demyelinating form is usually inherited AR. Compare with ***CMTAR*** at 8q24.
CMT-IVB at 11q23	AR	601382	***CMT-IVB*** is also demyelinating.
CMT-IVC at 5q23-q33	AR		Is also demyelinating. See ***CMT ND*** and ***CMT-IIC***.
CMT-V	AD	600361	***CMT-V*** with peroneal muscular atrophy and pyramidal features has its onset before age 20. See ***HMSN-V.*** (MIM 600361).
GJB1, CX32, CMT-X1 at Xq13.1	XR	302800 304040	Mutation in this connexin-32 gene causes degeneration of spinal nerve roots. May have deafness or some CNS involvement. See ***HMSN-XI.*** (MIM 302800).
NADMR at Xq24-q26.1	XR	310490	Cowchok syndrome with deafness and mental retardation. May be allelic with ***CMT-XI.*** at Xq13.1.
CMT-X2 at Xp22.2	XR	302801	May cause a type of **CMT** with slow nerve conduction..
CMT-X3 at Xq26	XR	302802	Mutation here may cause a type of **CMT**.
CMT-ND at 5q23-q33	AR	601596	Mutation here causes a demyelinating **CMT** disease.
HMSN-L at 8q24-qter, or 8q24.	AR	214370 601455 158580	**CMT** of the LOM type with **HMSN**, demyelination, deafness, vocal cord paralysis, and mental retardation.
HMSN-P at 3q13.1	AD	162375	A proximal ***CMT-II*** with excessive myelin folding. ***MHS4*** for malignant hyperthermia (AD) also maps here. For an AR type see MIM 256855.
Gene	AD, AR, XL	118300	**CMT** with deafness, childhood onset.
Gene	XL	302803	**CMT** with peroneal muscular atrophy and scalp aplasia.
Gene	AD, AR, XL	118230	Guadalajara, neuronal **CMT**. Infantile-onset peroneal muscular atrophy with weakness, respiratory problems, and sensory neuropathy.
Gene	AD, AR, XL	118301	**CMT** with ptosis, parkinsonism, and mild dementia..
Gene	XL	302900 602745	**CMT** with peroneal muscular atrophy, diabetes, GAA repeats, and Friedreich ataxia. See ***STM7/X25*** at 9q13.
Gene	AD, AR, XL	311070	Rosenberg-Chutorian syndrome, affects central and peripheral nervous systems, **CMT** with polyneuropathy, deafness, and optic atrophy. See also MIM 118300, 214303, and 258650.
HMN2 at 12q24.3	AD	158590	Hereditary distal motor neuropathy with clinical and neurological motor involvement. See spinal muscular atrophy.
HDMN V on chromosome 7p	AD		Affects the upper limbs.

Name	Gene	Comments
CHAR syndrome		See under cardiac nomalies.
CHARGE association (M, AR). M IM 214800	Deletion from ***PCA*** at 14q22-q24.3 or at 22q11 or a translocation t(2;7)(p14;q21.11 or t(X;2)(p22.1-q33)	Affects about 1/10,000. Affects twice as many women as it does men. Choanal atresia, difficult breathing, heart defects, mental retardation, deafness, hypogonadism, colobomas of iris, retina, or optic nerve. A person with anal atresia is more likely to have spinal defects, anomalies of the urogenital tract, and renal defects. A patient with the monosomy 9p syndrome has an AD deletion from a gene at 9p24. (MIM 158170).
Charlin syndrome	Gene	Neuritis of the nasal branch of the trigeminal nerve. Unilateral severe facial pain and rhinorrhea. See also Sluder's sphenopalatine ganglion neuralgia.
Chédiak-Higashi syndrome	***CHS1*** at 1q42.1-q42.2	See albinism with immune deficiency. (MIM 214500).
cherry-red spot myoclonus syndrome (AR). MIM 256550	Genes at 20q13.1 or at 10pter-q23 or a deletion from ***NEU*** at 6p21.3.	A neuraminidase (sialidase) deficiency, with myoclonus, hepatosplenomegaly, muscle wasting, ataxia, hypotonia, and cataract. See sialidosis-1, gene ***GNPTA*** at 4q21-q23
chloramphenicol toxicity or resistance. (Mito)	***MTRNR2*** at 1671-3229	Causes anemia.
chloride diarrhea (AR)	***CLD*** at 7q22-q31.1	A congenital Finnish type.
cholinergic muscarinic receptors	***CHRM1*** at 11q13, ***CHRM2*** at 7q35-q36, ***CH RM3*** at 1q41-q44, ***CHRM4*** and ***CHRM5*** both at 15q26	Acetylcholine receptor muscarinic. ***CHRM4*** may be at 11p 12-p11.2.
cholinergic nicotinic receptors	***CHRNA1*** at 2q24-q32 ***CHRNB2*** at 1p21, ***CHRNB3*** at 8p11.2, ***CHRND*** at 2q33-q34, ***CHRNG*** at 2q32-qter.	See also ***CHRNA2, CHRNA4, CHRNA7, CHRNB1,*** and ***CHRNE*** for other acetylcholine receptors.
cholestasis-1, familial intrahepatic. (AR). MIM 211600	***PFIC1*** at 18q21	Have cirrhosis, most die in their first decade. See Byler disease (AR) (MIM 211600, 601847).
cholestasis, gallstone, ataxia, jaundice, and visual disturbances. (AR). MIM 214980	Gene	Gallstone, hepatitis, jaundice, pruritus, cerebellar ataxia, retinal lesions, ptosis, and optic atrophy. For Byler disease (AR) (MIM 211600) the genes are: ***PFIC1*** at 18q21 ***PFIC2*** at 2q24 and ***PFIC3, PGY3*** on chromosome 7. (MIM 171060).
Cholesterol biosynthesis disorders include: **CHILD** syndrome (XD?) (MIM 308050), Conradi-Hunermann syndrome (MIM 118650), desmosterolosis (MIM 602398), and Greenberg dysplasia (AR), (MIM 215140).		
cholesterol acyltransferase deficiency (AR). MIM 245900	***LCAT*** at 16q22.1.	In Norum disease (MIM 136120) their plasma lecithin deficiency of alpha and beta ***LCAT*** causes them to store lipids in many tissues, have dilated veins, opacities in the corneal stroma, and retinal hemorrhages. Patients with fish-eye disease lack alpha ***LCAT***. (MIM 245900).
chondrocalcinosis-II. (AD). MIM 600668	***CCAL2*** at 5p15.1.	Mutation in ***CCAL2*** causes early-onset osteoarthritis. Mutation in ***CCAL1*** at 5p15.1 causes calcium pyrophosphate deposition and gout with minimal joint changes. (MIM 118600).
chondroectodermal dysplasia. (AR). MIM 225500, 602363.	***EVC*** and ***EVC L*** both at 4p16 or deletion from a gene at 12p11.21-p12.2.	Ellis-van Creveld disease. Signs are short limbs, polydactyly, and a heart defect. For an Ellis-vanCreveld-like syndrome see (MIM 602363). See also Weyers acrofacial dysostosis (MIM 193530).
chondrodysplasia, metaphyseal. (AD)	***COL10A1*** at 6q21-q22.3	Schmidt skeletal dysplasia. Compare with Schmidt autoimmune syndrome-II. T lymphocyte deficiency, familial polyglandular failure (AR, AD, M) (MIM 269200). Candidiasis, hypothyroidism, Addison disease, hepatitis, tetany, diabetes, anemia, keratoconjunctivitis, and cataracts. Associated with HLA-B8.
punctata type. (XR)	***CDPX1, CDPXR*** at Xp22.3	Causes deafness and mental retardation. An XD punctata type is called Conradi-Hunermann syndrome. (MIM 302960).
punctata type. (XD)	***CDPX2, CDPXD*** at Xq28	Happle syndrome is lethal in males.
rhizomelic punctate type. (AR)	***CDPR, RCDP1, PEX7*** at 6q22-q24	This peroxisome biogenesis disorder also causes dwarfism and cataract.
Gebe type. (AR). MIM 601146.	***CDMP1*** at 20q11.2	Scavenger receptor-rich.

chondroitin sulfate proteoglycan-2. (AD). MIM 118661	***CSPG2*** at 5q12-q14	Versican. ***CSPG1*** is at 13q26.1 (MIM 155760). ***AGC1*** is at 15q26.1. (MIM 155760).
chorea. (AD). MIM 118700 215450, 601372	***BCH*** without dementia. A benign type is inherited AR.	Involuntary dance-like movements, muscle weakness, disordered ocular movements, mydriasis, hippus, and anisocoria. One type (AR or XL) has weight loss, cataracts and nystagmus. For Huntington chorea (AD) the gene is huntingtin, ***HD, IT15*** at 4p16.3, they have many CAG repeats. (MIM 143100).
chorea, acanthocytosis. (AR). MIM 200150	***CHAC*** at 9q21.	Onset after age 25, seizures, tics, hyporeflexia, dementia, aberrant behavior, and abnormal gait.
choroideremia (XR). MIM 303100	***TCD*** at Xq21.2. The gene for the **RAB** escort protein is ***REP1*** at Xp21.1-q21.3.	Deletion affects GG transferase. The tapetoretinal dystrophy degeneration of the retina mostly affects males, reduces acuity, constricts the fields, causes night blindness, and retinal atrophy.
Ayazi syndrome. (XR, C). MIM 303100	***REP1, CHM*** at Xp21.1-p11.4.	Mutations in this GG transferase cause obesity, deafness, and choroideremia, reduced central vision, night blindness, and contracted fields. With ***CHM*** the macula is often preserved in spite of the chorioretinal atrophy. Many have a female relative with retinal changes. Compare with ***DFN3*** at Xq21.1. (MIM 304400).
Ayazi syndrome (AR). MIM 118825	***CHML*** at 1q42-qter	A choroideremia-like condition.
chorionic gonadotropin. MIM 118850	***CGA*** alpha unit at 18p11, ***hCG*** at 6q12-q21	***CGA*** is for the alpha polypeptide. For the beta polypeptide the gene is ***CGB*** at 19q13.32.
chorioretinal atrophy, congenital, progressive, bifocal type, (AD)	***PBCRA*** at 6q14	Compare with North Carolina foveal or macular dystrophy, (AD), ***MCDR1*** at 6q14-q16.2. (MIM 136550).
chorioretinopathy and pituitary dysfunction, a CPD syndrome.	***CPD1***	Retarded growth, hypothyroidism, mental retardation, cerebellar ataxia, unsteady gait, speech difficulty, bushy eyebrows, and late-onset chorioretinopathy.
choroidal dystrophy, (AR, XL)	***CACD*** at 17p13	Central areolar dystrophy. With chorioretinal dystrophy (XL) most have night blindness.
Christian syndrome MIM 309620	***CHRS*** at Xq28-qter	Mental retardation, skeletal dysplasia, and abducens palsy.. See ***MRSD*** for mental retardation, skeletal dysplasia, and abducens palsy.. Christian syndrome. (MIM 309620).
Christ-Siemens-Touraine syndrome (XL) MIM 305100.	***CST, ED1*** at Xq12.2-q13.1	Also called anhidrotic ectodermal dysplasia. (XL).
Chromosomal instability syndromes are involved in the recombination repair of damaged DNA. They include ataxia-telangiectasia (A-T), an ataxia-telangiectasia-like syndrome (ATLD), Bloom syndrome (BS), Fanconi anemia (FA), and the Nijmegen breakage syndrome (NBS). See also the trisomies, the deletion syndromes, and the abnormalities of the sex chromosomes.		
Chronic granulomatous diseases, CGD is often XL. Those affected are subject to recurrent infections.		
type A. (AR). MIM 233690	***CYBA*** at 16q24	Deficiency of CYBA, chronic granulomatous disease, and recurrent infections..
type B . (XR)	***CYBB, CGD*** at Xp21.1	A deletion here causes ***CGD***. Eighty percent of ***CGD*** cases are XL.
other types. (XL, AR)	***NCF1*** at 7q11.23, ***NCF2*** at 1q25	Subject to recurrent infections.
ciliary neurotrophic factor, receptor. (AD)	***CNTF*** at 11q12.2	Important in the development of the CNS. The gene for the receptor is ***CNTFR*** at 9p13. (MIM 118946).
MIM 116900	***CKS1*** at 8q21, ***CKS2*** at 9q22	These components of protein kinase help regulate cyclin B metabolism and cell division.
Churg-Strauss syndrome	***CSS***	Have antineutrophil cytoplasmic autoantibodies (ANCA). Asthma, severe allergic granulomatous angiitis, vasculitis, gastrointestinal signs, hypereosinophilia, and anti-myeloperoxidase. Uveoscleritis, papilledema, and optic atrophy. Treat with corticosteroids or with interferon alpha. Compare with: Alport syndrome (MIM 104200), Fabry disease ***GLA*** at Xq22, and Wegener granulomatosis.(MIM 177020, 251260).
cicatricial pemphigoid, ocular. (AD). MIM 164185	***OCP***	Have antibodies to components of skin and mucous membranes. Autoimmune disorder in which older patients may have blisters in pharynx, nose, and anogenital areas. Develop conjunctivitis, shrinkage of the conjunctiva, corneal opacity, and dry eyes. Thalidomide helps these patients.

cleft palate only. (AD)	***CPO*** (***CPO*** is also a symbol for coproporphyria.)	Gene locus is uncertain. Cleft palate appears in more than 20 syndromes.
cleft palate. (XR). MIM 303400	***CPX*** at Xq21.3	Is usually multifactorial. May have ankyloglossia (tongue-tie). Cleft palate is a feature of many syndromes.
cleft palate. (AR, XR). MIM 216300	Gene at Xq12-q13	Also have nerve deafness and no permanent teeth.
cleft lip +/- cleft palate. (M, AD)	***OFC1*** at 6p23, ***OFC2*** at 2q13, ***OFC3*** at 19q13.2	Cleft palate occurs with many conditions. Other genes are at 4q25-q31.3 and at 17q21.
cleft lip/palate, ectrodactyly of hands and feet, and ectodermal dysplasia. (AD). MIM 129900, 602077	***EEC1*** at 7q11.2-q21.3, ***EEC2*** on chromosome 19 .	Very variable manifestations. See also ankyloblepharon. (MIM 106250, 106260).
cleidocranial dysplasia (AD, AR)	***CBFA1*** at 6p21	Cleidocranial dysostosis, spastic paraplegia, mental deficiency, unilateral proptosis, hypertelorism, and down-slanting lid fissures.
clinodactyly or syndactyly MIM 131240	Deletions from ***EDN1*** at 6p23-p24.	Also have defects of brain, heart, and eye. ***EDN1***. Is for the endothelin gene. ***EDN2*** is at 1p34 and ***EDN3*** is at 20q13.2-q13.3.
clinodactyly or syndactyly MIM 180500.	Deletions from ***RIEG1*** at 4q25.	Rieger anomaly, deafness, hypertelorism, corneal opacities, and iris colobomas.
Clouston syndrome. (AD)	***ED2*** at 13q11-q12	See hidrotic ectodermal dysplasia. (MIM 129500).
COACH syndrome. (AR). MIM 216360	Gene	May be a variant of Joubert syndrome (AR) (MIM 213300, 243910). Hypoplasia of cerebellar vermis, oligophrenia, congenital ataxia, some have hepatic tumors, hepatic fibrosis, portal hypertension, renal insufficiency, abdominal pain, loss of appetite, and ocular colobomas.
Coats' disease. (S). MIM 194300	***CRB1*** at 1q31-q32.1 may have a role.	Unilateral retinal telangiectasia, grey-yellow retinal detachment, Leber miliary aneurysms, and macular edema.
Inherited defects of DNA repair occur in these (mostly AD) syndromes; Bloom, Cockayne, Rothmund-Thomson, Werner, and xeroderma pigmentosum.		
Cockayne syndrome-1. (AR). MIM 216400	***CKN1***, ***CSA*** on chromosome 5	Mickey Mouse syndrome. Dwarfism, progeria, mental retardation, UV sensitivity, deafness, cataracts, retinal atrophy, and pigmentary degeneration. Many have atherosclerosis and hypertension. Several subtypes relate to xeroderma complementation groups.
Cockayne-2. (AR, rarely AD). MIM 133540.	***CSB, ERCC6*** at 10q11-q21	With type B have progressive neurologic deterioration and are hyper sensitive to ultra violet radiation. Relate to xeroderma complementation group B at 2q23-qter..
Cockayne-3. (Mito, AR). MIM 216411	Gene.	Formerly called type C. Dwarfism, atherosclerosis, mental retardation, CNS demyelination, deafness, corneal dessication, retinal degeneration, and optic atrophy type D (MIM 126340), and type G (MIM 133530).
Cockayne syndromes. (AR, AD)	***ERCC1*** at 19q13.3-q13.2, ***ERCC2*** at 19q13.2-q13.3, ***ERCC3*** at 2q23-qter, ***ERCC4*** at 16p13.2-p13 .1 ***ERCC5*** at 13q32.3-q33.1, ***ERCC6*** at 10q11-q21.	Relate to these excision repair genes and also to xeroderma pigmentosum complementation groups. Precocious senile appearance, mrental retardation, deafness, retinal degeneration, and optic atrophy. There are three complementation groups in Cockayne syndrome. For group B see ***ERCC6*** which is ***CSB*** (MIM 133540), for group D see ***ERCC2*** which is ***XPD*** (MIM 126340), and for group G see ***ERCC5*** (MIM 133530), ***ERCC3*** is***XPB.*** (MIM 133510).
Coffin-Lowry syndrome. (XR, XD). MIM 303600	***CLS*** at Xp22.2-p22.1.	See faciodigital syndrome. ***CLS*** at Xp22.2-p22.1.
Cogan-1 oculomotor apraxia (AR). MIM 257550	***COMA*** Deletion from ***NPHP1*** at 2q13.	Cogan syndrome is a chronic, probably autoimmune, inflammatory disorder. Most have nausea, vomiting, vertigo, tinnitus, sensorineural hearing loss, and interstitial keratitis. A few have fever, lymphadenopathy and musculoskeletal complaints or aortitis. Look for jerky head movements, defective horizontal eye movements, and nystagmus.
Cogan-2 syndrome. (XL). MIM 314580	***WWS*** at Xq11.2-q13	Wieacker-Wolff syndrome with distal muscle atrophy, slowly progressive mild mental retardation, and oculomotor apraxia with rapid frequent blinking.

Cogan-Reese iris nevus syndrome.	***ICE*** (Compare with the ichthyosis-cheek-eyebrow syndrome.) (AD) (MIM 146720)	Membrane covers the anterior surface of the iris, unilateral glaucoma, ectropion uvea, keratoconus, and comeal edema. Compare with Chandler syndrome (Chandlers have more corneal edema), and the iridocorneal endothelial syndrome. See ***ACE*** syndrome, angiotensin-1 converting enzyme. (MIM 106180).
Cohen or Pepper syndrome (AR). MIM 216550	***COH1*** at 8q21.3-q22.1 or 8q22-q23 or 8q22, ***CSF1*** at 1p21-p13, ***NPY*** at 7p15.1	Obesity, mental retardation, microcephaly, retinitis pigmentosa, retinochoroidal dystrophy, optic atrophy, retinal detachment, cataract, strabismus, night blindness, and high myopia. Some show autism. See Mirhosseini-Holmes-Walton syndrome (AR). (MIM 268050).

Collagens. Most collagen gene disorders are inherited in the AD manner.
Collagens types 1, 2, 3, 5, and 11 are fibril-forming but all other types are non-fibril forming.

Type	Chains	Gene	Tissues
I	α1(I)	***COL1A1*** at 17q21.31-q22.05	Skin, tendons, bones, arteries. (MIM 120150).
I	α2(I)	***COL1A2, COL1B*** at 7q22.1	Skin, tendons, bones, arteries, tumors. (MIM 120160).
I	α, receptor	***COL1AR*** on chromosome 15	Collagen receptor. (MIM 120340).
II	α1(II)	***COL2A1*** at 12q13.11-q13.12	Cartilage, vitreous humour, osteoarthritis. (MIM 120140).
III	α1(III)	***COL3A1*** at 2q32.2	Skin, arteries, uterus. (MIM 120180).
IV	α1(IV)	***COL4A1*** at 13q34	Basal laminae, lens capsule.
IV	α2(IV)	***COL4A2*** at 13q34	Basal laminae.
IV	α3(IV)	***COL4A3*** at 2q36-q37 (AR, AD)	Basement membrane. Goodpasture antigen. See Alport syndrome.
IV	α4(IV)	***COL4A4*** at 2q36-q37.	Hematuria. See Alport syndrome. (MIM 203780).
IV	α5(IV)	***COL4A5, ATS, ASLN*** at Xq22-q24.	Basement membrane. See Alport syndrome. (MIM 104200).
IV	α6(IV)	***COL4A6*** at Xq22	Basement membrane. See Alport syndrome. (MIM 303631).
V	α1(V)	***COL5A1*** at 9q34.2-q34.3	Skin, placenta, vessels, chorion, uterus.
V	α2(V)	***COL5A2*** at 2q24.3-q31	Placenta. Ehlers-Danlos syndromes 1 and 2.
VI	α1(VI)	***COL6A1*** at 21q22.3	Ubiquitous, Bethlem myopathy. (AD). (MIM 158810).
VI	α2(VI)	***COL6A2*** at 21q22.3	Bethlem myopathy. (MIM 158810).
VI	α3(VI)	***COL6A3*** at 2q37	Bethlem myopathy. (MIM 158810).
VII	α1(VII)	***COL7A1*** at 3p21.3	Epithelial mesenchymal junctions. (MIM 120120).
VIII	α1(VIII)	***COL8A1*** at 3q12-q13.1	Many tissues including ocular.
VIII	α2(VIII)	***COL8A2*** at 1p34.3-p32.3	Descemet membrane.
IX	α1(IX)	***COL9A1*** at 6q13	Cartilage. See ***COL19A1.***
IX	α2(IX)	***COL9A2*** at 1p33-p32.2	Alpha-2 polypeptide. Epiphyseal dysplasia, deafness, and severe myopia.
IX	α3(IX)	***COL9A3*** at 20q13.3	Degenerative cartilage and eye diseases.
X	α1(X)	***COL10A1*** at 6q21-q22.3	Cartilage alpha polypeptide at 1p33-p32.2. (MIM 120110).
XI	α1(XI)	***COL11A1*** at 1p21	Cartilage, see Stickler-3 syndrome (AD). (MIM 120200).
XI	α2(XI)	***COL11A2*** at 6p21.3	See Stickler-2 syndrome. (AD). (MIM 120280).
XII		***COL12A1L*** at 6q12-q13	Alpha-1-like.
XIII	α1(XIII)	***COL13A1*** at 10q22	Alpha-1 polypeptide.
XV	α1(XV)	***COL15A1*** at 9q21-q22	May help adherence of basement membranes.
XVI	α1(XVI)	***COL16A1*** at 1p34-p35	Alpha-1 polypeptide.
XVII	α1(XVII)	***COL17A1*** at 10q24.3	Bullous pemphigoid antigen 2.
XVIII	α1(XVIII)	***COL18A1*** at 21q22.3	Resembles type XV.
XIX	α1(XIX)	***COL19A1*** at 6q12-q13.4	Compare with ***COL9A1*** at 6q13.

Name	Gene	Comments
colobomas of the optic nerve. (AD, AR, XR). MIM 167409	***PAX2*** at 10q24.1-q25.1	Mutations here can affect kidneys, eyes, ears, and CNS. ***ONCR*** (MIM 120330), optic nerve colobomas with renal disease.
colobomas of the iris, with ptosis, hypertelorism, and mental retardation. (AR). MIM 167415.	Possibly ***PAX8*** at 2q12-q14	See also the CHARGE association. (MIM 214800). See thyroid dysgenesis.
colobomas of the iris, choroid, and retina. (AD, AR). MIM 120200	***COI*** at 2p25.1-2pter.	Craniofacial dysmorphism, absent corpus callosum, and often microphthalmia.

Color vision anomalies, dyschromatopsias and achromatopsia. Often called color blindness. Among Western Europeans about 8% of males have defective color vision. In this group 75% have deuteranopia (a green defect) and 25 % have protanopia (a red defect). The peak sensitivity of protanopes is near 560nm, for deuteranopes it is near 530nm, and for tritanopes it is near 420nm.

opsin gene. MIM 600342	***RGR*** at 10q23	With choroidal sclerosis and ARRP.
protan and deutan types (XR). MIM 303900	***OPNILW, RCP, CBP***, and ***GCP, CBD*** at Xq28	Depends on red and green cone pigments. Protanopia and deuteranopia. A few deuteranopes have macular dystrophy. (MIM 303800)
blue-yellow or tritan types. (AD, X R). MIM 190900	***OPNISW, BCP, CBT*** at 7q31.3-q32	Blue cone pigment. Those with tritanomalous color vision retain their red-green mechanisms.
blue cone monochromatism (XR). MIM 303700	***CBBM, BCM*** at Xq28	Blue cone monochromacy is progressive.
tritanopia. (AD). MIM 190900	***CPA*** at 7q31.3-q32	Abnormal blue cone ERG. Defective blue and yellow vision is more common in males.
rhodopsin-related anomalies of color vision. (AD)	***RHO, RP4*** at 3q21-q24	Many mutations occur in rhodopsin.
rhodopsin kinase. MIM 180381 catalyzes rhodopsin phosphorylation	***GRK1*** at 13q34 ***GRK7*** at 3q21	Or G-protein receptor kinase. Exclusively in the retina in cone outer segments. See ***GPRK5*** at 10q23-qter and **GPRK6** at 5q35. (MIM 600870).
ACHM 1, rod monochromatism (AR). MIM 603096, see also MIM 200930	***RMCH*** at 2p11.2-q12	Can be caused by uniparental isodisomy, gene on chromosome 14. Person inherits a duplicate copy of a whole chromosome from one parent and has no genes on that chromosome from the other parent.
ACHM 2, rod monochromatism (AR). MIM 216900	***CNGA3*** at 2q11	Total color blindness can result from a mutation in the gene that codes for the alpha subunit of the cone photoreceptor cGMP-gated channel. Some may show a paradoxical pupillary constriction to darkness.
ACHM 3 (AR). MIM 116900	***CNGB3, CKS1*** at 8q21-q22	Codes for the beta channel of the cone photoreceptor cGMP-gated channel. Pingelap congenital, complete, non-progressive, color blindness with myopia, cataract, and nystagmus.

CNGC1, CNGA1 at 4p12-cen codes for the alpha subunit of the cGMP-gated rod photoreceptor channel protein.

Complement deficiencies and related anomalies have their genes inherited in the AR or AD manner. ***C1NH*** is a complement component inhibitor.

Deficiency	Gene	How inherited	Comments
component-1 subcomponent alpha polypeptide	***C1QA*** at 1p36.3-p34.1	AD	Autoimmune disease.
subcomponent beta polypeptide	***C1QB*** at 1p36.3-p34.1	AR	Membranous glomerulonephritis-II.
subcomponent gamma polypeptide	***C1QG*** at 1p36.3-p34.1	AR	See systemic lupus erythematosus.
component-1 r subcomponent	***C1R*** at 12p13	AR	Combined C1r and C1s deficiency.
component-1 s subcomponent	***C1S*** at 12p13	AD	Combined C1r and C1s deficiency.
C2 MIM 217000	***C2*** at 6p21.3	AR	Common deficiency, about 1/10,000 is homozygous.
C3 MIM 120700	***C3*** at 19p13.2-p13.11	AD	Pyogenic infections, sometimes chronic renal disease.
C3B/4B receptor-1 MIM 120620	***C3BR, CR1*** at 1q32		Alpha and beta polypeptides. See SLE.
C3B inactivator deficiency	***IF*** at 4q25	AR	Gene for a C3D type is ***C3DR*** at 1q32.
C4-A and C4-B	***C4BPA*** and ***C4BPB*** at 6p21.3	AR	Rheumatic disorders, pyogenic infections, and SLE-like illness.
C5 MIM 120900	***C5*** at 9q34.1	AR	Meningitis.
C5 receptor-2 MIM 113995	***C5R1, C5AR*** on chromosome 19	AR	Is structurally related to rhodopsin. Needed for defense in the lung.
C6 or C7 or C6/C7 combined	***C6*** at 5p13	AR	Meningitis. For C6 deficiency see MIM 217050.
C8-I and C8-II	***C8A*** and ***C8B*** at 1p32	AD	Alpha and beta polypeptides. Meningitis.
C8G. MIM 120930	***C8G*** at 9q34.3		Gamma polypeptide. This is a lipocalin.
C9 MIM 120940	***C9*** at 5p13	AD	Asymptomatic.

The gene ***CR2*** for the 3D/Epstein Barr receptor-2 is at 1q32. The gene ***HFI*** for complement H factor 1 (AD) is at 1q32.

Cone and **Cone-Rod Degenerations** and **Dystrophies**. More than 60 genes are involved in retinal dystrophies. See the retinal degenerations and see color vision. A gene for Nrl protein in the retina directs a retinal cell to become a cone rather than a rod. For rod photoreceptor diesterase the gene is??????????????

See ***RP7*** at 6p21.1-cen for a slow retinal degeneration. See also the ***RP2*** locus at Xp11.4-p11.23 and Leber-1 amaurosis. See also the enhanced S-cone syndrome with decreased L and M cone function. Note that ***RPE65*** at 1p31 is responsible for a retinal pigment epithelium-specific protein. The gene ***F7R*** for the DeGrouchy syndrome is at 8p23.2-p23.1. See also ***ABCA4*** for (AR) cone-rod dystrophy.

Gene	How inherited	MIM number	Description
RCD1 at 6q25-q26	AD	180020	Cone dystrophy-1 or degeneration.
RC D2 at 17p13.1	AD	601251	Cone dystrophy-2, progressive. Genes that map in this vicinity include ***RCV1*** for recoverin, ***GUC2D*** for guanylate cyclase, **PEDF**, and ***RP13***.
RCD3, PDE6A at 5q31-q33	AD, AR	180071	***PDE6*** in the rods is a key element in the phototransduction cascade.
COD1, PCDX at Xp21.1. or at Xp11.4-q13.1.	XL	304020	Cone dystrophy, nystagmus, myopia, progressive reduction in acuity, and a red color vision deficit. Incomplete achromatopsia.
COD2, XLPCD at Xq27.2-q28	XL	300085	Cone dystrophy-2, progressive.
COD3, GUCA1A at 6p21.1	AD	600364 602093	Cone dystrophy-3. See also ***GUCA1B*** at 6p21.1 (MIM 602275) for a guanylate cyclase activator. ***GUC2B*** is at MIM 601271.
RDH5, RDH1 at 12q13-q14	AR	601617	Retinol dehydrogenase. Progressive cone-rod dystrophy, recessive fundus albipunctatus.
RD3 on chromosome 1q	AD	180040	Retinal degeneration-3. See also ***USH2A***. (MIM 276901).
MCOP at 14q32	AR	267760	Nanophthalmia, cystic macular degeneration, angle-closure glaucoma, retinal degeneration.
COL2A1 at 12q13.11-q13.2 or at 5q13-q14.	AD	143200	Wagner-1 hyaloideoretinal degeneration.
CORD1 at 18q21.1-qter, or 18q21.1-q21.3. or 19q13.1-q13.2.	AR, AD.	600264	Cone-rod dystrophy-1.
CORD2, CRD, CRD2 at 19q13.1-q13.2, and ***CRX*** at 19q13.3 or at 19q13.1-q13.4 may be responsible	AD.	120970 602225	Cone-rod dystrophy-2, severe ADRP, and Leber amaurosis LCA-III. Deletions from ***CRX*** cause severe retinal degeneration.
CORD3, STGD1, ABCR, ABCA4 at 1p21-p13	AD, AR	601691	Cone-rod dystrophy-3. A mutation here is the major cause of cone-rod dystrophy.
CORD4 on chromosome 17q	AD		Cone-rod dystrophy-4.
CORD5 at 17p12-p13	AD	600977	Cone-rod dystrophy-5.
CORD6 , RETGC1, GUCY2D at 17p13.1	AD	601777 600179	Cone-rod dystrophy. A mutation here affects retinal guanylate cyclase. See LCA-I. CORD6 See ***RCD2*** See ***GUC2B*** at 1p34-p33.
CORD7 at 6q14-q16.2	AD		Cone-rod dystrophy. See ***RIM1***. or ***RHN.*** (MIM 268150). Rh null disease.
CORD8 at 1q12-q24	AR		Cone-rod dystrophy.
CORD9 at 8p11	AR		Cone-rod dystrophy.
UNC119, HRG4 at 17q11.2	AD		Cone-rod dystrophy.
Gene	AR	268315	Rod-cone dystrophy, sensorineural deafness, cataracts, and Fanconi-type renal dysfunction. Most die before age 20. Renal failure.
SCA7 at 3p21.1-p12	AD	164500	Rod-cone dystrophy, **OPCA-3**. See also ***ADCA***, type 2 at 3p13-p12.
ALSS, ALMS1 at 2p14-p13	AR	203800	Cone-rod dystrophy. Alstrom syndrome.
PRKCA at 17q22-q23.2	AD	176960	Cone-rod dystrophy.
RDS at 6p21.1-cen	AD	179605	Cone-rod dystrophy. See ***RP7*** and digenic RP.
RP13, PEDF at 17p13.3	AD	600059	Cone-rod dystrophy.
HHT1 at 9q33-q34.1	AD	187300	Cone-rod dystrophy. Telangiectasia.
DOD1 at Xp11.4-p11.3	XL		Cone-rod dystrophy.
AIH2 at 4q11-q21	AD, AR	104500	Amelogenesis imperfecta-II (AR) and can cause cone-rod dystrophy.
GUCA1A at 6p21.1	AD	600364	Mutation can cause cone dystrophy.
RP15 at Xp22.13-p22.11	XD	300029	Cone-rod degeneration and ADRP.
Gene at Xq28	XL		Cone degeneration.

Connexins are the names for the gap junction proteins. Gap junction proteins are specialized structures on the plasma membranes of contacting adherent cells. Some are inherited AR. At least eight connexins are known. ***GJA1***=connexin 43, at 6q14-q24.1, or at 6q21-q23.2. See uterine leiomyomata, (MIM 121014). ***GJA3***=connexin 46, at 13q11-q12 may have a role in cataract, (MIM 121015). ***GJA4***=connexin 37, at 1p35.1, for this alpha 4 type (MIM 121012). ***GJA5***=connexin 40, at 1q21.1an alpha 5 type (MIM 121013). ***GJA8***=connexin 50, may have a role in cataract, (MIM 600897). ***GJB1***=connexin 32, at Xq13, this beta 1 type affects the roots of the spinal nerves and may relate to ***CMTX*** (MIM 304040). ***GJB2***=connexin 26, at 13q11-q12, is a major cause of congenital deafness, (MIM 121011). ***GJB3***=connexin 31, at 3p22, (MIM 603324). ***GJB6***=connexin 30. See also the cadherins and the catenins.

Name	Gene	Comments
contractural arachnodactyly. (AD).	***FBN2, CCA*** at 5q23-q31.	Beal syndrome, severe arachnodactyly, with ocular complications.
convulsions, infantile paroxysmal choreoathetosis . (AD). MIM 602066	Gene is at 16p12-q12 or on chromosome 19q	See epilepsy. Compare with benign familial infantile convulsions ***BFIC*** on chromosome 19. (AD) (MIM 601764). See also: MIM 118800, 601042, 602042.
conical cornea, keratoconus. (AD, AR, S, M) MIM 148300.	One gene is ***COL6A1*** at 21q22.3	An AR pattern is associated with amaurosis congenita. Keratoconus is common in patients with Down syndrome. See van der Hoeve syndrome and Bethlem myopathy. Keratoconus can occur in a syndrome with allergy, tetany, and menopause.
keratoconus posticus circumscriptus (AR, S, AD). MIM 244600	***KPC***	Short webbed neck, hypertelorism, corneal nebulae, von Hippel internal corneal ulcer, ptosis, retinal coloboma, hyperopia, myopic astigmatism, cleft lip, and often mental retardation and urinary tract abnormalities. See Haney-Falls syndrome. (MIM 244600).
megalocornea-1, macrocornea. (XL). MIM 309300	***MGC1, MGCN*** at Xq21.3-q22, or at Xq12-q26	A large cornea can be inherited (S, XR, AD, AR) or can be secondary to congenital glaucoma. Often these patients have arcus juvenilis, cataracts, and mosaic corneal dystrophy.
microcornea with the Nance-Horan syndrome (XR). MIM 302350	***NHS*** at Xp22.3-p22.2	They also have Hutchinson teeth and cataract.
Rodrigues blindness. (AR). MIM 268320	Gene	Possibly an ectodermal dysplasia. Short stature, mental retardation, hair and dental abnormalities, microphthalmia, microcornea, and sclerocornea.
microcornea (AD, AR, XL, M, S)	One gene is ***COL4A5*** at Xq22	Can have cataract, glaucoma, microphthalmia, and aniridia.
cornea plana (AD). MIM 121400	***CNA1*** at 12q21	Hyperopia. The AD type is milder than the AR type. See the calcineurins, a group of protein phosphatase regulatory subunits..
cornea plana. (AD, AR) MIM 121400, 217300	***CNA2, KERA*** at 12q22	Mutations in keratocan. Cornea has a central opacity and is 6 to 13 diopters flatter than the normal average value of about 42.25 D. Many have epidermolysis bullosa dystrophica (AD, AR) for which the gene is ***COL7A1*** at 3p21.3.
corneal clouding. (AR)	***APOA1*** at 11q23	This is only one of several possible genes.
corneal hypesthesia. (AD). MIM 122450	Gene	Trigeminal anesthesia, epithelial erosions, corneal edema, a foreign body sensation, and corneal ulcers. (Contact lens wear reduces corneal sensitivity.)
corneal malformation, sclerocornea. (AD, AR) MIM 181700, 269400	Gene	May have monosomy 21 with cornea plana, and hypertelorism. Some have epidermolysis and syndactyly. Sclerocornea can be inherited AD but the AR type is more severe. Compare with cornea plana..
corneal limbal dermoids. (XL). MIM 304730	***CND*** at Xp22.2-p22.1	Congenital opaque corneal lesions.

Corneal Dystrophies. Genes for corneal dystrophy have been mapped to at least 10 chromosomes (1, 5, 9, 10, 12, 16, 17, 20, 21, and X). [Corneal procollagen, type 1 has its gene ***COL1A2*** at 7q21.3-q22.1.].

Transforming growth factor β-induced gene product of ***BIGH3***, keratoepithelin at 5q31 is involved in several dystrophies. Some corneal dystrophies that are described as distinct clinical entities may be caused by different mutations in the same gene. Fleischer vortex dystrophy, cornea verticillata, occurs in XL Fabry disease. The gene ***GLA*** for alpha galactosidase is at Xq22. For Thiel-Behnke dystrophy of the Bowman layer, the gene is ***CDB2*** at 10q24. The gene for four or more corneal dystrophies maps to 5q31.

Mutation in a gene for corneal hypesthesia (AD) causes trigeminal anesthesia, corneal erosions, and ulcers. Spanlang-Tappeiner syndrome (AD), onset age 5 to 20 years, includes: keratosis palmoplantaris, hyperkeratosis of palms and soles, hyperhidrosis, corneal dystrophy, the yellow tongue-shaped opacities in the cornea are not always in the central region.

Map-dot or fingerprint corneal erosions are epithelial dystrophies with pain. Cogan-Guerry map-dot fingerprint dystrophy mostly affects females, they synthesize an abnormal basement membrane, have fine dots and lines in the cornea, but their vision is only slightly reduced. (MIM 121820).

Name	*Gene*	Comments
Avellino granular-II dystrophy . (AD). MIM 601692	***ACD, TGFB1, BIGH3*** at 5q31	Transforming growth factor beta-induced. May have lattice and granular dystrophy. See granular type 1. ***BIGH3*** produces keratoepithelin which is mostly expressed in the endothelium. See MIM 601692 for dystrop[hy of the keratoepithelin layer.
honeycomb dystrophy of Thiel-Behnke. (AD). MIM 602082	***BIGH3*** at 5q31	Honeycomb dystrophy of the Bowman layer. Was called **CDTB-II** or **CDB2** at 10q24 for honeycomb or Theil-Behnke dystrophy whch is less severe than that due to **CDB1.** (The Thiel-Behnke name is also given to a gene at 10q24.). ***CDB1*** at 5q22-q33.3 (MIM 121900) is the gene for geographic or true Reis-Bucklers granular dystrophy of the Bowman layer.
ring-like, annular, granular-III (AD). MIM 601692	***BIGH3*** at 5q31	Mutation in the gene for keratoepithelin causes Reis-Bücklers, type IV granular dystrophy .**CDRB**. (MIM 121900). But see ***CDB1***
Meesmann juvenile epithelial dystrophy (AD). MIM 121900, 122100	***KRT3*** at 12q12-q13, ***KRT12*** at 17q12-q21	Have a keratin mutation and fragile corneal epithelium with erosions and many fine opacities here and in Bowman membrane. See MIM 148043, 601687.

Corneal Dystrophies, stromal types are mostly inherited in the AD manner. Bilateral clouding of the corneal stroma occurs with: cystinosis, fish-eye disease, gout, LCAT deficiency, mucolipidosis, Schnyder's crystalline dystrophy, and Tangier disease. A gene for a macular corneal dystrophy maps to 16q22. Schlichting posterior polymorphous dystrophy (AD) depends on a gene ***PPCD*** at 20p11.2-q11.2. With this posterior corneal dystrophy some have glaucoma. (MIM 122000).

See also mutations in ***ARSC, CHST6, COL8A2, GLA, GSN, KRT3, KRT2, M1S1***, and ***TGFBI (BIGH3***). Some have amyloid deposits see for example ***GSN, M1S1,*** and ***TGFBI.*** See MIM 601692 for dystrophies of the keratoepithelin layer. The gene for geographic or true Reis-Bücklers dystrophy of the Bowman layer is ***CDBI*** at 5q22-q33/3 For the less severe honeycomb or Theil-Behnke dystrophy the gene is ***CDBII*** at 10q24.

See also congenital hereditary corneal dystrophy (MIM 217700), endothelial dystrophy ***CHED2***. Maumenee type.

Sclerocornea (MIM 269400). The severe form is inherited AR, and the milder form is AD. Compare with cornea plana. See also keratoconus and keratoconus posticuss.

Genes are on chromosome 1 for central crystalline dystrophy, early-onset Fuch's dystrophy, familial subepithelial corneal amyloidosis, and for posterkior polymorphous dystrophy. The gene for keratoconus is also on chromosome 1.

Genes are on chromosome 16 for fish-eye disease, ***LCAT***, and for tyrosinemia type-II. The gene for Stocker-Hall syndrome gene is on chromosome 17. Genes are on the X chromosome for cornea farinata, filiform dystrophy, keratitis follicularis spinulosa decalvans, and for Lisch dystrophy.

granular and lattice dystrophy (AD).	***BIGH3*** at 5q31	A combined type.
granular or Groenouw type 1.(AD, S). MIM 121900, 217300	***BIGH3*** at 5q31	**CDGG1**. Reis-Bücklers type 1 or Grayson-Wilbrandt dystrophy. **CDRB**. Grey-white granules in a disc-shaped area of the central cornea. Some have strabismus. Avellino dystrophy may be a variant. (MIM 601692).
lattice-I or Bücklers type III. (AD). MIM 122200	***BIGH3*** at 5q31	**CDL1** Bieber-Haab-Dimmer dystrophy without systemic amyloidosis. Progresses to produce severe visual impairment by about age 50.
lattice-II, familial, or Finnish type. (AD). MIM 137350	***GSN*** at 9q34 The gene product is gelsoline.	Lattice type-II was called Meretoja dystrophy but the lines are amyloid not corneal nerves. With familial amyloid polyneuropathy type IV itching is severe. Skin and facial nerve degeneration. Amyloid deposition is also associated with ***BIGH3*** at 5q31, ***MSS1, PMSC2*** at 7q22.1-q22.3, and ***PMSC5*** at 17q23.1-q23.3.
lattice-III, or Japanese type. (AR). MIM 104770	***SAP*** at 1q12-q23	Onset after age 70, with cataracts but no systemic amyloidosis. Serum amyloid Pcomponent inhibits infection by the influenza virus.

lattice-IIIA. (AD). MIM 601692	***GFB1, BIGH3*** at 5q31	Amyloid deposits.
Bietti marginal crystalline corneoretinal dystrophy. (AR). MIM 210370	***BCD4*** at 4q35-qter.	Abnormal lipid metabolism. The metabolic disturbance causes chorioretinal atrophy with crystals, and retinitis punctata albescens. Onset in the twenties. Compare with Terrien corneal dystrophy.
Schnyder crystalline dystrophy. (AD, S). MIM 121800, 603024	***SCCD*** at 1p36-p34.1, or ***B120*** at 1p35-p36.1	Phospholipid and cholesterol crystals in the cornea beginning in childhood. Central crystalline disciform dystrophy. Compare with Bietti crystalline dystrophy. (MIM 210370).
Corneal dystrophies affecting the endothelium and Descemet membrane. One hereditary polymorphous posterior dystrophy with a reduced number of endothelial cells is AD. See also keratoconus.		
congenital Maumenee type (AD). MIM 121700	***CHED1*** at 20p11.2-q11.2	Hereditary endothelial corneal dystrophy.
congenital Maumenee type. (AR). MIM 217700	***CHED2*** at 20p11.2-q11.2	Posterior polymorphous dystrophy.
Other corneal dystrophies. See also microcornea. A gene ***MCDC1*** (AR) for macular corneal dystrophy is at 16q22. (MIM 217800). Two subtypes..		
brittle cornea, blue sclera, and most have red hair. (AR). MIM 229200	Gene	Joint hyperextensibility, fragile bones, dental anomalies, brittle cornea, cloudy cornea, fragilitas oculi, sclerocornea, cornea plana, keratoconus, risk of corneal perforation. Some have Ehlers-Danlos syndrome VIB (MIM 225400, 229200), or osteogenesis imperfecta, or Marfan syndrome.
Chandler syndrome	***CS***	This progressive essential iris atrophy was said to include peripheral anterior synechiae, a membrane on the anterior iris, no holes in the iris, but affected the posterior surface of the cornea, and caused corneal edema. Essential iris atrophy has the most effect on the corneal endothelium. See ***ICE*** syndrome (MIM 146720) which is a symbol for two (AD) conditions the ichthyosis-cheek–eyebrow syndrome and the iridocorneal endothelial syndrome
Cogan-Reese iris nevus syndrome. (AD)	***CRS***	Peripheral anterior synechiae, and pigmented nodules on the iris, iris nevi. Tend to develop angle-closure glaucoma. See ***ICE*** syndrome.
Conradi-Hünermann-Happle chondrodysplasia punctata. (XD). MIM 302960	***CDPX2*** at Xp11.23. AR subtypes also occur.	Gene for emopamil affects females. Anomalies of the spine, scoliosis, frontal bossing, short limbs, heart defect, skin anomalies, coarse hair, mental retardation, unilateral renal defect, hypertelorism, congenital cataracts, and corneal erosions. Compare with ***CHILD*** syndrome (XD), (MIM 308050).
corneal dermoids. (XL)	***CND*** at Xp22.2-p22.1.	Congenital opaque cornea.
corneo-dermato-osseous syndrome. (AD). MIM 122440	***CDO***	Tyrosine transaminase deficiency. Palmoplantar hyperkeratosis, short stature, photophobia, corneal epithelial and stromal changes may include keratoconus. See tyrosinemia-II. For Richner-Hanhart syndrome.(AR), the gene ***TAT*** is at 16q22.1-q22.3 (MIM 276600).
Franceschetti-Their syndrome. (AR).	Gene	A unilateral variant of Treacher-Collins syndrome. (MIM 154500). Multiple lipomas, mental retardation, and corneal dystrophy.
François dermo-chondro-corneal dystrophies. (AR). MIM 221800	Gene	Hypercholesterolemia, distal osteochondral dystrophy, seizures, cutaneous xanthomas, anterior cortical cataracts, and central subepithelial corneal opacities.
François-1 or François-Neetens central cloudy or speckled dystrophy. (AD). MIM 121850	Gene	Elevated levels of glycosaminoglycans and lipids. Lactose intolerance and malabsorption of fat, have snowflake opacities in the central corneal stroma and reduced corneal sensitivity. More common in eyes with a green iris.
François-2 or François-Evens speckled corneal dystrophy. (AD).	Gene	Agenesis of the corpus callosum, median facial cleft, ocular malformations, congenital fine, punctate, non-progressive opacities in all layers of both corneas. See MIM 217600 for an AR central corneal dystrophy.
Harboyan oto-palato-digital syndrome (AR, AD). MIM 217400	***CDPD1*** at 20p13	Skeletal dysplasia of hands and feet, palate anomalies, and blue-white corneal opacities present at birth. Onset of progressive deafness in the teens with nystagmus, and keratoconus,
keratosis palmoplantaris and corneal dystrophy. (AD). MIM 276600	***TAT*** at 16q22.1-q22.3. Some are AR.	Tyrosine aminotransferase deficiency. Hyperkeratosis of palms and soles, onset at age 5 to 20 years. The corneal opacities are yellowish, some have corneal ulcers. Reported to interact with ***HIV,*** Richner-Hanhart syndrome (M(M 276600) and tyrosinemia-II (MIM 276600). These patients need to restrict intake of phenylalanine and tyrosine.

macular corneal dystrophy (AR). MIM 217800	***MCDC1*** at 16q22	Groenouw dystrophy-II, defective glycoprotein processing with onset in the first decade, punctate grey corneal opacities with recurrent erosions. Note that ***ZNF23*** is at 16q22.
posterior polymorphous dystrophy. (AD, AR, S) MIM 122000	***PPCD*** at 20q11	Schlichting corneal dystrophy. Compare with Maumenee dystrophies. See ***CHED*** (MIM 121700, 217700)
Terrien marginal corneal degeneration, or gutter dystrophy .	Gene	Non-ulcerative thinning of the marginal cornea, inflammation, minimal pain, corneal vascularization, lipid deposits, keratoconus, high astigmatism, mostly affects both eyes of middle-aged males. Compare with Bietti corneal dystrophy. (MIM 210370).
Name	**Gene**	**Comments**
Cornelia (or Brachmann) de Lange syndrome. (S, AD, AR). MIM 122470	***CDL1*** at 3q26.3	Amsterdam dwarfism, mental retardation, ptosis, nystagmus, strabismus, and high myopia.
corpus callosum agenesis. (AD, AR, XL). MIM 218000, 217990	***ACCPN*** at 15q13-q15 for the AR type	Occurs in many conditions, usually causes peripheral neuropathy. See also ***CMT*** and the Andermann syndrome (AR) (MIM254900) with polyneuropathy, renal failure, and epilepsy. See also the Warburg microsyndrome (MIM 600118).
Costen temperomandibular joint syndrome	***TMD, TMJ***	Have dental malocclusion, pain, headache, deafness, tinnitus, vertigo, and blurred vision.
Cowden disease. (AD) MIM158350	***PTEN*** at 19q22-q23 or at 10q23.3	The major manifestation is Lhermitte-Duclos (LDD) gangliocytoma of the cerebellum. See cancer. Other signs are mental retardation, seizures, and ataxia. See the Bannayan-Riley-Ruvalcaba syndrome. (AD) (MIM 153480).
Crane-Heise syndrome (AR). MIM 218090	***ASSAS***	A severe, lethal syndrome with a cranial bone defect, cleft lip/palate, agenesis of the clavicles and cervical vertebrae, and talipes equinovarus. Most soon die.
craniofacial-deafness hand syndrome. (AD)	***PAX3, CDHS, WS1, HUP2*** at 2p35.	Signs include a flat face, hypertelorism, deafness, and ulnar deviation of the hands.
cranio-fronto-nasal dysplasia. (XR).	***CFNS, CFND*** at Xp22	Brachycephaly, cleft lip/palate, syndactyly, more prevalent in females, hypertelorism, and down-slanting lid fissures.
craniometaphyseal dysplasia. (AD, rarely AR)	***CMDJ*** at 5p15.2-p14.1	Jackson dysplasia, Pyle disease with compression of cranial nerves II, VII, and VIII, deafness, hypertelorism, rhinitis, facial palsy, and low intelligence.
otopalatodigital syndrome-I. (XL) MIM 311300	***OPD1*** at Xq28	Is milder than ***OPD2*** and may be the same as frontometaphyseal dysplasia. ***MNS*** (XD) at Xq28. (MIM 305620).
cranio-oro-digital, or otopalatodigital syndrome-II. (XD). MIM 304120	***OPD2*** at Xq28.	Also called faciopalatoosseous syndrome. Microcephaly, cleft palate, deafness, syndactyly, and hypertelorism.
craniosynotosis, congenital. (AD). MIM 101600 136350	***FGFR1*** at 8p11.2-p11.1.	Pfeiffer or Noack syndrome with severe proptosis, broad thumbs, clover-leaf skull, brain abnormalities, and pulmonary problems, most soon die. ***PLAT*** and ***CEBPD*** also map here.
craniosynostosis-mental retardation-clefting syndrome. (AR). MIM 218650	Gene may be ***FGFR2*** at 10q25.3-q26.	Also have, seizures, mental retardation, dysplastic kidneys, and choroidal colobomas. Several conditions depend on mutations in ***FGFR2***
craniosynostosis, non-syndromic (AD). MIM 134934	***FGFR3*** at 4p16.3	Mutation in the gene for a fibroblast growth factor receptor. ***FGFR3***. undergoes many mutations.
caniosynostosis-I (AD, AR, S, M, XR)	***CRS1, CSO*** at 7p21.3-p21.2.	Have a tower skull, acrocephaly.
craniosynostosis-II. (AD)	***MSX2, CRS2*** at 5q34-q35	Boston craniosynostosis.
craniosynostosis-III. (AD)	***CRSA, CRS3*** at 4p16	Adelaide type with digital anomalies.
Creatine kinases help to maintain intracellular ATP levels. Some examples are ***CKBB*** and ***CKBE*** in the brain, ***CKMM*** in muscle, and ***CKMT1*** and ***CKMT2*** that are mitochondrial.		
Creutzfeld-Jakob syndrome. (AD). MIM 176640, 123400	***PRNP, PRIP*** at 20pter-p12 or at 20p12	Prion production in middle age causes presenile degenerative changes in the cerebral cortex, spastic paralysis, ataxia, seizures, dementia, ptosis, nystagmus, paralysis of CNVII, some demyelination of the optic nerve, dyschromatopsia, and cortical blindness. A variant form of Creutzfeldt-Jakob is ***vCJD.*** Compare with Gerstmann-Straussler encephalopathy. See also bovine spongiform encephalopathy **BSE**, mad cow disease. See prion disease. (MIM 176640).

cri du chat, cat cry syndrome. (C). -IM 123450	Deletion from the gene ***CTNND2*** at 5p15.2 or more of the short arm. ***hTERT*** is at 5p15.3. Some have a deletion from chromosome 11p or from chromosome 13q.	Lejeune encephalomyeloneuropathy syndrome affects about 1/30,000 newborns, twice as many females as males. Progressive scoliosis. The mentally retarded child soon dies. The 5p deletion signs are hypertelorism, epicanthus, strabismus and down-slanting lid fissures. The 11p deletion signs are Wilms tumor, genitourinary anomalies, retardation. aniridia, glaucoma, nystagmus, ptosis, and foveal hypoplasia. The 13q deletion signs are retardation, microcephaly, malformed ears, congenital heart disease, and abnormalities of the thumbs and feet, retinoblastoma, hypertelorism, microphthalmos, epicanthus, ptosis, colobomas, and cataracts.
Crigler-Najjar-I. (AR). MIM 191740, 218800	***UGT1A1, GNT1*** on chromosome 2q .	***UGT1A1*** detoxifies bilirubin by conjugating it with glucuronic acid. Hyperbilirubinemia-II. Breast-feeding jaundice. Does not respond to phenobarbital treatment. The ***UGT1*** complex encodes 13 isoforms and 4 pseudogenes. See Gilbert syndrome.(AD). (MIM 191740).
Crigler-Najjar-II. (AD). MIM 143500	***UGT1A1*** on chromosome 2q	Hyperbilirubinemia-I or Gilbert syndrome which is benign. See neonatal jaundice. ***UGT1A6, 1A7,*** and ***2B15*** may also have a role in disease. Phenobarbital will lower serum bilirubin level by 30% in patients with Crigler-Najjar type 2 but not in those with type 1.
Criswick-Schepens vitreoretinopathy.(AR, XL)	***EVR***. MIM 133780 ***EVR2***. MIM 305390	See familial exudative vitreoretinopathy. (MIM 221900, 264200). See also ***FEVR*** (AD, AR, XL) (MIM 133780, 601813). An AR type has been described.
Crohn disease-1. (AR). MIM 266600	***IBD1*** at 16p12-q13 ***IBD2*** at 12p13.2-q24.1	Affects 1/400 in USA. Inflammatory bowel disease or regional enteritis or ulcerative colitis, perforating or nonperforating. About half have iridocyclitis. Conjunctivitis, corneal ulcers, macular edema, and EOM palsy. Other genes may be ***CKS2*** at 9q22 (MIM 116901) or ***CKS1*** at 8q21.
Crome syndrome. (AR). MIM 218900	Gene	Epileptic seizures, mental retardation, renal tubular necrosis, encephalopathy, nystagmus, and congenital cataract. Most die in childhood. Some similarity to Marinesco-Sjögren syndrome (AR) (MIM 248800) and to Lowe syndrome (XL) (MIM 309900).
Crouzon craniofacial dysostosis-1. (AD, S). MIM 123500	***CFD1, FGFR2*** at 10q25.3-q26.	Craniosynostosis, proptosis, hypertelorism, exophthalmos, nystagmus, strabismus, blue sclera, cataract, optic atrophy, and down-slanting lid fissures. Compare with the Jackson-Weiss (MIM 123150) and Apert syndromes. (MIM 101200).
Crouzon syndrome with acanthosis nigricans. (AD).	***FGFR3, ACH*** at 4p16.3	The thickened skin of acanthosis nigricans is mostly benign. Some show signs of Beare-Stevenson syndrome. (AD) (MIM 123790).
CRST syndrome . (AD). MIM 181750	Gene	Average age of onset is 45 years. Have calcinosis cutis, Raynaud's phenomenon, anti-centromere antibodies, pulmonary hypertension, bronchiectasis, scleroderma, sclerodactyly, autoimmune hepatitis, telangiectasia, and Intracranial aneurysms. May have corneal ulcers, keratoconus, ptosis, retinal hemorrhages, occlusion of retinal veins, optic atrophy, and papilledema. Is a variant of scleroderma and simulates hereditary telangiectasia, see MIM 187300. See scleroderma and when there is esophageal involvement see **CREST** syndrome. With **CREST** 90% have kinetochore antibodies. See Rendu-Osler-Weber disease. (MIM 601101).
cryptophthalmia with syndactyly (AR, rarely AD) MIM 219000, 123570	One gene is on chromosome 9. .Most are AR but one pedigree is AD.	Fraser syndrome (AR) patients have abnormalities of ears, nasal, laryngeal, pulmonary, and urogenital tissues, and syndactyly. Renal anomalies in 85%. Cryptophthalmia affects about 1/250,000 liveborn infants. Microphthalmia, enophthalmia, lids may cover the eyeballs, malformed lacrimal ducts, eyebrows missing. Some are mentally retarded. Not all with Fraser syndrome have cryptophthalmia. Compare with Bowen syndrome, gene at 9q22.3. (MIM 211200).
cryptorchidism. (S, XR)	***GTD*** at Xp21	Hypogonadism.
Curschman-Steinert disease. (AD)	***DMPK*** at 19p13.2-cen. .	May have muscle weakness, hypogonadism, cataracts, and many have CTG repeats. Compare with myotonic dystrophy.(MIM 160900). Common in the Saguenay-Lac St Jean region of Quebec.

Curtius syndrome. (AR). MIM 232000	***PCCA*** at 13q32.	Propionicaciduria type 1. Hidrotic ectodermal dysplasia, hypodontia, hypotrichosis, vomiting, lethargy, developmental retardation, hypertelorism, nystagmus, congenital cataract, colobomas, and tapetoretinal degeneration. The gene for Curtius type 2 is at 3q21-q22. (MIM 232050).
Cushing syndrome-1. (AR). MIM 219080	Gene may be ***GNAS1*** at 20q13.2-q13.3 or at 11p15.	An adrenocortical syndrome, adrenal hyperplasia, hirsutism, obesity, hypertension, skin pigmentation, diabetes, ocular muscle palsies, posterior subcapsular cataract, and central serous retinopathy. See Albright osteodystrophy-l ***AHOI*** (MIM 103580).
Cushing syndrome-2. MIM 219090	Gene may be ***MEN1*** at 11q13.	Cerebellopontine angle tumor syndrome. The pituitary tumor affects CN V, VI, VII, and VIII or the brainstem. Onset age 30 to 45 years. Deafness, tinnitus, facial paresis, ataxia, headac he, facial pain, nystagmus, EOM palsies, and bilateral papilledema.
Cushing syndrome-3, chiasmal syndrome MIM 219090	Gene	Aneurysm in the anterior part of the circle of Willis, or a suprasellar meningioma or craniopharyngioma or pituitary adenoma, or aneurysm, or glioma, or carcinoma, or metastatic tumor, bitemporal progressive hemianopia, and pale optic disc.
cyclic neutropenia. (AD)	***ELA2*** at 19p13.3	Have a high risk of bacterial infections.
cyclic nucleotide gated channel genes. (AR). MIM 123825	***CNGA1, CNCG1*** at 4p12-cen	Codes for the alpha subunit of rod cGMP-gated photoreceptor channel protein. ***CNGB1, CNCG2*** at 16q13 codes for the beta 1 channel.
MIM 600054	***CNGA2***	This cyclic nucleotide-gated channel relates to olfaction.
ACHM2. (AR). MIM 216900	***CNGA3*** at 2q11	Codes for the alpha subunit of cone photoreceptor cGMP-gated channel.
ACHM3. (AR). MIM 116900	***CNGB3, CKS1*** at 8q21 .	Codes for the beta subunit of cone nucleotide-gated cation channel.
cyclin B1. MIM 123836	***CCNB1*** at 5q12	Or possibly at 5q31 or at 5q13-qter.
cyclin-dependent kinases	***CDK1, CDK2, DK3***, ***CDK4*** at 12q13-q14	These kinases control cell cycles.
cyclooxygenase-1, ***COX-1.*** (AD) MIM 176805	***PTGS1*** at 9q32-q33.3	Prostaglandin-endoperoxidase synthase regulates prostaglandin synthesis.
COX-2 MIM 600262	***PTGS2*** at 1q25.2-q25.3	Increased production in malignancies including prostate adenocarc inoma.
cytochrome c oxidase deficiency. MIM 123864	***COX4*** at 16q22-qter	For subunit IV.
MIM 123866	***COX5B*** at 2cen-q13	For subunit Vb.
MIM 602072	***COX6A1*** at 6p21, ***COX6A1P*** at 1p31.1	For subunit VIa.
MIM 124089	***COX6B*** at 19q13.1	For subunit VIb.
MIM 123995	***COX7A1***, ***7A2,*** and ***7A3*** in muscle and liver	Subunit 7 genes may be on chromosomes 4, 14, or 19.
MIM 123870	***COX8*** at 11q12-q13	For subunit VIII.
cystathione beta synthase. (AR).	***CBS*** at 21q22.3.	Deficiency here causes homocystinuria, myocardial infarcts, mental retardation, cataracts, glaucoma, high myopia, and optic atrophy.
cystathioninuria. (AR). MIM 219500.	***CTH*** on chromosome 16	Cystathionase deficiency, causes mental retardation, seizures, and thrombocytopenia. May have kidney stones.
cystic fibrosis. (AR, S). MIM 219700, 602421	***CFTR, CF*** at 7q31.2 This gene regulates transmembrane conductance. Other mutations may be involved. Loss of phenylalanine F508 mutation.	Fibrocystic disease of the pancreas, formerly called mucoviscidosis, is the most common lethal AR disease in Caucasians, affecting 1/2500. Pancreatic insufficiency, recurrent pulmonary infections, affects the sweat glands, cramps, diarrhea, fever, ischemic retinopathy, venous congestion, retinal hemorrhages, abnormal pupillary response, macular degeneration, papilledema, optic neuritis, optic atrophy. Most die by age 31. Some develop Crohn disease. (MIM 266600). Can be an example of uniparental isodisomy when both genes are inherited from one parent.
cystinosis with renal tubular dysfunction. (AR). MIM 219800	***CTNS*** at 17p13	This lysosomal transport defect causes early-onset growth retardation, cerebral atrophy, confusion, renal failure, and rickets. Have corneal crystals and a narrow gonial angle in the anterior chamber. See Lignac-Fanconi syndrome. (MIM 219800)
cystinuria. (AR, AD). MIM 104614	***SLC3A1, D2H*** at 2p16.3	Abnormal protein metabolism, deafmutism, and pigmentary retinopathy. For cystinuria type III the gene is ***CSNU3*** at 19q13.1. Those with the AR type get stones in their urinary tract.
cystoid macular edema. (AD). MIM 153880	***CYMD*** at 7p21-p15	See Irvine-Gass syndrome. (MIM 153880).

D.

Danbolt-Close syndrome. (AR). MIM 201100	***AEZ***	Acrodermatitis enteropathica, onset in infancy, zinc deficiency, skin eruption, dermatitis, glossitis, stomatitis, alopecia, GI disturbances, diarrhea, loss of eyebrows and eyelashes, entropion, photophobia, conjunctivitis, and corneal opacities. Need zinc supplementation. Treat with diiodohydroxyquinoline.
Dandy-Walker syndrome. (AR, S, AD). Mostly AR. MIM 220200,	***DWS*** may be at 9pter-q12 .Some have trisomy 9p or a deletion from 13q22-q33.	Abnormal development of the neural crest with agenesis of the corpus callosum, atresia of the foramen of Magendie, hydrocephalus, cerebellar anomalies, posterior fossa cyst, paraplegia, ataxia, postaxial polydactyly, some are mentally retarded, some are deaf, some have anomalies of heart, liver, kidneys, pancreas, and skin, nystagmus, paralysis of CNVI, and papilledema.
Dandy-Walker malformation. (AR) MIM 220219 (XR). MIM 304340,	***PGS, MRXS5*** at Xq26-q27	At least 7 syndromes have a Dandy-Walker component. Signs are a posterior fossa cyst, hypoplasia of the cerebellar vermis, and often hydrocephalus with a bulging occiput. Some have mental retardation, nystagmus, and high myopia. See Pettigrew syndrome 5. (MIM 220210 and 220220). See Warburg and Mendel syndromes. (MIM 236670, 249000).
Darier disease		See keratosis follicularis. (MIM 124200).

Deafness is common**,** over 70 million people have impaired hearing. Genetic disorders account for 50% of early-onset deafness and for 33% of late-onset deafness. Mutations in ***GJB2*** (connexin 26) (AR) at 13q11-q12 account for 50% of congenital hearing impairments. Deafness can occur with at least 80 conditions including albinism, retinitis pigmentosa, mutations in the connexins (gap junction proteins), in the Usher syndromes, and in the Bartter syndromes.

Deafness and sometimes retinal pigmentary disturbances occur in these syndromes: Alport, Bardet-Biedl, Cockayne, Laurence-Moon, Stickler, Usher, Waardenburg, lactic acidosis, stroke-like episodes, MELAS, and MERRF. Deafness has been described with Charcot-Marie-Tooth disease of the AD type (MIM 118300 and of the AR type (MIM 214370). See also the Amalric-Dialinas syndrome with deaf mutism, retinal degeneration, atypical retinitis pigmentosa in the macula, and heterochromia iridis, but no night blindness. See also juvenile macular degeneration with deafness. With the **ADR** syndrome (AR) (MIM 208850) the signs are deafness, ataxia, and mental retardation. Compare with Richards-Rundle syndrome (MIM 245100).

Bazzana syndrome is a rare angiospastic ophthalmo-auricular syndrome with otosclerosis. Their deafness is progressive and they have constricted visual fields, and retinal vascular tortuosity.

Mutations in AR genes account for 80% of non-syndromic genetic deafness. One AR syndrome includes diaphragmatic hernia, exomphalos, absent corpus callosum, sensorineural deafness, hypertelorism, and myopia. For Eldridge syndrome (AR) ***DYDT*** at 9q32-q34, (MIM 221200) the signs include deafness, intellectual impairment, and myopia.

Name	Gene	Comments
craniofacial-deafness-hand syndrome. (AD). MIM 122880.	***PAX3, CDHS, WS1, HUP2*** at 2q35	Flat face, hypoplastic nose, deafness, ulnar deviation of hands, and hypertelorism.
deafness, aminoglycoside- induced. (Mito)	***12SrRNA, MTRNR1*** at 648-1601	Affects mitochondrial RNA.
deafness. (Mito)	***TRNA $^{Ser(UCN)}$*** at 17pter-p12	Another gene is at 17p13.1. Many genes map in this vicinity.
deafness-diabetes syndrome. MIM 590050.	***MTTL1*** at 3230-3304	Gene is for leucine. See **MELAS** syndrome. (MIM 540000).
deafness and achondrodysplasia. (S, AD, AR). MIM 134934.	One gene may be ***FGFR3*** at 4p16.3	See achondrodysplasia. (MIM 134934). See also Wolff-Hirschhorn syndrome. (MIM 194190, 602952).
deafness, diabetes mellitus, diabetes insipidus, and optic atrophy. (AR, Mito)	***WFS1*** at 4p16.1	See the Wolfram or DIDMOAD syndrome. (MIM 222300, 598500).
deafness with otosclerosis. (AD). MIM 166800	***OTS*** at 15q26.1-qter	This kind of conductive hearing loss affects about 0.5% of white adults as they age.

Deafness, (AD), non-syndromic, sensorineural, depends on mutations in the genes listed below. Gap junction genes, and some connexin genes (there are at least nine) have a major role in deafness. See also diabetes.

progressive low tone deafness	***DFNA1, LFHL1*** at 5q31	
non-syndromic progressive deafness.	***DFNA2*** at 1p32	
deafness	***DFNA3, CX26*** at 13q11-q12	See ***DFNB1.*** See ***GJB2***. (MIM 121011).
deafness	***DFNA4*** at 19q13	Deafness onset in their second decade.
high tone neural deafness.	***DFNA5*** at 7p15	
low frequency progressive deafness	***DFNA6*** at 4p16.3.	
high frequency progressive deafness.	***DFNA7*** at 1q21-q24	

defect in alpha tectorin.	***DFNA 8/12*** at 11q22-q24	See ***DFNB21***. (MIM 602574). See also ***DFNA12.***
sensorineural deafness non-syndromic	***DFNA9*** at 14q12-q13	
sensorineural deafness, non-syndromic.	***DFNA10*** at 6q22.2-q23.3	
neurosens ory deafness	***DFNA11, MYO7A*** at 11q13.5	.See ***USH1B.*** (MIM 276903).
mid-frequency hearing loss.	***DFNA12*** at 11q22-q24	See also ***DFNA8***.
non-syndromic deafness.	***DFNA13*** at 6p21.3	
non-syndromic deafness	***DFNA15, POU4F3, BRN3C*** at 5q31.	
deafness	***DFNA17***	See ***MYH9***. (MIM 160775).
deafness	***DFNA24*** at 4q35-qter	
Deafness, (AR). Probably 80% of non-syndromic deafness is due to an AR mutation. Some examples are mutations in the following genes. Mutations in the myosin gene ***MYO7A*** at 11q13.5 cause non-syndromic AR deafness ***DFNB2,*** and Usher syndrome ***USH1B.*** For infantile Bartter syndrome with deafness (AR) the gene ***BSND*** is at 1p31. (MIM 602552). An infancy-onset progressive sensorineural hearing loss with ataxia and mental retardation depends on the gene ***ADR***, (MIM 208850). Red hair may be linked. Compare with Richards-Rundle syndrome. (MIM 245100).		
deafness	***DFNB1, CX26*** at 13q11-q12	See ***DFNA3.*** See ***GJB2***.
deafness	***DFNB2, MYO7A*** at 11q13.5	See ***USH1B. (***MIM 276903).
deafness	***DFNB3, MYO15*** at 17p11.2	A major cause of hereditary hearing loss.
Pendred syndrome with goitre	***DFNB4, PDS*** at 7q31	See also ***DFNB17.***
neurosensory deafness	***DFNB5*** at 14q12	
neurosensory deafness	***DFNB6*** at 3p21-p14	
deafness	***DFNB7*** at 9q13-q21	See also ***DFNB11***.
deafness	***DFNB8*** at 21q22.3	Deafness onset in childhood, progressive. Gene is ***TMPRSS3***.
neurosensory deafness	***DFNB9*** at 2p23-p22	
deafness	***DFNB10*** at 21q22.3	Gene is ***TMPRSS3***. See ***DFNB8.***
deafness	***DFNB11***	Gene is ***TMEM2***. See ***DFNB7.***
congenital deafness	***DFNB12*** at 10q21-q22	See ***USH1D.*** (MIM 601067, 601386).
deafness	***DFNB17*** at 7q31	See ***DFNB4.***
deafness	***DFNB18*** at 11p14-p15.1.	See ***USH1C.*** (MIM 276904).
deafness	***DFNB21*** at 11q23-q25	Gene is tecta. (MIM 602574)
Deafness (XL) depends on mutations in the following genes.		
progressive deafness MIM 304700	***DFN1, DDP*** at Xq22.	Mutation in the diaphanous gene See Jensen syndrome with dementia. (MIM 311150).
congenital, perceptive deafness MIM 304500	***DFN2*** at Xq22	
progressive conductive deafness. MIM 304400	.***DFN3*** at Xq21.1	With stapes fixation, obesity, and choroideremia.
congenital sensorineural deafness MIM 300030	***DFN4*** at Xp21.2	May have RP and mental retardation.
sensorineural deafness MIM 300066	***DFN6*** at Xp22	

Name	Gene	Comments
de Barsy progeria.		See progeria.
debrisoquine sensitivity.		See Parkinson disease.
Degos malignant papulosis MIM 132800, 602248.	Gene is probably at 9q31.	Skin papules, gastrointestinal bleeding, and CNS infarctions. Mostly occurs in young adults.
DeGrouchy syndrome. (C). MIM 600624	***CORD1*** at 18q21.1-q21.3, ***CORD2*** at 19q13.1-q13.2, ***CRX*** at 19q13.3	Partial deletion causes dwarfism, hypertrophic neuropathy, deafness, heart disease, microcephaly, fish mouth, corneal opacities, and retinal dystrophy. Have an IQ about 50. May have hypertelorism, nystagmus, strabismus, glaucoma, optic atrophy, and myopia. See also ***F7R*** at 8p23.3-p23.1.
Déjérine-Roussy syndrome	Gene	A posterior thalamic syndrome with sensory disturbance, contralateral hemiplegia, pain, hemianopia, and may have unilateral blepharospasm. See Déjérine-Sottas syndrome (AD, AR) ***HMSN3*** (MIM 145900).
Déjérine-Sottas syndrome. (AD, AR). MIM 145900, 159440, 601097	***MPZ, CMT1B*** at 1q21.1-q23.3, ***PMP22, CMT1A*** at 17p11.2-p12	A demyelinating disease. Olivopontocerebellar atrophy-II, progressive hypertrophic neuritis, Fickler-Winkler cerebello-parenchymal disorder, onset about age 50 of ataxia, albinism, dysarthria, and head tremor. **HMSN-III.** Some are wheel-chair bound. Compare with the Charcot-Marie-Tooth diseases..

Delleman-Oorthuys syndrome (AD, S). MIM 164180	***OCCS***	An oculo-cerebro-cutaneous syndrome, cerebral malformations, agenesis of the corpus callosum, epilepsy, skin appendages, microphthalmia, orbital cyst, and may lack some orbital structures, often unilateral congenital anophthalmia. Note the overlap with Goldenhar syndrome. (MIM 164210) and Goltz syndrome (MIM 305600).
dementia, familial		See the mental retardation syndromes.
dementia, frontotemporal with parkinsonism.		See the Alzheimer diseases.
De Morsier syndrome MIM 182230	May depend on a mutation in ***HESX1*** at 3p21.2-p21.1. (MIM 602674) May not be Mendelian.	Septooptic dysplasia, growth hormone deficiency, abnormal corpus callosum, absent septum pellucidum, and hypoplastic optic discs.
dentatorubro-pallidoluysian atrophy. (AD)	***DRPLA*** at 12pter-p12	Myoclonus epilepsy with CAG repeats, choreoathetosis, dementia, ataxia, and death in the 40s. See the atrophies and ataxias.
dentinogenesis imperfecta-1. (AD)	***DGI1*** at 4q13-q21	Opalescent teeth.
Denys-Drash syndrome.		See Wilms tumor. (MIM 194080).
dermatitis, atopic (AD). MIM 147050	***IGER*** may be at 11q12-q13.	Besnier prurigo, elevated IgE, intense itching, eczema, asthma, hay-fever, keratoconjunctivitis, keratoconus, keratitis, corneal scars, and can have retinal detachment.
dermatoarthritis syndrome . (AD). MIM 142730	***FHD***	Familial histocytic syndrome onset in childhood with nodules on the skin, muscle weakness, glaucoma, uveitis, and cataract. Compare with François dermo-chondro-corneal dystrophy. (MIM 221800) and histiocytic dermatoarthritis (AD) (MIM 142730) and (MIM 186580).
Desmons syndrome resembles the (AR) KID syndrome. (MIM 242150).		
Deutman dystrophy. (MIM 169150). Several retinal degenerations may be related, see the fish-net, maculoreticular, and butterfly types. See especially ***RP7.*** (MIM 179605).		

Diabetes mellitus and **Diabetes insipidus.** Mutations that can affect glucose metabolism have been reported in more than three dozen genes including genes at 2q31, 3q21-q24, 4p15-q12, 9q21, and 22q12-q13 and in genes on chromosomes 7p, 15q, and 18q. Diabetes (Wills disease) often develops in those who are overweight.

Genes that regulate insulin expression and are potentially involved in susceptibility to diabetes are: ***LMX1*** at 1q22 (MIM 600298), ***CDX3*** at 13q12.3 (MIM 600297), and ***ISL1*** on chromosome 5q (MIM 600366) Mutations in ***PAX6*** at 11p13 (AD) can cause glucose intolerance and lead to diabetes. Mutations in a gene cluster at 19q13.2 cause insulin resistance. Mutation in one gene (MIM 147320) can be inherited in the AD manner and can increase the number of insulin receptors.

In a syndrome described by C. Carpenter the signs are hypothyroidism, adrenocortical insufficiency, and diabetes mellitus. Some of those with the Loken-Senior or Senior-Loken syndrome (AR) (gene ***NPHP1*** at 2q13) have diabetes insipidus. Tropical diabetes **TPD** is secondary to pancreatitis. They may have chorioretinitis, retinopathy, hemorrhages, and decreased acuity. Those with Vesell syndrome (possibly AD) have diabetes, deafness, and strabismus. Gene ***SYM1*** may be at 17q21-q22. (MIM 185800). See also Anderson-Fabry disease (XL), (MIM 301500).

Pancreatic insufficiency occurs in Johanson-Blizzard syndrome (AR). JBS patients have diabetes, mental retardation and deafness, (MIM 243800), in pancreatic agenesis, and in Shwachman-Diamond syndrome (AR) ***SDS*** at 7q11. (MIM 260400), and in various enzyme deficiencies.

See also the glycogen storage diseases. After some years of diabetes a few patients develop Kimmelstiel-Wilson syndrome with hypertension, arteriosclerosis, edema, nephrosis, hyaline degeneration of renal arterioles, glomerulosclerosis, and retinal and choroidal lesions including hemorrhages, exudates, and neovascularization.

Type 1 or insulin-dependent diabetes ***IDDM*** affects 2/1000, and the average age of onset is 11 years. In this genetically complex disease they have autoimmune destruction of the insulin-secreting cells in the pancreas.

Concentric annular macular dystrophy with dyschromatopsia is relatively benign.

The following genes can be involved in macular degeneratkion: ***IDDM1*** at 6p21.1, ***IDDM2*** at 11p15, and a gene at 16q22-q24. Some evidence supports the role of other genes: ***IDDM7*** at 2q31, possibly ***IDDM8*** at 6q27, ***IDDM10*** at 10p11, ***IDDM12***, ***IDDM13***, ***IDDM15*** at 6q21, and a gene at 1q42. If your monozygotic twin has type 1 diabetes your risk is 25% but if your dizygotic twin has type 1 diabetes your risk is only 5%.

Type 2 diabetes, non-insulin-dependent, affects 48/1000, average age of onset is 58 years. ***NIDDM*** affects more than 100 million people. They may secrete insufficient insulin, have insulin resistance, other metabolic defects, and elevated hepatic glucose production.

Gene	How inherited	MIM number	Description
Gene at 11q13	Mito	136560	Susceptibility to type 1 diabetes (IDDM). A fragile site mutation.
ART1 or ***ART2*** at 11p15.5.	AR	601625 125852	Susceptibility to type 1 diabetes. Formerly called ***RT6***.
IDDMX at Xp21-p11	XL	300136	Susceptibility to type 1 diabetes (IDDM). .
INS at 11p15.1 to 11p15.5	AD	176730	Insulin. Hyperproinsulinemia and hyperinsulinemia are possible. Alcoholism reduces insulin production.
INSR, IRR at 19p13.3	AD	147670	Insulin receptor gene. A mutation causes insulin-resistant diabetes, type A, acanthosis nigricans, and Rabson-Mendenhall syndrome.(AR) (MIM 262190)
AIR at 1p31 or at 4q32.1 or at 10p15.3		601676	For the acute phase of the insulin response. (The leptin receptor ***LEPR*** also maps to 1p31. (MIM 601007).
IPF1, PDX1 at 13q12.1	AR	260370 600733	An insulin promoter gene. Another gene may be at 6q24.. Compare with MODY IV.
Gene. For the AR type see MIM 260370	AD or rarely AR	600001	Pancreatic hypoplasia, congenital, with diabetes mellitus, an atrial septal defect, and transposition of the great vessels, tetralogy of Fallot..
Gene	AR	600089	Agenesis of pancreatic beta cells with neonatal diabetes. NIDDM.. For absence of the pancreas see (MIM 260370) and for absence of the islets of Langerhans see (MIM 304790).
IDE at 10q23-q25	AD	146680	An insulin degrading enzyme.
ICA1 at 7p22	AR	147625	An islet-cell autoantigen.
GCG at 2q36-q37	AD	138030 138033	Glucagon counteracts insulin. Type 2 diabetes NIDDM. The glucagon receptor gene (AD) is ***GCGR*** at 17q25.
GYS2 at 12p12.2	AD	138571	Gene is for glycogen synthase-2. Patient is susceptible to type 2 diabetes. ***GYS1*** is at 19q13.3. (AD) (MIM 138570).
TNDM, DMTN at 6q22-q23	Imprinted gene. often AR.	601410	Transient neonatal diabetes affects about 1/500,000 newborns. They may have paternal uniparental isodisomy of chromosome 6. See the ***ZAC*** gene at 6q24-q25. (MIM 603044).
GAPD, G3PD at 12p13	AD	138400	Glyceraldehyde-3-dehydrogenase. CAG repeats. The pseudogene ***HGMB*** is at Xp21-p11.(XL) (MIM 307030).
hemochromatosis, bronze diabetes Gene on chromosome 6p.		231100 235200 602390	Neonatal, juvenile, and other types For neonataal hemochromatosis see MIM 231100. Compare with (AR) hemochromatosis. (MIM 235200). which mostly affects males. Type 2 hemochromatosis. (MIM 602390) is a more severe juvenile type affecting males and females with iron accumulation, hypogonadism, and heart failure. Type 2 is **not** on chromosome 6p.
congenital diabetes with fatal diarrhea	XL	304790	Susceptibility to type 1 diabetes IDDM. May lack islets of Langerhans.
diabetes with immune dysregulation	XR	300063	Susceptibility to diabetes and diarrhea.
transient neonatal diabetes ***TNDM*** at 6q22-q23	Often AR	601410	Susceptibility to type 2 diabetes.
insulin resistance type A	May be AR	243095	Resistance to an insulin-like growth factor.
leprechaunism. (AR)	AR	246200	Mutations in the gene for the insulin receptor cause insulin resistance. Most die before 2 years of age.
IDDM1 at 6p21.3	AR, AD	222100	Type 1 IDDM. Insulin dependent diabetes mellitus, juvenile-onset.
IDDM2 at 11p15.5	AR	125852	Type 1 IDDM. See also MODY-III. Gene may be at 12q22-qter, .(MIM 600496).
IDDM3 at 15q25	AR	600318	Type 1 IDDM.
IDDM4 at 11q13	AR	600319	Type 1 IDDM.
IDDM5 at 6q24-q27	AR	600320	Type 1 IDDM.
IDDM6 at 18q21	AR	601941	Type 1 IDDM.
IDDM7 at 2q32	AR	600321	Type 1 IDDM.
IDDM8 at 6q25-q27	AR	600883	Type 1 IDDM.
IDDM10 at 10p11-q11	AR	601942	Type 1 IDDM.
IDDM11 at 14q24.3-q31.1	AR	601208	Type 1 IDDM.
IDDM12 at 2q33	AR	601388	Type 1 IDDM.
IDDM13 at 2q34	AR	601318	Type 1 IDDM. Gene may be at 2q33-q36.
IDDM15 at 6q21	AR	601666	Type 1 IDDM.
IDDM17 at 10q25		603266	Type 1 IDDM
WFS1 at 4p16.1	AR, S	222300	Wolfram or DIDMOAD syndrome. Have type 1 diabetes, with diabetes insipidus, deafness, optic atrophy, and degeneration of hypothalamus, pituitary, and adrenal glands.

Gene	S		Tunbridge-Paley disease includes juvenile type 1 diabetes, deafness, neurogenic bladder, ataxia, mental deficiency, epilepsy, ptosis, pigmentary retinopathy, and optic atrophy.. Some have epilepsy, ataxia, and other syndromes. Compare with Wolfram syndrome, gene on chromosome 4..
EIF2AK3 at 2p12	S, AR	226980	Wolcott-Rallison syndrome was called Mauriac syndrome, includes juvenile diabetes, type 1, epiphyseal dysplasia, dwarfism, hepatosplenomegaly, obesity, arteriosclerosis, hypertension, early-onset cataract, diabetic retinopathy with neovascularization, and optic neuritis. Was said to be at 15q11-q12.
GYS1 at 19q13.3	AD	138570	Susceptibility to type 2 diabetes mellitus, non-insulin dependent (NIDDM). See ***GYS2*** at 12p12.2. Other genes for type 2 diabetes may be on chromosomes 3q or 7p or at 11p13-p12 or at 15q13-q21 or at 20q12-q13.
IRS1 at 2q36	Often sporadic but can be AD	147545 600797 601283	Type 2 diabetes. NIDDM1. ***IRSI*** is for an insulin receptor substrate. The gene is for calpain 10. Insulin resistance is likely to be associated with obesity and atherosclerosis. ***IRS2*** mediates peripheral insulin action and B-cell survival. Disruption of ***IRS2*** causes diabetes in mice.
SLC2A1, GLUT1 at 1p35-p31.3	AD	138140	Type 2 diabetes. NIDDM. Non insulin dependent diabetes mellitus. Defective glucose transport. ***SLC6A9*** may be at 1p33. (MIM 176844).
SLC2A2, GLUT2 at 3q26.1-q26.3	AR	138160	Type 2 diabetes. NIDDM. Defective glucose transport. Often amplified in squamous cell lung cancer. Complete ***GLUT2*** deficiency causes Fanconi-Bickel syndrome. (AR). (MIM 227810).
SLC2A3, GLUT3 at 12p13.31.	AD	138170	This glucose transporter is especially active in the brain.
SLC2A4, GLUT4 at 17p13.	AD	138190	This carrier mediates postprandial and exercise-related insulin uptake. It may not be associated with IDDM.
SLC2A5, GLUT5 at 1p36.2.		138230	A fructose transporter especially in the kidney.
GLUT6 at 5q34-q35.		138170	***GLUT6*** is a sugar transporter in the brain and in leukocytes. This pseudogene is also symbolized as ***SLC2A3P*** or ***SLC2A3, GLUT3*** or as ***GLUT3P1***, and was called ***GLUT9.***
GLUT7			Is a fructose transporter.
GLUT8			Is a glucose transporter in brain, muscle, and testis,
GLUT9			Is a fructose transporter in liver and kidney.
GLUT10 at 20q12-q13.1			A glucose transporter in type 2 diabetes.
GLUT11			Is a fructose transporter in the heart and in skeletal muscle.
GLUT12			See also ***HMIT1*** a myo-inositol transporter.
SLC16A10 at 6q21-q22			Transports aromatic amino acids.
NIDDM 2 on chromosome 12q	AD	125853 142410	Polygenic type 2 diabetes depends on 2 or more genes.. An insulin secretion defect. See MIM 601407. For late-onset diabetes gene ***HNFA4*** see MIM 600281. See MODY-III at 12q22-qter.
GPD2 at 2q24.1	Mito	138430	NIDDM, type 2 diabetes.
MTTL1 at 3230-3304	Mito	590050 520000	NIDDM with deafness. Maternally transmitted.
CLBS at 11q13	AR	269700	Berardinelli-Seip syndrome with lipodystrophy, insulin-resistant diabetes mellitus, cardiac hypertrophy, hypertension, and acanthosis nigricans.
MODY-1 at 20q12-q13.1	AD	125850	Maturity-onset diabetes of the young. MODY-I with NIDDM. Compare with ***HNF4A*** (MIM 600281)..
GCK at 7p15-p13	AD	125851	Glucokinase mutations. MODY-II with NIDDM, type 2 diabetes of the young.
TCF1 at 12q22-qter or at 12q24.2	AD	600496 142410	MODY-III with NIDDM. Onset after age 25. Transcription factor 1. ***HNFI*** alpha. .
IPF1 at 13q12.1		600733	MODY-IV with NIDDM. See ***PDX1.*** A master control MIM 245349.
TCF2 at 17cen-q21.3	AD	189907	MODY-V with NIDDM. Transcription factor 2. ***HNF1*** beta is at 12q22-qter, (MIM 142410).
			MODY VI. Neurod 1.
			MODY-VII
Rh may be at 1p36.1-p34.3.	S, AR	268040	Retinohepato-endocrinologic syndrome. Affected females have elevated creatine phosphokinase, hypothyroidism, MODY diabetes, liver disease, progressive cone dystrophy, and defective color vision. Lose photopic function but retain scotopic function. See ***RHCE*** (MIM 111700). Those who are Rh positive have two Rh genes, while those who are Rh negative have only one.
ADHR, DIR, AVPR2, D11 at Xq28	XR or rarely AD	304800	Diabetes insipidus, nephrogenic type 1. Kidney tubules do not respond to antidiuretic hormone. Full expression in males but only partial expression in females.

AQP2 at 12q13	AR, AD	125800 107777	Gene product is aquaporin-2. Diabetes insipidus, nephrogenic type 2. Excrete much urine of low specific gravity, and are very thirsty.
Gene	AR, Mito	222000	Renal nephrogenic, vasopressin-resistant diabetes insipidus. Always thirsty. One gene may be at Xq28. See ***AQP2*** at 12q13. (MIM 107777).
AVP, AVRP, Vp at 20p13.	AD	125700 192340	Neurohypophyseal diabetes insipidus. Cranial type.
RAG1 at 11p13-p12	S, AR	179615	Hand-Schuller-Christian disease with diabetes insipidus, lipid histiocytosis of the bones, and immune deficiency.
HFE at 6p21.3-p12	AR, S, AD	235200	Hemochromatosis, bronze diabetes. A juvenile form also exists. About 20% have diabetes mellitus.
ALSS at 2p14-p13	AR	203800	Alström-Hallgren syndrome with diabetes, deafness, obesity, and retinitis pigmentosa but no mental defect, no polydactyly, and no hypogonadism.
INSR at 19p13.3	AR	147670	Insulin-resistant diabetes, acanthosis nigricans, deafness, mental retardation, hypogonadism, and retinitis pigmentosa. Compare with Edwards nephropathy syndrome. (MIM 104200, 250120).
Gene on chromosome 8.	AR	268020	Edwards *et al* syndrome, have diabetes mellitus, mental retardation, small testes, gynecomastia, deafness, cataracts, nystagmus, and retinitis pigmentosa. Compare with these syndromes: Alstrom (MIM 203800), Bardet-Biedl (MIM 209900), Laurence-Moon (MIM 245800), and Usher ***USH1A*** (MIM 276900).
Herrmann syndrome. Gene	AD	172500	Photomyoclonus, seizures, diabetes, progressive nerve deafness, nephropathy, cerebral dysfunction, ataxia, epilepsy, and horizontal nystagmus.
Gene	AR	241080	Hypogonadism with diabetes mellitus, alopecia, deafness, mental retardation, and electrocardiographic abnormalities.
Gene	AD	158500	Muscular atrophy with type 2 diabetes, ataxia, and retinitis pigmentosa.
vitiligo Gene	M, AD, AR	193200	Three alleles may be interacting to produce patchy skin depigmentation (halo nevi). May have an autoimmune basis, autoimmune thyroiditis. Some have diabetes and some are deaf. Depigmentation of lashes, iris, and retina. For halo nevi see MIM 234300.
Deletion from ***NRPN*** at 15q13, or from ***PWCR, PW*** at 15q11.2-q12.	C, AR, Mito	176270 241530	Royer syndrome is the Prader-Labhardt-Willi syndrome with diabetes. Compare with Angelman syndrome. ***UBE3A*** at 15q11.2-q13.
RPTPrho, PTPRT at 20q12-q13.1			A transmembrane receptor for tyrosine phosphatase is expressed in the CNS and may have a role in signal transduction.
CLBS at 11q13	AR	269700	Seip-Berardinelli syndrome see under diabetes.

Name	Gene	Comments
diaphragmatic hernia. (M, AR). MIM 142340	Gene	Exomphalos, absent corpus callosum, hypertelorism, and myopia.
Diamond-Blackfan anemia. (AD, AR). MIM 205900	***DBA*** at 19q13.2	Congenital hypoplastic anemia, musculoskeletal abnormalities, hypertelorism, microphthalmia, strabismus, and infantile glaucoma.
diastrophic dysplasia. (S, AR, C)	***DTD*** at 5q32-q33	Achondrodysgenesis. Some have trisomy 18.
DiGeorge third and fourth pharyngeal pouch syndrome. (S, AD). MIM 188400, 601754	***DGS1, DGCR*** at 22q11.2	Deletions from several adjacent genes cause a contiguous gene syndrome with hypoplasia of the thymus and parathyroids, immune deficiency, hypocalcemia, heart anomalies, deafness, seizures, and schizophrenia. Those with conotrunkal heart malformations (AR) often have deletions from ***CTHM*** at 22q11.2. (AR). (MIM 217095). One deletion can be from ***DGCR6*** at 22q11. (MIM 601279). See **CATCH 22** syndrome with deletions from ***UFDIL***. (MIM 601754).
DiGeorge velocardiofacial syndrome, complex-2. MIM 600594	***DGS2, DGCR2*** at 10p14-p13	A contiguous gene syndrome with deletions from several adjacent genes. Genes for other velocardiofacial syndromes are at 4q21.3-q25 and at 18q21.33.
distichiasis with congenital anomalies of heart and peripheral vasculature. (AD). MIM 126320	***FOXC2*** at 16q24.3	A venous disease of the legs, varicose veins, with bradycardia, congenital ventricular septal defect, lymphedema, ectropion, double rows of lashes, ptosis, and lack of Meibomian glands in the lids. (MIM 153400).
diverticulosis of bowel, hernia, and retinal detachment. (AR). MIM 223330	Gene	May also have diverticulosis of the bladder, esotropia, and severe myopia. See Meckel syndrome (AR) (MIM 249000). Perinatal death.
DK phocomelia		See MURCS syndrome (MIM 223340) .

dopamine beta hydroxylase deficiency (AR). MIM 223380	***DBH*** at 9q34	Lack of this enzyme interferes with the synthesis of norepinephrine and epinephrine from dopamine. Causes orthostatic hypotension, hypotonia, and ptosis.
Down syndrome, trisomy 21 (C, S, AR). MIM 190685	***DSCR*** at 21q22.3.	Have a deficiency of the mitochondrial heat shock protein, chaperonin 60 (Cpn60). This is the best known balanced translocation. It shares some features with Alzheimer syndrome. Effects become most apparent when the Down patient lives beyond age 40. Signs include mental retardation, simian palm creases, hypertelorism, up-slanting lid fissures, keratoconus, 50% have lens opacities, and 30% have myopia. Many have a high refractive error and often strabismus. Compare with Alzheimer diseases.
Down syndrome cell adhesion molecule MIM 602523.	***DSCAM*** at 21q22.2-q22.3	A member of the immunoglobulin superfamily.
Doyne honeycomb retinal degeneration. (AD). MIM 126600.	***DHRD, MLVT*** at 2p21-p16	Doyne honeycomb choroiditis with large soft radial drusen of Bruch membrane in childhood and early signs of senile macular degeneration. Gene for familial drusen is ***SIX3*** at 2p21-p16.
malattia Léventinese. (AD). MIM 126600	***EFEMP1*** at 2p21-p16 or rarely ***EF1A1*** at 6q14	May be the same as Doyne syndrome (MIM 126600). Small discrete drusen radiate into the retinal periphery and later drusen form in the macula. Mutations in ***EFEMP1*** account for some cases but other genes must be involved. ***EFEMP2*** is at 11q13. See Fraser syndrome. ***EF1A1*** is for an elongation factor. Gene ***EF1A2*** is at 20q13.3.
Drummond blue diaper syndrome. (AR). MIM 211000	Gene may also be X-linked.	Defective intestinal transport of tryptophan causes dwarfism, hypercalcemia, mental retardation, osteosclerosis, anorexia, nystagmus, abnormal eye movements, strabismus, microcornea, and optic atrophy.
drusen, familial, radial. (S, AD)	***SIX3*** at 2p21-p16	Drusen on Bruch membrane, macular edema, central scotoma. Compare with Doyne honeycomb choroiditis. (MIM 126600) and drusen of Bruch membrane (AD) (MIM 126700).
drusen with macular degeneration. (AD)	***MCDR1*** at 6q14-q16.2	North Carolina macular dystrophy. (MIM 136550).
Expansion of DNA trinucleotide repeats occurs in the following conditions: Curschmann-Steinert syndrome, ***FRAXA*** and ***FRAXE***, Friedreich ataxia, Huntington disease, Kennedy syndrome, spinocerebellar ataxia types I, II, VI, VII, VIII, and XII, and Taylor's oculopharyngeal muscular dystrophy		
Mutations in **DNA repair genes**. See Bloom syndrome, Cockayne syndromes, Rothmund-Thompson syndrome, trichothiodystrophy, Werner syndrome. and xeroderma pigmentosum (at least 7 genes).		
Duane syndrome. (AD). MIM 126800	***DUS*** at 8q13- q21.2 or ***DRRS***, ***SALLA*** at 20q13, or ***DURS1.*** Duane anomaly can accompany a cervico-oculo-acoustic syndrome, the cat eye syndrome, and some AD syndromes such as the acro-reno-ocular syndrome and the Okihiro syndrome.	Stilling-Turk-Duane retraction syndrome is bilateral in 20% of cases. Some have a translocation. See also ***CPAH***. Manifests in infancy, more frequent in females, they have fusion of C2 and C3, deafness, aberrant innervation affecting CNIII and CNVII, congenital ophthalmoplegia, convergence insufficiency, impaired ocular abduction, fibrosis of the lateral rectus, strabismus, and tend to produce crocodile tears. Adduction causes globe retraction and narrowing of the palpebral fissure. See the acro-reno-ocular (AD) (MIM 102490), Alzheimer, Klippel-Feil (MIM 148900, 274279), and MacDermot-Winter syndromes (MIM 247990), Okihiro syndrome (MIM 126800) can be part of the Duane syndrome. Peptidase genes include: peptidase A ***PEPA*** on chromosome 18 (MIM 169800), ***PEPB*** on chromosome 12q (MIM 169900), ***PEPC*** at at 1q42 or at 1q45 (MIM 170000), ***PEPE*** at 17q23-17qter (MIM 170200), and ***PEPS*** at 4p11-q12 (MIM 170250). A peptidase gene on chromosome 8q13 can be disrupted by a balanced translocation. t(8;8)(q26;q13).
Dubin-Johnson syndrome (AD, AR). MIM 237500	***CMOAT*** at 10q24	Deletion causes hyperbilirubinemia-II, a conjugated type with hepatomegaly, jaundice, and nausea.
Dubowitz syndrome. (AR). MIM 223370	Gene	Growth hormone deficiency. Anorectal anomalies, eczema, sparse hair, microcephaly, some have mild mental retardation, growth retardation, hypoparathyroidism, characteristic face, hypertelorism, cataracts, strabismus, epicanthus, and ptosis. Higher rusk of malignant tumors.
Duchenne pseudohypertrophic muscular dystrophy. (XR)	***DMD*** at Xp21.2	Subject to vertebral fractures. Compare with the milder Becker dystrophy. (MIM 310000).
duck-bill lips and ptosis (AD). MIM 126830	Gene	Anomalies of the face and fingers, low-set ears, as well as hypertelorism, strabismus, and ptosis. Some with this syndrome have a patent ductus arteriosus. (AD). (MIM 169100). See Char syndrome. (AD) (MIM 126830).
Duffy blood group. (AD)	***FY, GPD*** at 1q22-q23.	Or at 1p22.1.

dwarfism, achondroplasia (S, AD, AR). MIM 100800	***ACH, PGFR3*** at 4p16.3.	Robinow-Silverman-Smith or Parrot syndrome, is a type of dwarfism with a large head. Compare with the growth hormone deficiencies.
dysautonomia, familial. (AR). MIM 223900	***GYS, DYS*** at 9q31-q33	Deficiency of the enzyme beta hydroxylase interferes with the synthesis of norepinephrine and epinephrine from dopamine. Have Riley-Day syndrome, **HSAN-III**, sensory autonomic neuropathy, defective copper metabolism, recurrent respiratory infections, insensitivity to pain, hypotension, dry eyes, corneal anesthesia, keratitis, corneal ulcers, optic atrophy, one sign is a Kayser-Fleischer ring in the peripheral cornea.
dysferlin. (AR)	***DYSF, LGMD2B*** at 2p13.3-p13.1	See the numerous limb girdle muscular dystrophies.
dyskeratosis congenita (XL). MIM 305000	***DKC1*** at Xq28	Zinser-Cole-Engman syndrome, most get cataracts, and lacrimal duct obstruction. There are also AD and AR subtypes.
dyslexia susceptibility. MIM 600036	Gene may be ***EMA47*** or ***OTX1*** at 3p12-p15 .	Other genes for susceptibility may be ***DYX3*** and a gene at 2p12-p16. ***OTX1*** may be at 2p13. See also ***DYX3*** for susceptibility. See also a gene at 2p12-p16..
dyslexia. (S, AD) MIM 127700, 600202, 185070.	***DYX1*** at 15q21, ***DYX2*** at 6p21.3-p23, ***DYX3*** on chromosome 1p or on chromosome 2.	Some with reading and spelling difficulty have a mutation in ***DYX2.*** Other genes for dyslexia may be at 6p21.3-p22 or at 6q11.2-q12 or at 18p11.2. One AD gene is on chromosome 3 and others are on chromosomes 1, 2, and 15. A mutation in ***SPCH1*** at 7q31 causes language impairment. See also ***SLI*** on chromosome 7q. A gene for phonologic awareness is at 6p22-p21.
dysmorphic syndrome. (AR)	***GATA136AO4*** at 14q13-q21	Cranial abnormalities, open calvarial sutures, hyperpigmentation, hypertelorism with a broad prominent nose, hypertelorism, and sutural cataracts. Compare with Hirschsprung disease. (MIM 235760, 600837).
a learning gene MIM 123810	***CREB1*** at 2q32.3-q34	This gene needs the help of a binding gene ***CREBBP*** at 16p13.3-p13.2. See ***ADHD*** (MIM 143465) for attention-deficit hyperactivity disorder. A gene for susceptibility to this condition is on chromosome 6.
dystonia, torsion dystonia. (AD, XL). MIM 128100	***DYT1*** at 9q34.	Many subtypes of dystonia have been reported. Some have a GAG deletion. Dystonias produce sustained muscle contraction and movement disorders. Some neonatal dystonias improve over time.
(AR). MIM 224500	***DYT2***	May be allelic with ***DYT1.*** Eldridge syndrome, dystonia musculorum deformans-2 includes cochlear deafness, myopia, and intellectual impairment. Some have superior intelligence.
(XL). MIM 314250	***DYT3*** at Xq13.1	Filipino type dystonia with deafness and parkinsonism.
(AD). MIM 128101	***DYT4*** on chromosome 9q .	Musculorum deformans dystonia, torticollis, with speech loss. Symptoms begin at age 13 to 37 years.
(AD). MIM 128230	***DYT5*** at 14q22.1-q22.2.	Segawa syndrome (AR, AD) is DOPA responsive. For ***GCH1*** (AR) at 14q22.1-q22.2, see MIM 600225.
dystonia. (AD) MIM 602629	***DYT6*** at 8p21-q22	Adult-onset mixed dystonia. See also oromandibular dystonia.
(AD). MIM 602124	***DYT7*** on chromosome 18p..	Adult-onset focal dystonia, AFITD, with torticollis, head tremor. Age of onset can be between 28 and 70 years.
(AR). MIM 118800.	***DYT8*** at 2q33-q35..	When mutated causes paroxysmal nonkinesigenic dystonia. **PNKD..**
(AD). MIM 601042	***DYT9*** at 1p21-p13.3, ***PNDK*** at 2q35-q33	Causes choreoathetosis, spasticity, which is paroxysmal episodic. **CSE**
(AD). MIM 128200	***DYT10***	Causes familial paroxysmal dystonia. **PKC**
(AD). MIM 159900	***DYT11***	Hereditary essential myoclonus is alcohol responsive.
(XL)	***DYT12*** at Xq31	A rapid onset dystonia with parkinsonism. Filipino type.
(AD)	***DYT13*** at 1p36.13-p36.32.	Mixed dystonia.
(XL). MIM 300052	***DRP2*** at Xq22.	Dystonia, sensorineural deafness, and mental retardation.
dystrophia myotonica-protein kinase. (AD). MIM 160900	***DMPK, DMK*** at 19p13.2 or at 19p13.2-cen	Curschmann-Steinert syndrome. Onset about age 20. Have myotonic dystrophy with CTG repeats, muscular atrophy, speech disturbances, myotonic cataract, reduced corneal sensitivity, chorioretinitis, and ocular hypotony. See ***DMAHP*** (MIM 600963).

Dystrophy means hereditary degeneration. Some examples are : Deutman butterfly or patterned dystrophy (AD), (MIM 169150), fundus pulverulentus (AD) gene may be ***RP7, RDS*** (MIM 179605) in the gene on chromosome 6 at least 43 variants have been found, macular dystrophy of the Mesker type (AR), (MIM 179605), and reticular dystrophy of the Sjögren type (MIM 267800). See also the corneal dystrophies.

E.		
Eales' disease. (AD). MIM 176100	Gene may be ***PCT*** at 1p34 .	Young adult males with Eales' have periphlebitis, infarctions, encephalitis, peripheral retinal non-perfusion, neovascularization, and later develop retinal detachment. May relate to *Mycobacterium tuberculosis* infection. Compare with porphyria cutanea tarda types 1 and 2. (MIM 176100, 176090).
Ebstein anomaly (AR) MIM 224700	Gene may be on chromosome 11q.	Pulmonary atresia, tricuspid regurgitation, tachycardia, atrial fibrillation, and artial septal defect.
KID syndrome ectodermal defect, (AD). MIM 148210	***GJB2*** (Cx26) at 13q11-q12.	Congenital ectodermal dysplasia (rather than a true ichthyosis) with deafness, keratoderma, alopecia, hyperkeratosis of palms and soles, keratitis, and progressive corneal opacification. No hepatic disease, no mental retardation. The gap junction or connexin genes are important causes of deafness. See also the Senter syndrome.(AD). (MIM 148210).
KID syndrome (AR). MIM 242150	Gene	Ichthyosiform erythroderma with deafness, hepatomegaly, mental retardation, and corneal involvement (keratitis). Compare with Desmons syndrome. (MIM 242150).
ectodermal dysplasia, anhidrotic. (AR). MIM 224900	***HED*** at 13q11-q12.1	With hyperthermia, hypodontia, deafness and scanty eyebrows. More than 17 types are known and over 150 subtypes. See particularly these syndromes Clouston, EEC, Hay-Wells, and Rapp-Hodgkins. See also MIM 305100. Note the use of the symbol ***HED*** (MIM 224900) for an XL type and for an AR type. See ***EDA***.
ectodermal dysplasia, hypohidrotic or anhidrotic. (XL). MIM 305100	***EDA*** at Xq13-q21 or ***OXLHED*** at Xq12-q13.1 or a translocation t(X;1)(q13.1;p36.3)	Christ-Siemens-Touraine syndrome. See ***CST*** Most of the affected are male, with mental retardation, dry skin, few sweat glands, loss of eyebrows, dry eyes, corneal ulcers, cataracts, pupillary abnormalities, and up-slanting lid fissures. Comparre with: MIM 224900, and Siemens syndrome at Xp22.2-p21.2 (MIM 308800), and ***ED1*** (MIM 305100), and ***DXYS1*** at Xq13-q21, (MIM 302800).
ectodermal dysplasia. anhidrotic. (XL). MIM 305100.	***ED1*** at Xq12.2-q13.1. One gene maps to Xp22.2-p21.2.	Siemens syndrome signs are mental retardation, dry skin, absent teeth, hypertrichosis, madarosis, dry eyes, blepharitis, keratoconjunctivitis, corneal dystrophy, cataract, and myopia.
ectodermal dysplasia (AD). MIM 129500	***ED2*** at 13q11-q12	Clouston syndrome with nail dystrophy, alopecia, palmoplantar hyperkeratosis, mental retardation, and strabismus. See ***EDA.***
type-III, anhidrotic (AD)	One gene is ***ED3*** at 2q11-q13	Or hypohidrotic ectodermal dysplasia..
ectopia lentis. (S, AD, AR) MIM 134797, 225500, 129600, 225200	***FBN1, MFS1*** at 15q21.1	Gene product is fibrillin. Dislocated lens, bilateral cataracts. In one AR type the pupil may be displaced too, often in the opposite direction. See Marfan syndrome (MIM 154700) and other syndromes including Weill-Marchesani (MIM 277600) and homocystinuria (MIM 236200).
ectodermal dysplasia, anhidrotic (AD). MIM 129400	***RHS***	Rapp-Hodgkin anhidrotic ectodermal dysplasia with cleft palate/cleft lip, sparse dry hair, deficient sweat glands, dental anomalies, sparse eyebrows, pili canaliculi, and tear duct anomalies. See the Hay-Wells or AEC syndrome (MIM 129900,106260) and also MIM 106250, and see uncombable hair. (MIM 191480). For (AD) EEC the mutations can be in ***p63*** at 3q27. The ***p63*** family includes ***EEC, AEC***, and the ***ADULT*** (MIM 103285) syndromes as well as the limb-mammary (MIM 181450) and some split hand/foot syndromes.
ectodermal dysplasia, hypohidrotic. (AD). MIM 161000	***NFJ*** at 17q11.2-q21 or at 17q21.	Naegeli-Franceschetti-Jadassohn syndrome with absence of dermatoglyphics, hyperpigmentation, hypohidrosis, heat intolerance, palmoplantar keratoderma, and nail dystrophy. Soon lose their teeth.
ectodermal dysplasia hypohidrotic (XL), MIM 302800	***DXYS1, IGES*** at Xq13-q21	Also called a Christ-Siemens-Touraine syndrome. **CST, ED1.** See ***EDA*** or ***HED***. (MIM 224900, 305100,).
ectodermal dysplasia, hidrotic. (AR). MIM 264070	***PCBD, DCOH*** at 10q22	Hyperphenylalanemia with primapterinuria. See MIM 126090 for this dimerizatiohn cofactor.
ectopia lentis MIM 129600	Gene at 15q21.1	See fibrillin (MIM 134797)

propionic acidemia, type 1, (AR). MIM 232000, ***pccA***, 232050, ***pccB***, 253270, bio.	Three genes: ***pccA*** type I, ***pccB*** type II, ***MCD*** multiple carboxylase deficiency	Curtius syndrome with glycinemia, ocular malformations, hypertelorism, nystagmus, cataract, and tapetoretinal degeneration.
ectrodactyly, ectodermal dysplasia -cleft lip/palate. (AD). MIM 129900	***EEC*** may be at 7q21.3-q22.1.	More than 150 ectodermal dysplasias are known. Ectrodactyly, ectodermal dysplasia, clefting, limb anomalies, and lacrimal duct anomalies.
ectrodactyly-ectodermal dysplasia -clefting (EEC) syndrome. (AD, S). MIM 602077	***EEC1*** at 7q11.2-q21.3. Most have a mutation in ***p63*** at 3q27.	The Walker-Clodius syndrome with orofacial clefts, cleft lip, abnormalities of the urinary tract, dermatitis, nail hypoplasia, strabismus, corneal ulcers, absence of lacrimal puncta. The gene ***EEC2*** for ectrodactyly 2 with cleft lip/palate is on chromosome 19. Ectodermal dysplasia, clefting, and anomalies of the lacrimal ducts. See the AEC or Hay-Wells syndrome, gene ***p63*** at 3q27. The ***p63*** family includes EEC, AEC, the ADULT (MIM 103285) syndrome, the limb-mammary, ulnar-mammary or Schinzel syndrome (AD) (MIM 181450), gene ***TBX3*** (601621) with obesity, absent ulna, short radius, abnormal teeth, and ventricular septal defect, and the split hand/foot syndromes. Note the gene for the Noonan syndrome (MIM 163950) maps in the vicinity of ***TBX3*** on chromosome 12 (MIM 601621). The gene ***TBX5*** (MIM 601620) at 12q21.3-q22 (MIM 142900) is for the Holt-Oram syndrome and may cause Noonan syndrome (MIM 153950) and the ulnar-mammary syndrome ***UMS*** (MIM 181450).,
eczema, atopic dermatitis, (AD). MIM 147050.	***IGER*** on chromosome 11q	Besnier prurigo with elevated level of immunoglobulin E, eczema, asthma, hay fever, keratoconjunctivitis, keratitis, and cataract. With ***IGES*** at 5q31.1 (MIM 147061) they have high levels of IgE.
edema, chronic, hereditary lymphedema (AD). MIM 135352, 153100	***VEGFR3, FLT4*** at 5q33-qter	Nonne-Milroy-Meige disease, prevalent in females, can be present at birth or appear after age 35, can be unilateral. Mandibulofacial dysostosis with edema, lymphedema, edema of lids and conjunctiva, ptosis, strabismus, buphthalmos, and ectropion.. See also ***SOX18*** at 20q13 and ***FOXC2*** at 16q24.3.
edema, cystoid macular. (AD) MIM 153880	***CYMD*** at 7p21-p15.	Signs are macular edema with hyperopia.
Edwards syndrome (AR). MIM 256120	Gene	Trisomy 18, hyperparathyroidism, renal failure, and eyelid aanomalies. Compare with Apert syndrome. (MIM 101200).

Ehlers-Danlos syndromes are the most prevalent heritable disorders of connective tissue. Have defective collagen fibers. Most are inherited AD. The signs (present at birth) of the abnormal collagen synthesis are: elastic skin, bone disorders, lax joints, hernias, and fragile blood vessels including dissecting aortic aneurysms. May have thin blue scleras, ectopia lentis, iridodonesis, and loose conjunctiva. Anomalies of respiratory, gastrointestinal and genitourinary systems.

Other disorders of elastic tissues include Grönblad-Stromberg syndrome, pseudoxanthoma elasticum, and senile elastosis. An important substance is tenascin an extracellular matrix protein. (AR)

type I. (AD)	***COL5A1*** at 9q34.2-q34.3, ***COL5A2*** at 2q24.3-q31	Gravis.
type-II. (AD)	***COL5A2*** at 2q24.3-q31	Or at 2q14-q32.
type IIA. (AD)	***COL5A1*** at 9q34.2-q34.3	Mitis.
type IIB. (AD)		Granulomatous slack skin, cutaneous lymphomas.
type III. (AD)	***COL3A1*** at 2q32.2	Benign hypermobility but many have joint pain.
type IV. (AD, AR, XR)	Two AD, two AR, and one XR type. ***COL3A1*** at 2q32.2 for one AD and one AR type.	A Sack-Barabas variant of Ehlers-Danlos syndrome Mutation in collagen III gene.. Reduced serum level of procollagen-III aminopeptide. Arterial ecchymotic types with spontaneous ruptures of arteries or bowel.
type V. (XL). MIM 305200.	***EDSV, ED-V***	Rare, granulomatous slack skin. Their left ventricle shows a volume increase and they may have a floppy mitral valve.
type VI. (AR). MIM 225400, 229200	***PLOD*** at 1p36.3-p36.2	Mutation in the lysyl hydroxylase gene (MIM 153454) causes the ocular scoliotic type which may be called VIB. With their lysyl hydroxylase deficiency and abnormalities of the cornea some have glaucoma.
type VIIA . (AD). MIM 120150	***COL1A1*** at 17q21.31-q22.05	Mutation in type 1 collagenase genes causes arthrochalasis multiplex.
type VIIA2. (AD, rarely AR) MIM 120160	***COL1A2*** at 7q21.3-q22.1 or 7q22.1	Lysyl oxidase deficiency.

type VIIB. (AD). MIM 130060	***COL1A2*** at 7q21.3-q22.1 or at 1q22.1	Mutation in type 1 collagenase genes causes dermatosparaxis in which the skin tears easily.
type VIIC. (AR). MIM 225410	Gene is probably ***pNP1.***	Now called **EDS VII-B.** (MIM 130060). Have mutations in ***COL1A1*** or in ***COL1A2***. A procollagen N-proteinase deficiency causes periodontosis, skin fragility, dermatosparaxis, and a blue sclera.
type VIII. (AD)	***COL1A1*** or ***COL1A2***	Have periodontosis and prolonged bleeding time.
type IX . (XR). MIM 304150	***ATP7A*** at Xq13.3.	Decreased lysyl oxidase activity causes the occipital horn syndrome, XL cutis laxa. See Menkes disease. (MIM 300011, 309400)
type X .(AR)	***FNI*** at 2q34	Network forming.
Ehlers-Danlos-like syndrome. MIM 600261	***TNXA*** at 6p21.3.	Gene product is one of the tenascins. ***TNR*** is at 1q24. .***CYP21*** for adrenal hyperplasia (AR) is at 6p21.3.
Eldridge syndrome. (AR). MIM 221200	May have an enzyme deficiency.	Sensorineural hearing loss with severe myopia by 6 years of age, low intelligence, and mild renal disease, albuminuria or hematuria. Compare with ***DYT2*** at 9q32-q34. (MIM 224500)
Ellis-van Creveld syndrome (AR). MIM 225500	***EVC*** and ***EVCL*** both at 4p16. Some have a deletion from a gene at 12p11.22-p12.2.	Chondroectodermal dysplasia, short limbs, polydactyly of the hands but usually not of the feet, peculiar upper lip, nail dysplasia, a heart defect, esotropia, congenital cataract, and iris colobomas.
emphysema congenital (AD). MIM 130710	***CLE***	Early-onset lobar emphysema, bronchial cartilage hypoplasia, and hyper inflated lobe of the lung, respiratory distress in infancy.
emphysema. (AD)	***PI, AAT*** at 14q32.1.	Early-onset emphysema.
emphysema. (AD)	***A2M*** at 12p13.3-p12.3	Serum ***A2M*** deficiency causes chronic lung disease.
emphysema-cirrhosis syndrome (AR). MIM 210050	alpha-1-antitrypsin deficiency gene.	Berry aneurysms, portal hypertension, cirrhosis, pulmonary emphysema, cerebral calcification, and seizures. For familial, idiopathic, non-arteriosclerotic cerebral calcification the gene is **FINCC**. (AR) (MIM 213600).
encephalocele	Gene	Part of the brain or meninges herniate through a defect in the skull. Affects 1/7,500 newborn. Knobloch syndrome gene ***KNO*** at 21q22.3 (MIM 267750).
encephalocranio-cutaneous lipomatosis	Gene	Haberland syndrome. Unilateral hamartomata of scalp and outer globe of the eye, developmental delay, and mental retardation. See Dellman syndrome (AD) (MIM 164180).
encephalopathy. (AR). MIM 260565	***PEHO***	Produce too much nitric oxide and too little insulin-like growth factor ***IGF-1***.. Progressive neuronal loss in the cerebellum, hypotonia, brain atrophy, hypsarrhythmia, convulsions, profound mental retardation, edema, optic atrophy, and early death.
endoglin. (AD)	***ENG*** at 9q34.1	A membrane protein of the vascular endothelium. See Osler-Rendu-Weber syndromes.(MIM 187300, 600370, 601101).
endothelin-I. MIM 131240	***EDN1*** at 6p23-p24	Affects development of blood vessels. ***EDN2*** is at 1p34 and ***EDN3*** is at 20q13.2-q13.3.
endothelial dystrophy		See corneal dystrophy.
enhanced S-cone syndrome	***NR2E3, PNR*** at 15q23 or 15q22-q23.	Seems to regulate development of M and L cones from S cones. Mutation in this nuclear receptor gene causes early-onset night blindness.
enuresis-I. (AD)	***ENUR1*** at 13q13-q14.3	Nocturnal bed wetting-1.
enuresis-II. (AD)	***ENUR2*** at 12q13-q21.	Nocturnal bed wetting-2.
eosinophilia, familial. (AD)	***EOS*** at 5q31-q33	A cytokine gene cluster.
epiblepharon. (AD)..	Gene	Lower lid (MIM 131450) or upper lid (MIM 131460) can be affected. With lower lid epiblepharon tend to have more corneal astigmatism.
epicanthus. (AD, S)	***BPES1*** at 3q23	See also epicanthus inversus (AD, S). (MIM 110100).
epidermal growth factor. (AD).	***EGF*** at 4q25-q27	For the receptor, the gene ***EGFR*** is at 7p12.3-p12.1.
Epidermolysis. See also skin conditions.		
atrophic, bullous, benign MIM 113811	***COL17A1*** at 10q24.3	Collagen type 17.
bullosa inversa. (AR)	***LAMC1*** at 1q3	Controls development of eosinophils.
bullosa 2A. (AR)	***EBR2A*** at 1p31	Junctional, Herlitz epidermolysis. ***EBS1*** (AD) is at 8q24 (MIM 131950), and ***EBM*** (MIM 302000). Hallopeau-Siemens type (AR) gene ***COL7A1*** (MIM 120120).
bullosa dystrophica (AD, AR).(MIM 120120)	***COL7A1*** at 3p21.3	Hallopeau-Siemens type (AR). .***EBR1*** (MIM 226600) Compare with the pretibial variety.
bullosa, macular type (XL). (MIM 302000)	***EBM*** at Xq27.3-qter	Microcephaly, dwarfism, mental retardation, and hypogenitalism.

Weber-Cockayne bullosa of the hands and feet. (AD). MIM 148066, 148040	***KRT14*** at 17q12-q21, ***KRT5*** at 12q11-q13	Also called Dowling-Meara or Koebner epidermolysis simplex. Is a milder form of the Goldscheider epidermolysis bullosa syndrome. (AD, AR) in which the skin lesions may leave scars. In the AR type some are mentally retarded. May have conjunctivitis, keratitis, corneal ulcers, cataract, and retinal detachment.
junctional. (AR)	***LAMA3*** at 18q11.2, ***LAMB3*** at 1q32 ***LAMC2*** at 3p21.3-p21.2	These genes encode laminin 5. Mutation causes Herlitz lethal, blistering, epidermolysis.
bullous, junctional, lethalis (AR). MIM 226700	***LAMNB2, LAMB2T*** at 1q25-q31	Herlitz-Pearson epidermolysis. Genes may also be ***LAMA3*** (MIM 600805), ***LAMB3*** (MIM 150310), or ***LAMC2*** (MIM 150292).
bullous, junctional with pyloric atresia (AR).	***ITGB4*** at 17q11-qter, ***ITGB6*** at 2q24-q31.	This bullosa fetalis type causes death in infancy.
pretibial. (AD)	***COL7A1*** at 3p21.3	Bullosa dystrophica.
Ogna bullosa simplex (AD). MIM 131950	***EBS1*** at 8q24	See also ***EBM*** at Xq27.3-qter. (MIM 302000).
epidermolytic hyperkeratosis. (AD)	***KRT1*** at 12q11-q13, ***KRT10*** at 17q12-q21	Hyperkeratosis. For palmoplantar keratoderma the gene is ***KRT9*** at 17q21.1-q21.2.

Epilepsy of some type affects 17/10,000 people. At least 8 autosomal genes can be involved in epilepsy. Average age of onset is 4 years. Photic stimulation at 15 to 30 flashes per second can induce a seizure in susceptible individuals. (AD). Some of whom may be mentally retarded.

Susceptibility genes for epilepsy include genes for frontal lobe epilepsy (AD) on chromosomes 1q, 15q, and 20q. See also a gene for familial partial epilepsy (AD) with auditory features on chromosome 10q. Onset is between ages 8 and 19. A gene for familial partial epilepsy ***FPEVF*** (AD) maps to 22q11-q12. Another partial epilepsy depends on ***BFNC1*** and ***BFNC2*** on chromosome 22q. (MIM 121200). The gene ***BFIC*** (AD) for a benign epilepsy with centrotemporal spikes is on chromosome 15q.The onset is in the first year of life. (MIM 601764).

. Genes for epilepsy have also been mapped to chromosomes 1q, 20q, 21q, and 22q. See the ceroid lipofuscinoses and sialidosis-1. See spastic paraplegia with myoclonus epilepsy, (MIM 270805). See epilepsy with mental retardation (AD), (MIM 182610). Hypothalamic dysfunction causes a diencephalic syndrome in boys age 6 or 7 years. They have abdominal pain, headache, elevated blood pressure, seizures, proptosis, and excessive lacrimation.

Mutations in ***ARX*** at Xp11.2-p22.2 can cause myoclonic epilepsy. See also ***ISSX*** which causes infantile spasms. (MIM 308350). Lennox-Gastaut childhood epilepsy (onset age 3 to 8 years, more frequent in males), is a severe type with multiple seizure types, psychomotor delay, personality disorders, and encephalopathy. They can be helped with nitrazepam. Some use valproic acid several times a day. A mutation in ***ARX*** causes ***XMESID*** a form of X-linked epilepsy with spasticity and intellectual disability in boys. Probably allelic with ***ISSX***. West syndrome is inherited (XL), (MIM 308350) it too may depend on an ***ARX*** mutation. Progressive myoclonus epilepsy (mostly AR) causes muscular jerking, epilepsy, progressive neurologic deterioration, ataxia and dementia. Dentatorubral pallidoluysian atrophy is inherited AD. (MIM 270805).

The following syndromes can be associated with epilepsy: Angelman syndrome, deletion from ***UBE3A*** at 15q11-q31, Miller-Dieker liss encephaly, deletion from ***MDCR, LIS1*** at 17p13.3, Seemanova-I, Wolf-Hirschhorn syndrome, deletion from ***WHCR*** at 4p16.3, terminal deletions from chromosomes 1p and 1q, ring chromosomes 14 and 20, and the inversion duplication 15 syndrome.

Gene	How inherited	MIM number	Description
EBN1, BFNC1 at 20q13.2-q13.3	AD	121200 118504 602235	Convulsions-1, benign, neonatal, nocturnal, frontal lobe, familial. One gene may be ***KCNQ2***, a potassium channel gene. (MIM 602235). See also ***CHRNA4*** gene at 20q13.2-q13.3 (MIM 118504).
EBN2, BFNC2 at 8q24	AD	121201 602232	Benign, neonatal, familial convulsions-2. Idiopathic. See ***EG1*** at 8q24 and ***MEBA*** at 8q23.3-q24.1. (see below)
BFIC at 19q13.3	AD	601764	Benign, familial, infantile convulsions. Onset between 3 and 12 months of age, but cease before 3 years of age. See also ***PKD*** (MIM 173900).
ICCA at 16p12-q12	AD	602066	Infantile convulsions with choreoathetosis. See ***CLN3***. (MIM 204200).
a deletion from maternal ***UBE3A*** at 15q11.2-q13.		105830 601623	Angelman syndrome, happy puppet, infantile epilepsy includes mental retardation, ataxia, seizures, absence of speech, paroxysms of laughter, like to stick out their tongue, microcephaly, abnormalities of the retinal pigmented epithelium, pale irides with Brushfield spots, optic atrophy, and blindness.

EJM1, JME at 15q14, or at 6p21.2-p11 or at 6p11-p12 or 6p21.3	AR	254770 118511	Mutation here causes 5% to 10% of all epilepsies. Juvenile myoclonic is the most frequently inherited grand mal epilepsy. The gene for a receptor is ***GABABR1*** at 6p21.3. Petit mal epilepsy is AD but penetrance is reduced, see ***EBN1*** (AD) at 20q 13.2-q13.3 (MIM 121200).
EPT at 10q23.3-q24.1	AD	600512	Partial epilepsy but normal intelligence
DRPLA at 12pter-p12	AD	125370	Dentatorubral-pallidoluysian syndrome. Myoclonus epilepsy, ataxia, dementia, onset in the 20's and death in the 40's. See the atrophies and ataxias. See also the Haw River (**HRS**) (AD) syndrome with ataxia, seizures, and dementia. (MIM 140340).
EFMR at Xq22	XL	300088	Juberg-Hellman syndrome with epilepsy of the progressive Northern type, female restricted, with mental retardation.
EPMR at 8pter-p22	AR	600143	Progressive, Northern epilepsy, with mental retardation.
EGI at 8q24	AD	600669	Generalized idiopathic epilepsy. Note ***EBN2*** at 8q24 (MIM 121201), may be allelic.
SCN1B at 19q13.1-q13.2	AD	600235	Generalized epilepsy with febrile seizures. This sodium channel is voltage-gated.
MEBA at 8q23.3-q24.1	AD	601068	Have benign, adult, myoclonus epilepsy. Gene is for laforin. See ***BFIC.*** (MIM 601764).
M ELF, EPM2A at 6q24	AR, XR	254780	Lafora progressive myoclonus epilepsy, severe mental retardation, onset about age 15, congenital deafness, amaurosis, and early death. Unverricht-Lafora syndrome with epilepsy, seizures, myoclonus, and dementia.
EPM1, CSTB at 21q22.3	AR	254800 601145	Progressive myoclonus epilepsy of the Unverricht-Lundborg ty pe. This Baltic epilepsy has its onset about age 10 with mental retardation, seizures, convulsions, proximal limb myoclonus, mental deterioration, and later cerebellar ataxia. Gene ***CSTB*** is for cystatin B. Repeats of CCCGCCCGCG. Resembles Ramsay-Hunt syndrome. (MIM 159700).
EPM2A at 6q24	AR	254780	Progressive myoclonus epilepsy, onset about age 15, grand mal seizures, mental deterioration, and death within 10 years of onset of the disease.
MERRF	***MTTK*** or ***MTTL1***	545000 590060	The mitochondrial mutation is transmitted through the maternal lineage. Myoclonus epilepsy with ragged red fibers, ataxia, spasticity, and muscle weakness. See ***MTTK*** at 8295-8364, ***MTTL1*** at 3230-3304, and ***MELAS*** (MIM 540000) with lactic acidosis and stroke-like episodes.
Gene	AD, some AR	159600	Hartung myoclonic epilepsy, some have deafness. They have no Lafora bodies. For the AR type see (MIM 254780, 254800).
Gene Lennox-Gastaut epilepsy			Penfield autonomic epilepsy syndrome, a diencephalic syndrome occurs in boys age 6 or 7 years, abdominal pain, headache, rapid pulse, elevated blood pressure, seizures, excessive lacrimation, and pupillary abnormalities. Epilepsy.
autonomic epilepsy			
retinal degeneration with epilepsy.	AR	267740	Cyxtic macular degeneration, and nanophthalmia. See MIM 267760 with retinal degeneration, nanophthalmia, and macular degeneration.
nocturnal frontal lobe epilepsy.	AD	600513	Appears to depend on a mutation in the alpha-4 subunit of the nicotinic acetylcholine receptor. ***CHRNA4*** (MIM 118504).
Gene may be ***ISSX*** or ***ARX*** at Xp22.1-p21.3	XL	308350	West syndrome, infantile spasms affect 1/5000, onset at age 4 to 6 months, more common in males. Brain malformation, mental retardation, most die in their first decade.
RHS (Note ***RHS*** is also a symbol for Rapp-Hodgins disease.) ***CLN2*** at 11q15	AD? AR	159700 204500	Ramsay-Hunt peripheral facial nerve palsy caused by the varicella zoster virus, have a vesicular rash on the ear or in the mouth. May have tinnitus, deafness, myoclonus, ataxia, nausea, vertigo, and nystagmus. Geniculate neuralgia causes a dry eye. Need acyclovir. Similar to Unverricht-Lundborg myoclonus epilepsy. (MIM 254800). Some have a herpes simplex infection. Herpes simplex is the major cause of Bell's palsy, a facial palsy without a rash. Gene is for tripeptidyl peptidase-1. Jansky-Bielschowsky ceroid lipofuscinosis. Rapidly fatal neuronal atrophy but no optic atrophy. See the ceroid lipofuscinoses.
CLN4, ANCL	AR	204300	The designation Kufs disease has been used for an adult-onset ceroid lipofuscinosis with seizures and dementia. An AD pedigree has also been reported. See the ceroid lipofuscinoses and see the GM_2 gangliosidoses.
CLN5 at 13q31-q32	AR	256731	A Finnish lipofuscinosis variant has its onset age 4 to 7 years. They have myoclonus epilepsy and mental retardation. See the ceroid lipofuscinoses.
NES, CLN8, EPMR at 8pter-p22	AR	600143	Northern epilepsy has its onset in a child aged 5 to 10 years. It is a progressive epilepsy with mental retardation. See the ceroid lipofuscinoses.

FEB1 at 8q13-q21	AD	602476	Familial, febrile convulsions.
FEB2 at 19p13.3	AD	602477	Familial, febrile convulsions.
CHRNA4 at 15q24 or at 20q13.2	AD	600513	Autosomal dominant frontal lobe epilepsy with nocturnal attacks. Other genes may be at 118503, 118504, 118509 and 603204.

Name	Gene	Comments
epiphyseal dysplasia multiple-1. (AD).	***EDM1, PSACH*** at 19p13.1-p12	Pseudoachondroplasia with onset in childhood. Deafness, myopia, and retinal detachment.
multiple-2. (AD)	***COL9A2, EDM2*** at 1p33-p32.3	Have knee and ankle pain in childhood.
multiple-3. (AD)	***COL9A3*** at 20q13.3	Signs are stiffness in the knees and a waddling gait.
epiphyseal dysplasia, microcephaly, and nystagmus . (AR). MIM 226960	***LWS***	Lowry-Wood syndrome. Have short stature, microcephaly, epiphyseal dysplasia, and some have mild mental retardation, or retinitis pigmentosa or nystagmus.
Episkopi blindness. (XL). MIM 310600	***NDP*** at Xp11.3 or at Xp11.3-p11.2.	Microphthalmia, corneal opacity, iritis, cataract, Leber optic atrophy, and retinitis pigmentosa in males. **NOT** mentally retarded. See Norrie disease, ***NDP*** at Xp11.4-p11.3 which is similar.
epithelioma, squamous. (AD). MIM 132800	***MSSE*** at 9q31.	Ferguson-Smith type self healing squamous epithelioma. Former symbol was ***ESS1.***
Epstein nephrotic syndrome (AD). MIM 153650	***MYH9*** at 22q12.3-q13.2	Macrothrombocytopathy, nephritis, deafness, and prolonged bleeding time. Periorbital swelling, lid edema, and retinal edema. See the Fechtner (MIM 153640) and the Alport syndromes.
Erb-Goldflam syndrome	Gene	See myasthenia gravis. ***FIMG*** (MIM 254210), ***SYB2*** (MIM 185881), ***SYB1*** (MIM 185881)
Erdheim familial aortic dissection. (AD). MIM 132900	Gene	Erdheim-Gsell syndrome. Cystic medial necrosis of the aorta. May have a congenital bicuspid mitral valve. See also Erdheim-Chester syndrome.
erythremia. (AD)	***EPO*** at 7q21	Erythropoietin regulates red cell production. Mutation here causes anemia and osteomyelitis.
erythremia, alpha type. (AD).	***HBA1*** at 16p13.3- p13.11, ***HBB*** at 11p15.5.	Signs are jaundice and cyanosis.
erythroblastosis fetalis. (AD).	***RHD*** at 1p36.2-p34.	Hemolytic disease of the fetus.
erythrocytosis (AD)	***HBA2*** at 16pter-p13.3	Have unstable hemoglobin.
Erythroderma of the non-bullous ichthyosiform, **NBI** type. (AR)	***TGMI*** at 14q11.2.	Erythema and scaling. Some have retinitis pigmentosa.
esterase D (AR). MIM 133280.	***ESD*** at 13q14	Sixteen alleles have been reported.

The **hemoglobin anomalies** are inherited in the AD manner. ***HBA1*** is at 16p13,33 to 16p13.11. The alpha 2 locus ***HBA2*** has many variants. See also the delta locus ***HBD*** for beta defensins 1, 2, and 3.

Evans syndrome. (AR). MIM 601608	Gene. One patient had a deletion from 22q11.2.	Autoimmune pancytopenia with Coombs positive hemolytic anemia and immune thrombocytopenia. More likely to occur in women. Can have spastic paraplegia with SLE or with scleroderma. See the DiGeorge syndrome. (MIM 188400).

Excision repair complementary genes are: ***ERCC1 (UVO), ERCC2 (EM9), ERCC3 (XPD), ERCC4 (XFF), ERCC5 (XPG),*** and ***ERCC6 (CKN2).***

exostoses, multiple, of cartilage. (AD). MIM 133700, 133701, 600209	***EXT1*** at 8q24.11-q24.13 ***EXT2*** at 11p11-p12, ***EXT3*** on chromosome 19p, ***EXT4*** at 1p36.1	***EXTL1*** is at 1p36, ***EXTL2*** at 11p12-p11, and ***EXTL2P*** at 2q24-q31.
extraocular muscle fibrosis.		See ophthalmoplegia.
eyebrow whorl. (AD). MIM 133800	Gene	With deafness, proteinuria, hypertelorism, and myopia.
eyes absent, MIM 601655	***EYA3*** at 1p36	
eye color-1, (iris color) green-blue. MIM 227240	***EYCL1, GEY*** at 19p13.1-q13.11	See also brown hair color, ***BRHC, HCL3*** at 19p13.1-q13.11 The ***P*** gene for albinism 2 is at 15q11.2-q12. (MIM 203200).
eye color-3, (iris color), brown. MIM 227220	***EYCL3*** at 15q11-q15	See also hair color.

eyelid abnormalities (AD) MIM 110100	***BPES1*** at 3q23	With their eyelid problem and ptosis the affected females are infertile due to ovarian failure.
eyelid abnormalities MIM 601649	***BPES2*** may be on chromosome 7.	Normal fertility is possible.
F.		
Fabry disease or Anderson-Fabry disease (XR). MIM 301500	***GLA*** at Xq22	Ceramide hexosidase deficiency. Lipid storage disorder with lack of alpha-galactosidase A. Affects 5,000 people, they are unable to sweat. Angiokeratoma diffusum skin lesions, renal failure, pain in abdomen, angina, orthostatic hypotension, exercise intolerance, normal intelligence, and whorl-like, cream-colored, corneal epithelial opacities.
facial-digital-genital syndrome.		See Aarskog-Scott syndrome.(XL) (MIM 100050).
facial dysgenesis.	Deletion from 7p15.1-21.1.	Auditory canal atresia, cleft lip/palate, cryptophthalmia, or anophthalmia. Some have a deletion from the gene ***TWIST*** at 7p21.
facial hemiatrophy, syndrome. (AD?) MIM 141300	***HFA, PFH.*** Probably not mendelian.	Parry-Romberg syndrome is a neural crest migration disorder which begins in youth with epilepsy, atrophy of soft tissue on one side of the face, localized scleroderma, shrinkage of the eyeball and the orbital contents, enophthalmia, ptosis, EOM pareses, miosis, keratitis, heterochromia iridis, cataracts, and scleral melting.
facial paralysis, unilateral facial weakness.	Can be caused by a herpes infection.	Bell's palsy especially affects the facial nerve.
faciodigital syndrome. (XR, XD).	***CLS, RSKS*** at Xp22.2-p22.1.	Also called Coffin-Lowry syndrome. (MIM 303600).
facio-oculo-acoustico-renal, **FOAR** syndrome. (AR). MIM 227290	Gene	Have anomalies of the eyes, face, and kidneys with proteinuria. Most have telecanthus and are deaf, and many are retarded and myopic. Look for: iris colobomas, cataract, down-slanting lid fissures, and retinal detachment.
facio-scapulo-humeral muscular dystrophy syndrome-1A. (AR, AD)	***FSHMD1A, FSHD*** at 4q35.	Wasting of shoulder girdle, mental retardation, deafness, macular edema, retinal telangiectasia, onset at any age. See also ***FRG1*** which is near 4q35 and ***FSG1*** at 4q35.
familial adenomatous polyposis coli.		See under cancer.
familial dysautonomia (AR)		See Riley-Day syndrome, familial. ***HSAN-III***. (MIM 223900).
familial Mediterranean fever. (AR). MIM 249100	***MEFV, FMF*** at 16p13	Marenostrin. Recurrent polyserositis, arthritis, renal amyloidosis, abdominal pain, fever, headache, uveitis, and optic neuritis. May be asymptomatic but can be progressive and fatal.
familial periodic fever. (AD). MIM 142680	***FPF, FHF*** at 12p13.	Hibernian fever is usually benign but some have myalgia, abdominal pain, fever, and local skin lesions. Some have a mutation in ***TNFA*** at 6p21.3-p21.1 for a tumor necrosis factor.
periodic fever syndrome, (AR). MIM 260920	***HIDS*** at 12q24, ***MVK*** at 12q24.	Deficiency of mevalonate kinase MVK with Dutch periodic fever and hyperimmunoglobulin D. (AR). (MIM 251170).
periodic fever. (AD) periodic fever. (S)	***MWS/FCU*** at 1q44 ***PFAPA*** may be at 11p15.4-p15.1.	Arthralgia, skin rash, and amyloidosis. Occurs in a child under age 5 with aphthous stomatitis, pharyngitis, and cervical adenitis. In children under age 5 Marshall fever recurs every 6 weeks, their temperature reaches 40° C. Treat with prednisone.
periodic fever, **TRAPS**. (AD).	***TNFRSF1A*** at 12p13	With renal amyloidosis. A Mediterranean-like fever. Was called ***TNFRI*** for a tumor necrosis factor. TNFR=receptor-associated syndrome
Fanconi syndromes		See Fanconi renotubular syndromes under kidney (MIM 173890, 227650) and see also under anemia.(MIM 227646, 227659, 227660, 600901).
Farber lipogranulomatosis. (AR). MIM 228000	Gene	Ceramidase deficiency causes a lysosomal storage disorder with hepatosplenomegaly, a hoarse voice at 4 months of age, swollen joints, histiocytic infiltrates, lipogranulomatosis, fever attacks, and pigmentary changes in the retina. Type 1 have subcutaneous nodules, arthritis, laryngeal involvement and death by age 2. Those with type 2 and type 3 live longer. Type 4 hepatomegaly, macular cherry-red spots, death before age 6 months. Type 5 psychomotor deterioration begins in first or second year of the child's life.
favism (XL, AD). MIM 134700.	***G6PD1, G6PD*** at Xq28	Hemolytic anemia after ingesting fava beans.

FC fragment of IgG receptors. MIM 146760	***FCGR1A*** at 1q21.2-q21.3, ***FCGR2A*** at 1q23-q24, ***FCGR3A*** at 1q23, ***FCGR1B*** at 1p12, ***FCGR1C*** at 1q21, ***FRCGT*** at 19q13.3	The alpha receptor ***FCAR*** is at 19q13.4. The receptor for the FC fragment of IgE is at 19p13.3. The beta chain gene is at 11q13.
Fechtner syndrome (AD). MIM 153640	***MYH9*** at 22q12.3-q13.2, or ***FTNS*** at 22q11-q13	Resembles Alport syndrome but they have leukocyte inclusions and macrothrombocytopenia with nephritis, proteinuria, deafness, multiple ecchymoses, and congenital cataracts. Compare with these syndromes: Epstein (MIM 153650) and Sebastian (MIM 153640). ..
Felty syndrome (AD). MIM 134750	May depend on an allergy or infection. Associated with HLA-DRw4.	This collagen disorder is also called Chauffard-Still syndrome, have rheumatoid arthritis, splenomegaly, anemia, oral ulcers, keratoconjunctivitis, dry eyes, uveitis, scleritis, band keratopathy, and macular edema. Poor prognosis. Need splenectomy.
fetal alcohol syndrome (S). MIM 100650	***ALDH2, FAS*** at 12q24.2	Delayed physical and mental development, microcephaly, CNS dysfunction, cardiovascular defects, down-slanting lid fissures, ptosis, strabismus, corneal clouding, lens opacification, disorders of ocular motility, and myopia. See also alcohol intolerance.
fetal intrahepatic cholestasis. (AR). MIM 211600, 602397.	***PFIC1*** at 18q21	For benign recurrent cholestasis the gene ***BRIC*** is at 18q21. See also Alagille syndrome. (MIM 118450, 601920).
progressive familial cholestasis. (AR). MIM 601847	***PFIC2*** at 2q24	Was called Byler disease, see ***PFIC1*** at 18q21. Death in childhood. See ***BSEP*** (MIM 603201) for a bile salt export pump.
FG syndrome. (XL)	***FGS1*** at Xq12-q21.31	Mental retardation, hypotonia, large head, deafness, and constipation
fibrillin 1. MIM 134797	***FBN1*** at 15q21.1	See these syndromes: Barlow (MIM 104290) and Marfan .(MIM 154700).
fibrinogen. (AD)	***FGA, FGB***, and ***FGG*** are all at 4q31.	This plasma glycoprotein synthesized in the liver comes in alpha (FGA) (MIM 134820), beta (FGB) (MIM 134830), and gamma (FGG) (MIM 134850) polypeptide chains.
fibromatosis, gingival hereditary-1. (AD, AR)	***HGF1*** at 2p22-p21, ***HGF2*** at 5q13-q22	Some have a growth hormone deficiency, some have hypertrichosis and some are deaf. AR types (MIM 228560, 266270), and AD types (MIM 135500, 135400). See also ***GINGF*** at 2p21 (AD) (MIM 135300).
fibromatosis, juvenile hyaline (AR)	***JHF*** at 4q21	Hyaline accumulates in the dermis. Subcutaneous nodular tumors, gingival fibromatosis, and joint contractures.
Fibroblast growth factor genes include:		
MIM 131220	***FGF1*** at 5q31	For an endothelial growth factor. Acidic.
MIM 134920	***FGF2, FGFB*** at 4q25-q27	Basic.
MIM 164950	***FGFR3*** 4p16.3	Oncogene ***INT2.*** (MIM 164950).
MIM 164980	***FGF4*** at 11q13	Recombinant growth factor.
MIM 165190	***FGF5*** at 4q21	An oncogene.
MIM 134921	***FGF6*** at 12p13	An oncogene.
MIM 148180	***FGF7*** at 15q15-q21.1	Keratinocyte growth factor.
MIM 600483	***FGF8*** at 10q25-q28	Androgen-induced growth factor.
MIM 600921	***FGF9*** at 13q11-q12	Glia activating factor.
MIM 602115	***FGF10*** at 5p13-p12	Regulates development of brain, lung, and limbs.
MIM 601513	***FHF1*** or ***FGF12*** at 3q29-qter	Located in the nervous system.
MIM 300070	***FHF2*** or ***FGF13*** at Xq21	Nervous system development.
MIM 601514	***FRF3*** or ***FGF11*** at 17q21	Nervous system development.
MIM 601515	***FHF4*** or ***FGF14*** at 13q34	Nervous system development.
Fibroblast growth factor receptor genes include:		
MIM 136350	***FGFR1*** at 8p11.2-p11.1	Tyrosine kinase-II related.
MIM 176943	***FGFR2*** at 10q25.3-q26	Several syndromes. ***IGF2*** is reported to be at 4q25-q27.
MIM 134934	***FGFR3*** at 4p16.3	Fibroblast growth factor receptor. Many mutations
MIM 134935	***FGFR4*** at 5q35.1-qter	Fibroblast growth factor receptor.
	FGFR5 and ***FGFR6***	Recently identified.

fibrodysplasia ossificans progressiva (AD)	***BMP2*** or ***BMP2A*** at 20p12, ***BMP4*** at 14q22-q23	An anomaly of bone morphogenic protein.
Fickler-Winkler atrophy	***OPCA2*** at 12q23-q24.1	See olivopontocerebellar atrophy-II. (MIM 258300).
fish-eye disease, (AR). MIM 245900	***LCAT*** at 16q22.1	The lack of alpha-***LCAT*** causes a corneal opacity. Norum disease patients lack alpha and beta ***LCAT***. (MIM 245900).
Fisher or Miller-Fisher syndrome. MIM 104620	***ACY1*** at 3p21.1	Is a variant of Guillain-Barré syndrome (MIM 139393) with polyneuritis, ophthalmoplegia, ataxia, and areflexia. Have anti-***GQ1B*** antibodies.
Fleck retina syndromes, patients have multiple yellow-white fundus lesions of various sizes without vascular or optic nerve anomalies. Includes fundus albipunctatus (AD, AR), fundus flavimaculatus (AR), familial drusen (AD), fleck retina of Kandori (AR), and may also include Bietti crystalline dystrophy, Kjellin syndrome (AR), retinitis punctata albescens, as well as secondary flecks associated with metabolic disorders such as Alport's, cystinosis, oxalosis, proliferative glomerulonephritis, or vitamin A deficiency. A benign familial fleck retina (AR) with normal dark adaptation and no macular lesions and no night blindness has been described. (MIM 228980).		
floppy eyelid syndrome	Gene	Obesity, sleep aponea, some are mentally retarded, conjunctivitis, eyelids may evert during sleep, flexible upper tarsus, and keratoconus. With rheumatoid arthritis the cornea may perforate.
Flynn-Aird syndrome. (AD?). MIM 136300	Gene	Neuroectodermal condition with muscular wasting joint stiffness, ataxia, seizures, dementia, osteoporosis, dental caries, and progressive hearing loss. Onset of visual difficulties in first or second decade of life, severe myopia, cataracts, and atypical retinitis pigmentosa. Can become blind. Some similarity to these syndromes: Cockayne (MIM 216400), Refsum (MIM 266500), and Wermer (MIM 277700).
focal dermal hypoplasia (XD)	***DHOF, FODH*** at Xp22.31.1	See Goltz-Gorlin syndrome. (MIM 305600).
Følling syndrome. (AR). MIM 261600	Four subtypes, see phenylketonuria.	Unable to convert phenylalanine to tyrosine, have phenylketonuria, hypertonicity, epilepsy, mental retardation, partial ocular albinism, blue sclera, corneal opacities, and macular atrophy.
progressive foveal dystrophy. (AD). MIM 136550	***MCDR1*** at 6q14-q16.2.	Onset about age 10, aminoaciduria, increased glycine levels, pigmentary changes, and drusen in the macula.
foveal hypoplasia. (AD). MIM 106210	***PAX6*** at 11p13	Have aniridia, glaucoma, nystagmus, and colobomas. With O'Donnell-Pappas syndrome (AD) (MIM 136520) signs include corneal pannus, nystagmus, and presenile cataract. (MIM 136520).
foveomacular dystrophy (AD, S)	***VMD1*** at 8q24, ***VMD2*** at 11q13	Vitelliform macular dystrophy or adult-onset vitelliform macular dystrophy, AOFVD. ***VMD2*** for Best macular dystrophy. Most retain enough vision to be able to read.
fragile sites are located at these loci. MIM 136610 .	At 2q11, 9q31, 10q23, 10q25, 11q13, 16p12, 16q22, 20p11, and Xq28	Can cause early developmental delay, often signs of autism, or mental retardation. One XL type is ***FRAX3***. See also MIM 136540, 136580, 136630, 136640, 136660, 136670, 309550, 600651.
fragile X syndrome (XD, XR, S). MIM 309550	***FMR1*** at Xq27.3	Martin-Bell syndrome with multiple CGG or CCG repeats, epilepsy, and mental retardation. Mostly affects males. May have strabismus, glaucoma, cataract, optic atrophy, and high myopia.
Franceschetti-Their syndrome. (AR)	Gene	Lipomas, mental retardation, and corneal dystrophy. See also Franceschetti-Zwahlen-Kline syndrome.
François dermo-chondro corneal dystrophy. (AR). MIM 221800	***DCCD*** (There are other François dystrophies.)	Hypercholesterolemia, seizures, and deformities of the hands and feet. Causes gingivitis and central superficial corneal dystrophy. See also dermatoarthritis (MIM 142730).
Fraser syndrome		See kidney.
Frasier syndrome. (AD)	***WT1*** at 11p13	Gonadoblastoma. See Wilms tumor.
Freeman-Sheldon syndrome	Gene	See arthrogryposis. (MIM 108120, 193700, 208155, 277720, 601680).
Friedreich ataxia-I (AR, AD). MIM 229300	***STM7/X25*** at 9q13. (formerly ***FRDA***)	The gene product frataxin is reduced for this the most common form of AR ataxia. This neur/omuscular disease is due to an iron overload in the mitochondria. Boyhood onset of spinocerebellar degeneration, GAA repeats, mental retardation, cerebellar ataxia, congestive heart failure, diabetes mellitus, deformity of feet evident in the first year of life, nystagmus, and optic atrophy. Some develop glaucoma.
Friedreich ataxia-II MIM 601992	***FRDA2*** at 9p23-p11	Signs are similar to those of the ***STM7/X25*** mutation. Also have GAA/TTC repeats. Other subtypes exist.

fronto-facio-nasal dysostosis. (AR). MIM 229400	Gene	Facial clefts, cleft lip, epibulbar dermoids, blepharophimosis, lagophthalmos, S-shaped palpebral fissures, cataracts, microcornea, and colobomas of the iris, eyelids, or optic disc. Unable to close the eyes completely. Genes for susceptibility to cleft lip/palate are on chromosomes 6p and 17q.
fronto-nasal dysplasia. (S). MIM 136760, 305645	Gene may be at 3q23, 3q27, 7q21 or 11q21.	Tetralogy of Fallot, heart defects, hypertelorism, and rarely mental retardation. (MIM 229400).
fronto nasal dysplasia. (AR). MIM 203000	Gene	With alar clefts and telecanthus. Rare.
oculoauriculofronto nasal dysplasia MIM 136760, 305645, 601452	(XD, AD, AR) ***OAFNS***	Distinct from ***OAVS*** (MIM 164210) and from ***FMD*** (MIM 305620) but with some features of each. See also frontofacionasal dysostosis (MIM 229400) and MIM 155145), and median cleft facial syndrome. See Pai syndrome (AD) MIM 155145, cleft lip, skin polyps, ocular hypertelorism, iris colobomas, and down-slanting lid fissures.
frontometaphyseal dysplasia. (XD). MIM 305620	***FMD, MNS*** at Xq28.	Agenesis of frontal sinuses, multiple endocrinopathies, deafness, mouth breathing, dental anomalies, elongated phalanges, hypertelorism, strabismus, and hyperopia. Normal intelligence. See ***OPD1*** (MIM 311300), Melnick-Needles osteodysplasty, (MIM 249420, 309350), and Gorlin-Cohen syndrome. (MIM 218090, 305620)
frontotemporal lobe dementia. (AD). MIM 601630	***MAPT*** at 17q21.1 or 17q21-q22	This dementia has its onset in the fifties. Most have no tau deposition in the brain although tau protein is present in many diseases including Alzheimers and Niemann-Pick.
fructose intolerance (AR, AD). MIM 229600	***ALDOB*** at 9q21.3-q22.2	Hereditary fructose intolerance. Growth retardation.
fructose-1 phosphate (AR). MIM 229600	Gene at 9q21.3-q22.2. ***ALDB*** deficiency.	Aldolase B deficiency. Hereditary fructose intolerance. Have no dental caries.
fructose-1, 6 diphosphate deficiency. (AR). MIM 229700.	***FBP1*** at 9q22.2-q22.3	Onset before 4 years of age.
Fryns syndrome. Frequently relapsing nephrotic syndrome. Sometimes called anophthalmia plus. (AR). MIM 229850 600776	***FRNS*** at 1q24-q31.2 or on chromosome 6, 15, or 22.	Problems in neural crest development. Hydrocephalus, Dandy-Walker malformation, mental retardation, lung hypoplasia, esophageal atresia, diaphragmatic hernia, congenital heart defect, skeletal (distal limb anomalies), and genitourinary malformations, cleft lip/palate, bilateral anophthalmia, or microphthalmia, cloudy cornea, retinal dysplasia, early death. Some have steroid resistant nephrosis (**SRNS**). Cyclosporin is helpful in treatment. See Pallister-Killian syndrome. (MIM 601803).
Fuchs gyrate atrophy of the choroid and retina. (AR, AD, XR, Mito)	***OAT*** at 10q26	Hyperornithinemia, cataract. With atrophy of the RPE they are night blind. See also the OAT-like genes listed below. See also iminoglycinuria-I.
MIM 311240	***OATL1*** at Xp11.3-p11.23	Ornithine aminotransferase-like-1.
MIM 311241.	***OATL2*** at Xp11.22-p11.21	Ornithine aminotransferase-like-2.
MIM 258870	***OATL3*** at 10q26	Ornithine aminotransferase-like-3.
fucosidosis (AR). MIM 230000	***FUCA1*** at 1p34, in tissue. ***FUCA2*** at 6q25-qter, in plasma.	Gene is for fucosidase. This lysosomal storage disease causes osteochondrodysplasia, hepatomegaly, mental retardation, and peripheral cone dystrophy.
Fukuyama congenital muscular dystrophy. (AR). MIM 253800, 600308	***FCMD*** at 9q31. One gene is ***FKRP*** at 19q13.3. Reduced expression of ***AQP4***.	Mutation in fukutin. Muscular weakness, mental retardation, hydrocephalus, lissencephaly, and seizures. ***AQP1*** or ***CHIP*** at &p14 (MIM 107776), ***AQP2*** at 12q13 (MIM 107777), ***AQP3*** at 9p13 or at 9p21-p12 (MIM 600170), ***AQP4*** at 18q11.2-q12.1 (MIM 600308) seems to have a role in Duchenne muscular dystrophy.
fumarase deficiency. (AD)	***FH*** at 1q42.1	Gene is for fumarate hydratase. May have cerebral atrophy.
fundus albipunctatus. (AR). MIM 136880	***RDH5, RDH1*** at 12q13-q14	Also AR late-onset cone dystrophy and possibly retinitis punctata albescens. See Bietti disease. (MIM 210370). Some have a mutation in ***RDS, RP7*** at 6p21.1-cen.
fundus flavimaculatus. (AD, AR). MIM179605	Some have a mutation in ***RP7*** at 6p21.1-cen or in ***STGD*** at 1p21-p13.	Late-onset macular degeneration. May be called Franceschetti syndrome. See Stargardt disease ***ABCA4***. (MIM 248200). There are AD types too.

fundus pulverulentus. (AD). MIM 179605	Moxt have a mutation in ***RP7*** at 6p21.1-cen	A reticular dystrophy with late-onset macular degeneration.. May be called Franceschetti syndrome. See Stargardt diseases. (MIM 153900. 248200, 600110).
G. With the G syndrome (AD), (MIM 145410), affecteds have a defect of the esophagus, imperforate anus, deafness, mild mental retardation, hypospadias, cleft lip, hypertelorism, and retinitis pigmentosa. More males than females have this neuromuscular defect. See Opitz ***BBBG1*** syndrome at 5p13-p12 (XL) (MIM 300000).		
galactocerebrosidase deficiency. (AD?)	***GALC*** at 14q31	Krabbe disease. This variant of Sturge-Weber syndrome is present at birth. Cerebral angiomas, progressive atrophy of the brain, and mental deterioration.
galactosemia-I. (AR). MIM 230400	***GALT*** at 9p13	Deficiency of galactose-1-phosphate uridyltransferase so gangliosides become deposited in the CNS. Have cirrhosis, anemia, hepatomegaly, jaundice, diarrhea, vomiting, failure to thrive, weight loss, severe mental and neurologic effects, nystagmus, and bilateral cortical cataracts. Patient needs a galactose-free diet.
galactosemia-II. (AR). MIM 230200	***GALK1*** at 17q24	With galactokinase deficiency they are ubable to convert galactose into gluse, most have nystagmus and cataract. von Reuss syndrome. Need a galactose-free diet. See also ***GALK2*** on chromosome 15. (MIM 137028)
galactosemia-III. (AR). MIM 230350	***GALE*** at 1p36-p35	Galactose-III epimerase deficiency.
galactosialidosis. (AR). MIM 256540	***PGB, GSL, NGBE, GLB2*** at 20q13.1	Infantile and adult types exist.
galactosidase, alpha. (AR). MIM 104170	***GALB*** at 22q11	Progressive psychomotor deterioration.
galactosidase, beta-1 MIM 230500	***GLB1*** at 3p21.33	Have beta galactosidase deficiency. This structural gene works with the protective gene ***PPGB, GSL*** at 20q13.1
Galloway-Mowat syndrome.		See under kidney. (MIM 251300).
Gammaaminobutyric acid is present in 1/3 of all synapses. (AR). MIM 137150, 137192	The 16 receptors Include: ***GABRA 1*** *to* ***6, GABRB 1*** *to* ***3, GABRD, E, G1, G2, G3,*** and ***GABRR 1*** and ***2.***	GABA is a major inhibitory neurotransmitter in the CNS. Subtypes A and B. See ***GABR2*** at 5q31.1-q33.1 for one receptor. Another receptor is at 4p13-p12 and one at 15q11.2-q12. Other receptors are at ????????????? .
Gangliosidoses, generalized GM_1 types. (AR). Beta galactosidase deficiency.		
type I. MIM 230500	***GLB1*** at 3p21.33 Some report the gene is at 3p12-p13.1.	Norman-Landing infantile gangliosidosis. Deficiency of beta-galactosidase isoenzymes A, B, and C. Ganglioside accumulates in neurons causing cerebral degeneration, skeletal deformities, dwarfism, hepatomegaly, mental retardation, deafness, nystagmus, esotropia, macular cherry-red spots in 50%, corneal clouding, and death in infancy. See Morquio syndromes A and B. (MIM 253010).
type II. MIM 230600	***GLB1*** at 3p21.33	Juvenile, chronic gangliosidosis, and optic atrophy. For Goldberg syndrome (AR) with neuroaminidase deficiency ***GLB2*** is on chromosome 20, (MIM 256540).
type III. MIM 230650	***GLB1*** at 3p21.33	Beta galactosidase deficiency, adult, pseudo-Hurler gangliosidosis, and ataxia. For MPS type IVB see MIM 253010.
Gangliosidoses, sphingolipidoses, GM_2 types (AR). Signs include delayed motor function, spasticity, and speech loss. See also the ceroid lipofuscinoses and see other GM2 gangliosidoses.		
type I. MIM 272750	***HEXA, TSD*** at 15q23-q24 or 15q22-q25.1.	Tay-Sachs amaurotic idiocy, or Norman-Wood syndrome. Lack hexosaminidase A., have psychomotor delay, hypotonia, seizures, cherry-red macula, nystagmus, strabismus, optic atrophy, blind by age 12 to 18 months, and death before 4 years of age. See the ceroid lipofuscinoses, and see Bernheimer-Seitelberger syndrome. (AR) (MIM 272750).
type II. MIM 268800	***HEXB*** at 5q13	Sandhoff disease. Lack hexosaminidases A and B, macrocephaly, mental and motor deterioration, muscle weakness, cerebellar ataxia, startle reaction, early blindness, death by 3 years of age. Compare with: Kufs disease (AR, AD) (MIM 204300) and Tay-Sachs gangliosidosis. (AR).(MIM 272750).
type III. MIM 272750	***GM2A*** at 5q31.3-q33.1, or at 5q32-q33	Bernheimer-Seitelberger disease is a Tay-Sachs variant. Juvenile, seizures, paralysis, cherry-red macula, blindness, and death before age 16. But some have a later-onset type. See Leigh syndrome.(MIM 256000).

GM_3 gangliosidosis may not exist. It was said to be a deficiency of uridinediphosphate-N-acetylgalactoseaminyl transferase. (MIM 305650) with rapidly progressing hypotonia, failure to thrive, and psychomotor retardation.		
Gansslen syndrome. (AD).	Gene	Hemolytic icterus, brachydactyly, polydactyly, hip dislocation, ear anomalies, hypertelorism, microphthalmia, conjunctival hemorrhages, retinal hemorrhages, dyschromatopsia, and myopia.
Gap-junction proteins include: ***GJA1*** at 6q21-q23.2 (AR)=connexin 43, ***GJA3*** at 13q11-q12=connexin 46, ***GJA4*** at 1p35.1=connexin 37, ***GJA5*** at 1q21.1=connexin 40, ***GJA8*** at 1q21.1=connexin 50, ***GJB1*** at Xq13=connexin32, ***GJB2*** at 13q11-q12=connexin26, ***GJB3*** at 1p36-p34 or 1p35-p3=connexin 31. Mutations in ***GJB2*** and ***GJB3*** may cause impaired hearing. Some of the gap junction proteins affect the crystallins of the lens. See the connexins.(on page 53).		
GAPO syndrome. (AR). MIM 230740	Gene	A connective tissue disorder with growth retardation, alopecia, dilated scalp veins, pseudoanodontia, hepatomegaly, hypogonadism, failure of tooth eruption, progressive optic atrophy, keratoconus, and some develop glaucoma. Compare with the progeroid conditions.
Gardner polyposis coli, adenomatous. (AD). MIM 175100	***APC***, ***FPC*** at 5q21-q22	Average age of onset is 20 years. Intestinal polyps, colon cancer, exophthalmos, pigmented fundus lesions in both eyes. Compare with Turcot syndrome (AD, AR). (MIM 276300).
gastroschisis. (AR). MIM 230750	Gene	Incidence 1/5,000 to 1/10,000 infants. The intestine herniates through the defect in the anterior abdominal wall. Compare with omphalocele. (MIM 164750, 258320, 310980) which can occur with Beckwith-Wiedemann syndrome (MIM 130650) and with Shprintzen-Goldberg syndrome (MIM 182210).
Gaucher sphingolipidoses Affects 1.35/100,000. Glucocerebrosidase deficiency causes lipid deposits, hepatosplenomegaly, and bone destruction. Storage of glucocerebroside in the reticuloendothelial system can cause strabismus, EOM paralyses, corneal clouding, and large yellow pinguecula. If cotton-wool spots appear in the retina because the cells are loaded with kerasin then CNS damage is also present.		
type I. (AR, rarely AD)	***GBA*** at 1q21	Mild Gaucher-like disease.
type II. (AR, rarely AD)	***GBA*** at 1q21	Infantile neuronopathic type. Also called type A.
type III. (AR)	***GBA*** at 1q21	Have splenomegaly, ataxia, and ophthalmoplegia.
gelsolin. (AD)	**GSN** at 9q34	Gelsolin is an actin-severing protein that is down-regulated in several tumors e.g. invasive breast cancer.
MIM 600986	***Y*** at 1q21	Expressed in many tissues.
German measles, congenital rubella	Viral infection.	Gregg syndrome, mental retardation, ataxia, hernia, deafness, strabismus, glaucoma, corneal haze, nystagmus, uveitis, and some pigmentary changes in the retina.
general fibrosis syndrome (AD). MIM 135700	***FEOM*** on chromosome 12p	Fibrosis of extraocular muscles. Present from birth, ptosis, enophthalmos, astigmatism, esotropia or exotropia, eyes fixed in downgaze, nystagmus, and visual loss. The AR gene ***FEOM2*** is on chromosome 11. (MIM 135700, 602078).
geroderma osteodsplasticum (AR). MIM 231070	***GO***	See under progeria. Walt Disney dwarfism. Bamatter syndrome.
Gerstmann-Straussler spongiform encephalopathy AD). MIM 176640	***PRNP, PRIP*** at 20pter-p12	A prion disease with large amyloid plaques and ataxia. Diffuse vacuolation, hemianopsia. Lose ability to write or to do calculations. Compare with Creutzfeld-Jakob syndrome (AD).(MIM 123400, 176640) and bovine spongiform encephalopathy, **BSE,** mad cow disease.
Gilbert syndrome. (AD). MIM 143500, 191740	***GNT1, UGT1A1*** on chromosome 2q.	Benign hyperbilirubinemia-I, mild jaundice. Compare with these syndromes: Crigler-Najjar-I (MIM 218800), Arias (MIM 271650), and ***UGT1A4, 1A6, 1A9, 1A10***, ***1A28***, and ***2B7***.
Gilles de la Tourette syndrome. (AD, S). MIM 137580	***GTS*** at 18q22.1, ***ITIHL1*** at 3p21.2-p14.1.	Tourette syndrome affects nearly 1% of people, (M/F ratio 4/1) causing motor incoordination, tics begin in childhood, echolalia, and coprolalia.
Gillespie syndrome. (AR). MIM 206700	Have this translocation t(X;11)(p22.32;p12) or a mutation in ***PAX6*** at 11p13.	The signs are mental retardation, muscular hypotonia, cerebellar ataxia, partial aniridia, and fixed dilated pupils. Affects more females than males.
Gillum-Anderson syndrome (AD). MIM 110150	Gene	Weakness in orbital connective tissues, levator aponeurosis disinsertion, ptosis, ectopia lentis, and high myopia.
Gitelman syndrome. (AR). MIM 600938	***SLC12A3*** at 16q13.	In this variant of Bartter syndrome the signs are renal tubulopathy, hypokalemia, metabolic alkalosis, hypocalcemia, arthralgia, tetany, weakness, and sclerochoroidal calcification.

Glaucoma, open-angle. Congenital glaucoma can be AD and so can glaucoma with elevated episcleral venous pressure. Also inherited AD is glaucoma with goniodysgenesis, some have cataracts. Glaucoma (AD) occurring in patients with microcornea, and absence of the frontal sinuses is accompanied by thickened palmar skin and epicanthus. (MIM 156700). Myopes are more likely to develop glaucoma.

Ackerman syndrome (AR) patients have juvenile glaucoma and dental defects. One AR glaucoma includes headaches, buphthalmia, corneal edema, and optic atrophy. In the Posner-Schlossman glaucomatocyclitic crisis syndrome, unilateral, they have allergy, many have HLA-BW54, peptic ulcers, mydriasis, heterochromia iridis, and anisocoria. Their episodes of high IOP last for hours or weeks and can recur. See also ***FKHL7*** at 6p25, ***IRID1*** at 4q25, ***CDG1a*** at 16p13.3-p13.2, ***PITX2*** at 4q25, and ***LMX1B*** at 9q34

In the glaucoma-ectopia lentis-microspherophakia syndrome ***GEMSS*** (AD) they also have short stature and stiffness. (MIM 137765).

Patients with a glucagonoma syndrome have an alpha-cell tumor in the pancreas, diabetes, anemia, recurrent venous thromboses, retrobulbar neuritis, and a central scotoma.

Acute angle-closure glaucoma is likely to develop in eyes with a narrow gonial angle and high hyperopia. Angle-closure glaucoma can occur in a retinal degeneration syndrome (AR) with nanophthalmia, cystic macular degeneration, nyctalopia, and hyperopia. (MIM 267760).

Forkhead transcription factors can be involved in glaucoma. With ***FOXC1*** at 6p25 corneal thickness is increased. With ***FOXC2*** at 16q24.3 they have anterior chamber anomalies. See ***FOXC3.*** ??????????

Gene	How inherited	MIM number	Description
GLC1A, MYOC, TIGR at 1q24.3-q25.2,	AD	601652 137750 503221	Juvenile, primary, and chronic open-angle glaucomas, and possibly congenital open-angle glaucoma. Male female ratio=2/1. Formerly mapped to 1q21-q31 or to 1q21-q23. or to 1q23-q25.
GLC1B at 2cen-q13	S, AD	137760	Normal tension, adult-onset, open-angle glaucoma, formerly called low-tension glaucoma. Some depend on the gene ***OPA1*** at 3q28-q29 for Kjer optic atrophy.
GLC1C at 3q21-q24	AD	601682	Primary open-angle glaucoma C.
GLC1D at 8q23		602429	Primary, open-angle, adult-onset glaucoma D.
GLC1E at 10p15-p14	S, AD	602432	Normal tension, open-angle glaucoma, formerly called low-tension glaucoma.
GLC1F, PDS1 at 7q35-q36.	AR	603383	Primary, open-angle, adult-onset glaucoma. Compare with a pigment dispersion type (MIM 600510).
GLC3A, CYP1B1 at 2p21	AR	231300 601771	Congenital, infantile, juvenile, and primary open-angle glaucoma. More frequent in males.
GLC3B at 1p36.2-p36.1	AR	500975	Causes congenital and infantile open-angle glaucoma B.
EGF at 4q25-q27	AD	131530	Mutation in this epidermal growth factor gene may cause congenital open-angle glaucoma.
SJS at 1p36.1-p34	AR	255800	Schwartz-Jampel syndrome, small stature, microcornea, with pigment granules blocking aqueous outflow, secondary open-angle glaucoma, blepharophimosis, and some have uveitis or retinal detachment.
GPDS1 at 7q35-q36	AD, AR	600510	Pigmentary glaucoma occurs in the pigmentary ocular dispersion syndrome. Pigmentation of the posterior trabecular meshwork, myopia, disc cupping, and field defects.

Name	Gene	Comments
glucagon (AD)	***GCG*** at 3q36-q37	See diabetes. The receptor is ***GCGR***. (MIM 138033).
platelet-derived growth factors. (AD)	***PDGFA*** at 7p22	Alpha polypeptide.
MIM 602116	***GAS41*** at 12q13-q15	Gene for a transmission factor is amplified in gliomas and in other tumors.
(AR)	***NEU*** at 6p21.3	Gene codes for a zinc finger protein.
(AD, S)	***erbB2*** at 17q21.1	Compare with the ***NEU*** gene at 6p21.3.
(AD)	***NF2*** at 22q12.2	Bilateral acoustic neuromas.
(AD)	***PTEN, MMAC1*** at 10q23.3	Deletions cause cancer.
glucocorticoid receptor deficiency. (AR)	***MC2R*** at 18p11.2	Mutation here causes ACTH unresponsiveness.
glucocorticoid resistance. (AD)	***GRL*** at 5q31-q32	Glucocorticoid receptor deficiency, cortisol resistance, severe hypertension.
glucose dehydrogenase deficiency. (AD)	***GDH*** at 1p36.13	For a glucose transport defect the gene ***GLUT1*** is at 1p35-p31.3.

glucose-6-phosphate dehydrogenase deficiency. (XR, M)	***WAS, IMD2*** at Xp11.3-p11.2, ***G6PD, G6PD1*** at Xq28, ***G6PC*** (AR) at 17q21, ***G6PT*** at 17q21.1.	Signs include jaundice, anemia, and chronic granulomatous disease. ***G6PDL*** on chromosome 17 is the gene for a glucose-6-phosphate dehydrogenase-like product. (MIM 158110).
glucose phosphate isomerase. (AD). MIM 172400	***GPI*** at 19cen-q12	Bone disorders, splenomegaly, hypertelorism, microphthalmia, anemia, retinal hemorrhages, macular star, and myopia.
glucose/galactose malabsorption. (AD)	***SGLT1*** at 22q11.2-qter	Affects sugar transport.
glutaricaciduria-I. (AR)	***GCDH*** at 19p13.2	Glutaric acidemia-I, dystonia, and spastic diplegia.
type IIA. (AR). MIM 231680.	***ETFA, GA2*** at 15q23-q25	Glutaricaciduria-IIA, hepatomegaly, muscle weakness, nausea, congenital cataract. Early death.
type IIB. (AD)	***ETFB*** at 19q13.3	An electron transfer flavoprotein.
type C. (AR)	***ETFDH*** at 4q32-qter	
glutathione peroxidase deficiency. (AD)	***GPX1*** at 3q11-q12	Mutation here can cause hemolytic anemia.
glutathione reductase deficiency. (AD)	***GSR*** at 8p21	Mutation here can cause hemolytic anemia.
glutathionuria. (AR). MIM 231950	***GGT1, GGT*** at 22q11.1-q11.2.	***GGT*** deficiency and mental retardation. Siegrist syndrome is malignant hypertension (AR) at an advanced age.
glycerol kinase deficiency. (XR).	***GK1*** at Xp21.3-p21.2	Deletion causes osteoporosis, poor growth, and mental retardation. Clinical effects are variable.
Glycogen storage diseases The mucopolysaccharidoses are now called **glycosaminoglycans**. Other types are ***GSD-X*** which may be AD, and ***GSD-X1*** which may map to 1p31.		
type Ia. (AR). MIM 232200	***G6PT, GCPC*** at 17q21	Von Gierke glycogenosis, glucose-6-phosphatase deficiency causes hypoglycemia, growth lag, kidney stones, arthritis, hypertension, and hepatocellular carcinoma.
type Ib. (XD) MIM 311870, 306000.	***PHKA1*** at Xq12-q13 ***PHKA2*** at Xp22.2-p22.1	Affects the heart. See types VIII and IXB. The gene for glucose-6-phosphate translocase is ***G6PT1*** at 11q23-q24.2. (MIM 602671).
type Ic. MIM 602671	***G6PT1*** at 11q23-q24.2	Mutation here can cause types 1b or 1c.
type IIa. (AR)	***GAA*** at 17q25.2-q25.3	Pompe disease, cardiac glycogenosis, hypotonia, weakness, dyspnea, and death in their first year. Type-II (MIM 232300). Type-IIb (MIM 232330).
type IIIa. (AR, S)	***AGL, GDE*** at 1p21	Forbes or Cori disease. (MIM 232400). Usually affects liver and muscle but 15% have only liver ijnvolvement.
type IIIb. (AR)	***AGL*** at 1p21	Glycogen debrancher deficiency especially affects the heart.
type IV. (AR)	***GBE1*** at 3p12	Andersen disease with cirrhosis, portal hypertension, cardiomyopathy, limb-girdle muscular dystrophy, and death by age 4 years.
type V. (AR, AD)	***PYGM, ARAD*** at 11q13	McArdle disease. Have myoglobinuria, muscle cramps, and exercise intolerance..
type VI. (AR)	***PYGL*** at 14q21-q22	Hers disease is mild with growth retardation and hepatomegaly.
type VII. (AR)	***PFKM*** at 12q13.	Tarui disease. Gene is for muscle phosphofructokinase. Signs are muscle weakness, gallstones, and hyperuricemia.
type VIII. (XR)	***PHKA2*** at Xp22.2-p21.1	See types Ib and IXB. ***PHKA1*** is at Xq12-q13. (MIM 311870)
type IXA. (AD)	***PHKB*** at 16q12-q13.1	See type VIII.
type IXB. (XR)	***PHKA2*** at Xp22.2-p21.1	See types Ib and VIII.
type IXC. (AD)	***PGM1*** at 1p31.	Phosphorylase kinase deficiency.
glycogenosis. (XL, AR)	For hepatic types I and II the gene ***PHKA2*** is at Xp22.2-p21.1	For an AR type the gene is ***PHKG2*** at 16p12.1-p11.2. See Greig or frontodigital ***GCPS*** syndrome. (AD) (MIM 175700). ***GLI3*** at 7p13-p12.3.
glycogen synthase. (AR). MIM 138570.	***GYS1*** at 19q13.3.	Active in the liver. Deficiency causes hypoglycemia. ***GYS2*** in the liver maps to 12p12.2. (MIM 138571).

Goitre. Thyroid disorders affect 2% of the population but affect 15% of those over age 75. Genetic, environmental, and endogenous factors can interact. Smoking is related to severe thyroid disease. For papillary and medullary thyroid cancers see cancer. Thyroid cancers affect 22,000 Americans a year and constitute half of all head and neck cancers. A mutation in ***BRAF*** occurs in 68% of papillary thyroid cancers and in a few other cancers.

The hypothalamus produces thyroid releasing hormone ***TRH*** also called thyrotropin releasing hormone (MIM 275120), The receptor is ***TRHR*** (MIM 188545). The pituitary gland produces ***TSH*** a thyroid stimulating hormone, thyrotropin (MIM 275100). ***TSHB*** the thyroid stimulating hormone gene is at 1p22 or 1p13. The receptor is ***TSHR*** at 14q31. The thyroid gland secretes thyroxine (T4) and triiodothyroxine (T3). T3 is the active form. Its receptor is ***TRAP*** (MIM 190445).Testing for thyroid stimulating hormone can detect both hypo and hyper thyroidism. See the thyroid anomalies including hypothyroidism and hyperthyroidism.

For hypothyroidism, thyroiditis, hypothyroid goitre, cretinism, myxedema, the signs are: dry yellowish skin, slow pulse, mental retardation, blepharitis, ptosis, tear deficiency, glaucoma, proptosis, optic neuritis, optic atrophy, and scotomas. Se also Ascher syndrome (AD) (MIM 109900).

Hyperthyroidism signs include nervousness, trouble sleeping, weight loss, goitre, tachycardia, diarrhea, warm moist palms, tremor of the fingers, and staring eyes. Hashimoto thyroiditis is a transient increased output of thyroid hormone but not increased synthesis of thyroid hormone.

For autoimmune thyrotoxicosis the gene may be ***HLA*** at 6p21.3. ***CTLA4*** at 2q33 is the gene for cytotoxic T-lymphocyte-associated esterase-4.

Named ocular signs of goitre include: lid lag (von Graefe), globe lag (Koeber), lid trembling (Rosenbach), reduced blinking (Stellwag), difficult to evert upper eyelid (Gifford), convergence weakness (Moebius), impaired fixation on lateral gaze (Suker), possible external ophthalmoplegia (Ballet), staring appearance (Dalrymple), and some less common signs.

congenital goitre. (AR)	***TPO, TPX*** at 2p25, ***TDPX1*** at 13q12	Hypothyroidism, goitre.
adolescent-onset goitre. (AD, AR).	***TG*** at 8q24.2-q24.3	Gene for thyroglobulin, a deficiency causes goitre. For thromboglobulin see ***TGB2*** at 4q12-q13. (MIM 188035) and ***TGB1***.
multinodular goitre-1 (AD).	***MNG1*** at 14q32	Adolescent goitre with thyroid calcification.
Graves' disease susceptibility. MIM 603388.	Genes at 20q11.2 or at Xq21.33-q22	Goitre. See CD 40 which is involved in tumor and inflammatory angiogenesis
Graves' autoantigen MIM 139080	Gene at 10q21.3-q22.1.	
Graves' disease. (AR, S, AD). MIM 275000	***TSHR*** at 14q31 is the gene for the thyroid stimulating hormone receptor. Two other leukocyte antigens are: ***HLA*** at 6p21.3 and ***CTLA4*** at 2q33.	Thyroid ophthalmopathy is also called Basedow or Parry disease. Graves' autoimmune thyrotoxicosis is responsible for 90% of all cases of hyperthyroidism in Canada. Affects about 2% of women and 0.2% of men. Signs of hyperthyroidism, with an abnormal thyroid stimulating antibody include weight loss, tachycardia, moist skin, diffuse toxic goitre, and 50% show ophthalmopathy, often defects of the ocular muscles. Linkage to HLA-DR3 and HLA-DQA1 but HLA-DRB1 protects against Graves' disease.
non-endemic goitre. (AR)	***TG*** at 8q24.2-q24.3	Gene for thyroglobulin.
familial goitre. (AR). MIM 600635	***NKX2A, TTF1*** at 14q13	Most hypothyroidism manifests after age 40, affects 6% of women over age 65. Signs are bradycardia, fatigue, loss of energy, depression, dry skin, and goitre.
Pendred syndrome. (AR). MIM 274600	***PDS, DFNB4*** at 7q31. Gene is pendrin.	Defective thyroxine biosynthesis produces goitre, deafmutism, and mental retardation with retinal pigmentary degeneration, and macular degeneration.
Goldberg syndrome (AR). MIM 256540.	***PPGB*** at 20q13.1 and a gene at 10pter-q23.	Cerebro-macular degeneration, neuraminidase deficiency, mental retardation, deafness, dwarfism, seizures, corneal clouding, and a macular cherry-red spot. See APMPPE for acute posterior polar multifocal placoid pigment epitheliopathy. See also Shprintzen-Goldberg syndrome (AD) (MIM 182212).
Goldenhar-Gorlin, oculoauriculo-vertebral dysplasia, or facioauriculovertebral syndrome. (M, S, AR, AD) MIM 164210	***OAVS, GHS, FAV*** on chromosome 7p. (Gene is on mouse chromosome 10.)	Hemifacial microsomia with unilateral deformity of the external ear, deafness, vertebral anomalies, microphthalmia, colobomas of the upper lid, congenital trigeminal anesthesia. Affects about 1/45,000 and 60% of those affected are male. May have corneal anesthesia and ulcers. See tetralogy of Fallot. (MIM 187500, 187501). See CHARGE association (MIM 214800).
Goldmann-Favre degeneration. (XR). MIM 303100	***TCD, CHM*** at Xp21.1-p11.4	Have progressive tapetoretinal or vitreoretinal degeneration and night blindness. See also Wagner syndrome. (MIM 143200).

Goldston syndrome. (AR). MIM 267010	Gene	Renal-hepatic-pancreatic dysplasia with Dandy-Walker cyst. May be a variant of Meckel syndrome. (MIM 249000).
Goltz-Gorlin focal dermal hypoplasia. (XD). MIM 305600	***DHOF, FODH*** at Xp22.31	Linear streaks of skin atrophy, heart defects, microphthalmia, and iris colobomas. Lethal in males. Compare with these syndromes: Midas with gene ***MLS*** at Xp22.3. (MIM 309801) and Gorlin-Goltz (MIM 109400).
gonadal dysgenesis, male type. (YL)	***TDF, SRY*** at Yp11.3	Many subtypes.
gonadal dysgenesis, female type. (XR)	***GDXY, SRVX*** at Xp22.3- p21 or at Xp22.11-p21.2.	Swyer syndrome. Develop no secondary sexual characteristics at puberty.
gonadotropin deficiency. (XL).	***GTD*** at Xp21.	See adrenal hypoplasia.
gonadotropin leutinizing releasing hormone-I.	***GNRH1*** at 8p21-p11.2	See Kallmann syndrome. The gene ***GNRHR*** at 4q13.1-q21.1 is for the receptor. (MIM 138850).
gonadotropin releasing hormone-2	***GNRH2*** at 20p13	Is mostly expressed outside the brain. For the receptor a gene ***GNRH2R*** has been identified.
Goodpasture syndrome. (S, AR)	***COL4A3*** at 2q36-q37	Have hemosiderosis with glomerulonephritis and retinal hemorrhages. Can be fatal in young males.
Goodman syndrome.		See achrocephalopolysyndactyly-IV. (MIM 201020, 272350).
Gordon syndrome. (AD). MIM 114300	***SCNIG*** at 16p13-p12 Genes may be ***PHA2*** at 1q31-q42, ***PHA2B*** (AR) at 17q21-q22, or ***PHA2C*** on chromosome 12	Abnormal handling of potassium, hyperkalemic hypertension, arthrogryposis multiplex congenita type IIA with camptodactyly, pterygium coli, cleft lip/palate, club feet, and ptosis. Look for reduced penetrance and carrier females. See Aase-Smith syndrome-I. ***PHA3*** at 17p11-q21. (MIM 147800).
Gorlin-Chaudhry-Moss syndrome. (AR). MIM 233500	Etiology unknown. ***GCM***	Craniofacial dysostosis, mild mental retardation or normal intelligence, deafness, dental anomalies, wrist anomalies, hypoplasia of fingers and toes, microphthalmia, hypertelorism, nystagmus, lid notching, keratoconus, corneal scars, down-slanting lid fissures, and marked hyperopia. Compare with Saethre-Chotzen syndrome. (MIM 101400).
Gorlin-Cohen syndrome. (AR, XL). MIM 218090, 305620	***FMD***	Signs are frontometaphyseal dysplasia, joint deformities, osteosclerosis, musculoskeletal changes, restrictive lung disease, bradycardia, and hypertension. May be the same as the Crane-Heise syndrome (MIM 218090) in which the child dies soon after birth. May be the same as osteodysplasty in females. See Melnick-Needles syndrome (MIM 309350, 249420).
Gorlin-Goltz, nevoid basal cell carcinoma. (S, AD). MIM 109400	***BCNS, NBCCS*** at 9q22.3-q31, ***ESS1*** at 9q31, ***PIN1*** at 19p13, ***PIN1L*** at 1p31.	Their mental retardation is mild but they may have ovarian carcinoma, basal cell carcinomas, medulloblastomas, and other cancers, cleft lip/palate, brachydactyly, hypertelorism, strabismus and glaucoma. See also ***PTCH*** at 9q22.3. Compare with these syndromes::Goltz-Gorlin (MIM 305600), and. Melnick-Needles (MIM 249420, 309350).
gout, primary hyperuricemia (AD). MIM 138900	Gene	Hyperuricemia is a disease of purine metabolism. Arthritis and urate tophi.
gout, hypoxanthine phosphoribosyl transferase related. (XL)	***HPRT*** at Xq26-q27	Arthritis, renal failure, swelling of the feet and ankles, EOM disturbances, band keratopathy, paralimbal nodules. See the Lesch-Nyhan (XR) syndrome. (MIM 308000).
gout, phosphoribosyl pyrophosphate related. (XL). MIM 311850	***PRPS1*** at Xq22-q24, ***PRPS2*** at Xp22.33-p22.2.	Signs of X-linked gout include mental retardation, seizures, deafness, ataxia, and cardiomyopathy.
Gradinego syndrome	Gene?	Inner ear infection, mastoiditis, deafness, facial paresis, may have paralysis of CNIII and CNIV, and pain in the area supplied by the ophthalmic branch of CNV.
Grebe chondrodysplasia (AR) MIM 200700	***CDMP1*** at 20q11.2	Skeletal disruption, tiny digits. See also MIM 601146 and ***CDMP2*** (MIM 601147).
Greig cephalopolysyndactyly (AD, S, XR, Mito). MIM 175700	***GLI3*** at 7p13-p12.3 or this translocation t(3;7)(p21;p13)	Signs are skull abnormalities, mental retardation, cleft lip, ocular hypertelorism, epicanthus, paralysis of CNVI, esotropia, and optic atrophy. See the Pallister-Hall syndromes (MIM 146510, 165240).
Griscelli disease. (AD). MIM 160777, 214450	***MYO5A, MYH12***, ***RAB278A*** at 15q21	Mutation in the gene ***MYO5A*** for myosin type V or in ***RAB278A*** for a RAS-associated protein. Impaired function of T-helper cells and natural killer cells. Patients are immune deficient and hypopigmented.

Grönblad-Strandberg syndrome. (AR, AD, S). MIM 264800	***PXE*** at 16p13.1. Two AR and two AD inheritance patterns.	Pseudoxanthoma elasticum with thick, yellowish, grooved skin, gastrointestinal bleeding, coronary artery disease, angioid streaks in the retina, macular hemorrhages, optic atrophy, and RPE atrophy.
grouped pigmentation of the macula or RPE. (AR). MIM 233800	Gene. May be inherited AD.	A hole in the foveal area surrounded by pigmented spots.

Granulomatous disease of childhood. Their leukocytes are unable to operate the hexose monophosphate shunt during phagocytosis. Phosphomannomutase-2 deficiency. Recurrent bacterial and fungal infections, chronic eczematous dermatitis, skin abscesses, conjunctivitis, keratitis, and destructive chorioretinal lesions. Gene? Can be inherited AD (MIM 138990). For the chronic type the gene ***CDG1A*** is AR or XL (MIM 212065). Types 1a to 1h and other subtypes are reported. For ***CDGS*** type 1b the gene is ***PMI1*** (MIM 602579). Have reduced visual acuity and myopia.

growth hormone deficiency. (AD) growth hormone releasing hormone receptor deficiency. MIM 139191	***GH1, GH2***, and ***GHN*** are all at 17q23-q24 ***GHRHR*** at 7p21-p13, ***GHRF*** at 20q11.2	The hormone is produced by the pituitary. Deficiency causes multiple effects. Gigantism or acromegaly. For a growth hormone releasing factor the gene ***GHRH*** is on chromosome 20p. (MIM 139190)..
growth hormone receptor. MIM 600946	***GHR*** at 5p13-p12	Pituitary dwarfism.
growth factor, epidermal. (AD)	***EGF*** at 4q25-q27	The gene for the receptor is ***EGFR*** at 7p12.3-p12.1.
growth factor-I, insulin-like. (AD).	***IGF1*** at 12q22-q24.1	Somatomedin C. Growth retardation, deafness, and mental retardation
growth factor-I, insulin-like, receptor. MIM 147370	***IGF1R*** at 15q25-q26	Is overexpressed in most malignant tissues, acts as an anti-apoptotic agent.
growth factor-2, insulin-like MIM 146731	***IGFBP2*** at 2q33-qter	Somatomedin A. For an insulin-like growth factor binding protein-2 the gene is ***IGFBP2.*** See also ***IGFBP1*** (MIM 146730), ***IGFBP3*** (MIM 146732), and ***IGFBP5*** (MIM 146734).
growth factor-2, insulin-like, receptor. MIM 147280	***IGF2R*** at 6q26	Mutation here can affect the intelligence. There are at least 6 binding proteins.
growth factor-3 (XR). MIM 307200	Gene	Fleischer syndrome, hypogammaglobulinemia. See the pituitary anomalies.
guanylate cyclase-1, soluble alpha-2. MIM 601244	***GUCY1A2*** at 11q21-q22	These enzymes catalyze the conversion of GTP to GMP. ***GUCY1B3*** at 4q31.3-q33 (MIM 139397).
guanylate cyclase 2D. MIM 600179, 139396	***GUCY2D*** at 17q13.1, ***GUCY1A3*** at 4q32	***GUCY2D*** for the membrane retina-specific type maps to 17p13.1.
guanylate cyclase 2F. (XL). MIM 300041.	***GUCY2F, GUC2F*** at Xq22	Mutation may cause XLRP. ***GUCY2E*** at 17p13.1 is the gene for guanylate cyclase type 2 E.
activators of retinal guanylate cyclase types 1A and 1B MIM 600364, 602275	***GUCA1A*** and ***GUCA1B*** both at 6p21.1.	Other related genes also have a role. Mutation in ***GUC2B*** at 1p34-p33 may cause ***CORD6.***
guanylate kinases 1 and 2	***GUK1*** and ***GUK2*** both at 1q31-q43	See MIM 139270, 139280 and for ***GUK3*** see MIM 139290.
Guillain-Barré syndrome (S, AD?). MIM 139393	***GBS***	Landry polyneuritis, a demyelinating polyneuropathy, often have IgG antibodies, sympathetic polyactivity, facial diplegia, may have ophthalmoplegia, ptosis, nystagmus, papilledema, anisocoria, or tonic pupils. Fisher syndrome is a variant. Some use gabapentin to treat the pain. May need mechanical ventilation. Treat by plasmapheresis.
Gunther disease. (AD)	***FECH*** at 18q21.3.	The deficiency of ferrochelatase causes congenital erythropoietic protoporphyria. (MIM 177000). Can be AR at 18q21.3.
gynecomastia. (AD) MIM 107910, 118485.	***CYP19, ARO*** at 15q21.1, ***CYP11A*** at 15q23-q24	Affects males.
gyrate atrophy of the choroid and retina. (AR). See Fuchs gyrate atrophy (AR, AD, XR, Mito) MIM 258870	***OAT*** at 10q26.	Deficiency of ornithine ketoacid aminotransferase. Cystinuria, lysinuria, diabetes, chorioretinal atrophy, brown pigment in the fundus, cataract, iris atrophy, night blindness, and constricted fields. See also the OAT-like genes. ***OATL1*** at Xxp11.3-p11.23, ***OATL2*** at Xp11.22-p11.212, and ***OATL3*** at 10q26.

H.

Alopecia is a feature of (AR) Belgian mental retardation with deafness. (MIM 241080). See keratosis follicularis spinulosa decalvans (XL) with scarring alopecia of the scalp and hypotrichosis. For other **hair anomalies** see Rapp-Hodgkin ectodermal dysplasia (MIM 129400) and Unna syndrome (AD) (MIM 146550). An AR mutation in ***CDH3*** that encodes P-cadherin causes hypotrichosis, juvenile macular degeneration, and blindness during the second or third decade. See Moynahan alopecia (AR) (MIM 203600). See Netherton syndrome (MIM 256500) with skin scales and high levels of IgE. Hairy elbows and short stature tend to occur together and may relate to Weil-Marchesani syndrome. (MIM 277600). See also ***GAPO*** syndrome (AR) (MIM 230740), alopecia, and mental retardation.

Ccongenital atricia is (AR) (MIM 209500). For alopecia universalis (AR) the gene is ***ALUNC*** at 8p22-p21 (MIM 602153) they lack hair follicles. See atricia with papular lesions (MIM 602153). For beaded hair see ***HB1*** (MIM 602153) and see ***KRTHB6*** (MIM 601928), and for monilethrix see ***HB1*** (MIM 602153). See also ***HB3*** (MIM 602765), and ***HB5*** (MIM 602767).

hair color 1, brown. (AD)	***BRHC, HCL1*** at 19p13.1-q13.11	***HCL3*** at 15q11-q21 also for brown hair may be linked to ***BEY2*** at 15q11-q15. See ***OCA2*** (MIM 203200) and ***EYCL1*** (MIM 227240).
hair color 2, red. (AR). MIM 266300	***HCL2, RHC*** at 4q28-q31	A few have ataxia and deafness.
red hair with fair skin. MIM 155555	***MC1R*** at 16q24.3 is the receptor for the melanocyte stimulating hormone.	Affects the melanocortin receptor and causes a poor tanning response. .A gene for blond hair is (AR) (MIM 210750). Red hair can be recessive.
hair, uncombable, or pili trianguli et canaliculi (AD, AR, S). MIM 191480	Gene.	Many develop ectodermal dysplasia, dental anomalies, juvenile cataract, and retinal dysplasia. See Bork syndrome (AD) (MIM 191482). Uncombable hair, dental anomalies, brachydactyly, pigmentary retinal dystrophy, and juvenile cataracts.
hairy ears alopecia universalis. (AR). MIM 203655	Y-linked MIM 425500, AD. MIM 139500 ***ALUNC*** at 8p12 The ***Notch 4*** gene, a non-HLA gene seems to have a role.	More males than females are affected. Some are diabetic. One gene may be on chromosome15. Most have cataracts and some have mental retardation. Thalidomide helps many of these patients.
alopecia areata. (AD, S). MIM 104000	One gene is on chromosome 6. See ***IL1RN*** at 2q14.2 for an interleukin receptor antagonist.	Alopecia areata affects 1% of the population. Some lose eyelashes and eyebrows and a few get cataract. Most people soon regrow the hair. Familial focal alopecia with patchy hair loss is AD. Focal alopecia is mostly an immune reaction. See ***TNFA*** at 6p21.3-p21.1. ***IL1A*** alpha and beta map to 2q14. See also androgenic alopecia. See ***APECED*** (AR) mutation in the gene ***AIRE*** at 21q22.3 can cause alopecia and asthma.
alopecia, psychomotor epilepsy, pyorrhea, and mental retardation. (AD). MIM 104130	Gene Congenital alopecia of one type is X-linked.	Congenital alopecia totalis, seizures, a giant pigmented nevus, pyorrhea, and mental retardation. See also an AR type, gene ***AMR***, (MIM 203650) with severe mental retardation and deafness. Alopecia is a feature of Belgian mental retardation with deafness. (MIM 241080, 249599).
alopecia-epilepsy-oligophrenia. (AR). MIM 203600	Gene	Moynahan syndrome, alopecia, seizures, and mental retardation. Resembles the ***AMR*** syndrome (AR) (MIM 203650) with alopecia, deafness, and severe mental retardation.
alopecia-mental retardation-convulsions-hypogonadism. (AR, XL). MIM 601217	Gene	Seizures begin at age 1 month but tend to cease by age 4 years. Alopecia is a feature of Belgian mental retardation with deafness.(AR). (MIM 241080, 249599). See also MIM 203600, 203650, 230740.
hypertrichosis, congenital, generalized hirsutism . (XL, AD, AR)	***HTC2*** at Xq24-q27.1. One gene for hairy ears Is Y-linked, see MIM 425500.	Hypertrichosis may accompany the acquired immunodeficiency syndrome. AIDS. A gene for hairy ears (AD) may be on chromosome 15. More males than females are affected, some are diabetic.
hair-brain syndrome. (AR). MIM 234050	Gene	An Amish syndrome with short stature, mental retardation, brittle hair, and decreased fertility. See also MIM 211390 and for trichorrhexs nodosa (MIM 275550).

hair kinky, Menkes-2 type. (XR). MIM 300011, 309400	***MNK, ATP7A*** at Xq13.3	Defective copper metabolism with steely hair, pigment deficiency, mental retardation, spasticity, seizures, and jaundice. Onset in infancy, affects only males. Compare with Wilson disease, (AR) (MIM 227900). The gene ***DLX3*** at 17q21.3-q22 is for the trichodento-osseous syndrome (MIM 600525).
hair whorl. (AD). MIM 139400.	Gene	A crown cowlick. See also the FG syndrome (XL) (MIM 305450).. More common in twins. One type depends on a gene at 6q14-q16.
pili torti. (S, AR, AD, XL). MIM 261900, 262000, 261990.	Gene	Several types of twisted hair. See Menkes disease, gene ***ATP7A*** at Xq13.3. (MIM 309400). Wooly hair can be inherited AD, AR, or XL.
Björnstad syndrome. (AD, AR). MIM 262000	***BJS, PTD*** at 2q34-q36	Pili torti with nerve deafness before age 5. May have mental retardation and hypogonadism. See also Crandall syndrome (AR) (MIM 600525).
cartilage-hair hypoplasia. (AR). MIM 250250	***CHH*** at 9p13. The ***RMRP*** gene (MIM 157660) may be mitochoindrial.	Short-limb dwarfism, celiac syndrome, Hirschsprung disease, anemia, and more susceptible to viral hepatitis and herpes labialis. Metaphyseal chondrodysplasia ***TDO*** with a deletion from 7q32. Dysplastic nails, dental anomalies, curly hair, and sclerosis of long bones. (AD) MIM 190320). May have a mutation in ***DLX3*** at 17q21 (MIM 600525).
CHANDS syndrome. (AR). MIM 214350	Gene	Congenital ankyloblepharon, curly hair, and hypoplastic nails. Some have ataxia, and some have dental anomalies.
Unna hypotrichosis. (AD). MIM`146550	Gene	In Marie Unna hypotrichosis, the teeth and nails are affected too. Affects males and females.
Hallermann-Streiff syndrome		See progeria.
Hallervorden-Spatz disease. (AR, AD). MIM 234200	***HSS, PANK, HSD*** at 20p13-p12.3. ***PANK2*** is on chromosome 20. A suggested name is ***NBIA1.***	Fail to synthesize coenzyme A. Accumulate cysteine which binds iron. Pantothenate kinase neurodegeneration, pigmentary degeneration of the globus pallidus. Demyelination of nerve fibers. Late infantile neuroaxonal dystrophy, iron accumulation in brain, speech difficulty, mental retardation, seizures, motor abnormalities, progressive rigidity, exophthalmos nystagmus, blepharitis, internal ophthalmoplegia, corneal ulcers, cataract, papilledema, and optic atrophy . Most die in their twenties. See the HARP syndrome. (AR) (MIM 200150).
Hallgren syndrome.		Now called Usher 3 syndrome. (MIM 276902).
Hand-Schuller-Christian disease. (S). MIM 179615, 179616.	***RAG1*** and ***RAG2*** at 11p13	Lipid histiocytosis of bones, skin lesions, anemia, diabetes insipidus, lung fibrosis, cardiac insufficiency, exophthalmos, blepharitis, uveitis, hypopyon, corneal ulcers, cataracts, and retinal detachment. May relate to Letterer-Siwe disease.(AR). (MIM 246400).
Haney-Falls syndrome. (AR). MIM 244600	***KPC***	Keratoconus posticus with mental retardation and cleft lip/palate.
HARD+/-E syndrome. (AR)	Gene	See Walker-Warburg syndrome. (MIM 236670) and see the ***COD-MD*** syndrome.
HARP syndrome. (AR). MIM 200150	***CHAC*** at 9q21	Pallidal degeneration, hypoprebetalipoproteinemia, acanthocytosis, progressive extrapyramidal rigidity, dysarthria, and retinitis pigmentosa. Compare with Hallervorden-Spatz syndrome. (MIM 234200).
Hartnup disease. (AR). MIM 234500 .	***HND*** at 11q13	Abnormal metabolism of tryptophan, niacin deficiency, affects 1/14,200 newborn. Photodermatitis, skin rash, cerebellar ataxia, encephalopathy, aminoaciduria, emotional instability, progressive mental retardation, nystagmus, scleral ulcers, and corneal scars.
Hay-Wells syndrome		See the AEC syndrome. (MIM 106260)
Heerfordt uveoparotid fever	Usually associated with sarcoidosis. See MIM 181000.	More frequent in females. Lymphadenopathy, swollen parotid gland, facial nerve palsy, band keratopathy, uveitis, cataract, snowball vitreous opacities, and retinal vasculitis. May involve the lacrimal gland.
hemifacial microsomia. Most are S but some are AD. MIM 164210.	***HFM*** may be at 14q32	Affects 1/45,000 in Northern Ireland. Craniofacial abnormalities and cardiac, vertebral, and CNS defects. Oculoauriculovertebral dysplasia. Unilateral deformity of the external ear and vestibular anomalies.
The **hemoglobin anomalies** are inherited in the AD manner. Alpha-1 gene ***HBA1*** is at 16p13.33 to 16p13.11. The alpha 2 locus ***HBA2*** has many variants. See also the beta-1 and zeta types and for the delta locus ***HBD*** see MIM 142000.		
hemangioma, capillary, hereditary. (AD)	***HEMC*** at 5q31-q33	See also the Klippel-Trenaunay-Weber hemangioma syndrome (AD). (MIM 149000).
hematuria, familial benign. (AD).	***BFH*** at 2q35-q37.1	Have a thin glomerular basement membrane.
hematuria or bronze diabetes. (AR, S, AD)	***HFE*** at 6p21.3-p12, C282Y mutation.	Skin pigmentation, diabetes mellitus, cirrhosis and hepatocellular carcinoma. See hemochromatosis (MIM 235200).

hemeralopia. (AD). MIM 163500	***CSNB3*** at 4p16.3.	Bilateral loss of outer quadrant of visual field progresses to blindness, may have corneal ulcers. See nightblindness. The term hemeralopia is also used to mean night-blindness
hemochromatosis. (AR). MIM 235200	***HFE*** at 6p21.3-p12	Disorder of iron metabolism affects 5% of the population mostly males. Signs include heart failure, diabetes, hepatocellular carcinoma, arthropathy, and elevated iron. May have diabetes, cirrhosis, pigmented eyelids, and retinopathy. See also ***HLA-A***.. Compare with bronze diabetes. For type 2, juvenile hemochromatosis (MIM 602390), the gene is **not** on chromosome 6.
hemolytic uremic syndrome. (AD).	***HF1, HUS*** at 1q32	Vasculitis. Acute renal failure is often virally induced. May relate to factor H. (AD) (MIM 134370).
hemosiderosis. (AD)	***CP*** at 3q21-q24	Defective iron mobilization. See ceruloplasmin. (MIM 117700).
hepatic lipase deficiency. (AD).	***LIP*** at 15q21-q23	Those affected have angina and xanthomas.
hepatolenticular degeneration (AR). MIM 227900	***ATP7B, WND*** at 13q14.3-q21.1	Wilson disease, a disorder of copper metabolism, a Kayser-Fleischer ring forms in the peripheral cornea. Compare with Menkes disease. (MIM 300011, 309400).
Hermansky-Pudlak-I syndrome. (AR). MIM 203300	***HPS1*** at 10q23.1-q23.3	Deficiencies in lysosomal-related organelles. Platelets lack dense bodies, some patients have ceroid lipofuscinosis, pulmonary fibrosis, or granulomatous colitis. Some have a bleeding tendency. See albinism. A pseudogene maps to 22q12.2-q12.3.
Hermansky-Pudlak-II	***HPS2, ADTB3A*** at 15q15.	Gene codes for the beta 3A subunit of adaptor complex-3.
Hermansky-Pudlak-III	***HPS3*** at 3q24	Is a susceptibility locus. Bleeding tendency.
Hermansky-Pudlak. (AR)	***TPK4*** at 12q12-q13	***HPS4*** is reported to be at 22q11.2-q12.2. Subtypes 5 and 6 have also been described..

Hereditary Neuropathies, include motor and sensory types. Less common neuropathies depend on mutations in genes on chromosomes 8q, 10q, and 11q. Compare with the Charcot-Marie-Tooth and the Déjérine-Sottas syndromes. ***HMSN-III***. Hereditary sensory neuropathy (AD) ***HSN-1*** at 9q22.1-q22.3 (MIM 162400) onset at age 15 to 36, deafness, foot ulcers, and pain.

Gene	How inherited	MIM number	Description
PMP22 at 17p11.2-p12	AD	601097 118220	Duplication causes ***HMSN-IA***. See also ***CMT-IA.*** (MIM 118210). Deletion causes ***HNPP*** neuropathy.
HNPP at 17p11.2-p12	AD	162500	Deletion causes ***HMSN-IA.*** (MIM 118220). Reduced expression of the ***PMP22*** gene causes episodic recurrent demyelinating neuropathy. Risk of pressure palsies.
HMSH1	AR	256855 162375	In an AD type have excessive myelin folding and motor and sensory neuropathy.
HMSN-IB at 1q21.1-q23.3, or ***PMP22*** at 17p11.2-p12	AD	118200 118210	See ***CMT-IB*** and ***HMSN-II*** and ***HMSN-IIB*** and also ***MPZ*** at 1q21.1-q23.3. ***HMSN-1A*** (MIM 118220) and ***CMT-1A*** (AD) at 17p 11.2 (MIM 118220).
HMSN-IIA at 1p36-p35	AD	145900 118210	See Déjérine-Sottas hypertrophic neuropathy syndrome. See ***CMT-IIA***. ***HMNII*** is reported to be on chromosome 12q.
HMSN-IIC at 5q23-q24	AD	158580	See ***CMT-IIC***.
HMSN-III, MPZ at 1q21.1-q23.3	AD	145900 159440 501097	See ***CMT-IB***. (MIM 118200) and ***CMT-1A*** (AD) at 17p11.2 (MIM 118220) but some are AR or XL. See Déjérine-Sottas syndrome (MIM 145900, 159440, 601097).
HMSN-IV at 10p13	AR	266500 145900	See Refsum syndrome (AR) with its gene ***PAHX/PHYH*** at 10p13. (MIM 266500, 602026).
HMSN-V on chromosome 7p	AD	600361	Peroneal muscular atrophy, peripheral motor and sensory neuropathy, onset in childhood, hereditary spastic paraparesis with absent ankle jerks, ptosis, and irregular pupils. See ***DHMNVP*** at 2q14, ***CMT1B*** (MIM 118200), and ***CMT*** type 5 (MIM 600361).
HMSN-VI	AR, AD	601152	Gene may be mitochondrial. Peroneal peripheral neuropathy, with nystagmus, and optic atrophy. Vision declines in their first decade. Some have normal hearing.
HMSN-VII	AR, AD	256855 162375	Signs are myelin outfolding, peroneal muscular atrophy, and retinitis pigmentosa. See ***HMSN-P*** at 3q13.1. (MIM 162375).
HMSN-XI at Xq11.2-q12.	XL	302800	Deafness and mental retardation. See ***CMT-X1*** at Xq13.1. (MIM 302800).

HMSN-L at 8q24-qter	AR	601455 214370	With this Lom type they have hereditary motor and sensory neuropathy, slow nerve conduction, and deafness.
HMSN-P at 3q13.1	AD	162375	Proximal dominant type with painful cramps, areflexia, elevated level of creatine kinase, hyperlipidemia, and diabetes mellitus. See ***CMT-IIC*** at 5q23-q24 and ***HMSN-VII.*** (MIM 256855, 162375).
HSN-I, HSAN-I at 9q22.1-q22.3	AD	162400	Hereditary sensory and autonomic neuropathy-I.
HSAN-II, NTRK-I at 1q31-q41	AR	191315 201300	Congenital sensory and autonomic neuropathy-2, with anhidrosis. ***NTRK-2*** for a tyrosine kinase receptor is at 9q22. (MIM 600456).
HSAN-III at 9q31-q33	AR	223900	Riley-Day syndrome, familial dysautonomia.
NAPB at 17q24-q25	AD	162100	Familial brachial plexus neuropathy, neuralgic amyotrophy causes painful brachial plexopathies.

Name	Gene	Comments
heterochromia iridis. (AD). MIM 142500	Gene	Different pigmentation in sectors of one iris. Heterochromia iridum means the two irides are of different color. Iris heterochromia may or may not be associated with Horner (MIM 143000), Waardenburg (MIM 193500), or Marfan (MIM 154700), or melanomas (several genes), or piebald trait (MIM 172800).
hexokinase deficiency. (AR). MIM 142600	***HK1*** at 10q22. .	Mutation here can cause hemolytic anemia. ***HK2, HK3,*** and ***HK4*** have been reported.
high density lipoprotein cholesterol	Genes may include ***FCHL*** at 2p25.1 and ***HDL-C*** at 9p23 or at 16q24.1	***FOXC2*** may be at 16q24.3. This foxhead factor may have a role in the AD lymphedema-distichiasis syndrome (MIM 153400).
Hilding syndrome	Gene	Atrophy of cartilage, joint dislocation, ocular hypotony, destructive plastic iridocyclitis, iris atrophy, and cataracts.
Hirschsprung-I disease. (S, AR, XR) MIM 235760, 600837.	***GDNF*** at 5p13.1-p12, ***DOM*** at 22q12-q13, ***MEN2A, RET*** at 10q11.2.	Congenital megacolon, aganglionosis in distal gastrointestinal tract. See ***IPOX*** at Xq28 for intestinal pseudoobstruction.
Hirschsprung-II disease. (AR, AD). MIM 142623	***EDNRB, HSCR2*** at 13q22 or an AD type ***RET*** at 10q11.2.	Compare with Waardenburg-Shah syndrome.(AR) (MIM 277580).
histidinemia. (AR). MIM 235800	***HAL*** at 12q22-q23.	Deficiency of histidine ammonia lyase, speech defects, mental retardation, nystagmus, and hypopigmentation of the macula.
Histocompatibility complex, Class 1A. Types HLA, B, C, D, E, F, G, and H, are on T and B lymphocytes. They are inher ited in the AD manner with the genes at 6p21.3. Class 2 are on B lymphocytes. They too are inherited in the AD manner. The gene is at 6p21.3. The DR type (AD) gene is at 6p21.3-p23. Many subtypes.		
HMC syndrome. (S, AR). MIM 239800	***ABS*** at 1q31.2 and at 7p15.1-p15.3. A gene for an AD type may be ***FGFR2***.	Antley-Bixler adrenal hyperplasia, hypertelorism, microcephaly, microtia, deafness, radio-humeral synostosis, psychomotor retardation, ectopic kidneys, congenital heart malformation, facial clefting, and abnormal genitalia. High mortality rate. See factor XIII deficiency.(AD). (MIM 134570, 134580).
Hodgkin disease. (S, AR). MIM 236000	One gene is near the HLA complex on chromosome 6p. May relate to an Epstein- Barr virus infection.	Malignant lymphogranulomatosis with elevated IgM may be caused by deletions from genes at 4q25, or at 7p15.1-p15.3, or from genes on chromosomes 1p, or 6p. Not all Hodgkin patients show a genetic linkage.
Holmes-Adie or Adie syndrome	Cause unknown. MIM 103100	Loss of tendon reflexes in ankle or knee. Adie's tonic pupil, slight mydriasis, often unilateral iridoplegia.
Holoprosencephaly. (AR, AD). Abnormal craniofacial development. Compare with the Smith-Lemli-Opitz syndromes. (MIM 258670, 270400).		
type I. (AR) MIM 236100	***HPE1*** at 21q22.3	Alobar with cleft lip and endocrine disorders.
type II. (AD) MIM 157170	***HPE2, HPC*** at 2p21	Alobar or semilobar with cleft palate, holoprosencephaly, pituitary deficiency, and mental retardation.
type III. (AD) MIM 142945	***HPE3, HLP3*** at 7q36	Hypotelorism or cyclopia.
type IV. (AD) MIM142946	***HPE4*** at 14q11.1-q13 or at 18p11.3	Semilobar.
Holt-Oram syndrome. (AD) MIM 601620, 142900	***TBX5, HOS1*** at 12q21.3-q22	Heart-hand syndrome. Atrio-digital dysplasia. See ***TBX3*** (MIM 601621). May relate to Noonan syndrome (MIM 163950) and to ulnar mammary syndrome. ***UMS*** (MIM 181450).

Homocystinuria. This disorder of amino acid metabolism allows homocysteine to accumulate in blood. Affects about 1/300,000. Cystathionine beta-synthase deficiency causes mental retardation (one third have normal intelligence). Most have thrombotic lesions in arteries or veins (sticky platelets), long fingers and toes, long limbs, and many have retinal detachment, and ectopia lentis. Their crystalline lens is usually dislocated downward. Some develop glaucoma. Some have B12 metabolic defects. Some respond to vitamin B6. Some can be helped with pyridoxine therapy. Methionine restriction when initiated neonatally can prevent mental retardation and may help to reduce the rate of lens dislocation and the frequency of seizures.
(A gene related to intelligence may be ***IGF2R*** at 6q26.)

homocystinuria type I (AR). MIM 236200	***CBS*** at 21q22.3	Myocardial infarcts, osteoporosis, mental retardation, ectopia lentis, cataract, high myopia, glaucoma, and optic atrophy.
type I. (AR)	***MTHFR*** at 1p36.3	Hallucinations, delusions, and flinging arm movements.
type III. (AD)	Gene on chromosome 1.	Milder with a late onset, have anemia and developmental delay. A type IV has been reported.
homosexuality, male. (XL).	***GAY1, HMS1*** at Xq28	Up to 4% of males may be gay.
homeobox, HOX genes affect limb growth	Genes.	Chromosomes carry clusters of paralogous loci including:1q21-q25, 6p21.3-p22.3, 9q33-q34, and 19p13.1-p13.4.
Hooft hypolipidemia syndrome. (AR). MIM 236300	Gene	Disorder of tryptophan metabolism, hypolipidemia (low serum lipids), mental retardation, skin rash, tapetoretinal degeneration, wet-appearing macula.
Horner oculopupillary syndrome. (AD). MIM 143000	Gene	Bernard-Horner unilateral cervical sympathetic paralysis can accompany many other conditions. Look for ptosis, miosis, anhidrosis, and iris heterochromia.

Human lerukocyte antigens are glycoproteins on the surface of nucleated cells. These antigens play a role in many conditions. They fit into two major subgroups.
Class I, ***HLA-A*** gene at 6p21.3 (MIM 142800), ***HLA-B*** at least 19 genes (MIM 142830), ***HLA-C*** (MIM 142840), ***HLA-E*** (MIM 143010), ***HLA-F*** (MIM 143110), ***HLA-G*** (MIM 142871).and HLA-H. They are on T and B lymphocytes. The corneal endothelium expresses Class I HLA antigens
Class II genes are at 6p21.1 or at 6p21.3-p23 They include the HLA-D group ***HLA-DRA*** (MIM 142860), ***HLA-DQA1*** (MIM 146880), and ***HLA-DP*** at 6p23-p21 (MIM 142860), ***HLA-DMA*** (MIM 142855), ***HLA-DRB1*** (MIM 142857),and ***HLA-DZ*** (MIM 142930). Class-II HLA antigens are in the corneal stroma and epithelium.

Hunter syndrome.		See mucopolysaccharidosis-II. (MIM 309900),
Huntington disease. (AD, S). MIM 143100	***HD, IT15*** at 4p16.3 The mutation rate in this gene is five times greater in men than in women. Shows anticipation i.e. appears earlier in subsequent generations.	Mutations in the gene ***HAP1*** at 17q21-q22 produce huntingtin which causes excessive apoptosis, atrophy in the striatum and cerebral cortex, dementia, increased CAG repeats, abnormalities of movement, bradykinesia, rigidity, choreiform movements, abnormalities of cognition, and emotion. Huntington chorea affects 5/100,000 people. In this progressive disease only 10% show signs before age 20. Most die of heart or respiratory disorders. ***BDKF*** a brain-derived growth factor is necessary for the development and survival of neurons in the striatum. Compare with Wolf-Hirschhorn syndrome. (MIM 194190, 602952).
Hutchison neuroblastoma. (S)	***NBS, SRC2*** at 1p36-p34	Tumor can metastasize to the orbit. ***FGR*** at 1p36.2-p36.1 is for an oncogene. .(MIM 164940).
hyaline fibromatosis, juvenile. (AR)	***JHF*** at 4q21	Hyaline accumulates in the dermis, subcutaneous nodules, tumors, gingival fibromatosis, and joint contractures.
hydrocephalus with aqueductal stenosis. (S, XR, AR)	***LICAM, CAML1, HSAS1*** at Xq28	Have stenosis of the aqueduct of Sylvius. Can be mentally retarded, have spastic paraplegia, and adducted thumbs.
hydrocephalus and endocardial fibroelastosis.	Can be caused by a viral infection.	Some have congenital cataract.
hydrocephalus, skeletal anomalies, and mental retardation. (XL, AD) MIM 134934, 601389	Some have a mutation In ***FGFR3*** at 4p16.3	Sprengel anomaly (AR). Psychosis with alterations in the white matter, kidney anomalies, an undescended scapula, and immune thrombocytopenia.
hydrops fetalis. (AD)	***GP1*** at 19q13.1 (?)	Have edema and anemia at birth.
hyperalpha-lipoproteinemia (AD). MIM 107720.	***APOC3*** at 11q23	Mutation causes no vascular anomalies but fusion of ***APOA1/APOC3*** causes several anomalies.
type I. (XD)	***OTC*** at Xp21.1	Ammonia intoxication, mental deterioration.
type II. (AR)	Several subtypes.	Retard growth and mental development
abetalipoproteinemia. (AD)	***APOB*** at 2p24-p22.	Hypercholesterolemia, progressive CNS demyelination, and coronary artery disease.

hyperammonemia-1 (AR). MIM 237300	***CPSI*** at 2q35	Deficiency of carbamyl phosphate synthetase.
hyperammonemia-2 (XD). MIM 311250	***OTC*** at Xp21	Deficiency of ornithine transcarbamylase, occurs only in infants. Irritability, vomiting, and ataxia.
hyperornithinemia-hyperammonemia-homocitrullinuria syndrome. (AR). MIM 238970	Mutation in ***ORNT1, SLC25A15*** at 13q14.	Mitochondrial ornithine transporter deficiency causes neurological symptoms, mental, retardation, spastic paraparesis, ataxia, and can cause coma due to hyperammonemia.
hyperbilirubinemia, types 1 and 2. (AD, AR). MIM 143500	Many subtypes, more than one gene.	The Arias (MIM 271650), Crigler-Najjar-I (MIM 218300), and Gilbert (MIM 143500) syndromes result in unconjugated hyperbilirubinemia.
hypercalcemia, hypercalciuric type-1. (AD, S).	***HHC1, PCAR1, FHH*** at 3q21-q24	Neonatal hyperparathyroidism. Drummond syndrome, see also Williams-Beuren syndrome (MIM 194050). ***ELN*** at 7q11.2 for elastin (MIM 130160) has a role here.
type-2. (AD).	***HHC2, FHH2*** at 19p13.3	With this hypercalcemia they have jaw tumors.
type-3. (AD)	***HHC3*** at 12q14.	Hypocalciuric hypercalcemia.
hypercholesterolemia, familial. (AD, M, AR, S) MIM 138491, 107730.	***GLRA, STHE*** at 5q33-q35, ***APOB*** at 2p24-p23	Can cause xanthomas, coronary artery disease, and corneal arcus. For the LDL receptor the gene is ***LDLR1*** at 19p13.2-p13.1. Compare with these syndromes: Bassen-Kornzweig (AR) (MIM 200100) and Robinow-Sorauf (AD) (MIM 180750).
hypercholesterolemia. (AR).	***ARH1*** at 15q25-q26	For type B see MIM 144010, for type C see MIM 143890. and for a suppressor see MIM 144020.
hyperexplexia. (AD, AR)	***GLRA1, STHE*** at 5q32	Hyperexplexia, the startle disease with congenital hip dislocation.
hyperferritinemia-cataract syndrome. (AD).	***FTL*** at 19q13.3-q13.4	Have elevated serum ferritin and congenital nuclear cataract.
Hyperglycerolemia, hyperglycinemia. (AR, one type is XR). Defects in the glycine cleavage system involve proteins P, H, T, and L. Cause mental retardation. Other genes are ***UGT2B*** at 4q13 and a gene at 4q32. Known pseudogenes are at 1q41 and at Xq23.		
type-I. isolated non-ketotic type. (AR). MIM 238300	***NKH1*** at 9p24-p23, or at 9p13	Partial deletion of P and T proteins. Death in infancy.
type-II. (AR). MIM 238310.	***NKH2*** at 3p21.2-p21.1	Defect in T protein. Mental retardation.
type-III. (AR).MIM 238330.	***NKH3***	Have a protein H defect, hypotonia, myoclonic jerks, hyperglycinemia-III, progressive neurodegeneration, and mental retardation.
(AR). MIM 238331	***GCSL***	Glycine cleavage system protein L, absent corpus callosum, death in infancy. See component P (MIM 238300), component T (MIM 238310), and component H (MIM 238330) and L protein.
hyperglycerolemia. (XR)	***GK1*** at Xp21.3-p21.2	Glycerol kinase deficiency causes osteoporosis, mental retardation, and esotropia.
hyperimmunoglobulin G1 syndrome. (AD)	***IGHR*** at 14q32.33	Have hyper IgG and IgA1. Hyperimmunoglobulin D is one cause of periodic fever.
hyperkalemic metabolic alkalosis		See the Bartter syndromes. (AR)
hyperkalemic periodic paralysis. (AD)	***SCN4A, HYPP, NAC1A*** at 17q23.1-q25.3	Myotonia in transient attacks, risk of sudden death.
hyperleucine-isoleucinemia (AR). MIM 238340	Gene	Mental retardation, seizures, deafness, and failure to thrive. Amino acid transferases ***BCT1*** at 12pter-q12. (MIM 113520). ***BCT2*** on chromosome 19. (MIM 113530).
Hyperlipidemia.		
familial combined-1 type. (AD?)	***HYPLIP1*** at 1q21-q23	Hyperlipidemia.
combined type. (AD)	***FCHL*** at 11q23-q24	Myocardial infarction, elevated VLDL, or LDL, or both.
Hyperlipoproteinemia. (AR, AD, M, S). Lipids become deposited at various sites in the body. Teend to have hypercholesterolemia and atherosclerosis. Some get Schnyder crystalline corneal dystrophy. May have xanthelasmas at inner canthus, arcus senilis, and occlusion of the central retinal artery.		
type Ia. (AD)	***LPL, LPD*** at 8p22	LPL deficiency, hepatosplenomegaly, xanthomas, and lipemia retinalis.
type Ib. (AR)	***APOC2*** at 19q13.2	With diabetes mellitus.
type II. (AD). MIM 143890.	***LDLR*** at 19p13.2-p13.12 for type IIA without hypertriglyceridemia	With this LDL receptor disorder some are deaf. Atheromas, hypercholesterolemia, xanthomas, deafness, and corneal arcus. Type II B have hypertriglyceridemia.
type III. (AD, AR)	***APOE*** at 19q13.2, ***MTP*** at 4q22-q24	Angina, coronary artery disease, and late-onset Alzheimer disease.
type IV. (AD, M)	***APOA1*** at 11q23	Have precocious atherosclerosis.

type V. (AD)	***FPLD*** at 2q21-q22	Increased chylomicrons and VLDL, decreased LDL and HDL, and hyperlipoproteinemia, hypertriglyceridemia, and insulin-resistant diabetes.
LDL receptor defect. (AD)	***LDLR, FHH1, PCAR1*** at 19p13.2-p13.12	Death from renal failure.
hyperlysinemia (AR). MIM 238700	***AASS*** at 7q31.3	Mental retardation, seizures, lax muscles, and ectopia lentis. Can occur in several syndromes, see for example : Asperger (MIM 207850), and Woody-Ghadimi. (MIM 238700).
hyperopia. (AD, AR, S). MIM 238950	Gene.	Short eyeball. High hyperopia is often AR. One form of high hyperopia is seen in pilodental dysplasia (AR). (MIM 262020). At 15 years of age 95% of hyperopes had less than 3.25 diopters of hyperopia and 95% had less than 1.5 diopters of astigmatism.
hyperoxaluria, oxalosis. (AR)	***AGXT, SPAT*** at 2q36-q37.	Congenital. See oxalosis. (MIM 259900).
hyperparathyroidism. (S, AD). MIM 145000.	***HRPT1*** at 11q13	Hypophosphatemia and hypercalcemia, brown tumor. Band keratopathy, calcification of choroid and sclera, ptosis, optic atrophy, and unilateral visual loss.
hyperparathyroidism-2 with jaw tumor. (AD). MIM 145001.	***HRPT2*** at 1q21-q31	Rare. May have parathyroid adenomas.
hyperphenylalanemia. (AR). MIM 126090, 264070	***PCBD*** at 10q22.	With primapterinuria.
Hyperphosphatemia.		
juvenile Paget disease. (AD, AR). MIM 241500	***ALPL, HOPS*** at 1p36.1-p34, ***PDB1*** at 6p21.3	Engelmann syndrome with hypophosphatasia, skull deformities, kyphoscoliosis, hypertension, arteriosclerosis, osteoarthritis, weakness, deafness, proptosis, corneal ring opacity, cataract, retinal hemorrhages, optic atrophy.
adult Paget disease of bone. (AD) . MIM 167250, 602080.	***PDB1*** at 6p21.3, ***PDB2*** at 18q21-q22	Osteogenic sarcoma is more frequent in men but mire severe in women. Hypertension, arteriosclerosis, cataracts and retinal hemorrhages.
hyperpipecolic acidemia.		See Zellweger syndromes.
hyperprolinemia.		See under kidney.
hyperreflexia. (AD). MIM 145290	***HRX*** on chromosome 7q or may be at 11q23.	Microcephaly and anomalies of retinal pigmentation. Average or low normal intelligence, pigmentary retinal changes. May be linked to the Kell blood group at 7q33-q35.(MIM 110900)
hypertelorism. (AD, S, XR, Mito) MIM 165240	***GLI 3*** at 7p13-p12.3 or a translocation.	Wide separation between the eyes, enlarged sphenoid bone. Deletion causes Greig cephalopolysyndactyly syndrome. See Aarskog-Scott syndrome and many other conditions with hypertelorism. ***GLI*** at 12q13 (MIM 165220) can be associated with gliomas. ***GLI 2*** (MIM 165230. ***GLI 3*** relates to Pallister-Hall syndrome (MIM 146510)
hypertelorism, iris dysplasia, psychomotor retardation. (AD). MIM 147590	Gene	Also may have lax joints, mild sensorineural deafness, strabismus, and Rieger anomaly. Ocular hypertelorism is a component of many other ocular syndromes.
hypertelorism, polysyndactyly, hypospadias. . (AR). MIM 239710	Gene	Their polydactyly is of the preaxial type. Syndactyly of fingers 3 and 4. Hypertelorism and ptosis.
hypertelorism, with tetralogy of Fallot. (AR). MIM 239711	Gene	Also have mild mental retardation and cardiac anomalies, See also MIM 601127 with severe mental and growth retardation See tetralogy of Fallot (AD) (MIM 187500).
hypertelorism, diaphragmatic hernia, exomphalos. (AR). MIM 222448	Gene	Donnai-Barrow syndrome. Absent corpus callosum, severe deafness, diaphragmatic hernia, exomphalos, and severe myopia. Some overlap with the **FOAR** syndrome MIM 227290.
Teebi hypertelorism. (AD). MIM 145420	Gene	Affects males and females. Also have brachydactyly, small hands and feet with webbing, an umbilical hernia, renal anomalies, shawl scrotum, ocular colobomas, and an anti-mongoloid lid fissure slant. Some have cleft lip, and abnormal scapulae.
hypertelorism, microtia, and facial clefting. (AR). MIM 239800	***HMC***	Psychomotor retardation, deafness, cleft lip/palate, ectopic kidneys, vertebral anomalies, syndacty ly of toes 2 and 3, heart malformation, and an antimongoloid lid fissure slope.

Hypertension, high blood pressure. (S, M, AD). Population prevalence is 60/1000 and the average age of onset of essential hypertension is 58. Look for narrowing of retinal arterioles. See also adrenal hyperplasia and aldosteronism. (AR).

Familial hyperkalemic hypertension with a ***WNK1*** deletion is also called pseudohypoaldosteronism type-II For ***PHA2A*** (MIM 145260) and ***PHA2B*** (MIM 601844) and ***PHA2C*** on chromosime 12 see the salt-losing syndromes. See also Paige syndrome with episodes of elevated blood pressure, Siegrist (AR) malignant hypertension of the elderly, Gordon syndrome. (MIM 114300), and the Shy-Gonatas syndrome. (MIM 255140).

A group of genes that are involved include ***GNAT1*** (MIM 305371), ***GNAT2*** (MIM 137295), ***GNAT3*** at 10p15 (MIM 131320), and ***GNAT4*** at 8p23.1-p22 (MIM 600576).

Mutation in ***GATA136AO4*** at 14q13-q21 causes an AR dysmorphic syndrome with skull anomalies and hyperpigmentation.

Patients with autonomic failure get disabling hypotension but some show hypertension when supine.

susceptibility to hypertension (M, AD). MIM 106150	***AGT*** at 1q42-q43, ***GNB3*** at 12pter-p12.3.	Angiotensin-1. Angiotensinogen-1. Genes for angiotensin receptors are ***AGTR1*** at 3q21-q25 and ***AGTR2*** at Xq22-q23.
essential hypertension. (AD). MIM 145500	***PNMT*** at 17q22-q24, ***SAH*** at 16p13.11	***PNMT*** catalyzes the synthesis of epinephrine In Alzheimer disease the brain neurons that degenerate show reduced activity of ***PNMT.***
hypertension, of one type. MIM 601745	***TWIK1, KCNK1*** at 1q42-q43	Controls potassium membrane conductance. See ***KCNK2***, ***KCNK3***, ***KCNK6***, and ***KCNK10***.
hypertension, familial hyperkalemic (FHH) or pseudohypoaldosteronism type-II (PHA2). (AD)	***CASR*** at 3q13.3-q21, ***PHA2A*** at 1q31-q42, ***PHA2B*** and ***PHA2C*** ***PHA3*** at 17p11-q21	Mutation affecting a calcium-sensing receptor can cause hypocalcemia. Some have a ***WNK1*** deletion. This gene affects control of blood pressure. See ***PHA2B*** (MIM 601844), and ***PHA2C*** on chromosome 12. Patients with the Gordon hyperkalemia-hypertension syndrome (AD) have a renal potassium secretory defect.
primary pulmonary hypertension. (AD)	***PPH1*** at 2q31-q32	Hypertension-1. Right heart failure.
salt-resistant hypertension. MIM 108962	***NPR3, ANPRC*** at 5p13-p14	Affects the level of peripheral resistance. Human naturiuretric receptors/guanylcyclase gene family includes: ***ANPRA*** at 1q21-q22, ***ANPRB*** at 9p12-p21, and ***ANPRC*** at 5p13-p14. Types A and B are guanylcyclases that synthesize cyclic GMP as a second messenger.
hypertension with brachydactyly. (AD)	***HTNB*** at 12p12.2-p11.2	Also have short stature.
hypertension with mineral corticoid excess. (AR)	***HSD11B2*** at 16q22	Have hyperkalemia and hypertensive retinopathy.
pregnancy-induced hypertension. (AD)	***NOS3*** at 7q36	Nitric oxide production declines.

Hyperthermia, malignant, is mostly AD with myopathy and hypertonicity of voluntary muscles. Flow of calcium ions into mucosa causes acidosis and production of heat. Common general anesthetics can trigger a potentially lethal reaction in a person with hyperthermia, signs include mydriasis and fixed pupils.

susceptibility to hyperthermia. (AD)	***MHS1*** at 19q13.1-q13.2, MIM 145600 ***MHS2*** at 17q11.2-q24	King-Denborough syndrome patients are subject to joint dislocations, kyphosis, ptosis, and strabismus.
type 3. (AD) MIM 154276	***MHS3*** at 7q21-q22	Can be precipitated by some general anesthetics.
type 4. (AD) MIM 600467	***MHS4*** at 3q13.1	Can be precipitated by some general anesthetics.
type 5. (AD) MIM 601887	***MHS5*** at 1q32	Affects the calcium channel.
type 6. (AR). MIM 601888	***MHS6*** on chromosome 5p	Dihydrolipoamide dehydrogenase. Susceptible to malignant hyperthermia. Compare with ***MHS5*** at 1q32. (MIM 601887)
hyperthyroidism.		See thyroid and goitre.
hypertrichosis,		See hair, hirsutism.
hypertriglyceridemia (AD, AR, M)	***APOA1, APOA3*** both at 11q23.	Hypoalphalipoproteinemia HEXA, with coronary atherosclerosis, and renal failure.
hypertrophic cardiomyopathy syndrome. (AD)	***CMH1*** to ***CMH5***. Some AD types are linked to 1q3, 11p13-q13, 14q1, and 15q2.	Mitochondrial myopathy of voluntary muscles, five subtypes lactic acidosis, congenital cataracts, nystagmus, strabismus, myopia, and premature death.
hypertrophic neuropathy. (AR). MIM 239900	Gene	Rosai-Dorfman thyroid disorder might be caused by excessive intake of vitamin A. Sinus histiocytosis with lymphadenopathy, elevated spinal fluid pressure, sensory and motor losses, and cataract. In very rare cases the lacrimal gland is involved. Some with AR hypertrophic neuropathy and cataract have severe distal sensory and motor loss. .

hypervalinemia. (AR). MIM 113520, 113530.	***BCAT1*** at 12p12, ***BCAT2*** at 19q13.	The deficiency of branched-chain amino transferase, valine transaminase causes vomiting, weakness, and growth failure.
hypoadrenocorticism (AR, XL). MIM 240300	***APECD, AIRE-1*** at 21q22.3	Addison disease, familial adrenal insufficiency, hypoparathyroidism, anemia, diarrhea, seizures, hypoglycemia, hyponatremia, and hyperkalemia. Skin and mucosal pigmentation, hepatitis, weight loss. See Schmidt syndrome. APS-II. (MIM 289200).
hypoalphalipoproteinemia		See Tangier disease. (MIM 205400).
hypobetalipoproteinemia. (AD)	***APOB*** at 2p24-p22	Familial low-density lipoproteinemia.
Hypocalcemia can be caused by foscarnet treatment for AIDS.		
hypocalciuric hypercalcemia-I. (AD)	**HHC1** at 3q21-q24	Hyperparathyroidism, hypercalcemia, chondrocalcinosis, and chronic renal failure.
type-II. (AD)	***HHC2, FHH2*** at 19p13.3	Defective G protein receptor and chronic renal failure.
type-III. (AD)	***HHC3*** at 12q14	With this Oklahoma variant some develop osteomalacia.
hypodontia. (AR)	***HYD1*** at 16q12.1, ***HYD2*** at 16q12.1	Dental anomalies.
hypogammaglobulinemia AR, XR) MIM 240500	Mutations in tyrosine kinases.	Produces common variable immunodeficiency CVID Have antibody deficiency, anemia, retinal telangiectasia, and are subject to infections. See the severe combined immunodeficiencies.
hypoglycemia. (AR)	***PCK1*** at 20q13.31	Have fatty liver and fatty kidneys.
Hypogonadism, familial. (S, AR, AD). Mutations in the genes listed below can cause idiopathic hypogonadotropic hypogonadism (IHH). See also the genes for the receptors for gonadotropin-releasing hormone, leutinizing hormone, or follicle stimulating hormone beta-subunit gene. In one AR type the signs include myotonic dystrophy and cataract. Some with defective testosterone production lose vision and become deaf. See also adrenal hypoplasia. Some have anosmia.		
Kallmann syndrome. (XL, AD, AR). MIM 308700	***KAL-1*** at Xp22.3.	The gene product is anosmin-I which has a key role in the migration of GnRH neurons and olfactory nerves to the hypothalamus. Patient has hypogonadism and anosmia or hyposmia.
Kallmann-2 (AD). MIM 147950.	***KAL-2*** may be on chromosome 1.	Hypogonadism, anosmia, deafness, and mental retardation.. See also MIM 308700 (XL).
Kallmann-3. (AR, AD, XL). (AR). MIM 244200	***KAL-3*** may be at 8p11.2.	Hypogonadism, anosmia, cleft lip/palate, and unilateral renal agenesis.
adrenal hypoplasia, congenita. (XL) MIM 300200	***DAX1*** at Xp21.3-p21.2	Have adrenal insufficiency. See **IHH** at 2q33-q35. (MIM 600726).
prohormone convertase-I. MIM 601841.	***PCI*** at 14q32.1	Deficiency of this protein C inhibitor causes IHH and defects in prohormone processing. A receptor for the gonadotropin releasing hormone is ***GNRHR*** at 4q13. (MIM 138850)
hypergonadotropic type. (AD). MIM 152780	***LHB*** at 19q13.32	Nerve growth factor, gamma subunit.
hypogonadotropic type. (AR). MIM 152760	***LHRH, GNRH1*** at 8p21-p11.2	Cerebellar ataxia. The receptor for ***GNRH1*** is ***GNRHR*** at 4q13. (MIM 138850).
hypokalemic periodic paralysis . (AD). MIM 170400	***HOKPP1*** at 1q31-q32	Episodic weakness. See ***HOKPP2*** (MIM 600304) which is **NOT** linked to 1q31-q32.
periodic paralysis, familial. MIM 601011, 182389, 601745, etc	Mutations in genes for calcium (12 or more), sodium (12 or so), or potassium (30 or more) can cause periodic paralysis.	FHypoKPP. ***CACNL1 A3*** may or may not map to 1q31-q32.(AD) (MIM 114208). See the channelopathy genes. ***SCNA4*** at17q23.1-q25.3 (MIM 170500). ***KCNK3*** at 2p23 affects voltage-gated potassium channels.(MIM 603220)
thyrotoxic hypokalemic periodic paralysis. MIM 188580	a potassium channel gene.	THhypoKPP . Causes Hashitoxic periodic paralysis. Mostly occurs in Oriental males.
hypomagnesemia, familial (AR)	***HOMG, HSH, HMGX*** at 9q12-q22.2	With secondary hypocalcemia, seizures, and tetany.

hypomelanosis of Ito. (AD). MIM 146150, 308300	***HMI, IPA*** at Xp11.21 or ***ITO*** at 15q11-q13 or may result from a translocation .	This mosaicism is often sporadic. Two genes seem to be competing in this skin sensitivity and hypopigmentation that affects about 1/9,000. Nervous system dysfunction occurs in 50%, iris heterochromia, esotropia, cataract, retinal detachment, and myopia. See Bloch-Sulzberger syndrome (MIM 146150, 308300). See also ***IP1*** the old name (MIM 308300), and ***HSPA5*** at 9q33-qter, (MIM 138120), for an immunoglobulin heavy chain, and ***GRP78*** for a heat-shock protein.
Hypoparathyroidism. (XR, AD, AR). Have decreased blood calcium and increased serum phosphate, tetany, muscle cramps, convulsions, mental retardation, and renal agenesis. Keratitis, ptosis, cataract, optic neuritis, colobomas, papilledema, and myopia. See Albright osteodystrophy-I, (AD) gene ***AHO1*** at 20q13.22-q13.3. (MIM 103580, 203330, and 300800)		
(XL). MIM 307700	***HPTX, HYPX*** at Xq26-q27	Agenesis of parathyroid glands.
MIM 168468, 168450	***PTH*** between 11p15.4 and 11p15.3	Parathormone. The receptors are ***PTHR1*** at 3p21.3-p21.2 and ***PTHR2*** at 2q33.
MIM 168470	***PTHLH*** or ***PTHRP*** at 12p11.2.	Parathyroid-like hormone, humoral causes hypercalcemia of malignancy.
(AR), MIM 158120	***SPG7, PGN*** at 16q24.3	Paraplegin.
(AD). MIM 146200	***FIH*** at 3q13	Familial tetany, seizures.
(AD). MIM 146255	***HDR*** at 10p13.5	Deletion causes nephrosis, deafness, progressive renal failure, and cataracts. Mitral valve prolapse.
(AR). MIM 247410	***SPG9*** at 10q23.3-q24.3	Hypoparathyroidism, lymphedema, progressive renal failure, and cataracts. See also an (AR) gene MIM 241400.
(AR). MIM 241410	***HRD*** at 1q42-q43	Deafness, dysmorphism, mental retardation, growth retardation, and renal dysplasia.
Hypophosphatasia, vitamin D-resistant rickets. More prevalent in females. Have excess inorganic phosphate in their blood, defective bone formation, hypercalcemia, convulsions, premature loss of teeth, corneal subepithelial calcification, cataract, papilledema, and optic atrophy. The perinatal type is often lethal in utero. For the infantile type see MIM 241500, for the childhood type see MIM 2415110, and for the adult type see MIM 146300. A gene for hypophosphatemic rickets (AD) maps to Xp22. (MIM 307500).		
AR or AD types. MIM 171760	***ALPL, HOPS*** at 1p36.1-p34, ***VDR*** at 12q12-q14.	Compare with juvenile Paget disease.
XD types. MIM 307800	***HYP, HPDR1*** at Xp22.2-p22.1	Another gene is at Xq28. For vitamin D resistant rickets see ***PHEX*** at Xp22. (MIM 307800).
phosphatemia-III, hereditary (XR). MIM 300008	***CLCN5, NPHL2*** at Xp11.22	Dent disease (XD) mutation in ***CLCN5***, a chloride channel gene. (MIM 300008).. See also Fanconi syndrome with kidney stones.
with rickets. (AD). 193100.	***ADHR, H PDR2*** at Xp11.22	Impaired transport of renal phosphate.
with deafness. (XD). MIM 307800	***GY, HYP1*** at Xp22.1	Vitamin D resistant rickets with deafness. Hypophosphatemia.
hypopituitarism, panhypopituitarism. (XL). MIM 103580	***PHP*** at Xq25-q26	Pituitary dwarfism. See ***AHO.*** (MIM 103580, 203330, and 300800). For Albright osteodystrophy see ***AHO2*** (MIM 103581).
Simmonds or Simmonds-Sheehan hypopituitarism. (mostly XL). MIM 311850.	***PRPS1*** at Xq22-q24, ***PRPS1L2*** at 9q33-q34 ***PRPS2*** at Xp22.2-p22.3	Phosphoribosyl pyrophosphate synthetase superactivity. Damage to the anterior pituitary gland causes weight loss, weakness, anorexia, bradycardia, hypotension, anemia, psychosis, deafness?, loss of eyebrows and eye lashes, optic atrophy, and a central scotoma. When this occurs in diabetics their retinopathy improves.
hypospadias-dysphagia syndrome. Also called the oculogenitolaryngeal syndrome. (AD). MIM 145410	One gene is ***BBBG1*** at 5p13-p12.	Duplication causes this syndrome, esophageal abnormality, cleft lip, hypospadias, imperforate anus, heart disease, mental retardation, hypertelorism. But for the XL types see type 1 of the Opitz syndromes with the gene ***MID1*** at Xp22 and for type 2 which is AD and depends on a deletion from ***BBBG2*** at 22q11.2.
androgen insensitivity. (XR). MIM 158120	***AR, TFM, AIS*** at Xq12	Hairless pseudofemale. See Reifenstein syndrome. (MIM 312300) See ***SBMA*** at Xq12 for Kennedy disease. (MIM 271150).
hypothalamic hamartoblastoma hypopituitarism. (AD). MIM 146510	***PHS, GL13*** at 7p13-p12.3	Pallister-Hall syndrome with short limbs, postaxial polydactyly, renal dysplasia, imperforate anus, and congenital heart defect.

Hypothyroidism. See goitre. Congenital hypothyroidism is detected in 1/4000 infants. Five subtypes: iodide concentration defect, (MIM 264300), organification defect, peroxidase defect (AR) ***TPO*** at 2pter-p23 (MIM 274500, 274700, iodotyrosine deiodinase defects (AR) (MIM 274800), defects in thyroglobulin synthesis (AR) (MIM 274900), and Pendred syndrome (AR) (MIM 274600), affects 1/14,000, signs include congenital deafness. Causes 5% of hereditary deafness. Some show linkage to ***DFNB44*** at 7q31. For lack of peripheral response to thyroid hormone see ***TARB*** at 3p24.3 (AD) (MIM 188570). For familial goitre see ***NKX2A, TTF1*** at 14q13. (AR). (MIM 600777).

hypothyroidism, athyroidal. (AR)	***FKHL15*** at 9q22	With spiky hair and cleft palate. Genes for transcription factors are ***TTF1, TTF2***, and ***PAX8*** at 9q22.
hypothyroidism. (AR). MIM 603372	***TSHR*** at 14q31	Some have a mutation in the ***TSHR*** gene for the thyroid stimulating hormone receptor. See goitre.
hypothyroidism, autoimmune. (AD, M). MIM 275200	***TSHR*** at 14q31	Graves disease, incidence 4/1000. In Caucasians, is associated with HLA-B8 and HLA-DR3. Graves disease Is at least 8 times more common in women than in men. Exophthalmos and weak extraocular muscles.
disorders of thyroid hormone transport. (XL). MIM 314200	***TGB*** at Xq21-q22.	
Hashimoto struma (AD). MIM 140300	Gene	Thyroid autoimmunity. Have thyroid antibodies. A defect in thyroid basement membrane. Associated with HLA-B8, HLA-DR3, and HLA-DR5. More common in females. See ***FAS*** at 10q24.1 (MIM 134637) and ***FASL*** (MIM 134638).
hypouricemia, (AR, XL). MIM 242050, 307830. 134600, 220150	Genes	Can occur with xanthine oxidase deficiency (AR) (MIM 278300), Wilson disease (AR) (MIM 277900), Fanconi renotubular syndrome (MIM 134600), with an (AD), renal tubular defect, primary renal hypouricemia, (AR), and with (XL) familial renal hypouricemia with renal tubular urate hypersecretion. Hypouricemia, hypercalinuria, and decreased bone density. Hypouricemia is associated with insulin-resistant type 2 diabetes. Exercise-induced renal failure can occur in a patient with hypouricemia. With Dalmatian type hypouricemia (AR) their defective urate transport causes renal hypouricemia.

I.

I-cell or LeRoy disease.		See mucolipidosis-II. (MIM 252500).

Ichthyosis. More than 20 subtypes of these skin conditions. Some of those affected are born as collodion babies. See other conditions and Rud syndrome.

The signs of non-bullous ichthyosiform erythroderma (**NBIE**) (AR) are erythema and scales.

Ichthyosis bullosa of one type is also called hereditary ectodermal dysplasia or Siemens disease. With IB5 (MIM 146800) have a mutation in ***KRTZE*** at 12q11-q13 (MIM 600194).

vulgaris. (AD). MIM 135940.	***FLG*** at 1q21	Gene for filaggrin is profilaggrin..
vulgaris .(XL). MIM 308100	***STS, ARSC1, SSDD*** at Xp22.32.. The gene for one ichthyosis without sulfatase deficiency is **NOT** at Xp22.3.	Dark scales on the skin and corneal opacities a few days after birth. A harlequin syndrome bullous erythroderma collodion baby has congenital ichthyosis. Soon after birth has scales on the skin, keratitis, iris atrophy, corneal scarring, and excess lacrimation.
bullosa. (AD). MIM 600194.	***KRT2A, KRT2E*** at 12q11-q13.	Mutations in one of the five keratin genes. ***IBS*** (MIM 146800). Siemens disease (AD) ***KRT2E*** (MIM 600194).
ichthyosis lamellar-I. (AR). MIM 242300, 190195.	***TGM1***, ***ICR2*** at 14q11.2.	Transglutamase. Ichthyosis congenita. Skin scales.
lamellar-II. (AR). MIM 601277	***ICR2B, LI2*** at 2q33-q35	Congenita-2. No hepatosplenomegaly.
lamellar non-bullous (AD). MIM 146750	Ge ne	With pruritus and hyperkeratosis. Collodion membrane at birth.
(AR). MIM 212400	Gene	Congenital with cataract.
(AR). MIM 242520	Gene	Hepatosplenomegaly, cerebellar degeneration, ataxia, and dysarthria.
(AR). MIM 601039	Gene	Mental retardation and large keratohyalin granules in skin.
(AR). MIM 242550	Gene	Mental retardation with split hairs and aminoaciduria.
(AR). MIM 242400	Gene	Congenital with biliary atresia.
(AR). MIM 258840	Gene	With oral and digital anomalies, gap between fingers.
(AR). MIM 242530	Gene	With mental retardation, dwarfism, and renal impairment.
(AD). MIM 146600	Gene	Hystrix gravior, porcupine man. Lambert type. Ichthyosis.

MIM 602540	Gene	Hystrix-like with deafness, HID syndrome.
(XL). MIM 308100	***STS*** at Xp22.3	Steroid sulfatase deficiency, dark skin scales, and corneal opacities.
(XL). MIM 300001	May be at Xp22.3	Without steroid sulfatase deficiency but this is questioned.
(XR). MIM 308205	***IFAP***	With congenital ichthyosis follicularis, and atrichia, most have photophobia, recurrent respiratory infections, and some have mental retardation or trachoma.
(XR, AR). MIM 308200 308700	***RUDS*** said to be at Xp22.3.	RUD syndrome was said to be a congenital non-bullous ichthyosiform erythroderma (NBIE is AR) with anemia, seizures, male hypogonadism, small stature, mental retardation, and retinitis pigmentosa. Compare with: tuberous sclerosis (MIM 191092, 191100), neurofibromatosis (***NF-1*** at 17q11.2), and Kallman syndrome ***KAL-1***. (MIM 308700).
Kaufman syndrome, or oculocerebrofacial syndrome (AR). MIM 244450	Gene	Seems to be a subtype of the now largely abandoned Rud syndrome. Ichthyosis, hypergonadotropic hypogonadism, growth retardation, small stature, hypotonia, respiratory distress, cranial dysmorphism, mental retardation, epilepsy, abnormal EEC, hypertelorism, strabismus, ptosis, epicanthus, myopia, and sometimes retinitis pigmentosa.
Kaufman syndrome of another type	May be inherited AD or be caused by the herpes simplex virus.	Subject to recurrent corneal erosions.
McKusick-Kaufman syndrome. (AR). MIM 236700	***MKKS, BBS6*** at 20p12	Postaxial polydactyly, congenital heart disease, vaginal atresia, hydrometrocolpos, males have cryptorchidism, micropenis, choanal atresia, and Hirschsprung megacolon. See the Bardet-Biedl syndromes. (MIM 209900, 209901, 600151, 600374)
Senter syndrome. (AD). MIM 148210	Gene	Short stature, ichthyosiform erythroderma, mental retardation, sensorineural deafness, alopecia, hepatic cirrhosis, corneal ulcers, and vascularizing keratitis. Cyclosporin A is applied topically on the eye to treat. Compare with these syndromes: KID of the AD type. (MIM 148210), and Desmons (AR) (MIM 242150)
imidazole aminoaciduria. (AR)	***CLN3*** at 16p12.1-p11.2	Neuronal ceroid lipofuscinosis-3. Amaurotic family idiocy. Compare with these diseases: Batten (MIM 601980), and Vogt-Spielmeyer (MIM 204200).
iminoglycinuria-I. (AR). MIM 242600	***EAAC1, SLC1A1*** at 9p24	Dicarboxylic aminoaciduria with mental retardation and gyrate atrophy of the choroid and retina. Type II is AD (MIM 138500) . See Fuchs gyrate atrophy. (AR) ***OAT*** at 10q26.
immotile cilia. (AR). MIM 242650	***ICS1*** at 6p21.3	See Kartagener syndrome (XL, AD, AR) (MIM 244400). Situs inversus viscerum gene ***SIV*** is at 14q32. (MIM 270100).
immunodeficiency.		See severe combined immunodeficiency.
immunoproliferative syndrome (XL)	***SAP, SLAM***	Rare, often fatal, mostly due to the Epstein-Barr virus
imperforate anus (M, AR, XL) MIM 207500, 301800.	Gene	Incidence 1/5000 . Some are deaf. See also the ***PIV*** syndrome (AD). (MIM 174100)
incontinentia pigmenti achromians. (XD, S, AD)	***NEMO*** at Xq28	See Bloch-Sulzberger syndrome, formerly ***IP1***. (MIM 308300).
incontinentia pigmenti-I (XD). MIM 146150, 308300	***HMI, IPA*** at Xp11.	Often said to be sporadic. Lethal for males. See hypomelanosis of Ito, gene ***ITO*** at 15q11-q13.(MIM 308300). Bloch-Sulzberger syndrome.
incontinentia pigmenti-II. (XD). MIM 308310	***IP2*** at Xq28.	Lethal for males. Females may have a variety of ocular disorders.
inflammatory bowel disease. (AR)	***IBD1*** at 16p12-q13, ***IBD2*** at 12p13.2-q24.1	Other genes may be on chromosomes 1p, 3q, and 4q. Crohn inflammatory bowel disease. (MIM 266600). (May be AR)
inositol triphosphate-3 kinase. MIM 147521	***ITPKA*** at 15q14-q21	Inositol releases calcium.
inositol triphosphate kinase. MIM 147522	***ITPKB*** at 1q41-q43 or at 1q42-q44	An inositol kinase.
inositol triphosphate-5/6 kinase. MIM 601838	***ITRPK1***	Inositol 1, 3, 4-triphosphate 5/6 -kinase.
inositol receptor type 1 (AR). MIM 147265	***ITPR1*** at 3p26-p25	Mental retardation.
inositol receptor-2 MIM 600144	***ITPR2*** at 12p11	Inositol 1, 4, 5-triphosphate receptor-2.
inositol receptor-3 MIM 147267	***ITPR3*** at 6p21	Inositol 1, 4, 5-triphosphate receptor-3.

Inositol polyphosphate-1-phosphatase	***INPP1*** at 2q32	Has a role in intracellular signalling.
polyphosphate-like-1 MIM 600829	***INPPL1*** at 11q23	Encodes ***SHIP2***, may have a role in type 2 diabetes. Insulin resistance, and affects neural development.
polyphosphate-4-phosphatase . MIM 600916	***INPP4A*** at 2q11.2	Inositol polyphosphate-4-phosphatase type 1.
polyphosphate-5-phosphatase MIM 600106, 147264, 309000	***INPP5A*** at 10q26.3, ***INPP5B*** at 1p34, ***INPP5D*** at 2q36-q37	These genes act as precursors for messenger molecules.
myoinositol monophosphatase-1 MIM 602064	***IMPA1*** at 8q21.13-q21.3	***IMPA2*** is at 18p11.2 and relates to a bipolar disorder. Lithium helps some patients with a manic-depressive disorder.
insulin-like growth factors		See growth factors.
interferon immunedeficiency, many subtypes. (AD)	***IFNA1*** at 9p22	Interferons are pleiotropic cytokines that are induced in response to viral infection. They lead to activation of the STAT factor. The gene for interferon gamma is ***IFNG*** at 12q14. Deletion causes acute lymphoblastic leukemia and gliomas.
interferons alpha, beta, and omega, receptors 1 and 2.	***IFNAR1*** and ***IFNAR2*** at 21q22.1.	Interferons are virus inhibitors. Interferon regulatory factors are ***IRF1*** on chromosome 5 (MIM 147575), ***IRF2*** on chromosome 4 (MIM 147576), and ***MUM1/IRF4*** has oncogenic activity (MIM 501900).
interleukins mediate the acute-phase response.	At least 15 subtypes, one gene is ***IL1A*** at 2q14.	Among the nine genes in the interleukin-1 cluster most bind to specific receptors. A gene at Xq24 directs synthesis of IgE but does not act on T cells.
interleukin-I receptor antagonist	***IL1RN*** at 2q14.2 or at 2q12.	A receptor antagonist. May have a role in arthritis. The beta 2 receptor ***IL2RB*** is at 2q12-q22.
interleukin-II receptor, alpha chain interleukin-II, gamma chain	***IL2RA*** at 10p15-p14 ***IL2RG*** at Xq13.1	T-cell growth factor receptor. The common gamma chain is a signalling component for all T-cell growth factors. ***IL2R*** maps to 10p14-p15. (MIM 147730)
interleukin-III	***IL3*** at 5q31.1	The receptor ***IL3RA*** is at Yp13.3 and Xp22.3.
interleukin-IV receptor, alpha chain	***IL4RA*** at 16p12.1-p11.2	Asthma and more IgE in the serum. Other interleukin receptors are: 5 alpha at 3p26-p24, 7 at 5p13, 10 at 1q31-q32, and 12 beta 2 at 1p31.2.
intelligence, subnormal. (P, M)	One gene is ***IGF2R, MPR1*** at 6q26	See mental retardation and dementia.
intestinal pseudoobstruction, neuronal, primary, idiopathic. (XR).	***IPOX, CIIPX*** at Xq28	May relate to Hirschsprung disease the most common cause of neural intestinal pseudoobstruction. (MIM 142623, 235730, 235735, 235740, 235750, 235760, 306980, 600155, and 600156, and possibly 600837).
iris nevus, Cogan-Reese, Chandler, and the iridocorneal endothelial syndrome. (AD) MIM 146720, 601359.	***ICE*** Some overlap is apparent in this group of conditions. This ***ICE*** syndrome can be confused with the ichthyosis-cheek-eyebrow syndrome. (AD).	***ICE*** has three variants, all have corneal endothelial degeneration, iris damage, and progressive closure of the angle. Usually unilateral, mostly affects young women, a membrane covers the iris. May have endothelial proliferation following intraocular surgery, unilateral glaucoma, in eyes with peripheral anterior synechiae, corneal edema, ectropion uvea, ectopic pupil, and keratoconus. Some have Chandler syndrome with considerable corneal edema, some have Cogan-Reese syndrome, and some have progressive iris atrophy. May also have a herpes simplex infection. If ***ICE*** is unilateral the other eye is likely to have some minor anomalies The Cogan-Reese syndrome is the most common form of ***ICE*** syndrome and its glaucoma is difficult to control by drugs or surgery.

iridogoniodysgenesis-1. (AD). MIM 601631	***IRID1*** at 6p25	Iris hypoplasia, goniodysgenesis,and juvenile glaucoma. Compare with ***FKHL7*** at 6p25. (MIM 601090), Rieger syndrome. ***RIEG2*** at 13q14 (MIM 601499), ***IRID2*** (AD) (MIM 137600), and ***IHG*** (XL) (MIM 308500)
iridogoniodysgenesis-2. (AD).MIM 180500, 601542	***PITX2*** at 4q25,	Pale iris, glaucoma. See anterior chamber mesenchymal dysgenesis. See ***FOXC1*** at 4q25 and ***GHRF*** or ***GHRH*** at 20q11.2. (MIM 139190).
iris, coloboma. (S, AD, AR)	***PAX2*** at 10q24-q25	May have deafness and renal hypoplasia.
iris, hypoplasia. (AD)	***RGS*** at 4q25-q27, ***RGS3*** at 9q31-q33	Irideremia.
iris dysplasia (AD). MIM 147590	Gene	With unilateral or bilateral hip dislocation, lax joints, hypotonia, Rieger anomaly, psychomotor retardation, sensorineural deafness, hypertelorism, iris hypoplasia, and synechiae between iris and cornea.
iris color, green-blue. (AR)	***GEY, EYCL1*** at 19p13.1-q13.11	Blue is recessive to brown.
iris color, brown. (P)	***BEY2, EYCL3*** at 15q11-q15	***HCL3*** at 15q11-q21 is a gene for brown hair color.
Isovaleric acidemia is a disorder of leucine metabolism. Gene ***IVA*** (AR) at 15q13-q15. (MIM 243500). Two types. (a) severe neonatal type: vomiting, seizures, hypothermia, may go into coma. Half do not survive the neonatal period. (b) chronic intermittent type, onset about age 12 months, vomiting, lethargy, coma, and likely to have a psychomotor handicap.		
Ivemark syndrome or heterotaxy. (AR). MIM 263200	***PKHD1*** at 6p21-p12	Mutation here alters body symmetry and causes hypoplasia of the spleen, polycystic kidney, and hepatic disease.
Irvine-Gass cystoid macular edema. (S, AD). MIM 153880	***CYMD*** at 7p21-p15.(AD). .	Autoimmune polyendocrinopathy with candidiasis, ectodermal dystrophy, hypoparathyroidism, Addison disease, and keratoconjunctivitis. Note cystoid macular edema often develops after cataract surgery when the vitreous face is ruptured.
J.		
Jabs syndrome. (AR, AD)	***ACUG*** at 16p12-q21.	Synovitis, arthritis, deafness, fever, hypertension, granulomatous uveitis, and sixth nerve palsy.
Jackson-Weiss syndrome. (AD)	***FGFR2*** at 10q25.3-q26	Craniosynostosis and foot malformation.
Jacobsen syndrome. (S, AD)	***JBS*** at 11q24.1	Deletion causes psychomotor retardation.
Jacobs syndrome. (AR).	***JCAP*** at 1q25-q31	Camptodactyly, arthropathy, and pericarditis.
Jacobs triple X syndrome. MIM 244600	XXX	Microcephaly, some have mental retardation, dental anomalies, hypogenitalism, hypertelorism, strabismus, and up-slanted lid fissures. See keratoconus posticus. (MIM 244800). See Haney-Falls syndrome. (MIM 244600).
Jadassohn-Lewandowsky syndrome. (AD)	***KRT6A*** at 12q12-q14, ***KRT16*** at 17p12-p11	Pachyonychia congenita, corneal dyskeratosis, and cataract. Three subtypes. ***ARF4L*** may be at 17q12-q21.(MIM 600732).
Jaeken disease. (AR, XL). MIM 601785	***PMM2, CDGS1a*** at 16p13.3-p13.2	Encephalopathy, psychomotor retardation, cerebellar hypoplasia, abnormal eye movements, and retinitis pigmentosa. See carbohydrate deficient glycoprotein syndrome-I for which the gene is ***PMM1*** at 22q13. (MIM 601786). Phosphomannomutase.
jagged-1. (AD)	***JAG1*** at 20p12.1-p11.23.	See Alagille syndrome.(AD, S). ***AGS*** at 20p12.1-p11.23. (MIM 118450, 601920).
Jansen syndrome. (AD). MIM 168468).	***PTHR1*** at 3p21.3-p21.2	Parathyroid hormone receptor. Have metaphyseal chondrodysplasia, dwarfism, deafness, mental retardation, and exophthalmos.
Janus kinases. (AR)	***JAK1*** at 1p31.3, ***JAK2*** at 9q24, ***JAK3*** at 19p13.1	These protein-tyrosine kinases also activate the transcription pathway.
Jensen syndrome. (XR). MIM 311150	***DFN1, DDP*** at Xq22	Optic-acoustic nerve atrophy, dementia, and juxtapapillary retinopathy. See Mohr-Tranebjaerg syndrome, (XL) (MIM 304700). Deafness, constricted fields, myopia, and decreased acuity.
Jervell and Lange-Nielsen syndromes. For the long QT or Romano-Ward syndrome, see under cardiac anomalies. With the rarer Jervell-Lange-Nielsen syndrome (AD) the signs are marked QT prolongation and sensorineural deafness.		

Jeune syndrome. (AR). MIM 208500	***ATD*** on chromosome 12p or at 15q13.	One of the six short-rib polydactyly syndromes. Have asphyxiating thoracic dystrophy, polydactyly, and may have chronic nephritis with cystic renal lesions, hepatic changes, nystagmus, strabismus, retinal degeneration, and retinitis pigmentosa. Severe and mild forms exist. About 70% die in early childhood. Compare with Ellis van Creveld syndrome (AR), (***EVC*** at 4p16) which mostly affects the heart. Short-rib polydactyly, Jeune, and polydactyly-III, Verma-Naumoff syndromes appear to be variants of the same disorder.
Jeune syndrome-2. (AR). MIM 208750	Gene may be ***ATD*** on chromosome 12p.	Childhood onset of cerebellar ataxia, progressive deafness, mental deficiency, kidney failure, cardiomyopathy, and freckles. Need a kidney transplant.
Johanson-Blizzard syndrome. (AR). MIM 243800	***JBS***	Dwarfism, microcephaly, hypothyroidism, pancreatic insufficiency, some are retarded, heart defect, ectodermal dysplasia, aplasia of the cutis, aplasia of the alae nasi, beaked nose, anorectal anomalies in 50%, congenital deafness, dental malformation, absent permanent teeth, and lack of eyebrows and eyelashes.
Joubert cerebello-parenchymal disorder IV. (AR). MIM 213300, 243910	***CPDIV*** may be at 9q34 or at 17p11.2-p12 but this uncertain. ***WNT1*** is probably **not** responsible.	Cerebellar vermis agenesis, breathing disorder, beaked nose, mental retardation, ataxia, malformed heart, polydactyly, the "molar tooth sign", nystagmus, and bilateral choroidal colobomas. Some have Dandy-Walker malformation, cyst in posterior fossa, aplasia of cerebellar vermis and often hydrocephalus. Compare with the COACH syndrome (AR), (MIM 216360) where the signs are: cerebellar vermis aplasia, ataxia, tachypnea, renal cysts, hypertelorism, ptosis, and colobomas.
Juberg-Hayward syndrome	***JHS*** MIM 216100	See under optic atrophy.
juvenile intestinal polyposis. (AD)	***PTEN*** at 10q23 or ***DPC4, SMAD4, JIP*** at 18q21.1	Lack of these tumor suppressors results in multiple GI polyps.
juvenile Paget disease. (AR)	***PDB1*** at 6p21.3, ***ALPL, HOPS*** at 1p36.1-p14	Causes hypophosphatemia and death in infancy. Compare with adult Paget disease for which one gene is ***PDB2*** at 18q21-q22.
juvenile rheumatoid arthritis	Probably an autoimmune reaction.	Still disease onset is before age 16, arthritis, hepatosplenomegaly, anemia, rheumatoid nodules, hypopyon, band keratopathy, scleritis, uveitis, cataract, glaucoma, macular edema, and cells in vitreous.
K		
kallikrein, renal, pancreas, and salivary	***KLK1*** at 19q13.3-q13.4	Family of 15 serine proteases. Seem to have a role in malignancy.
Kallmann syndrome. (AD, AR, XR) MIM 308700	***KAL1, KMS, ADMLX*** at Xp22.3	The deleted gene is for anosmin-I. Disorder of the hypothalamus. Signs of this neuroendocrine disorder are olfactory lobe agenesis, anosmia, cryptorchidism, hypogonadism, mental retardation, hypertension, and ataxia. Some are color blind. See also ***KAL-2*** and ***KAL-3***. See the Rud syndrome (MIM 308200) and the deMorsier syndrome (MIM 147460).
Kandori fleck retina syndrome. (AR). MIM 228990	Gene	Disturbance of the retinal pigmented epithelium causes fleck retina of Kandori. These relatively benign large yellow flecks in the retinal mid-periphery do impair dark adaptation. See the other fleck retina syndromes. (MIM 228980).
Karsch-Neugebauer syndrome. (AD). MIM 183800	***KNS***	Split hand-split foot, congenital nystagmus, strabismus, cataract, and fundus changes.
Kartagener syndrome. (AR, AD). MIM 244400	***SIV*** at 14q32	Onset in infancy, sinusitis, bronchiectasis, deafness, and visceral situs inversus, glaucoma, retinal pigmentary degeneration, and myopia.
Kaufman oculo-cerebro-facial syndrome. (AR). MIM 244450	Gene. May depend on a herpes simplex infection.	Signs include respiratory distress, hypotonia, constipation, mental retardation, hypertelorism, ptosis, microcornea, exotropia, myopia, and up-slanting lid fissures. With epithelial erosion they have pain when opening the eyes in the morning.
Kearns-Sayre syndrome. (Mito, AR). MIM 530000	***KSS*** deletions. Mitochondrial mtDNA deletions or duplications. One had a G3249A mutation	Kearns-Shy or CPEO plus syndrome. Defective oxidative phosphorylation has its onset before age 20. Signs are growth retardation, ataxia, ragged red fibers in skeletal muscles, impaired hearing, heart block, renal tubular acidosis, anomalies of the cranial nerves, external ophthalmoplegia, and retinitis pigmentosa. Creatine supplements may help. May need a pacemaker. Mitochondrial deletions also occur in Treft syndrome, Pearson syndrome, progressive external ophthalmoplegia, ***CPEO,*** and in many other conditions.

Kell blood group.(AD)	***KEL*** at 7q33-q35	See hyperreflexia. (MIM 145290).
Kenny or Kenny-Caffey syndrome (AR). MIM 244460	***TBCE*** at 1q43-q44	Dwarfism, transient hypocalcemia, nanophthalmia, papilledema, retinal vessel tortuosity, bilateral optic atrophy, and hyperopia.
keratins. MIM 139350.	Some genes are at 11p15.5 and 11q13.5.	Nineteen subtypes have been identified. Have high sulfur. See ***KRT1*** at 12q11-q13. Type 2 keratins are in a cluster at 12q13.
keratin. (AD)	***PAX6*** at 11p13.	Aniridia-II, nystagmus, and optic nerve hypoplasia. See keratitis. Keratin-7 is at 12q12-q14.
keratitis fugax. (AD). MIM 148200	Gene	Episodes of keratitis with transient endothelial corneal opacities before 12 years of age. Each attack can last for days or weeks. Attacks become less frequent after age 50. Compare with corneal erosions. (MIM 122400).
keratoconjunctivitis acute hemorrhagic	Cause can be coxsackie virus A24 or enterovirus 70.	Usually bilateral follicular conjunctivitis.
keratoconus.		See cornea.
keratoderma, palmoplantar (AD). MIM 139350	***KRT1*** at 12q11-q13	Epidermolytic hyperkeratosis Bothnia type. Those with Vohwinkel syndrome (***DFNB1*** and ***DFNA3***) have deafness and palmoplantar keratoderma.
keratoderma, non-epidermolytic MIM 148067	***KRT16*** at 17p12-p11 or at 17q12-q21	Variable phenotype. Diffuse or focal thickening of skin of palms and soles. See also ***KRT9*** (MIM 144200), ***KRT10*** at 17q12-q21 (MIM 148080), ***KRT12*** (MIM 601687), ***KRT14*** (MIM 148066), and ***KRT18*** (MIM 148070).
keratoderma with deafness. (AD, AR)	***GJB2*** at 13q11-q13.	Mutation in connexin 26 gene (Cx26). Gene product may be loricrin. Disease onset in childhood. See the gap junction proteins and the connexins.
keratosis follicularis spinulosa decalvans. (XL).	***KFSD*** at Xp22.2-p22.13 .	Signs are thick skin, alopecia, blepharitis, and corneal degeneration. An AD type has also been reported. (MIM 124200). Darier-White disease, ***DAR*** at 12q25-q24.1.
keratosis follicularis. (AD). MIM 124200	***DAR*** at 12q23-q24.1	Darier-White disease with mild mental retardation, increased risk of seizures, psychosis, and affective disorders. Flesh-colored papules on head, neck, back or abdomen, genital hypoplasia, conjunctival keratosis, corneal subepithelial infiltrations, and may have corneal ulcers.
keratosis palmoplantaris striata . (AD, AR).	***PPK*** at 18q12.	Hyperkeratotic changes in the palms and soles, hyperkeratosis of lids and cornea, corneal ulcers, and optic atrophy.
keratosis palmoplantaris papulosa (AD). MIM 148600	May relate to keratin clusters on chromosome 12q, keratin 9 at 17q21, or ***PPHK*** at 17q12-q24.	See also Papillon-Lefevre syndrome. For mal de Meleda type keratosis palmoplantaris (AR) (MIM 248300), the gene is ***SLURP-1*** at 8q24-qter or at 8q24.3. **ARS** encodes ***SLURP-1***. Onset in early infancy. (MIM 601214).
keratosis palmoplantaris with corneal dystrophy MIM 276600	Gene for tyrosinemia-2 is ***TAT*** at 16q22.1-q22.3.	Tyrosine transaminase deficiency. Richner-Hanhart syndrome. Hyperkeratosis of palms and soles, nail dystrophy, and corneal ulcers or yellowish corneal opacities. May have alopecia congenita and mental retardation. See Oregon tyrosinemia. (MIM 276600).
KID syndrome. (AD). MIM 148210, 121011	***GJB2***, connexin 26 (Cx26) at 13q11-q12 Mutations in ***GJB2*** cause 50% of congenital hearing impairments.	Keratitis, ichthyosis, deafness, alopecia, cirrhosis, keratoderma, erythroderma, hyperkeratosis of palms and soles, vascularizing keratitis, and corneal ulcers.. No skin plaques on the trunk. They have an ectodermal dysplasia rather than a true ichthyosis. Treat the corneal problem with cyclosporin A. topically. See Senter syndrome (AD) with mental retardation. (MIM 148210).
KID syndrome (AR). MIM 242150.	Gene	Ichthyosiform erythroderma, hepatomegaly, progressive cirrhosis, mental retardation, deafness, and keratoconjunctivitis. Compare with Desmons syndrome. (AR). (MIM 242150).

Kidney. Chronic renal tubular insufficiency (AD) is also called Albright hereditary osteodystrophy. Signs are hypocalcemia, short stature, seizures, keratitis, strabismus, blepharospasms, and some have papilledema.

Potter renal agenesis syndrome may depend on a trisomy 18 anomaly. Spina bifida, limb abnormalities, cystic dysplasia of the kidney, oligohydramnios, hypertelorism, down-slanting lid fissures, and epicanthal folds

Bilateral renal agenesis (AD) (MIM 191830), infantile polycystic kidney disease (MIM 263200), and renall dysplasia with retinal dysplasia (AR) (MIM 266900). Several renal diseases are associated with tapetoretinal degeneration, retinitis pigmentosa, night blindness, and constriction of the visual fields. See medullary cystic disease (AD, AR). Mutation in a gene at 11q24 can cause AD nephropathy with deafness.

In the hemolytic uremic syndrome increased thrombogenesis and inhibition of fibrinolysis precede renal injury.

Medullary cystic kidney disease is an adult-onset (AD) condition that can lead to renal failure. Genes are ***MCKD1*** at 1q21 and ***MCKD2*** at 16p12. Compare with nephronophthisis.

See also arginemia, gene at 6q23 (MIM 207800). Arginosuccinic aciduria gene at 7cen-q11.2 (MIM 207900).. Carbamyl phosphate synthetase-1 deficiency, gene on chromosome 2p (MIM 237300). Citrullinemia gene at 9q34, (MIM 215700). Ornithine aminotransferase deficiency, gene at 10q26 (MIM 258870). Ornithine transcarbamylase deficiency, gene at Xp21.1 (MIM 311250). Senior-Loken retinal-renal disease (MIM 266900). Medullary cystic kidney disease (AD) with early onset of kidney cysts. Medullary cystic kidney disease (AR) ***NPHI*** (MIM 256100). Familial juvenile nephronophthisis gene is at 2p24.1. Some of the patients with the oral-facial-digital syndromes (XD) also have cystic kidneys. Lethal in males. ***OFD1*** (MIM 311200), ***OFD2*** (MIM 252100), ***OFD3*** (MIM 258850), and ***OFD4*** (MIM 258860). Mutation in a gene at 11q24 can cause (AR) nephropathy and deafness.

Gene	How inherited	MIM number	Description
Gene	AD	102490	Acro-reno-ocular syndrome with horseshoe kidney, cardiac defect, thumb hypoplasia, polydactyly, Duane anomaly (MIM 126800), and optic nerve coloboma. Some of these patients are mentally retarded.
AK1 at 9q32	AD	102990	Adenylate kinase deficiency causes muscle rigidity, hyperpyrexia, tachycardia, and renal failure.
COL4A3 at 2q35-37, ***COL4A5*** at Xq22, ***ASLN*** at Xq22-q24	AR, XL, AD	301050 203780 104200	With Alport syndromes many have nephritis, and nephropathy. See Fechtner syndrome (AD). (MIM 153640). Compare with Epstein syndrome (MIM 153650).
GK1 at Xp21.3-p21.2	XL	307030	Glomerulocystic kidney disease. Hyperglycerolemia.
GCKD at 10q21	AD	137920	Glomerulocystic kidney disease.
MCKD1 at 1q21	AD	174000	Medullary cystic kidney disease.
C1QB at 1p36.3-p34.1	AR	120570	Mutation in a gene for complement subcomponent beta results in membranous glomerulonephritis-II.
C3 at 19p13.2-p13.11	AD	120700	Deficiency of complement component C3 causes nephritis, proteinuria, and pyogenic infections.
ADHR, DIR, AVPR2 at Xq28	XR	304800	Nephrogenic diabetes insipidus.
AQP2 at 2q13	AR	125800 107777	Nephrogenic diabetes insipidus.
NPHP1 at 2q13 Gene is nephrocystin. Gene may be at 9q22-q23 .	AR, AD	256100 266920 174000	Nephronophthisis-1, juvenile, or Loken-Senior syndrome with hereditary renal-retinal dystrophy, Saldino-Mainzer syndrome, growth failure, short stature, anemia, diabetes insipidus, renal dysplasia, tubulointerstitial nephropathy, hypertension, mental retardation, osteomalacia, cerebellar ataxia, deafness, hepatic fibrosis, convulsions, oculomotor apraxia, and sometimes cataract, rubeosis iridis, corneal opacities, retinitis pigmentosa, sector RP, narrowing of retinal arteries, and progressive loss of vision. Reach end stage renal disease by age 13 years. Many die before adulthood. The AD variety was called a salt-losing syndrome. Gene ***MCKD*** at 1q21. (MIM 174000). See the other salt-losing syndromes. With nephronophthisis some have oculomotor apraxia, see Cogan oculomotor apraxia (MIM 257550), others have retinitis pigmentosa, or Senior-Loken syndrome.(AR), (MIM 266900).
NPHP2 at 9q22-q31	AR	602088	Infantile nephronophthisis-2. Polycystic kidneys.
NPHP3 at 3q21-q22.1. ***SLSN3*** also maps here.	AR		May be called hereditary renal-retinal dystrophy, many subtypes. Reach endstage renal disease by about age 19. Compare with Senior-Loken syndrome (AR) (MIM 266900) who have nephronophthisis, Leber congenital amaurosis (5 subtypes), and retinitis pigmentosa (many subtypes).
NPHP4 at 1p36			Gene is nephroretinin. May also have Senior-Loken syndrome (MIM 266900) or one of the retinitis pigmentosa syndromes.
NPHL1, XRN, NLX at Xp11.22	XL	310468	Nephrolithiasis with renal failure.
NPHL2 at Xp11.22	XL	300009	Dent disease. Kidney stones, Fanconi syndrome ,and renal failure. See also ***CLCN5*** (MIM 300008) for chloride channel 5.
SRN1 at 1q25-q31	AR	600995	Congenital, steroid-resistant nephrotic syndrome.
MUT at 6p21.2-p12	AR	251300	Galloway-Mowat syndrome with microcephaly, hiatus hernia, and nephrotic syndrome.
NPHS1, NPHN at 19q13.1	AR	256300	Congenital nephrosis-1, Finnish type. Gene is nephrin.
FA1, FA, FACA at 16q24.3	AR	227650	Oculorenal, Lignac-Fanconi, or renotubular syndrome-1, renal rickets, dwarfism, renal failure. Cystine accumulates in lysosomes, and in conjunctiva, cornea, lens, and causes pupillary-block glaucoma, and patchy retinopathy. Child needs a renal transplant. See ***CTNS*** (AR) at 17p13 for cystinosis. (MIM 219800). See Diamond-Blackfan syndrome. ***DBA*** at 19q13.2. (MIM 205900).

ADPRT, PPOL at 1q42	AD, S	173870	Oculorenal, renotubular syndrome-II. Pseudogenes map to 13q34 and to 14q24.
SPAT at 2q36-q37	AR	259900	Renal failure and early death.
LDLR, FHH1, PCAR1 at 19p13.2-p13.12	AD	143890	Hypercholesterolemia, xanthomas, and corneal arcus. Death from renal failure.
Fraser syndrome, gene on chromosome 9 or ***FRAS1*** at 4q21.	AR, rarely AD	219000	Fraser cryptophthalmos-syndactyly affects about 1/250,000 live-born infants, maldeveloped kidneys, renal agenesis in 45%, anal stenosis in 29%, mental retardation, ambiguous genitalia, ear malformation in 69%, syndactyly in 61%, absent lacrimal ducts, and blindness. A few do not have cryptophthalmia. Compare with Bowen syndrome. (MIM 211200). A Fraser-like syndrome is AR. (MIM 229230).
PRODH at 22q11.2 MIM 237000, 239510. ***PCK1*** at 20q13.31	AR AR	239500 261680	Hyperprolinemia with congenital renal anomalies. Hypoglycemia with fatty kidneys and liver.
Gene	AR or XL	242050 278300	Hypouricemia, hypercalcinuria, and decreased bone density. Some secrete excess renal tubular urate. Exercise can cause renal failure. See also MIM 134600, 220150, 278300.
ASLN at Xq22-q24	XD	301050	Nephropathy and deafness. Genes are ***COL4A5*** at Xq22-q24 (MIM 303630) and ***DFN2*** (XL) at Xq22 (MIM 304500).
ALMS1 at 2p14-p13	AR	203800	Alström-Hallgren syndrome with nephropathy, diabetes, obesity, early loss of central vision, nystagmus, and retinitis pigmentosa.
EYA1 at 8q13	AD	113650	Melnick-Fraser branchiootorenal syndrome with polycystic kidneys.
PUJO at 6p21	AD	265380 143400	Familial, persistent hypertension of the newborn. In this lethal condition they develop pelviureteric junction obstruction, and secondary hydronephrosis.
Fanconi renotubular syndromes . ***FANCA*** at 16q24.3, ***FANCC*** at 9q22.3-q31, and ***FANCD*** in the region 3p26-p22.	AR	227700 227650 227640 227640 227800 134600	Adult Fanconi syndrome patients can have defects in at least 8 genes. Fanconi-1 (AR) in infants and children, (MIM 227700), Fanconi-2 (AR) in adults without cystinosis, onset about age 40, muscle weakness, hypouricemia, and hypophosphatemia, (MIM 227800), an adult renotubular type is (AD), (MIM 134600). A renal tubular defect, short stature, hypokalemia, hypophosphatemia, osteomalacia, aminoaciduria, and may have retinal hemorrhages. See also familial renal tubular urate hyposecretion (XL) and the Dalmatian type (AR) due to defective urate transport. Multiple alleles are common.
MUT at 6p21.2-p12	AR	251300	Galloway-Mowat syndrome, microcephaly, psychomotor retardation, hiatus hernia, nephrotic syndrome, and early death from renal failure.
ARPKD, PKHD1 at 6p21.1-p12	AR	263200	Infantile polycystic kidney and hepatic disease-1. Half die in the neonatal period. See the Holzgreve syndrome (MIM 236110). See Potter syndrome type 1. (AR). (MIM 263210).
Gene	AR	263100	Polycystic kidneys, cataract, congenital blindness, and early death.
May depend on a trisomy 18 anomaly.	AD	191830	Potter renal agenesis or renofacial syndrome, oligohydramnios, clubbing of hands and feet, spina bifida, pulmonary hypoplasia, hypertelorism, epicanthus, and down-slanting lid fissures.
CALM1 at 14q24-q31, ***CALM2*** at 2p21.1-p21.3, ***CALM3*** at 19q13.2-q13.3	AR	114180 114182 113183	Potter renofacial syndrome, oligohydramnios, clubbing of hands and feet, spina bifida, pulmonary hypoplasia, hypertelorism, epicanthus, and down-slanting lid fissures. The Potter sequence consists of a heart defect, cleft palate, polydactyly, and skeletal defects.
PKD at 16p13.11 to 16p13.33	AD	173900 601313	Potter type-3 polycystic kidney disease, severe with tuberous sclerosis.
PKD1 at 16p13.3	AD	173900	Gene is polycystin-I in the pyruvate dehydrogenase kinase family. **ADPKD** affects about 1/1000 and accounts for 85% of polycystic kidney disease cases and 7% of end stage renal diseases. Tends to have very early onset. May also have tuberous sclerosis. See type 2.
PKD2 at 4q21-q23 or at 4q13-q23.	AD	173910	Onset after age 30. This **ADPKD** is responsible for 10% to 15% of polycystic kidney disease,. Type 2 is milder than type 1.
PKD3 on chromosome 2 ***PKDTS*** at 16p13.3	AD AD	600666 600273	Polycystic kidney disease **ADPKD** type 3 (***ADPKD-III*** or ***APKD*** (MIM 173900) may be bilateral. Gene is **NOT** on chromosomes 4q or 16p. Severe Infantile, polycystic kidney disease with tuberous sclerosis.
PLD	AD	174050	Phospholipase D regulates some aspects of cell physiology and has a role in many cancers. Polycystic liver, kidney, and pancreatic cysts. Some have no kidney disease and no cerebral hemorrhage but repress expression of p21 gene. ***CDKN1A*** is at 6p21.2. (MIM 116899).
ERBB1, EGFR at 7p12.3-p12.1	AD	131550 164891	Mutation in this epidermal growth factor receptor gene causes polycystic kidney disease. Tyrosine kinase growth factor receptors are ***ERBB2*** at 17q21.1, ***ERBB3*** at 12q13, and ***ERBB4*** at 2q33.3-q34.

ONCR, PAX2 at 10q25.1	AD	120330 167409	Renal hypoplasia, renal coloboma syndrome, deafness, optic nerve colobomas, and morning glory disc syndrome.
RCA1, RCC1, HRCA1, FRA3B at 3p14.2, ***PTEN*** at 10q23.3	S, AD	144700 601728 158350	Renal carcinoma, familial associated. Some have a deletion from ***VHL*** at 3p26-p25 or from ***FHIT*** at 3p14.2 others have this translocation t(3;8)(p21;p24)
RCC, RCCP1 at 1q21, ***MET, HPRC*** at 7q31, ***RCCP2*** at Xp11.2 ***VHL*** at 3p26-p25.	AD, AR, XL	179755 312390 193300 164860	Renal cell carcinoma, papillary. The psoriasis susceptibility gene ***PSORS4*** also maps to 1q21. Some have this translocation t(X;1)(p11;q21).
OCRL1, LOCR, OCRL at Xq24-q26 or at Xq26.1	XR	309000 257970	Lowe Terry-MacLachlan, oculo-cerebro-renal syndrome with mental retardation, renal failure, rickets, osteomalacia, behavior problems, nystagmus, blue sclera, cataract, glaucoma, miosis, and corneal scars. Onset in infancy, affects only males, Usually have early death. Some have this translocation t(X;3)(q25;q26) or a deletion from ***OCRL1.***
REN at 1q32	AD	179820	Renin.
BRA at 5q11.2-q13.3	AD	191830	Bilateral renal agenesis, Incidence 1/3300, renal cysts, and urogenital dysplasia.
TKCR at Xq28	XD	314300	Renal dysplasia, cryptorchidism, keloids, and torticollis.
See ***CTNS*** at 17p13 for infantile nephropathic cystinosis	AR	219800	Lignac-Fanconi cystinosis. Defect of cystinosin affects about 1/300,000. Renal rickets, dwarfism, motor dysfunction. Cystine crystals accumulate in lysosomes and in the conjunctiva, cornea, and lens, and produce patchy retinopathy. This child needs a renal transplant.
conorenal syndrome ***SMS*** at 2q13 (But note ***SMS*** is also a symbol for Smith-Magenis progeria syndrome.	AR	266920	Saldino-Mainzer or Mainzer-Saldino syndrome, cerebellar ataxia, renal dysplasia, renal failure, nephronophthisis, skeletal dysplasia, cone-shaped epiphyses in the hands, Leber amaurosis, and retinal pigmentary dystrophy. Compare with: the Senior-Loken syndrome (MIM 266900), and the disease caused by gene ***NPHP1*** (AR) at 2q13 (MIM 256100).
SGLT1 at 22q11.2-qter	AR	182380	Slight, intermittent renal glycosuria. See ***SLC5A1*** (MIM 182380) and ***GLYS1*** (MIM 233100).
SGLT2 at 16p11.2	AD	182381	Renal glycosuria.
GLYS1	AR	233100	Problem in transport of glucose and sodium, renal glycosuria. May be linked to HLA. ***SGLT2*** is at 16p11.2 (MIM 182381), and ***SLC5A2*** is at 16p11.2. (MIM 182381).
MPST at 22q11.2-qter		602496	Mercaptopyruvate sulfur transferase
Renal tubular acidosis, several subtypes.: ***RTAI*** (AD) (MIM 179800), ***RTA II*** (XR) (MIM 312400), ***RTA III*** (AR) (MIM 267200), and ***RTA*** with deafness (may be AR) (MIM 267300).			
CA2 at 8q22 ***GLUT2, SLC2A2*** at 3q26.1-q26.3	AR AR	259730 138160 227810	Renal tubular acidosis-osteosclerosis syndrome. Fanconi-Bickel syndrome. Renal tubular acidosis with osteomalacia.
E4F1 at 16p13.3	AR	603022	Renal tubular acidosis with osteoporosis.
SLC4A1 at 17q21-q22	AD	109270	Renal tubular acidosis, distal.
ATP6B1 at 2cen-q13 ***CTNS*** at 17p13	AR AR	192132 219800	Renal tubular acidosis with nerve deafness. Nephropathic cystinosis.
SLC12A1 at 15q15-q21.1	AR	241200 602522 601678	Bartter syndrome-1 with renal tubulopathy and tyrosine negative oculocutaneous albinism. Some are deaf.
ROMK1 at 11q24	AR	600359	Bartter syndrome-2 with renal tubulopathy and tyrosine negative oculocutaneous albinism.
CLCNKB at 1p36	AR	602023 602024	Bartter syndrome-3 with renal tubulopathy and tyrosine negative oculocutaneous albinism.
SLC12A3 at 16q13	AR	600968 263800	Bartter syndrome, Gitelman variant, with renal tubulopathy and tyrosine negative oculocutaneous albinism.
BSND at 1p31	AR	602522	Bartter syndrome with renal tubulopathy and tyrosine negative oculocutaneous albinism. Some are deaf.
REN at 1q25-q32	AD	179820	The gene for renin may be at 1q32 or at 1q41-q42.
TAR gene may be at 22q11.	AR	274000	TAR syndrome affects about 1/250,000 infants causing thrombocytopenia, bleeding, excessive perspiration, absent radius bilaterally, knee or other leg problems, and renal malformation. About 7% are retarded. May have petechiae, deafness, cow's milk intolerance, and 13% have cardiac defects. May have cataracts, glaucoma, megalocornea, and blue sclerae. Treat with interleukin to stimulate thrombopoiesis. Most die young. For Roberts syndrome see MIM 268300. A similar syndrome is AD. Some have a splenogonadal fusion limb defect and micrognathia. **SGFLD**. (AD) (MIM 183300). They are stillborn or die in infancy.

Roberts syndrome. ***RBS***	C, AR	268300	Defective chromosomal replication, premature centromere separation, is similar to the TAR syndrome and to the Sc phocomelia syndrome. Signs are tetraphocomelia, growth retardation, deformities of the long bones, craniofacial anomalies, cleft lip/palate, and corneal opacity. About 1/3 die in their first year. May have normal intelligence. Some have ***SGFLD*** (AD) (MIM 183300) for the splenogonadal fusion limb defect with micrognathia. Most affecteds are male and soon die..
Sc PHOCOMELIA is allelic to **TAR** and to **Roberts** syndromes.	AR	269000	Was called SC-pseudothalidomide syndrome. Limb reduction, flexion contractures, growth retardation, micrognathia, hypotrichosis, silver-blonde hair, heart anomalies, mental retardation, and cloudy corneas. See also Holt-Oram syndrome (MIM 142900).
COL4A3 at 2q36	AR	233450 120070	Goodpasture autoimmune glomerulocystic disease occurs in young males. with glomerulonephritis, renal failure, hemosiderosis, proteinuria, anemia, retinopathy, hemorrhages, and rarely retinal detachment.
G6PT at 17q211	AR	232400	Glycogen storage disease-IIi.
VHL at 3p26-p25	S, AD	193300	von Hippel-Lindau syndrome, renal cell carcinoma, hypertension, and retinal angiomas. See under cancer.
VBP1 at Xq28	XL	300133	von Hippel-Lindau binding protein. Cerebroretinal angiomatosis with renal cancer.
TSC1 at 9q34, ***TSC2*** at 16p13.3	AD	191100 191092	Deficiencies of these genes cause tuberous sclerosis with renal cysts and angiomyolipomas.
WHCR at 4p16.3	C, S	194190 602952	Deletion here causes Wolf-Hirschhorn syndrome with renal hypoplasia, mental retardation, and CAG repeats. Signs appear after age 40. Huntington disease (AD) can be caused by a mutation in ***HD*** at 4p16.3. (MIM 143100).
Gene may be ***FGFR1*** at 8p11.2-p11.1.	AR	247990	MacDermot-Winter syndrome with hydronephrosis, immunodeficiency, failure of psychomotor development, microcephaly, and death in infancy. Some have adenosine deaminase deficiency.
CLCN5 at Xp11.22	XR	300008 300009	Nephronolithiasis-2, Dent disease (AD) MIM 300009), Fanconi syndrome (MIM 134600, 227800), kidney stones, chronic renal failure, proteinuria.
ORC The ORC cycle regulates DNA replication.	AR	257970	Oculorenocerebellar syndrome, lack a cerebellar granular layer, have spastic diplegia, jerky movements, mental retardation, sclerosis of renal glomeruli, and progressive tapetoretinal degeneration with loss of retinal vessels. Most die about age 10. The gene ***ORC5 L*** may have a role in myeloid disorders. (MIM 602331).
Nephrotic syndromes or **nephrosis** occur in the conditions listed below, and also in the ***FRNS*** syndrome (AR) (MIM 229850, 600770), the nail-patella syndrome (AD) (MIM 161200), hereditary persistence of alpha fetoprotein (AD) (MIM 104150), congenital nephrosis (AR) (MIM 256300), familial Mediterranean fever (AR) (MIM 249100), Galloway-Mowat syndrome (MIM 251300), sialic acid storage disease (AR) (MIM 269920), and with microcephaly hiatus hernia syndrome (AR) (MIM 251300).			
Deficiency of ***PMM2, CDG1a*** at 16p13.3-p13.2	XL, AR	601785 212065	Carbohydrate-deficient glycoprotein syndrome type 1a or Jaeken syndrome. The phosphomannomutase deficiency causes psychomotor retardation, hypotonia, cerebellar hypoplasia, and alternating internal strabismus. Many die in their first year.
ARC is also called ***ARCC-NDD***	XR, AR	208085 210550	Arthrogryposis, renal tubular insufficiency, and cholestasis. Some have diabetes insipidus, cerebral anomalies, Fanconi syndrome, jaundice, diarrhea, and deafness. Death in infancy.
ASH at 11p13	AD	194080	Denys-Drash syndrome, Wilms tumor, nephropathy, and gonadal dysgenesis.
NPHS1, NPHN at 19q13.1. ***SRN1*** at 1q25-q31	AR AR	602716 256300 600995	Congenital nephrotic syndrome, Finnish type. Gene is nephrin. Proteinuria or nephrosis at birth. Idiopathic, steroid-resistant nephrotic syndrome.
Edward's nephropathy	AR	256120 104200	Nephropathy, deafness, and hyperparathyroidism. See Am J Med Genet 1989;289-293. See Alport syndrome MIM 203780.
trisomy 18-like syndrome, (may also be called Edward's syndrome)	C	601161	This is the second most common trisomy. It affects more female than male babies. The meiotic nondisjunction mostly occurs in the mother's cells especially in an older mother. Affected infants soon die from anomalies of the heart and GI tract.
MUT at 6p21.2-p12	AR	251300	Galloway-Mowat syndrome with progressive encephalopathy, convulsions, hypsarrhythmia, edema, microcephaly, mental retardation, hypotonia, drowsiness, optic atrophy, and early death.
APRT at 16q22.2-q22.3	AD	102600	Kidney stones with a deficiency of adenine phosphoribosyl transferase.
DSL at 22q13.1	AR	103050	Kidney stones with a deficiency of adenylsuccinase.
DPYD at 1p22	AR	274270	Kidney stones with a deficiency of dihydropyrimidine dehydrogenase.
G6PT at 17q21	AR	232200	Kidney stones with glycogen storage disease-1a.

XRN, NPHL1 at Xp11.22	XL	310468	Nephronolithiasis with phosphatemia-III, and renal failure. See also ***CLCN5*** at Xp11.22 (MIM 300008), ***CLCN4*** (MIM 302910), and ***CLCN3*** (MIM 600580)
NOV at 8q24.1 or at 3q21-qter.	AD	164958	A mutation in this oncogene causes nephroblastoma.

Name	Gene	Comments
Killian or Pallister-Killian syndrome. (C). MIM 601803	***PKS*** Tetrasomy of chromosome 12p.	Mental retardation, seizures, and hypertelorism.
Kiloh-Nevin syndrome. (AD). MIM 164300	***OPMD*** at 14q11.2-q23 . One type is AR.	Progressive dystrophy of extraocular and facial muscles, muscle weakness, ataxia, ptosis, diplopia, may go to bilateral ophthalmoplegia. May have heart block or pigmentary retinopathy.
Kimmelstiel-Wilson diabetic glomerulosclerosis	Gene	Patients who have had diabetes mellitus for some years may develop: hypertension, nephrosis, proteinuria, elevated serum creatinines, nodular glomerulosclerosis, arteriosclerosis, and severe proliferative retinopathy with hyaline degeneration of retinal arterioles, retinal hemorrhages, exudates, and neovascularization.
Kimura disease. MIM 191044, 600692	Mutation in cardiac troponin-1 gene ***TNNI3*** at 19q13.41.	Angiolymphoid hyperplasia, eosinophilia, lymphadenopathy, dermal nodules, a nephrotic syndrome, proptosis, some have an orbital tumor. See ***TNNI1*** (MIM 191042), ***TNNI2*** (MIM 191043), ***TNNI3*** (MIM 191044), ***TNNT1*** (MIM 191041), ***TNNT2*** (MIM 191045), and ***TNNT3*** (MIM 600692).
Kindler syndrome. (AR). MIM 173650.	***KIND1*** at 20p12.3	Bullous poikloderma with photosensitivity and periorbital disease. Can be inherited (AD). See epidermolysis bullosa (AD) (MIM 131960).
KI2 or ***KIP2*** or ***p57*** MIM 600856	***CDKN1C*** at 11p15.5	This cyclin-dependent kinase inhibitor is a cell cycle regulator with a role in the development of moles and is a tumor suppressor. See Beckwith-Wiedemann syndrome. (AD, S) ***CDKN1C*** at 11p15.5
Kjellin syndrome. (AR). MIM 137800	Gene may be on chromosome 9p or at 10q25.1 or on 19q. .	Brain glioma with progressive degeneration, spastic paraparesis, dementia, leg weakness, speech problems, round yellow flecks in the posterior pole of the retina at the level of the RPE, and poor vision. One of several fleck retina conditions. See ***CDG1A*** (MIM 212065) and ***ABCA4*** at 1p21-p13 for Stargardt disease. (248200).
Kjer juvenile optic atrophy. (AD) MIM 165500	***OPA1*** at 3q28-q29	Onset in childhood, central scotoma, and may have a role in normal tension glaucoma.
Kline syndrome. (AD)	Gene	Deafness, syndactyly, partial albinism, hypertrichosis, hypertelorism, and blue irides.
syndrome	***HaNDL***	Headache, neurological defects, cerebrospinal fluid lymphocytosis, decreased vision with papilledema, and paralysis of CNVI. May relate to migraine. Acetazolamide lowers their intracranial pressure.
Klinefelter syndrome. (AR). MIM 254000	***47XXY***	This testicular hypoplasia affects 1/700 new-born boys and 1% of retarded males, can also cause ovarian dysgenesis, congenital muscular dystrophy, ocular colobomas, infantile cataract, and corneal opacities.
Klippel-Feil syndrome. (S, AD, AR) MIM 148900, 274270	***KFS*** at 5q11.2, ***DPYD*** at 1p22	More often appears in females. Have spinal anomalies, torticollis, short neck, heart defects, deafness, nystagmus, and esotropia. May develop paraplegia late in life. Compare with these syndromes: spinal segmentation syndrome-I, gene at 8q22.2, Larsen (AD), and less common (AR) subtypes. (MIM 245600) and ***DPYS*** at 8q22. (AR). (MIM 222748).
Klippel-Trenaunay-Weber syndrome. (AD). MIM 149000	***KTW*** possibly not inherited. A gene may be at 5p11 or on chromosome 5q.	Angioosteohypertrophy, vascular nevi, capillary angiomas, thrombosis, polydactyly, limb hypertrophy, enophthalmos, iris colobomas, and cataracts. Some similarity to Sturge-Weber syndrome (MIM 185300). Some have Kasabach-Merritt syndrome, (MIM 141000.
Kloepfer or Rosenthal-Kloepfer syndrome. (AD). MIM 102100	Gene Some may be inherited AR.	Progressive degenerative dementia develops in childhood, erythema, blistering in sunlight, cutis verticis gyrata, longitudinal skin folds, unilateral or bilateral corneal leukoma, blindness, and most die in their twenties.
Kniest dwarfism. (AD). MIM 156550	***COL2A1*** at 12q13.11-q12.2	Have abnormal collagen, metatropic dwarfism, short stature, kyphosis, deafness, ectopia lentis, cataracts, retinal detachment, and severe myopia. See MIM 245160 for a Kniest-like dysplasia with ectopia lentis. See MIM 245190 for a lethal Kneist-like syndrome.
Knobloch syndrome. (AR). MIM 267750	***KNO*** at 21q22.3, ***COL18A1*** at 21q22.3.	Have occipital encephalocele, normal intelligence, an increased risk of retinal detachment, vitreoretinal degeneration, and high myopia. Those with ***COL18A1*** have more risk of epilepsy.

Kohn-Romano syndrome (AD). MIM 110101	***BPES1*** at 3q23	Mostly affects males, have deformed ears, telecanthus, ptosis, divergent strabismus, and microcornea. See Wisconsin or Plott syndrome.(XR) (MIM 308850) with laryngeal abductor paralysis See ***FOXL2*** at 16q24.3. See also ***BPES1*** (AD) eyelid abnormalities and female infertility due to ovarian failure. With ***BPES2*** on chromosome 7p, have eyelid malformation but normal fertility is possible..
Komoto syndrome. (AD). MIM 600856	***CET, CDKNIC*** at 11p15.5 See ***p57(KIP2)*** gene. (MIM 600858)	Congenital eyelid tetrad, ptosis, epicanthus inversus, telecanthus, and blepharophimosis. The epicanthus and telecanthus may lessen over time but the ptosis and blepharophimosis usually need surgery. See Beckwith-Wiedemann syndrome, ***BWS***. at 11p15.5. (AD, S) (MIM 130650, 192500, and 603240).
Krabbe globoid cell leukodystrophy. (AR). MIM 245200	***GALC*** at 14q31	Deficiency of beta galactosidase, onset at age 4 to 6 months, is a variant of Sturge-Weber syndrome, with demyelination, progressive CNS degeneration, seizures, mental retardation, cerebral angiomas, nystagmus, retinal aneurysm, and optic atrophy. Life expectancy is less than 2 years, but infantile, juvenile, and adult-onset subtypes exist.
Kufs-Hallervorden syndrome. (AR, AD) MIM 204300	Gene	Often called Kuf's disease. Deficiency of leukocyte peroxidase. Adult amaurotic idiocy. A rare congenital idiocy is (AR) (MIM 204600). See amaurotic idiocy and ***CLN4*** (MIM 204300). Note Parry type neuronal ceroid lipofuscinosis is (AD) (MIM 162350).
Kugelberg-Welander syndrome. (AD, AR, XL) MIM 158600, 253400, 253550	***KWS***	Muscular dystrophy. Some types are inherited AR.
Kuhnt-Junius syndrome (AD, AR)	Gene	This macular degeneration is often called senile but can appear at any age and produces a central scotoma.
L.		
lacrimal ducts, imperforate (AD). MIM 149700	Gene	Some of these patients lack lacrimal puncta (AD) or have aplasia of the lacrimal glands, some lack canaliculi, many have a dry mouth. See also MIM 113620, 129900, 165600.
lactase deficiency. (S, AR?)	***LCT, LAC*** at 2q21	Milk intolerance.
lactic acidosis. (AR, AD, Mito).	***NDUFS1*** at 2q33-q34	The familial infantile type is inherited AD.
lactosyl ceramidosis (AR). MIM 245500	Gene questioned.	Deficient activity of beta-galactosidase, store lactosyl-ceramide in viscera, brain, connective tissue, and reticuloendothelial system. Psychomotor delay, hepatosplenomegaly, CNS degeneration, ataxia, lymphadenopathy, optic atrophy, and death in childhood.
Ladd-Levy-Hollister syndrome (AD). MIM 149730	***LADD***	Lacrimo-auriculo-dento-digital syndrome. Radial aplasia, malformed ears, deafness, renal and dental anomalies, dry mouth, triphalangeal thumbs, obstructed nasolacrimal ducts, and chronic epiphora.
Langer-Giedion syndrome. S, AD, AR). MIM 150230	The deleted gene is ***LGCR, LGS, TRPS2*** at 8q24.11-q24.12	Tricho-rhino-phalangeal syndrome-II with microcephaly, mental retardation, and loose skin. Some have iris colobomas.
Lanzieri syndrome	Gene	Present at birth, show dwarfism, skeletal anomalies, dental anomalies, skin atrophy, microphthalmia, and colobomas of the iris, choroid or optic nerve.
Laron dwarfism. (AR). MIM 262500, 245590	***GHR*** at 5p13-p12	Defective growth hormone receptors cause pituitary dwarfism.
Larsen syndrome. (AD). MIM 150250 (AR). MIM 245600	***LRS1*** at 3p21.1-p14.1	Osteochondrodysplasia. Multiple congenital dislocations, syndactyly, genital anomalies, heart defects, cleft palate, facial, dental, and skeletal defects, club feet, hypertelorism, cataract, and corneal neovascularization.
Laurence-Moon syndrome. (AR?). MIM 245800	Gene	Mental retardation, hypogonadism, spastic paraplegia, pigmentary retinopathy, and optic nerve atrophy. Compare with the Bardet-Biedl syndromes.
laryngeal adductor paralysis. (AD)	***LAP*** at 6p21.3-p21.2	Vocal cord dysfunction. Compare with laryngeal abductor paralysis. (XR) (MIM 308850).

Leber congenital amaurosis is the most severe inherited retinal dystrophy and the most frequent cause of inherited blindness in children. Leber amaurosis accounts for about 5% of all retinal dystrophies. Leber tapetoretinal dystrophy occurs from the teens to 30 years of age. This inherited retinopathy has the earliest age of onset and produces nystagmus with early loss of vision. See Saldino-Mainzer cerebellar ataxia (MIM 266920) and the Senior-Loken syndrome (AR), (MIM 266900) both of which may occur in Leber's congenital amaurosis. With the Loken-Senior syndrome have hepatic fibrosis, ataxia, and retinitis pigmentosa.

Some have a mitochondrial disorder or mutations in ***PEDF*** at 17p13.3 (see ***RP13***), or in ***CRB1*** at 1q31.3, or 1q31-q33, or in ***CRX*** at 19q13.3, or in ***RPGRIP1*** at 14q11. ***PEDF*** is a glycoprotein produced by the RPE and by the photoreceptors. It has neurotrophic and neuroprotective roles and may inhibit angiogenesis.

See ***PDEB*** at 4p16.3. See also a severe, early-onset retinal degeneration with a mutation in ***TULP1*** at 6p21.3. Some have a phosphodiesterase gene in retinal rods.

LCA-I. (AR). MIM 204000, 600179	***GUC2D, GUCY2D, CORD6, RETGC1*** at 17p13.1	***RETGC1*** converts GTP to CGMP. Mutation in guanylate cyclase causes mental retardation, deafness, cataract, and pigmentary retinopathy.
LCA-II. (AR). MIM 204100, 180069 535000	***RPE65*** at 1q31. See also ***CRX*** at 19q13.3. MIM 602225	***RPE65*** has a role in vitamin A metabolism in the retina. Mental retardation, keratoconus, cataract, RP, and blindness. Macular drusen in heterozygotes. Mutations in ***RPE65*** account for at least 10% of early-onset retinal degenerations. See Alstrom-Olsen syndrome (AR). (MIM 204100).
LCA-III. (AR, AD)	***CORD2*** at 14q24	Signs are cone-rod dystrophy, night blindness, and ADRP.
LCA-IV. (AR)	***AIPL1*** at 17p13.1. May have mitochondrial dysfunction.	Mutation in the aryl-hydrocarbon receptor interacting protein-like-1 accounts for 10% or more of recessive Leber cases. May have anterior lenticonus or keratoconus..
LCA-V. (AR)	Gene at 6q11-q16.	
Leber hereditary optic neuropathy. (Mito). MIM 535000	Any one of 15 mutations in mitochondrial DNA.	**LHON** mostly affects males in their 2nd or 3rd decade. Acute or subacute loss of vision, optic atrophy, and headache. Only maternal mitochondria are inherited. A few have AR mutations in autosomal genes.
lecithin-cholesterol acyltransferase deficiency. (AR)	***LCAT*** at 16q22.1	Faulty metabolism of cholesterol, hyperlipoproteinemia, anemia, renal failure, hypertension, corneal lipid deposits. Patients with Norum disease. (AR) lack alpha and beta ***LCAT*** but those with fish-eye disease. (AR) lack only alpha ***LCAT***.
Leigh necrotizing encephalo-myelopathy (Mito, AR). MIM 256000	***MTATP6*** at 8527-9702 or at nt 8993 or ***SDHA*** at 5p15	Hyper-alpha-alanemia, cytochrome C oxidase deficiency, infantile-onset progressive mental deterioration, ataxia, spastic quadriplegia, muscular weakness, respiratory failure, deafness, retinitis pigmentosa, nystagmus, optic atrophy, and blindness. See GM_2 type III. See ***NDUFS8*** at 11q13.1-q13.3 (MIM 602141). See also MIM 186520, 516060, and 312170.
leiomyomatosis, diffuse, with nephropathy. MIM 308940	***COL4A5*** at Xq22 MIM 303630	Leiomyoma of vulva and esophagus. See Alport syndrome. (XL, AD, AR).(MIM 301050, 308940). For a leiomyomatosis esophagogastric and vulvar. syndrome see MIM 150700
leiomyomatosis, cutaneous, multiple. (XL)	***ASLN*** at Xq22-q24	Malignant transformation is rare. See Alport syndrome.
leiomyomatosis, cutaneous multiple and uterine. (AD)	***MCUL1*** at 1q42.3-q43	May also act as a tumor suppressor.
leiomyomatosis, (AD). MIM 150800	***MCL*** at 18p11.2	Hereditary cutaneous leiomyomatosis may result from a deletion.
Lennox-Gastaut syndrome	Gene	Epilepsy.
Lenoble-Aubineau syndrome. (May be XD).	Gene	Affects males in childhood. Tremors of head and limbs, myoclonia, dental anomalies, and nystagmus.
lens, major intrinsic protein. MIM 154045	***LIM2, MP19*** at 19q13.4, ***MCL1*** at 1q21	**MP19** is the second most abundant protein in the lens and has a role in cataract. ***MCL1*** resembles ***BCL2***. (MIM 151430).
lentigenes, multiple syndrome. MIM 151100	Gene	
Lenz microphthalmia syndrome. (XR). MIM 309800	***MAA*** at Xq27-q28	Severe renal dysgenesis, with digital anomalies, severe speech impairment, lordosis, strabismus, colobomas, and nystagmus. Compare with these syndromes: Goltz (MIM 305600), Aicardi (MIM 304050), nonsyndromic colobomatous microphthalmia at Xp11.4-q11.1 (MIM 300345), and nonsyndromic anophthalmia ***ANOP1*** at Xq27-q28 (MIM 301590).
leprechaunism. (AR)	***INSR*** at 19p13.2	Defective insulin receptor gene. Insulin resistance, hyperglycemia. See diabetes. Donohue syndrome is more prevalent in females, fail to thrive,and have mental retardation.

Leri dwarfism. (AD) MIM 115430	***CTS1*** at 18q11.2-q12.2 .	Congenital; osseous dystrophy, joint anomalies, **carpal tunnel syndrome,** median nerve compression, microphthalmia, EOM paralyses, cataract, and corneal clouding.
Lermoyez syndrome	Gene	May be a form of Ménière disease, (MIM 156000), onset in third or fourth decade, dizziness, vertigo, deafness, and nystagmus. During an episode of vertigo and nystagmus their hearing improves. Some show aspirin intolerance.
Lesch-Nyhan syndrome (S, XR). MIM 308000	***HPRT1, LNS, HGPRT*** at Xq26-q27	Hyperuricemia and mental retardation. Most are in a wheelchair. Those with a partial ***HGPRT*** or ***HPRT*** deficiency develop gouty arthritis, and often ataxia.
Letterer-Siwe syndrome. (S, AR). MIM 246400	***LESD*** at 13q14-q31	Non-lipid histiocytosis, acute differentiated histiocytosis, has onset in infancy, prognosis iss poor. Note the relation to Hand-Schuller-Christian disease. (MIM 179615).
leucine zipper protein MIM 601422	***LUZP*** at 1p36	The gene ***TCF11*** at 17q22 is for transcription factor H . (MIM 600115). The gene for the kinase is ***ZPK*** at 12q13.

Leukemia, numerous types, mostly inherited AD, but many result from translocations. Acute lymphoblastic leukemia is the leading cause of cancer-related death in childhood. See also the blood dyscrasias.
See also Abelson leukemia ***ABL*** at 9q34.1 (AD) (MIM 189980).

leukemia-I. (AD)	***TAL1, TCL5, SCL*** at 1p32	Acute T-cell lymphocytic leukemia.
leukemia-II. (AD)	***TAL2, ESS1*** at 9q31	Acute T-cell lymphoblastic leukemia.
leukemia. (AD)	***TAN1*** at 9q34.3, ***RBTN1, RHOM1*** at 11p15	Acute T-cell lymphoblastic leukemia.
leukemia. (AD)	***LYL1*** at 19p13.2-p13.1	Acute T-cell lymphoblastoid leukemia.
leukemia. (AD)	***HOX11, TCL3*** at 10q24	Acute T-cell lymphocytic leukemia.
leukemia. (AD)	***RBTNL1, GHOM2, TTG2*** at 11p13 or 11p15. ***TCL2, WT1*** at 11p13, Also genes at 11q22-q23 and at 14q23.1.	Acute T-cell leukemia. For acute lymphoblastic leukemia the gene is ***LALL*** at 9p22-p21. (M(M 247640).
leukemia. (AD)	***IGJ*** at 4q21. May have a 4/11 translocation or this translocation t(15;17)(q22;q11).	The J chain links immunoglobulin to the secretory component.
leukemia. (AD)	***DEK, D6S231E*** at 6p23	Non-lymphocytic leukemia.
leukemia. (AR)	***LALL*** at 9p22-p21	Acute lymphoblastic leukemia.
leukemia. (AD)	***TCF3, E2A*** at 19p13.3	Acute lymphoblastic leukemia.
leukemia. (AD)	***D13S25, DBM*** at 13q14 or this translocation t(11;14)(q13;q22)	Chronic B-cell lymphocytic or lymphoblastic leukemia.
leukemia. (AD)	***RARA*** at 17q12 or ***PML, MYL*** at 15q22 or this translocation t(15;17)(q13;q32).	Acute promyelocytic leukemia.
leukemia. (AD)	***IRF1*** at 5q31.1 or a translocation involving ***ETO, MLIT1*** at 8q22.	Acute myelogenous leukemia.
leukemia. (AD)	***D9S46E, CN, ABL1*** at 9q34.1, ***AML1*** at 21q22.3	Acute myeloid leukemia.
leukemia. (XR)	***CSF2RA*** at Xp22.32	Acute myeloid M2 type.
leukemia. (AD)	***ABL1*** at 9q34.1, ***BCR, CML, PHL*** at 22q11.21, or this Philadelphia translocation t(9;22)(q34;q11)	Chronic myeloid or myelocytic leukemia. The gene for myeloid cell leukemia sequence 1 (***BCL9*** related) is at 1q21.
leukemia.	May have a translocation t(11;14)(q13;q32) or ***BCL-1*** rearrangements or a ***p53*** mutation.	Atypical, chronic, lymphocytic leukemia.
leukemia. (AD, XL).	***MLL, HRX, HTRX1*** at 11q23 or this translocation t(X;11)(q13;q23).	Myeloid/lymphoid or mixed lineage leukemia. ***GZMM*** at 19p13.3 is the gene for granzyme M which is one of the four serine proteases. (MIM 600311).
leukemia. (AD)	***KIT, PBT*** at 4q12	Mast-cell leukemia.
leukemia.	a translocation t(10;11)(p16;p11;q23)	Monocytic leukemia.
leukemia. (AD)	***RNR4*** at 21p12, ***MST*** at 21q11.2.	Transient leukemia.
leukemia. (AR) leukemia MIM 164785	***PKLR, PK1*** at 1q21 ***MDM2*** at 12q14.3-q15	Hemolytic, PK deficient leukemia. This oncoprotein binds ***p53*** and has a role in leukemia and in various tumors.
leukemia. (AD)	***PBX1*** at 1q23	Factor 1. Pre B-cell transcription
leukemia.	***PBX2*** at 3q22-q23	Factor 2. A pseudogene is ***PBXP1*** at 6p21.3
leukemia.	***PBX3*** at 9q33-q34	Factor 3.
leukemia/ lymphoma, B-cell type. (AD)	***BCL1*** at 11q13.3, ***BCL2*** at 18q21.3, ***BCL3*** at 19q13.1, ***BCL5*** at 17q22, ***BCL6*** at 3q27, ***BCL7*** at 12q24.1, ***BCL8*** at 15q11-q23, ***BCL9*** at 1q21.	A sporadic type has its gene ***ATM*** at 11q22.3. Mutation in ***BCL2*** (AD) (MIM 151430) causes follicular B-cell lymphoma. See also ***BCL-IIB***.

leukemia / lymphoma, T-cell type. (AD)	***TCL1*** at 14q32.1, ***WT1, TCL2*** at 11p13	Various translocations can also be involved. ***TCL1*** is for prolymphocytic leukemia the most common of mature T cell malignancies. The serpin genes map to 14q32.1 and so does the gene for Machado-Joseph disease. See also Hodgkin's disease (MIM 236000) and ***BCL-IIB***
leukemia / lymphoma, T-cell type. (AD). MIM 186860	***TCL4*** at 2q34 and a gene at 17p13.1	Sezary syndrome with erythroderma, alopecia, lymphadenopathy, pruritus, pain, and ectropion. See Leber amaurosis. ***LCA-I, CORD6***, and ***RETGC1***.
leukemia / lymphoma, (AD)	***TCRA*** at 11p13	Acute T-cell leukemia.
lymphoma, T-cell type, (AD)	***TCRA*** at 11p13, ***TCL1*** at 14q32.1, ***TCL4*** at 2q34, ***TIAM1*** at 21q22.1.	Various translocations can be involved
lymphoma, B-cell type. (AD)	***BCL2*** at 18q21.3, ***BCL3*** at 19q13.1, ***BCL6*** at 3q27	Various translocations can be involved. See also ***BCL-IIB***.
lymphoma, follicular B-cell type (AD)	***BCL2*** at 18q21.3, or this translocation t(14;18)(q32;21).	Regulates cell functions.
lymphoma, B-cell, Burkitt type. (AD)	***MYC*** at 8q24.12-q24.13	Deletions or translocations can also be involved.
lymphoma, diffuse, large-cell type. (AD)	***BCL6*** at 3q27	B-cell lymphoma.
lymphoma, centrocytic type. (AD).	***CCND1, PRAD1*** at 11q13	A gene for cyclin.

Leukoencephalopathies and **leukodystrophies**. The leukoencephalopathies are disturbances of the white matter of the brain, have defective myelination.

Leukodystrophies include: childhood ataxia with CNS demyelination, a leukodystrophy with linkage to chromosome 3, a megalencephalic type with subcortical cysts, and others. For an AD type see ***SAP1*** at 1q12-q23 or 1q32 and ***SAP2*** at 12q23.

Gene	How inherited	MIM number	Description
PXR1 at 12p13.3, ***PEX1*** at 7q21-q22, ***PEX10, JTV 1*** at 7q22.	AR	202370	Neonatal adrenoleukodystrophy, **NALD**, with mental retardation. ***PEX5*** may be the same as ***PXR1***. (MIM 600414)
ALD, ABCD1 at Xq28, ***APECED, AIRE-1*** at 21q22.3	XR	300100	X-linked adrenoleukodystrophy, onset in late childhood, is a peroxisomal disorder with impaired beta oxidation of **VLCFA**s, demyelination of the nervous system, Addison disease, adrenocortical insufficiency, peripheral neuropathy, ataxia, deafness, and some affected males are color blind.
ABCD2, ALDL1, ALDR at 12q11-q12		601081	An adrenoleukodystrophy-like syndrome. Cholesterol regulates ***ABCD2.*** ***PEX19p*** is an acceptor protein for the ABC transporters ***ALDP, PMP70***, and ***ALDRP***. (Do not confuse with ***ADLR1*** at 7q35 for aldose reductase, MIM 103880).
ABCD3, PMP70, XMP1 at 1p22-p21	AR	170995	An ATP-binding cassette transporter.
ASPA at 17pter-p13	AR, AD	271900	Canavan or van Bogaert-Bertrand spongy leukodystrophy, with megalencephaly, atonic neck muscles, and mental retardation..
GALC at 14q31	AR	245200	Child with Krabbe globoid leukodystrophy is deaf and blind.
PSAP at 10q21-q22	AR	176801 178603	Deficiency of the pulmonary surfactant protein SAP-1 causes neonatal respiratory failure, myoclonus, and hyperkinetic behavior. (***COL13A1*** maps to 10q22).
ARSA at 22q13.31-qter	AR	250100	Metachromatic leukodystrophy due to lack of arylsulfatase A activity. Hypotonia, unsteady gait, muscle weakness, and neuropathy. Infantile, juvenile, and adult-onset types. Greenfield disease is the late infantile type. See also the Austin variant. (MIM 141900).
PLP, PMD, PMLD at Xq22.	XR, AD, AR	311601 312080	Pelizaeus-Merzbacher progressive leukodystrophy with cerebral sclerosis.
leukocyte antigens ***MIC4*** at 11p13, and ***LAG5*** on chromosome 4	AD	600169 151450 601081	Antigens on the surface of B cells.include ***CD53*** at 1p13 and ***CD37*** at 19p13-q13.4.
Alexander disease. ***GFAP*** at 11q21-q23.	AR	203450	Dysfunction of astrocytes causes this fatal leukodystrophy. Alpha-B-crystallin accumulates in the brain (MIM 123590) causing megalencephaly, atrophy of the medulla oblongata and upper spinal cord, demyelination, Rosenthal fibers, hydrocephaly, mental retardation, dementia, and progressive spasticity. Most die in childhood but one subtype has an adult onset. Resembles Canavan disease. (MIM 271900). May relate to the presenilins. ***PRES1*** at 14q24.3 and ***PRES2*** at 1q31-q42. See also the ***Notch-I*** cleavage gene at 9q34.3. (MIM 190198).

Name	Gene	Comments
Lewy-body dementia. (AD). MIM 127750	***LBD, DLB, DLBD***	Probably is the second most common form of dementia. Have a deficiency of ApoA4. Are more likely to have debrisoquine 4-hydroxylase (***CYP2D6,*** at 22q13.1 (AR) (MIM 124030)). Degeneration of cortical cholinergic and striatal dopaminergic neurons. Degeneration of superficial cortex. Onset in late adulthood. Have neuritic plaques, progressive dysphasic dementia, psychosis, with hallucinations or delusions. The signs overlap with those of: Parkinson and Alzheimer diseases. The cholinesterase inhibitor rivastigmine helps some of these patients.
Liddle syndrome. (AD). MIM 600760	***SCN1B*** at 19q13.1-q13.2, ***SCN1G*** at 16p13-p12	Pseudoaldosteronism with renal failure, hyperkalemic alkalosis, hypertension.
Li-Fraumeni sarcoma family syndrome. (AD).	***p53, TP53*** at 17p13.1-p12	Mutations here cause many cancers. About 50% of those who carry the mutated gene develop cancer by age 30.
Lignac-Fanconi cystinosis. (AR). MIM 219800	***CTNS*** at 17p13	Defect in cystinosin, cystine accumulates in lysosomes. Rickets, dwarfism, renal failure, polyarthralgia, cystine crystals in conjunctiva, cornea, sclera, iris, and lens. Causes a cloudy cornea, pupillary block glaucoma, and patchy retinopathy. Need a renal transplant.
limb-girdle muscular dystrophy	Several genes.	See the muscular dystrophies.
limb-mammary or ulnar-mammary or Schinzel syndrome (AD). MIM 181450	***UMS*** at 12q23-q24.4. Gene may be ***TBX3*** MIM 601621.	Absent ulna, short radius, absent 4th and 5th fingers, obesity, delayed growth, abnormal teeth, and a ventricular septal defect. See also ***TBX5*** (MIM 601620).
lipase deficiency. (AR) lipoamide dehydrogenase deficiency. (AR)	***LIPA*** at 10q23.2-q23.3 ***DLD, LAD, PHE3*** at 7q31-q32	Wolman disease. (MIM 278000). A cholesterol ester storage disease. See maple syrup urine disease-III. (MIM 246900).
lipodystrophy, familial, partial, (AD). MIM 602094	***LDP1*** at 1q21, ***LFP, FPL*** at 1p11-q24	Kobberling-Dunnigan syndrome mostly affects females. Insulin resistant diabetes, lipoproteinemia type 4, accumulation of fat in neck, shoulders, and buffalo hump, enophthalmos, corneal opacity, and choroidal atrophy. Compare with Berardinelli-Seip lipodystrophy (AR). (MIM 269700).
Berardinelli-Seip lipodystrophy. (AR). MIM 269700	***BSCL2*** at 11q13.	Gene encodes the protein seipin. Disorder of the hypothalamus with high lipid levels. Congenital lipodystrophy, insulin-resistant diabetes mellitus, cardiac hypertrophy, hypertension, acanthosis nigricans, and corneal infiltration. Mutation in ***BSCL1*** at 9q34 causes a milder disease.
lipofuscinosis		See the ceroid lipofuscinoses.
lipomatosis encephalo-cranio-cutaneous syndrome	Gene	Haberland syndrome with developmental delay and mental retardation. Unilateral hamartomata of scalp, eyelids, and other parts of the eye.
lipoprotein binding protein.	***HDLBP*** at 2q37	High density lipoprotein binds proteins .
lipoprotein very low density, receptor MIM 192977	***VLDLR*** at 9q24	Important in triglyceride metabolism.
lipoprotein lipase. (AR)	***LPL, LIPD*** at 8p22	Hyperlipoproteinemia-I. (MIM 238600)
lissencephaly. (XL). MIM 300067	***LISX*** at Xq22.3-q23, ***DCX, DBCN*** at Xq22.3-q23	Severe mental retardation and seizures.
lissencephaly, Miller-Dieker type-I. (S, AD, AR, C). MIM 247200.	Deletion from ***MDCR***, ***MDLS***, ***PAFAH, LIS1*** at 17p13.3	Their cortex has only four layers instead of the normal six. Motor and mental retardation, microcephaly, and a congenital heart defect. Most die by 2 years of age. Patients with the Norman-Roberts syndrome (AR), gene at 17p13. (MIM 257320) have lissencephaly and microcephaly.
lissencephaly type-II. (AD, AR). MIM 600217	***LIS2*** at 2p11.2 or a pseudogene ***LIS2P*** at 2q13-q14.	Compare with these syndromes: Walker-Warburg (AR), gene ***COD-MD*** at 9q31-q33, (MIM 236670), ***HARD+/-E*** (AR) (MIM 228020), and Neu-Laxova (AR). (MIM 256520).
loiasis	Caused by the filarial worm *Loa loa.*	Have parasites in the anterior chamber and in the vitreous.

Loken-Senior syndrome. (AR) MIM 266900	***NPHP1*** at 2q13	Or Senior-Loken syndrome, see under kidney. Have nephronophthisis, ataxia, hepatic fibrosis, and retinitis pigmentosa.
Longfellow-Graether syndrome	Gene	Dilated retinal veins, attacks of monocular blindness, cause unknown.
Long QT interval. (AD, AR, S), see under cardiac anomalies, the Romano-Ward, Jervell and Lange-Nielson or surdocardiac syndromes.		
loricrin. (AR). MIM 152445	***LOR*** at 1q21	Is important in the epidermis. Mutation causes spherocytosis and keratoderma.
Louis-Bar syndrome. (AR, AD, S). MIM 208900	Four subtypes, ***ATM, AT1*** at 11q23. Other breaks may be at 7p14, 7q35, 14q12, or 14q32. Pseudogenes are ***PAFAH1P1*** at 2p11.2 and ***PAFAH1P2*** at 2q13.	Over 400 mutations are known. Thymic abnormality, defective DNA repair causes ataxia-telangiectasia, cerebellar degeneration, with dementia, and increases the risk of leukemia and other malignancies in heterozygotes. Red streaks in the conjunctiva at age 4 to 6 years. Show rapid blinking on upward gaze, nystagmus, telangiectasia of the anterior segment. They are hypersensitive to ionizing radiation.
Lowe-Terry-MacLachlan syndrome. (XL). MIM 309000	***OCRL1*** at Xq24-q26	See the oculo-cerebro-renal syndrome under kidney. Female carriers of this gene may have crystalline lens opacities.
Lowry-Wood syndrome MIM 226960	***LWS***	Short stature, epiphyseal dysplasia, microcephaly, and some have nystagmus, or retinitis pigmentosa.
lupus erythematosus, susceptibility to. MIM 601744	***SLE1*** at 1q41-q42.	Anemia, polyarthritis, ptosis, keratitis, corneal ulcer, and retinal detachment. .
lupus erythematosus. (S, AD). MIM 152700	***FCGR3A, CD16, IGFR3, FASL*** at 1q23, ***CD4*** at 12pter-p12. May also depend on a viral infection.	Systemic lupus erythematosus (SLE) is a chronic febrile disorder of connective tissue, affecting about 30/100,000, polyarthritis, fever, renal disease, anemia, CNS disorder, maculopapular rash, keratitis, corneal ulcers, paralysis of CNIII, nystagmus, mydriasis, orbital myositis, occlusion of central retinal vein, and retinal detachment.
lymphedema-1. (AD). MIM 153100	. Gene	Reduced number of lymphatic vessels. Nonne-Milroy early-onset, severe lymphedema, mostly below the waist.
lymphedema-2. (AD). MIM 153200	. Gene	Meige lymphedema especially in the legs, onset about age 12. May lack lateral third of the eyebrows and some have cleft palate and Increased risk of cancer.
lymphedema with ptosis. (AD). MIM 153000	. Gene	Adult-onset lymphedema of the legs. Have yellow nails and may have edema of hands , face, and genitalia. Compare with these syndromes: Noonan (MIM 163950) and Nonne-Milroy-Meige (MIM 153400).
lymphedema with distichiasis. (AD). MIM 153400	***FOXC2*** at 16q24.3. .	Late onset edema, signs may include heart disease, cleft palate, webbed neck, distichiasis, corneal ulcers, and ptosis. ***FOXC2*** is a forkhead transcription factor that may protect against insulin-resistant diabetes.
lymphoproliferative syndrome (XL). MIM 308240	***LYP, IMD5, XLP, XLPD*** at Xq25	Epstein-Barr infection, anemia, lymphoma, and immunodeficiency.
Lynch-1 cancer family syndrome.		See under cancer.
Lynch-2 cancer family syndrome.		See under cancer. Relates to Muir-Torre syndrome (MIM 120436).
lysosomal storage disorders. (AR)	***CLN1*** at 1p35-p33, ***CLN2*** at 11p15, ***CLN3*** at 16p12.1-p11.2	Specific genes cause other subtypes. Infants with lysosomal storage disorders and hydrops fetalis may have: mucopolysaccharidosis type VII (hydrops fetalis is common), Gaucher disease type 2 (hydrops fetalis is common), sialidosis, GM1 gangliosidosis, galactosialidosis hydrops fetalis is common in the infantile type, Niemann-Pick disease type L, Farbers lipogranulomatosis, infantile free sialic acid storage disease (ISSD) (hydrops fetalis is common), mucolipidosis-II, and I-cell disease. Large yellow-brown pingueculae, and cotton-wool spots in the retina
lysozyme. MIM 153450	Gene on chromosome 12.	See renal amyloidosis.
Anderson-Fabry disease. (XL). MIM 301500. See Fabry disease.	***GLA*** at Xp22.	Metabolic deficiency of lysosomal enzyme alpha-galactosidase A. Accumulate globotriaosylceramide. Pain attacks, renal failure, cardiac problems, hypotension, autonomic dysfunction, anhydrosis, acroparesthesia, rash, diffuse angiokeratoma, and whorl-like corneal dystrophy. Affected males die at age 40 to 50 but affected females live 15 or 20 years longer. Treat with alpha galactosidase A..

M.

MacDermot-Winter syndrome, (AR). MIM 247990	Gene may be ***FGFR1*** at 8p11.2-p11.1	May have adenine deaminase deficiency, hydronephropsis, growth deficiency, failure of psychomotor develoment, microcephaly, and death in infancy.
Machado-Joseph ataxia. (AD). MIM 109150	***SCA3, MJD1*** at 14q32.1	For this Azorean disease, also called Brown-Marie ataxia, the gene is serpin. Three subtypes. Signs are spinocerebellar degeneration, ataxia, dysarthria, dysphagia, fasciculations, pyramidal syndrome, CAG repeats, and external ophthalmoplegia.

Macrocephaly see Baraitser-Winter syndrome (AR), (MIM 243310). Gene may be at 2q12-q14. Signs are mental retardation, hypertelorism, ptosis, and iris colobomas. Note ***PAX8*** maps to 2q12-q14 (MIM 167415). True **macrocephaly** is (AD) with male predominance (MIM 153470). See also megalencephaly (MIM 155350).

Macular Dystrophies and Degenerations. Agenesis of the macula can be AD with microcephaly, nystagmus, central scotoma, and myopia. One XL syndrome with lipidosis and neurologic disorders has macular dystrophy. Some have an AR coloboma of the macula with skeletal anomalies, brachydactyly, cleft lip, retinal detachment, and myopia. Those with a macular halo have granular crystallized opacities in the fovea, and may have hyperlipidemia or hepatosplenomegaly.

Juvenile macular degeneration includes four groups of conditions.

(a).involving the neuroepithelium: Stargardt, dominant juvenile degeneration, central or peripheral pigmentary retinopathy, progressive dystrophy of the cones, and cystoid macular edema.

(b). involving the pigment epithelium: vitelliform degeneration, fundus flavimaculatus, Sjögren reticular dystrophy butterfly dystrophy, and grouped pigmentation of the macula.

(c). involving Bruch's membrane: hyaline dystrophy, drusen, and dominant progressive foveal dystrophy.

(d). involving the choroid: central areolar choroidal dystrophy and Sorsby's pseudoinflammatory dystrophy

Stargardt ***STGD3*** is the commonest early-onset macular degeneration. See Stargardt-2 macular dystrophy with flecks. (AD). See also ***ELOVLA*** (AD) possibly at 6cen-q14. For juvenile macular dystrophy (AR) the gene is ***CDH3*** which encodes P-cadherin. Signs are hypotrichosis, macular dystrophy, and blindness in the second or third decade.

Fenestrated sheen macular dystrophy (AD), (MIM 153890), onset in the sixth decade, a progressive yellowish sheen in the macula, and hypopigmentation of the retinal pigmented epithelium. See also retinal denerations and dystrophies. ***APOE*** at 19q13.2 transports lipids and ***ABCA4, ABCR*** at 1p21-p13 transports vitamin A.

See also Kuhnt-Junius macular degeneration. (AD, AR).

Coloboma of the macula (bilateral) may occur with type B brachydactyly (AD) (MIM 120400), skeletal defects, cleft palate, colobomas of the retina, choroid and macula, retinal detachment, and myopia.

An XL macular dystrophy patient may have lipidosis or a neurologic disease, signs includes changes at the posterior pole, night blindness, and reduced vision.

Gene	How inherited	MIM number	Description
VMD1 at 8q24.3	AD	153840 138200	Atypical vitelliform macular or foveomacular dystrophy. See ***GPT*** at 8q24.3. Glutamate pyruvate transaminase.
VMD2, BMD at 11q13	AD, S	153700	Best, juvenile-onset, vitelliform, macular dystrophy. An egg-yolk-like lesion at the macula before age 8 years. May leave a macular hole or a tear.
peripherin/RDS, RP7 at 6p21.1-cen	AD, S	179605	Adult vitelliform macular dystrophy. bull's eye, butterfly or Deutman dystrophy. Can also cause ADRP.
PRPH at 12q12-q13	AD	170710	Mutation in the gene for peripherin can cause butterfly or Deutman macular dystrophy.
Gene	AD	153870	Bull's eye macular dystrophy is a heterogenous group of disorders, with concentric annular hyperpigmentation in foveal and parafoveal region, and dyschromatopsia.
MDDC, DCMD, CYMD. at 7p21-p15	AD	153880	Dominant cystoid dystrophy. Leakage from perifoveal retinal capillaries, cystoid macular edema, beaten-bronze appearance of macula, decreased acuity, hyperopia, and strabismus.
EVR1 at 11q13-q23	AD, XL	133780	Exudative vitreoretinopathy-I. Criswick-Schepens syndrome. Gene may be caalled ***FEVR.*** Signs resemble those of falciform retinal detachment (MIM 221900) and pseudoglioma (MIM 264200). The gene ***VMD2*** for vitelliform macular dystrophy also maps in this vicinity.
ARMD1 at 1q25-q31	AD	603075 601691	Haab age-related macular degeneration. See also ***ABCR*** at 1p21-p13. ***ARMD2*** depends on ***ABCR***. (MIM 601691).
Sorsby-1 macular coloboma.	AD	120400	Dystrophy of the hands and feet, brachydactyly type B, (MIM 113300) renal agenesis, cleft palate, nystagmus, macular coloboma with sharply defined borders, and hyperopia.

Sorsby-2 macular dystrophy. Some have a mutation in ***ABCR*** at 1p22.1-p21.	AD	153800 601691	Onset in third or fourth decade of life, age-related macular degeneration, chorioretinitis, retinal hemorrhages, and macular dystrophy.
Sorsby-3, dystrophy, ***SFD*** at 22q13.1-qter	AD, AR	136900 264420	Pseudoinflammatory or hemorrhagic dystrophy, with onset in the fifth decade. Some may be caused by a mutation in ***TIMP3*** at 22q12.1-q13.2 (AD). Hemorrhagic macular dystrophy is **not** associated with the ***TIMP3*** gene.
ADMD at 6q14. Some have mutations in ***CACNL1A6*** at 1q25-q31.	AD	601013	Both ***STGD3*** (AD) and ***ADMD*** may depend on a deletion from ***ELOVL4*** at 6cen-q14. The band 6p11-q16 contains several genes including ***CORD 7***, ***MCDRI*** at 6q14-q16, progressive bifocal chorioretinal atrophy ***PBCRA*** at 6q14, and ***RP25*** and ***ELOVLA*** at 6cen-q14.
MCDR1 at 6q14-q16.2	AD	136550 600790	North Carolina non-progressive macular dystrophy often with drusen. Compare with bifocal chorioretinopathy. ***PBCRA*** (AD) at 6q14..
STGD1, ABCR, ABCA4 at 1p22.1-p21	AR	248200 601601 600110 153900	Stargardt macular dystrophy (AR). ***ABCR*** transports vitamin A.. For the AD types the genes are ***STGD2*** which is **NOT** at 13q34, and ***STGD3, ELOVLA*** at 6cen-q14, and ***STGD4*** (AD) on chromosome 4p.

Name	Gene	Comments
mad cow disease		Bovine spongiform encephalopathy. **BSE**
Maffucci syndrome (AR). MIM 166000	Mostly sporadic. Gene ?	See Ollier osteochondromatosis syndrome (MIM 166000). Perinatal death is usual. Those who also have hemangiomata are said to have the Maffucci syndrome. About 30% have a chondrosarcoma.
Majewski syndrome-2 (AR). MIM 263520	***SRPS*** may be at 4q13 or at 4p16	Neonatal chondrodystrophy, dwarfism, short rib polydactyly, cleft palate, lack eyelashes, have a persistent pupillary membrane, cataracts, and optic atrophy. Early death. Other subtypes are type 1 (MIM 263530), and type 3 (MIM 263510).
major affective disorder-1. (AD, XD) MIM 125480, 309200	***MAFD1*** relates to genes on chromosomes 4p, 5q, 11p, 13, 15, 18p, 21q, and Xq.	Manic-depressive psychosis, with increaased risk of suicide. See also genes at 1q21-q25, 6p21.3-p22.2, 9q33-q34, and 19p13.1-p13.4.
major affective disorder-2. (XD)	***MAFD2, MDX*** at Xq28	See manic depressive psychoses.
major histocompatibility complex, class 1-A. (AD)	One group is ***HLA-A*** at 6p21.3. Some class 2 genes are at 6p21.1. The ***DR*** group is at 6p23-p21.	Many subtypes exist. See Bodner et al . Nomenclature for factors of the HLA system. Tissue Antigens 1994;44:1-18.
major histocompatability complex class 1 chain-related gene	***MICA, MICB*** at 6p21.3	***MICA*** may relate to Behçet syndrome. MIM 109650. ***MICA*** (MIM 600169). ***MICB*** (MIM 602436).
major intrinsic protein of the lens fibers. (AD). MIM 154050	***MIP, AQPO*** at 12q13	***AQPO, AQP5***, and ***AQP6*** are all close together at 12q13
malattia Léventinese. (AD). MIM 126600.	***EFEMP1*** at 2p21-p16	Compare with: Doyne honeycomb choroiditis or dominant drusen of Bruch membrane. (MIM 182790).
follicle stimulating hormone. MIM 102480, 136530, 365300.	***FSHB*** at 11pter-p11.2, ***ACR*** at 22q13-qter	Has a role at puberty. May relate to ***WAGR*** gene (MIM 194072).
Malignant hyperthermia, see hyperthermia, malignant.. Six subtypes. Mostly inherited AD.		
Malpuech orofacial clefting syndrome (AR) facial clefting with mental and growth retardation and hypertelorism. (MIM 248340). Some overlap with Juberg-Hayward orocraniodigital syndrome, (MIM 216100).		
ML-II (MIM 252500) affects 1/6184 infants at birth in the Saguenay-Lac St Jean region of Quebec. See also ***DMPK*** (AD) at 19p13.3-cen (MIM 160900, 600963).		
Mannosidosis(AR). Patients with this disorder of mannosidase store glycoproteins containing mannose, are mentally retarded, and susceptible to infections. For beta neuraminidase deficiency the gene is at 6p21.3 (MIM 256550). See the sialidoses.		
alpha A type MIM 154580	***MANA1*** at 15q11-q13	Affects mannosidase. Onset in first year.
alpha II type MIM 154582 alpha B type. MIM 248500	***MANA2*** at 5q21-q22 ***MANB*** at 19p13.2-q12	Mannosidase. See ***MANA2X*** at 15q25. (MIM 600988). Lysosomal.
beta A type. MIM 248510	***MANB1*** at 4q22-q25	Lysosomal with deafness and mental retardation.

Maple syrup urin e diseases (AR). Occur in 1/200,000 births. Deficient oxidative decarboxylation of alpha-ketoacids, branched chain ketoacidosis. Those affected are mentally retarded and have seizures and coma. Some soon die but others live for 10 years. More common in the Mennonites of North America. Some are thiamine responsive.		
MSUD 1A MIM 248600	***BCKDHA, MSUD1*** at 19q13.1-q13.2	Branch chain dehydrogenase deficiency (alpha subunit) causes mental and physical retardation in their first postnatal week.
MSUD 1B MIM 248611	***BCKDHB, E1B*** at 6p22-p21	Intermittent form, deficiency of E1 beta subunit, with hyperaminoacidemia, growth retardation, mental retardation, and seizures,
MSUD-II MIM 248610	***DBT, BCATE2*** at 3q24 or at 1p31	Intermediate form, defect in E2 subunit, deficiency of branch-chain alpha-keto acid dehydrogenase. Onset after the newborn period.
MSUD-III MIM 246900	***DLD*** in the 7q31-q32 region .	Lipoamide dehydrogenase deficiency. Defect in the E 3 subunit.. Thiamine responsive.
Marcus-Gunn jaw winking syndrome. May be AD. MIM 154600	Gene	Aberrant nerves. Maxillo-palpebral synkinesis. Their external pterygoid muscle affects the levator palpebrae. Bilateral or unilateral jaw winking, unilateral ptosis, jaw movement causes the ptotic lid to rise. About 1/3 have strabismus, and amblyopia. Compare with Marin-Amat syndrome.
Marden-Walker syndrome (AR). MIM 248700, (AD). MIM 108120	***MWS*** May relate to distal arthrogryposis-IIb, one AR type is without psychomotor retardation. (MIM 600920)	Growth retardation, mental retardation, Zollinger-Ellison syndrome (MIM 131100), may have Dandy-Walker malfunction, absent corpus callosum, renal cystic disease, mask-like face, microcephaly, arachnodactyly, joint contractures, microphthalmia, blepharophimosis, ptosis, and strabismus. Schwartz-Jampel syndrome, (AR) gene ***SJS*** is at 1p36.1-p34. (MIM 255800). ***AMCD1*** (AD) at 5q35 is a gene for arthrogryposis multiplex, (MIM 108120).
Marfan arachnodactyly. (AD, S). Incidence 1/7,000. Form defective elastic fibers. The signs are kyphoscoliosis, pectus excavatum or carinatum, lax joints, heart problems, and emphysema. May have aneurysms, hernias, muscle underdevelopment, and long limbs with long fingers and toes. The affected person is tall, thin, has myopia, blue scleraas, and 80% have ectopia lentis. The lens can dislocate into the anterior chamber. Some have strabismus, exotropia, nystagmus, paralysis of accommodation, and retinal detachment. They have normal intelligence. Average age at death of Marfan patients is 40 for males and 50 for females.		
Marfan-I MIM 154700, 134797	***FBN1, MFS1*** at 15q21.1	Mutation affecting the fibrillin gene causes a disorder of connective tissue. Skeletal anomalies, joint contractures, scoliosis, pulmonary and kidney effects. See also ectopia lentis. Mutation in ***FBN2*** (AD) at 5q23-q31 (MIM 121050) causes congenital contractural arachnodactyly. (**CCA**)
Marfan-II. MIM 154705	***MFS2*** at 3p25-p24.2	A disorder of connective tissue.
an atypical Marfan syndrome. MIM 602090	***LTBP3*** at 14q24. See also ***LTBP2*** MIM 602091, and ***LTBP1*** at 14q24. MIM 150390).	Anomaly of transforming growth factor protein. See Achard syndrome (AD) (MIM 100700). Achard-Levi syndrome can be caused by a midbrain stroke, have dysostosis, and ligament laxity.
Marin Amat syndrome	Gene	Also called an inverted Marcus-Gunn phenomenon. One eyelid closes upon full opening of the jaw.
Marinesco-Sjögren syndrome. (AR). MIM 248800	***MSS*** at 18qter	Defective handling of lipids, demyelinating neuropathy, cerebellar ataxia, mental retardation, short stature, muscle weakness, scoliosis, microcephaly, congenital cataracts, nystagmus, strabismus, and some have hypogonadism and one developed leukemia. Some overlap with ***CCFDN***, have neuropathy, facial dysmorphism, and congenital cataracts.
Maroteaux-Lamay syndrome. (AD, AR). MIM 253200	***ARSB*** at 5q11-q13.	A lysosomal disorder with.deficiency of aryl sulfatase B See mucopolysaccharidosis-VI. (MIM 253200).
Marshall atypical ectodermal dysplasia. (AD). MIM 154780	***COL11A1*** at 1p21.	Hypohidrosis, deafness, flat mid-face, cleft palate, hypertelorism, esotropia, congenital cataract, fluid vitreous, myopia.
Martin-Bell syndrome. (XR, S). MIM 300031, 600819	***FMR1, FRAXA*** at Xq27.3	A fragile X syndrome. Have CCG or CGG repeats.
Martsolf syndrome. (AR). MIM 212720	One patient had trisomy 17. Gene	Affects mostly males, causing microcephaly, severe mental retardation, short stature, hypogonadism, congestive heart failure, and cataract.

Matsoukas syndrome. (AD, AR). MIM 156530, 250600	Gene	Metatropic dwarf ism with mental retardation and cataract. One AR subtype is lethal soon after birth. (MIM 245190). Compare with: the oculo-cerebro-articulo-skeletal syndrome. MIM 156530, 200600).
May-Hegglin anomaly (AD) MIM 155100	Gene	Thrombocytopenia, giant platelets, and Dohle leukocyte inclusions.
McArdle glycogenosis. , (AD). MIM 153460, (AR). MIM 232600	***PYGM, ARAD*** at 11q13.	Glycogen storage disease V with muscle weakness and cramping.
McCune-Albright polyostotic fibrous dysplasia. (S, AD). MIM 174800	***GNAS1, GNAS, GPSA*** at 20q13.2-q13.3	Pseudohypoparathyroidism, café-au-lait skin spots, osteodystrophy with endocrine anomalies, and some have a Cushing syndrome.
McFarland syndrome. (AR). MIM 245600	May have duplication of a gene at 16q22.	Joint dislocations, cleft lip, and hypertelorism. See Larsen syndrome. (AD, AR), MIM 150250, 245650.
McKusick-Kaufman syndrome. (AR). MIM 236700	***MKKS*** at 20p12.	Gene is chaperonin. Signs include polydactyly, cryptorchidism, hydrometrocolpos, and a congenital heart defect. See the Bardet-Biedl syndromes.
McKusick-Weiblaecher syndrome	Gene	Absence or deformity of a leg, scoliosis, imperforate anus, congenital cataract, and partial paralysis of CNIII.
McLeod neuro-acantho-cytosis syndrome. (XR). MIM 314850	***KX*** at Xp21.2-p21.1	Acanthocytosis and anemia. Progressive chorea begins in the fifth decade. ***KX*** forms a complex with the Kell protein. (MIM 110900).
Meckel or Meckel-Gruber syndrome. (AR). MIM 249000	***MKS*** at 17q21-q24	Have numerous malformations including Dandy-Walker type, encephalocoele, polycystic kidneys, and often polydactyly, microphthalmia, microcornea, cataracts, and partial aniridia. Resembles trisomy 13-15 syndrome. Die a few weeks after their birth. For Meckel type 2, see ***MKS2*** at 11q13. (MIM 603194). For Meckel diverticulum, see MIM 155140.
median cleft facial syndrome	Gene	Pai syndrome, have cleft upper lip, cleft palate, poiyps in facial skin, hypertelorism, iris colobomas, and down-slanting lid fissures.
Mediterranean fever. (AR)	***MEFV, FMF*** at 16p13	Marenostrin. Their polyserositis is treatable with colchicine.
medulloblastoma (AD). MIM 155255	***MDB*** at 17p13.1-p12. Another gene may be ***DMBT1*** at 10q25.3-q26.1.	May have a loss from chromosome 17q or amplification of ***MYCC***, or ***MYCN***, or ***MDM2*** or rarely a ***TP53*** mutation. (Reported **not** to have mutations in the tumor suppressor gene ***hSNF5/IN I1*** at 22q11.23.)
Meesmann corneal dystrophy.		See corneal dystrophy.
megalocornea.		See cornea.
Meige syndrome. (S, AD). MIM 117700	***CP*** at 3q21-q24	Copper accumulation, dysarthria, ataxia, blepharospasm, and a Kaiser-Fleischer corneal ring. Oromandibular dystonia causes dry eyes.
melanoma, familial multiple mole. (FAMMM), (AD, S)	***CMM1*** at 1p36, ***MG50*** at 2p25.3, ***CMM2*** at 9p13-p22, ***CMM3*** at 6q22-q23	See cancer, melanoma associated genes, and BK moles. See also ***CDK4*** at 12q14. ***CDKN2A*** and ***TP16*** are also at 9p13-p22.
MELAS syndrome (Mito). MIM 540000	***MTTL1*** at 3230-3304	Mitochondrial myopathy, encephalopathy, lactic acidosis, stroke-like episodes, and cataracts. See ***MERRF*** for myoclonic epilepsy with ragged red fibers (MIM 545000) and see Kearns-Sayre syndrome (MIM 530000).
Melatonin is produced by the pineal gland and is understood to have a regulatory role. Genes for receptors for melatonin are ***MTNR1A*** at 4q35.1 and ***MTNR1B*** at 11q21-q22.		
Melkersson-Rosenthal syndrome. (AD)	***MROS*** at 9p11	Chronic edematous swellings of the face, lid edema, lagophthalmos, keratitis, and corneal opacities.
Melnick-Fraser syndrome. (AD)	***EYA1, BOR*** at 8q13	Deletion causes branchio-oto-renal dysplasia with deafness, and preauricular pits.
Melnick-Needles osteodysplasty syndrome. (XD, AR) MIM 309350, 249420	***MNS*** at Xq28	May be the same as frontometaphyseal dysplasia. See also otopalatodigital syndromes 1 and 2. Sclerosis of skull base, bowel, radius and ulna, vertebral anomalies, exophthalmos, and strabismus. Often lethal to a male fetus.
Menetrier syndrome (AD) (MIM 137280). Familial giant hypertrophic gastritis.		

Ménière disease (AD) MIM 156000	Gene ? Family concentrations are unusual.	Enddolymphatic hydrops with episodic vertigo, nausea, vomiting, tinnitus, and progressive deafness. Mostly seen in males age 40 to 60 yearss. Giaant cell arteritis, facial paralysis, nystagmus, with attacks of vertigo and tinnitus. Compare with Lermoyez syndrome where the attacks last for several hours but the hearing loss lasts for days to months Can become bilateral. See vestibulocerebellar ataxia. (MIM 108500).
meningomyelocele (AD). MIM 207950.	Gene	Arnold-Chiari malformation has an incidence of 1/750. The posterior neural tube fails to close, have spina bifida, hydrocephalus, and bladder and bowel incontinence. Four subtypes are known.
Menkes kinky hair syndrome. (XL). MIM 300011, 309400	***ATP7A*** at Xq13.3	This defective copper transportation affects about 1/75,000 male infants. Signs include spastic diplegia, mental retardation, seizures, strokes, diarrhea, lax skin, kinky hair, and short stature. Some have iris cysts, cataracts, or optic atrophy. See also Wilson disease (AR) (MIM 277900) and the milder occipital horn syndrome (XL) (formerly Ehlers-Danlos IX). See cutis laxa, (MIM 304150).
A **metabolic disease** of some type affects 1/3,000 newborns.		

Mental Retardation (IQ less than 70) includes more than 75 different conditions. Mental retardation is the most common developmental disability, affects at least 3% of the population, and affects 7/1,000 children. More than 900 genes can be involved. Trisomy 21 is the most common cause of mental disability. Mental retardation of the X-linked type affects 1/600 males. More than 100 mutated genes causing mental retardation are on the X chromosome. Mutations at fragile sites (see Xq27-q28) are common causes of mental retardation, mostly among boys. Rett syndrome causes a progressive retardation in girls. Among congenitally blind children about 20% are mentally retarded.

Alcohol is the most common identifiable teratogenic cause of mental retardation in North America. The gene for the fetal alcohol syndrome is ***FAS*** at 12q24.2. The commonest amino acid causes of mental retardation in India are: hyperglycemia, homocystinuria, alkaptonuria, and phenylketonuria.

Early-onset dementia (AD) can be caused by mutations involving amyloid precursor protein ***APP***, and presenilins1 and 2. See also the tau protein gene ***MAPT, FTDP17***, and ***PI12.*** Some dementia relates to genes on chromosomes 3, and 20, and to ***DRPLA,*** and to prion protein. Deletion from a gene in the region of 3p25-pter causes low birth weight, mental retardation, micrognathia, telecanthus, and ptosis. One AR condition includes mental retardation, ptosis, and polydactyly. Some with a trisomy involving 15q25-qter, get craniosynostosis and mental retardation. Mutations or deletions involving ***ARX*** at Xp22.1-p21.3 can cause mental retardation and epilepsy. (MIM 309510). Mutations in a gene at MIM 309620 cause mental retardation, skeletal dysplasia, and abducens palsy.

Walker-Warburg syndrome (AR) gene is ***COD-MD*** at 9q31-q33 or ***POMGT1***, (MIM 236670). Signs are mental retardation, congenital glaucoma, and high myopia.

See also schizophrenia, Parkinson disease, Huntington disease, Wolf-Hirschhorn syndrome and the dementias such as Creutzfeldt-Jakob syndrome (AD) ***PRNP, PRIP*** at 20pter-p12, familial dementia (AD) ***DEM*** at 3p11.1-q11.2, and olivopontocerebellar atrophy-V (AD) ***OPCA5*** with ataxia, chorea and rigidity.

Mutations in genes affecting phenylalanine kinetics seem to have a role in psychotic disorders.

All conditions in this list typically include mental retardation among their manifestations unless some other mental condition is mentioned.

Among the mentally retarded 52% have ametropia, 25% have epilepsy, 20% have amblyopia, 13% have anisometropia, 10% have anophthalmia, and 9% have Down syndrome.

Gene	How inherited	MIM number	Description
AHO1 at 20q13.2-q13.3	AD, AR, XL	103580 300800	Albright osteodystrophy 1. Hypothyroidism and seizures.
AHO2 at 15q11-q13, ***GNAS1*** at 20q13.2-q13.3	AD, XL, AR	103581	Albright osteodystrophy 2. Hypothyroidism and tetany.
BDMR at 2q37	AD	600430	Albright osteodystrophy 3. Mental retardation.
ALDOA at 15q22-q24	AR	103850	Aldolase A deficiency.
PEX1 at 7q211-q22	AR	602136	Adrenoleukodystrophy with seizures, cataracts, and esotropia.
AHDS at Xq21	XL	309600	Allan-Herndon-Dudley syndrome with hypotonia and severe mental retardation.
HBHR, ATR1 at 16pter-p13.3	AD	141750	Deletion here causes alpha-1 thalassemia with microcephaly and hemoglobin H disease.
ATR at 16p13.3	AD	14175-0	
ATRX at Xq21.1-q12	XR	301040	Alpha thalassemia with mental retardation.

Alexander disease ***GFAP, ALX*** at 11q21-q23 . Three subtypes.	AR, AD	203450	Dysfunction of astrocytes causes this fatal leukodystrophy.. Alpha-B-crystallin accumulates in the brain. Signs are megalencephaly, hydrocephaly, demyelination, many Rosenthal fibers in brain tissue, and mental retardation. Have progressive spasticity, seizures, and dementia. Most die in childhood but others have an adult-onset type. Resembles Canavan disease (AR) ***ASPA*** at 17pter-p13, (MIM 271900).
ALSS, ALMS1 at 2p14-p13.	AR	203800	Allström-Hallgren syndrome with argininosuccinicaciduria
amaurotic idiocy	AR	204600	Two subgroups: (a) gangliosidoses GM1, GM2 and GM3 with subtypes. (b) neuronal ceroid lipofuscinoses, several subtypes A rare congenital type is AR. (MIM 204400).and late infantile (AR) (MIM 204500), and juvenile (AR) (MIM204200) types also occur. Most have late-infantile onset, seizures, epilepsy, dementia, and blindness. Adult types are : Kufs disease (AD but can be AR) (MIM 204300) adult Parry type (AD) (MIM 162350).
UBE3A at 15q11-q13 deletion. Inherited from the mother.	may be AD	105830	Angelman syndrome. Child moves jerkily, puppet-like, has insomnia, does not learn to speak, has severe mental retardation but is happy. Compare with Prader-Willi syndrome. (MIM 176270).
ASL at 7cen-q11.2	AR	207900	Argininosuccinicaciduria with seizures and rough skin.
Gene	AR	204730	Aminoaciduria, dwarfism, muscular dystrophy, osteoporosis, and mental retardation.
ED1, HED at Xq12.2-q13.1.	XL	305100	Anhidrotic ectodermal dysplasia. See Christ-Siemens-Touraine syndrome. Some are retarded.
ANOP1 at Xq27-q28	XL	301590	Anophthalmia-I.
ARG1 at 6p23 ***ASL*** at 7cen-q11.2	AR AR	207800 207900	Argininemia with seizures. Arginosuccinaciduria with rough skin and seizures.
AGA at 4q32-q33	AR	208400	Aspartylglycosaminuria is the third commonest cause of mental retardation.
ADR	AR	208850	Ataxia, progressive deafness, mental retardation manifest in infancy. Possibly linked to red hair. Differs from the Richards-Rundle syndrome (MIM 245100). See MIM 212710 (AR) with retardation, deafness, ataxia, and cataract.
Gene	XL	301840	Ataxia, delayed walking, tremor, pyramidal tract signs, and adult-onset dementia.
BBS1 at 11q13	AR	209901	Bardet-Biedl syndrome-I with polydactyly, obesity, renal disease, and retinitis pigmentosa. See also ***BBS3***. (MIM 600151).
GM2A at 5q31.3-q33.1	AR	272750	Bernheimer-Seitelberger variant of Tay-Sachs disease, (MIM 272800), have a cherry-red macula, seizures, mental retardation, and blindness.
Gene at 2p12-q14. (***PAX 8*** is at 2q12-q14).	AR, XL	243310	Baraitser-Winter syndrome. Microcephaly, obesity, mental retardation, down-slanting lid fissures, iris colobomas, ptosis, and hypertelorism. Resembles Noonan syndrome. (MIM 163950).
Gene	AR	249599 241080	Belgian type moderate mental retardation, mild deafness, alopecia, seizures, hypogonadism, diabetes mellitus, and electrocardiographic abnormalities.
BDMR at 2q37	AD	600430	Brachydactyly is often the result of a deletion.
CAMFAK	AR	212540	An inherited demyelinating disease similar to Cockayne syndromes. (MIM 216400), severe spasticity, bilateral hip dislocation, microcephaly, arthrogryposis, kyphosis, demyelination, and severe mental retardation. See also ***CAMAK*** syndrome. (MIM 212540).
CAHMR	AR	211770	Congenital lamellar cataract, hypertrichosis, and mental retardation.
Gene	AR	212710	Congenital cataract, ataxia, polyneuropathy, mild mental retardation, and later-onset deafness. Compare with the ***ADR*** syndrome.(MIM 208850).
ASPA at 17pter-p13 ***CFC*** at 12q24	AR AD	271900 115150	Canavan disease, megalencephaly, and atonia of neck muscles. Cardio-facio-cutaneous syndrome with congenital heart defect, and nystagmus. See Noonan syndrome. (AD). (MIM 163950).
CES, CECR1 at 22q11.2.	C, S, AD	115470	Cat-eye syndrome, Schmidt-Fraccaro syndrome with ear malformation, and iris colobomas.
CADASIL at 19p13.2-p13.1.	AR	600142	Cerebral arteriopathy and subcortical infarcts with thin skin, alopecia, and disc disease. See the ***Notch-3*** gene (MIM 600276).
CASIL at 19p13.2-p13.1	AD	125310	Causes 10% of all dementias. Multiinfarct dementia, subcortical infarcts, and leukoencephalopathy. Cerebrovascular infarcts, seizures, strokes, and depression. See the ***Notch-3*** gene (MIM 600276).
PXMP3 at 8q21.1	AD	170993	One of the cerebrohepatorenal or Zellweger syndromes, type III. For type III (AR) the gene is ***PXMP3*** at 8q21.1.

NLS at 1q23 or 16q13, or these AD genes ***XPD*** at 19q13.2-q13.3, ***XPG*** at 13q32.3-q33.1 or ***CSB*** at 10q11-q21.	AR, AD	214150	Cerebro-oculo-facial-skeletal (**COFS**) or Pena-Shokeir-II syndrome with microcephaly, deafness, and cataracts. Death in childhood. They are UV sensitive. Compare with Cockayne syndromes as there is some overlap. One patient had this translocation t(1;16)(q23;q13).
One gene is ***CLN1*** at 1p32.	AR	256730	Ceroid lipofuscinosis, neuronal.There are eight subtypes of lipofuscinosis.
Genes	AD, AR, XR		See Charcot-Marie-Tooth syndromes. Multiple subtypes aree known..
CDPX1, CDPXR at Xp22.3	XR, XD	302950	Chondrodysplasia punctata with deafness.
One gene is ***CSB, ERCC6*** at 10q11-q21	AD	133540	Cockayne syndromes. Three subtypes, most are inherited AR.
CLS, RSKS at Xp22.2-p22.13	XR, XD	303600	Coffin-Lowry facio-digital syndrome. Mental retardation, deafness, and stooped posture. The disease is mild in female heterozygotes.
COH1 at 8q21.3-q22.1, ***CSF1*** at 5q33.1, ***NYP*** at 7p15	AR	216550	Cohen or Pepper syndrome with hypotonia, microcephaly, craniofacial anomalies, cheerful disposition, chorioretinal dystrophy, myopia, and poor night vision.
FCMD at 9q31-q32	AR	253800	Fukuyama syndrome, congenital muscular dystrophy, and mental retardation.
DFN4 at Xp21.2	XL	300030	Congenital sensorineural deafness and some may have retinitis pigmentosa and mental retardation.
PTEN, MMAC1 at 10q23.3.	AD	158350 601728	Cowden disease with hamartomas of skin, breast, thyroid, and intestine and renal cell carcinomas. Some are retarded and have seizures and ataxia.
PRNP, PRIP at 20pter-p12.	AD	1234001 176640	Creutzfeldt-Jakob dementia is a prion disease. A variant type with gene ***vCJD*** has been identified.
Deletion from ***CTNND2*** at 5p15.2 to 15.3, especially from 5p15.2.	C	123450	Cri du chat, or LeJeune syndrome affects 1/50,000 newborns, have encephalomyeloneuropathy and progressive scoliosis. Most have a low IQ and die young. The gene is for a delta catenin. ***CdCS***. Deletions from chromosomes 11p and 13q can be involved in this cat cry syndrome.
ATP7A, OHS at Xq13.3	XL	304150 300011	Cutis laxa of the neonatal type with mild mental retardation.
CTH on chromosome 16.	AR	219500	Abnormal functioning of cystathionase, causes cystathioninuria, seizures, thrombocytopenia, and may have mental retardation and urinary calculi.
DEM at 3cen or at 3p11.1-q11.2	AD	600795	Dementia, familial, non-specific. Onset at a younger age when paternally inherited. See also frontal lobe dementia **FLDEM,** for which the gene is ***MAPTL*** at 6p21.2-p12. (MIM 157160).
DSCR at 21q22.3	C, S, AR	190685	Down syndrome, trisomy 21.
DYDT at 9q32-q34	AR	221200	Eldridge syndrome with deafness, myopia, and intellectual impairment.
EPMR at 8pter-p22	AR	600143	Juberg-Hellman syndrome. Epilepsy of the progressive northern type, often become seizure-free after age 35.
EFMR at Xq22	XL	300088	Juberg-Hellman syndrome with epilepsy, is female-restricted,.
MELF at 6q24	AR	254780	Epilepsy and myoclonus with congenital deafness,
FA1, FACA at 16q24.3	AD	227650	Fanconi-I anemia with pancytopenia, small stature, microcephaly, deafness, defects of heart and kidney, and strabismus.
FGS1 at Xq12-q21.31	XL	305450	FG syndrome with a large head, deafness, and hypotonia.
FMR1, FRAXA at Xq27.3. See also ***FXR1*** at 12q13.	XR, S	309550	Fragile X syndrome, Martin-Bell syndrome. Seen in 8% of males with a mental handicap, mainly affects boys, severe neonatal retardation (average IQ is about 40), macroorchidism, large ears, and expanded CGG or CCG repeats. High refractive errors.
MAPTL, MSTD, DDPAC at 6p21.1-p12	AD	600274 601630	Frontotemporal dementia with parkinsonism. Microtubule associated protein tau. See ***FTDP-17*** at 17q21.11.(MIM 157140)
FRAX3	XL		
FRNS gene may be on chromosome 6, 15, or 22.	AR	229850	Fryns syndrome affects 7/100,000 infants, Dandy-Walker malformation, hydrocephalus, osteochondrodysplasia, diaphragmatic defects, lung hypoplasia, congenital heart defect, nephrotic syndrome, distal limb defects, cloudy cornea, retinal dysplasia. Some similarity to Pallister-Killian syndrome. About 14% survive the neonatal period, most have normal chromosomes but one had tetrasomy 12p and another had trisomy 22. The immunosuppressant Mizoribine may help these patients.
FUCA1 at 1p34, ***FUCA2*** at 6q25-qter	AR AR	230000 136820	Fucosidosis with osteochondrodysplasia and hepatomegaly.

MUT at 6p21.2-p12	AR	251000 251300	Methylmalonic aciduria due to methylmalonic CoA-mutase deficiency. Galloway-Mowat syndrome, about 30 mutations produce a wide spectrum of severity, microcephaly, CNS disorder, cerebellar atrophy, hiatus hernia, hypotonia,, early-onset nephrotic syndrome, glomerulosclerosis, and early death from renal failure. For type III methylmalonic aciduria, (AR) see MIM 251120.
GLB1 at 3p21.33	AR	230500	Morquio disease type B. Gangliosidosis-I.
t(X;11)(p22.32;p12)	AR	307030	Gillespie syndrome with cerebellar ataxia, and aniridia.
GGT1, GTG at 22q11.1-q11.2	AR	231950	Glutathioninuria.
GK at Xp21.3-p21.2	XR	307030	Glycerol kinase deficiency. Hyperglycerolemia
BCNS at 9q22.3-q31	AD	603404	Gorlin-Goltz syndrome, basal-cell nevus, often with glaucoma.
PRPS1 at Xq22-q24, ***PRPS2*** at Xp22.33-p22.2	XL	311850 311860	Gout, phosphoribosyl-pyrophosphate-related, with seizures, deafness, ataxia, and cardiomyopathy.
MRGH at Xq22-q27.1	XL	300123	Growth hormone deficiency and mental retardation.
IGF1 at 12q22-q24.1	AD	147440	Deficiency of somatomedin C, insulin-like growth factor causes growth retardation and deafness. For somatomedin A, the gene ***IGF2*** is at 11p15 (MIM 147470).
HND at 11q13	AR	234500	Hartnup disease with encephalopathy, progressive mental retardation, light-sensitive dermatitis, cerebellar ataxia, scleral ulcers, and corneal scars.
HMSN-XI at Xq11.2-q12	XL	302800	Hereditary motor and sensory neuropathy
ED2 at 13q11-q12	AD	129500	Hidrotic ectodermal dysplasia. Clouston syndrome with strabismus.
CBS at 21q22, ***MTHFR*** at 1p36.3	AR	235200 235250	Homocystinuria, ectopia lentis, and retinal detachment.
HHH at 13q34	AR	238970	Hyperammonemia with paraparesis and epilepsy.
AMT at 3p21.2-p21.1	AR	238310	Hyperglycerolemia, hyperglycinemia.
GK at Xp21.3-p21.1	XL	307030	Hyperglycerolemia.
BBBG at 5p13-p12	AD	300000 145410	Hypospadias-dysphagia. Opitz syndrome with esophageal abnormality, heart disease, cleft lip, and hypertelorism. See other Opitz syndromes.
CLN3 at 16p12.1-p11.2	AR	204200	Imidazole aminoaciduria. Batten ceroid lipofuscinosis.
SLC1A1 at 9p24	AR	133550	Iminoglycinuria with gyrate atrophy of the choroid and retina. See Fuchs gyrate atrophy. ***OAT*** at 10q26.
PAX8 at 2q12-q14.	AR	167415	Iris colobomas, ptosis, and hypertelorism. Some have a translocation.
PTHR1 at 3p21.3-p21.2	AD	168468 156400	Jansen syndrome with chondrodysplasia.
DFN1, DDP at Xq22	XL	311150 304700	Jensen syndrome with opticoacoustic nerve atrophy and dementia.
ATD may be at 15q13 or on chromosome 12p	AR	208750 208500	Jeune syndrome-II is a thoracic-pelvic-phalangeal dystrophy, four subgroups: lethal, severe, mild, and latent, with cardiomyopathy, nephritis, ataxia, deafness, and freckles. Retinal degeneration. Most die in infancy. See short-rib polydactyly-III or Naumoff syndrome. (MIM 263520)
JHS	AR	216100	Juberg-Hayward. oro-cranio-digital syndrome with growth hormone deficiency, horse-shoe kidneys, microcephaly, cleft lip/palate, abnormal thumbs, hypertelorism, up-slanting lid fissures. Some have ptosis and some are mentally impaired. See aminopterin deficiency and see ***ASSAS*** syndrome (MIM 600325). See also Crane-Heise syndrome. (MIM 218090).
DAR at 12q23-q24.1	AD	124200	Darier-White disease, keratosis follicularis with risk of seizures, psychosis, and affective disorders.
RRS	AR	245100	Richards-Rundle syndrome with ketoaciduria, ataxia, deafness, hypogonadism, absence of secondary sexual characteristics, mental disorder, and muscle wasting. See the ***ADR*** syndrome (AR), (MIM 208850) and see Roussy-Levy syndrome (AD) for which the gene may be at 17p11.2. (MIM 180800).
tetrasomy of chromosome 12p. ***PKS.*** inverted duplication of 12pter-p12.3.	C	601803	Killian or Pallister-Killian syndrome with diaphragmatic hernia, seizures, profound mental retardation, lack of speech, deafness, limb shortening, facial abnormalities, hypertelorism, and streaks of hypo and hyper pigmentation. The extra 12p chromosome is in skin fibroblasts.
XY Also said to have XXY.	AR	254000	Klinefelter syndrome occurs in 1% of retarded males. They have muscular dystrophy, testicular hypoplasia, gynecomastia, mental retardation, and may have anophthalmia, colobomas, and corneal opacities.
Gene	AR	245800	Laurence-Moon syndrome with spastic paraplegia, mental retardation, and pigmentary retinopathy, but without obesity and polydactyly. Compare with the Bardet-Biedl syndromes.

Genes	AR, AD	600179 180069	See Leber congenital amaurosis. Five subtypes. See ***RPE65*** at 1q31 and see ***GUCY2D*** at 17p13.1. ***LCA-1***.
MTATP6 at 8527-9702	Mito, AR	516060	Leigh necrotizing encephalomyeloneuropathy with ataxia, respiratory failure, retinitis pigmentosa, and blindness.
HPRT at Xq26-q27	XR	308000	Lesch-Nyhan syndrome with hyperuricemia.
Lewy body dementia ***CYP2D6B*** allele at 22q13.1 is over represented. A, B, C, D, and E alleles.	AD, AR	127750 124030	Debrisoquine 5-hydroxylase deficiency with progressive dementia, dysphasia, hallucinations or delusions, parkinsonism, cerebral atrophy, degeneration of the substantia nigra, paralysis agitans, and formation of Lewy bodies in the substantia nigra. Relates to Pick-Alzheimer and Parkinson diseases.
Genes			Limb-girdle muscular dystrophies are listed separately. Several subtypes, see under the muscular dystrophies.
LISX, DCX, DBCN at Xq22.3-q23..	XL	300067 300121	Lissencephaly.
MDCR, LIS1 at 17p13.3	AD, AR	247200 601545	Lissencephaly of the Miller-Dieker type with macrocephaly and congenital heart defects.
LIS2 at 2p11	AD	600217	Lissencephaly.
ASSAS, without aminopterin	AR	218090 600325	Crane-Heise syndrome with a cranial bone defect, cleft lip/palate, agenesis of the clavicles and cervical vertebrae, talipes equinovarus, and some are mentally impaired. Generally die soon after birth.
ATM, AT1 at 11q23	AR, AD, S	208900	Louis-Bar ataxia telangiectasia with dementia. Four complementation groups can be involved.
Gene may be ***FGFR1*** at 8p11.2-p11.1.	AR	247990	MacDermot-Winter oculo-facial-bulbar palsy with facial anomalies, large ears, dilated cerebral ventricles, seizures, failure of psychomotor development, death in infancy.
MAFD1 on any one of several chromosomes	AD XD	125480 309200	Major affective disorder, manic-depressive psychosis. This bipolar disorder affects nearly 1/100 sometime in their life. Genes on chromosomes 4p, 5q, 11p, 13, 15, 18, 21q, and Xq. ***MAFD2*** maps to Xq28. Many other genes can be involved. See also HLA at 6p21.3 (AD). (MIM 142800). More often inherited from the father. Mutation in a gene at 309620 causes mental retardation, skeletal dysplasia, and abducens palsy.
Genes on four chromosomes.	AR.	154580 154582 248500 248510	See mannosidosis. They are subject to infections.
Genes on four chromosomes	AR	248600 248610 248611 246900	See maple syrup urine diseases. They may have seizures.
Gene	AR	212720	Martsolf syndrome, with short stature, microcephaly, cataract, and hypogonadism. A few have congestive heart failure and many are mentally retarded. Mostly affects males.
MCPH1 at 8pter-p22, ***MCPH5*** at 1q31	AR, XL	251300 156580	Microcephaly with seizures.
IDUA at 4p16.3	AR	252800	Mucopolysaccharidosis-I, Hurler syndrome. Deficiency of alpha-L-iduronidase. Hurler-Scheie phenotypes with mental retardation and corneal opacities.
SIDS at Xq27.3	XL	309900	MPS-II. Hunter syndrome. Deficiency of iduronate 2-sulftase.
ML-II	AR	252500	Mucolipidosis II or I-cell disease affects 1/6184 people in the Saguenay-Lac St.Jean region of Quebec. For myotonic dystrophy, Steinert disease (AD) the gene ***DMPK*** is at 19p13.2- 19cen (MIM 160900, 600963).
MPS-I (AR) Mucopolysaccharidosis or **glycosaminoglycan. Hurler-Scheie phenotype** (MIM 252800) at 4p16.3, dwarfism, deafness, coronary artery disease, kyphosis, mental retardation, and corneal opacities.			
MPS-II (XL). **Hunter syndrome** (MIM 309900) at Xq27.3, dwarfism, deafness, heart disease, mental retardation, retinitis pigmentosa, and papilledema. Type IIa is severe but type IIb is mild.			
MPS-III (AR) Sanfilippo syndrome, four subtypes. Mutations in the genes needed for degradation of heparan sulfate. Causes severe nervous system degeneration. See the mucopolysaccharidoses, the glycosaminoglycans. The four subtypes are biochemically distinct but are clinically indistinguishable.			
MPS3A, SGSH at 17q25.3	AR	252900	MPS-IIIA. Mental retardation and deafness.
NAGLU at 17q21	AR	252920	MPS-IIIB is a milder disease.

GNS at 12q14	AR	252930	MPS-IIIC, deficiency of acetyl-CoA alpha glucosamide N-acetyl transferase. Sanfilippo syndrome C.
NAGL2 at 17q21	AR	252940	MPS-IIID, deficiency of N-acetyl glusosamine-6-sulfatase. Sanfilippo D syndrome with mental retardation, deafness, and heart failure.
MPS-IV. Deficiency of N-acetylgalactoseamine-6-sulfate sulfatase. Corneal opacities occur with type IV.			
GALNS at 16q24.3	AR	253000	MPS-IV A, Morquio A. Deficiency of galactosamine-6 sulfate sulfatase. Have aortic valve disease, deafness, and corneal clouding.
GLB1 at 3p21.33	AR	253010 253500	MPS-IV B, Morquio B. Lack beta galactosidase. Have joint laxity and deafness but normal intellect. Their skeletal dysplasia and corneal clouding are milder. Half have a cherry-red spot in the macula. Most die in infancy.
MPS-V, Scheie syndrome with lesions in the white matter of the brain similar to those of ***MPS-1***. See ***MPS1.*** See the glycosaminoglycans. (MIM 252800).			
GNPTA at 4q21-q23, ***PPGB, ENO1*** at 20q13.1	AR	252500 256540	Mucolipidosis types II and IV have mental retardation.
ARSA at 22q13.31-qter	AR	272200	Multiple sulfatase deficiency. See for example Austin metachromatic leukodystrophy with unsteady gait, motor symptoms, muscle weakness, and ptosis.
ARSB at 5p11-q13	AR	253200	MPS VI. Maroteaux-Lamy syndrome, deficiency of aryl sulfatase B, with osseous and corneal changes.
GUSB at 7q21.11	AR	253220	MPS VII. Deficiency of the lysosomal enzyme beta-glucuronidase. Sly syndrome. Mucopolysaccharidosis type VII (AR) (MIM 253220).
Questioned.	AR	253230	MPS VIII. DiFerranti syndrome. Deficiency of glucosamine-6-sulfate sulfatase, mental retardation,and coarse hair.
NLS at 1q23 or at 16q13	AR	256520	Neu-Laxova, the cerebro-oculo-facio-skeletal or the Pena-Shokeir-II syndrome. With this lethal dysplasia-malformation syndrome the signs are intrauterine growth retardation, a cerebro-arthro-digital syndrome (CAD), edema, swelling of hands and feet, ichthyosis, ectodermal dysplasia, Dandy-Walker anomaly, absent corpus callosum, microcephaly, severe CNS developmental defect, lissencephaly, microphthalmia, cataract, exophthalmos, and ectropion. Neonatal death is usual. **COFS** syndrome (MIM 214150) is similar but has much less severe retardation of brain development.
PPGB at 20q13.1	AR	256540	Goldberg syndrome is a neuraminidase deficiency, with heart defects, deafness, and corneal clouding.
NF1 at 17q11.2, ***NF2*** at 22q12.2	AD, S	162200 193520 101000	Neurofibromatosis, von Recklinghausen or Watson syndromes. At least four subtypes. ***NF3A*** is the Riccardi type and ***NF3B*** has been reported.
Genes	All but one are AD	256730 204500 204300 256731	Neuronal ceroid lipofuscinoses. Nearly a dozen subtypes including Santavuori-Haltia, Vogt-Spielmeyer, and Batten-Mayou diseases. See separate listing of the lipofuscinoses. See MIM 162350, 204200, 600143, and 601780., .
One gene is ***NPD*** at 11p15.4-p15.1	AR, XL	257250	Niemann-Pick histiocytosis. Six subtypes
NDP at Xp11.4-p11.3	XR, S	310600	Norrie retinal dysplasia. Corneal degeneration and cataract. Compare with Andersen-Warburg syndrome with clefting, ectropion, hypertelorism, conical teeth or the blepharocheilodontic **BCD** syndrome (AD) (MIM 119580). Was called Elschnig syndrime. See Episcopi blindness.
OCRL1, LOCR at Xq24-q26	AR	309000 257970	Oculo-cerebro-renal or oculo-reno-cerebellar syndrome. See Lowe-Terry-MacLachlan syndrome (XL) ***OCRL1*** at Xq24-q26.
OPCA1, SCA1 at 6q23	AD	164400	Olivo-ponto-cerebellar atrophy, or Fickler-Winkler atrophy, some subtypes develop dementia.
MID1 at Xp22.3	XL	300000	Opitz G syndrome-I with dysphagia and strabismus.
OFD1 at Xp22.2-p22.3	XD	311200	Oral-facial-digital, orofaciodigital syndrome. Types 1 and 3 show mental retardation.
OTC at Xp21.1, ***CPT1A*** at 1p13-p11	XD AR	311250 600528	Ornithine transcarbamylase deficiency, hyperammonemia-II.
Orthostatic hypotension occurs in the following conditions: amyloid polyneuropathy ***TR*** gene (MIM 176300), diabetic retinopathy, dopamine beta hydroxylase deficiency (MIM 223360), Fabry disease (MIM 301500), familial dysautonomia ***DYS*** (MIM 223900), and Shy-Drager syndrome (MIM 146500).			
AHO, GNAS1 at 20q13.2-q13.3, ***AHO2*** at 15q11-q13, ***BDMR*** at 2q37	AD	103580 139320 103581 600430	Osteodysplasty, lax joints, deformed chest, hypoplastic kidneys, and exophthalmos. See Albright syndromes I, II, and III. (MIM 103580, 103581, 203330, and 300800.

GLI3 at 7p13-p12.3	AD	165240	One of the genes for a Pallister-Hall syndrome. Hamartoblastoma, hypopituitarism, imperforate anus, polydactyly, and other anomalies. Greig syndrome (MIM 175700) can be caused by a mutation in this gene. . The zinc finger glioma-associated oncogene ***GLI1*** is at 12q13 (MIM 165220). The oncogene ***GLI2*** is at 2q14 (MIM 165230).
PHS at 7p13	AD	146510	Mental retardation, polydactyly, and ptosis. There at least three other Pallister-Hall syndromes. Compare with MacDermot-Winter syndrome (MIM 247990).
PRTS, MRXS1 at Xp22.1, or at Xp22.2-p22.1.	XR	309510	Partington syndrome with ataxia, dystonic movements of the hands, seizures, and mild to moderate mental retardation. May have a mutation in ***ARX*** at Xp22.1-p21.3. (MIM 309510).
PRS, MRXS2 at Xp11-q21	XL	390610	Prieto syndrome with dysmorphism and cerebral atrophy,
MRXS3, SHS at Xp11.4-q21 or at Xp11-q21.3.	XL	309470	Sutherland-Haan syndrome-III with microcephaly, short stature, spastic diplegia, and mental retardation.
MRXS4, MCS at Xq13-q22.	XL	309605	Miles-Carpenter mental retardation syndrome-4 with congenital contractures and exotropia.
PGS, MRXS5 at Xq26-q27.	XR	304340 220219	Pettigrew syndrome-5 with Dandy-Walker malformation, hydrocephalus, seizures, mental retardation, deafness, nystagmus, and myopia.
WTS, MRXS6 at Xp21.1-p22	XL-6	309585	Wilson-Turner syndrome with gynecomastia, obesity, speech difficulty, and emotional lability.
MRXS7			
MRXS8, RENS1 at Xp11.4-p11.2	XL	309500	Renpenning syndrome with microcephaly, short stature, and up-slanting lid fissures,
MRXS9 at Xq12-q21.31	XL		Mental retardation, microcephaly, and short stature. Compare with ***DYT3*** at Xq13. (MIM 314250)
PAH at 12q24.1, ***QDPR*** at 5p15.31, ***PTS*** at 11q23-q23.3, ***DHPR*** at 4p15.31	AR	261600 261630 261640 114204	Phenylalanine accumulates in the blood. Four subtypes. Some have an albino-like appearance and somer are mentally retarded.
PGK1 at Xq13.3	XL	311800	Phosphoglycerate kinase deficiency with myopathy, anemia, and retinitis pigmentosa.
MAPT at 17q21.11	AD	172700	Frontotemporal dementia with intracellular tau protein inclusions. Pick disease resembles Alzheimer disease clinically.
Deletion from ***PRDS*** at 4p16.	AR ?	262350	Pitt-Rogers-Danks syndrome. Growth retardation, seizures, microcephaly, and developmental delay.
PWCR at 15q11.2-q12 Deletion inherited from the father.	C, AR, Mito	176270	Prader-Labhart-Willi or Royer syndrome. The floppy child eats to become very fat, has mild mental retardation, but subject to tantrums. Paternal genes are responsible for the placenta but maternal genes are responsible for most of the embryo. Compare with the Angelman syndrome.
PPMX at Xq28	XL	300055	Psychosis, pyramidal signs, macroorchidism, tremor, and shuffling gait.
PAX8 at 2q12-q14	AR	167415	Ptosis and hypertelorism due to hypothyroidism.
PEX1 at 7q21-q22, ***PXR1, PEX5*** at 12p13	AR	602136 602859 600414	Refsum syndrome of the infantile type. See Refsum syndrome. ***PXR1*** is now called ***PEX5***.
RIEG, PITX2 at 4q25	AD	180500 601532 601499	With Reiger syndrome some are mentally retarded.
Gene on chromosome 8.	AR	268020	Edwards et al. syndrome. Retinitis pigmentosa, insulin-resistant diabetes, acanthosis nigricans, deafness, hypogonadism, mental retardation, cataracts, and nystagmus. See ***INSR*** at 19p13.3.(AD) (MIM 147670). Compare with Laurence-Moon syndrome. (MIM 245800).
RTT at Xp22.3	XD	312750	Rett syndrome (named for a patient), incidence 1/12,000, females have encephalopathy, seizures, and ataxia. Is the most frequent cause of progressive mental retardation in girls. Scoliosis develops later. Lethal in males.
RSTS at 16p13.3	M, S, AD	180849	Rubinstein-Taybi syndrome with agenesis of the corpus callosum, cardiac disorders, and glaucoma.
RUDS may be at Xp22.3.	XR, AR	308200	Rud syndrome was defined as a neurocutaneous disorder with non-bullous ichthyosis, male hypogonadism, anemia, seizures, mental retardation, epilepsy, and retinitis pigmentosa. See ichthyosis. See Kallmann syndrome, ***KAL-1*** at Xp22.3. (MIM 308700).
NAGA, GALB at 22q11	AD	104170	Schindler disease with seizures, strabismus, and optic atrophy.
APP at 21q11.2-q21	M	104760	Schizophrenia, several subtypes.
DFN4 at Xp21.2	XL	600652	Severe deafness with retinitis pigmentosa.

PAF at 6p21.1-p12	AD	146500	Shy-Drager multiple system atrophy with degeneration of catecholamine-containing cells in brain stem and cholinergic cells in intermediolateral columns, adult-onset progressive autonomic nervous system dysfunction, orthostatic hypotension, ataxia, bladder and bowel incontinence, and external ophthalmoplegia. Responsible for about 7% of spinocerebellar degeneration cases. Treat with vasopressin. See the glycosaminoglycans, numerous s ubtypes. For dopamine beta hydroxylase, see ***DBH*** (AR) (MIM 223360) The Streeten orthostatic hypotension (AD) gene is on chromosome 18q (MIM 143850).
Gene .	AR, Mito	255140	Shy-Gonatas syndrome with abnormal mitochondria, lipid accumulation in muscles, weakness, and atypical retinitis pigmentosa.
SLS at 17p11.2	AR	270200	Sjögren-Larsen or Torsten-Sjögren syndrome with xerodermal idiocy, ichthyosis, spastic diplegia, and some have retinitis pigmentosa.
RSD, CHRS at Xq28-qter.	XL	309620	Skeletal dysplasia and abducens palsy..
SLOS at 11q12-q13	AR	270400 602858	Smith-Lemli-Opitz-I cerebro-hepato-renal syndrome.
MRSD at Xq28-qter	XL	309620	Mental retardation, skeletal dysplasia, and abducens palsy. See also Christian syndrome ***CHRS*** at this same site.
SRS, RSR at Xp21	XL	309583	Snyder-Robinson syndrome with large head, cleft palate, asthenic body, and scoliosis.
Five subtypes of paraplegia, some include mental retardation. Genes	AD, AR	182610 182830 246555 270700 270950	Spastic paraplegia. Some have epilepsy, tremors, deafness, or limb defects, others have exotropia, ptosis, nystagmus, retinitis pigmentosa, retinal degeneration, miosis, or optic atrophy. With spastic quadriplegia (AR) they have mental retardation and possibly tremors, deaf ness, exotropia, ptosis, miosis, nystagmus, and retinitis pigmentosa.
MRST at 15q24	AR	602685	Spasticity and severe tapetoretinal degeneration.
SPCH1 at 7q31	AD	602081	Speech language disorder-I with orofacial dyspraxia.
BTS, CLN3 at 16p12.1	AR, AD	204200	Spielmeyer-Sjögren juvenile cerebral sphingolipidosis, seizures, psychosis, subject to infections. See the other ceroid lipofuscinoses.
COL2A1 at 12q13.2	AD	120140	Spondyloepiphyseal dysplasia congenita with dwarfism, scoliosis, deafness, retinal detachment, and myopia.
DM, DMPK at 19q13.2-cen	AD, S	160900	Steinert or Curschmann-Steinert myotonic muscular dystrophy, myotonia, polyneuropathy, cardiac anomalies, and cataract.
LGCR, TRPS2 at 8q24.11-q24.13 ***TSC1*** at 9q32-q34, ***TSC2*** at 16p13.3	S, AD S, AD	150230 191100 191092	Tricho-rhino-phalangeal syndrome-II or Langer-Giedion syndrome. Mental retardation and deafness. With ***TRPS1*** at 8q24.12 (MIM 190351) they have short stature but normal intelligence. Patients with ***TRPS3*** (MIM 190351) do not have mental retardation. Tuberous sclerosis, epiloia or Bourneville disease. Signs are adenoma sebaceum, Wilms tumor, renal cysts, and retinal tumors.
CSTB, EPM1 at 21q22.3	AR	254800	Unverricht-Lundborg myoclonus epilepsy is a Baltic type that resembles the Ramsay-Hunt syndrome. (MIM 159700).
VCF at 22q11	AD	192430	Velo-cardio-facial or Shprintzen syndrome with learning difficulties, cardiac anomalies, and cleft palate.
WSN, BGMR at Xq28	XL	311510	Waisman syndrome, a basal ganglia disorder with early-onset parkinsonism.
WHCR at 4p16.3	C, S	194190 602952	Deletion here causes Wolf-Hirschhorn syndrome with renal hypoplasia. See Huntington disease. (MIM 143100).

Genes for X-linked mental retardation also include: ***FMR2, OPHN1, GDI1, PAK3, IL1RAPL, TM4SF2, VCX-A***, and ***ARHGEF6*** at Xq26. Mental retardation of the X-linked type affects 1/600 males. See also ***RSK2*** and ***XNP/ATR-X*****.** Mutations in or deletions from ***ARX*** at Xp22.1-p21.3 can cause mental retardation and epilepsy. See Partington syndrome, (XR) (MIM 309510) Also reported to cause mental anomalies are mutations in genes ***MRX 18, 19, 20, 24, 31, 34, 37,*** also ***ATRAX*** and ***XLMR***. See also ***MRSD*** and ***MRXS1*** to ***MRXS9*** and several other genes.

At Xq28 are the genes for 10 syndromal forms of mental retardation and for 5 non-syndromal types. For example ***SLC6A8*** at Xq28 with a mutation in the creatine transporter gene causes XL mental retardation with speech and behavioral difficulties.

ARX at Xp22.11-p21.3	XL	309510	When mutated or deleted can cause me ntal retardation and epilepsy. See Partington syndrome. (MIM 309510).
FRAXA, FMR1 at Xq28	XL	309550	Fragile site mental retardation with expanded CGG repeats.
FRAXE, FMR2 at Xq28	XL	309548	Fragile-site mental retardation with expanded GCC repeats. See ***FRAXF*** (MIM 300031).
MRXA at Xp11.22 or at Xq28.	XL	309545	Non-specific mental retardation with aphasia, absent or delayed speech, seizures, and frequent infections.
DXS6673E at Xq13.1	XL	300061	A candidate gene for mental retardation.
IL1RAPL1 at Xp22.1-p21.3.	XL		Deletion can cause non-syndromic mental retardation.

MRX1 at Xp22	XL-1	309530	Non-dysmorphic mental retardation. Atkin syndrome. Several genes cluster here.
MRX2 at Xp22.1-p22.2	XL-2	309548	Fragile site mental retardation.
MRX3 at Xq28	XL-3	309541 309620	***CHRS*** for Christian syndrome is at Xq28-qter. Signs include skeletal dysplasia, and abducens palsy.
MRX5 gene may be ***TM4SF2*** at Xq11.	XL	300096	
MRX7	XL	300115	
MRX8	XL		
MRX9 at Xp11.22-p11.4	XL-9	309549	Compare with ***MRX2.***
MRX10 at Xp21.3-p11.4	XL		Several genes are in this vicinity.
MRX11 at Xp21.3-p11.22.	XL		
MRX12 at Xp21.3-q21.1	XL		
MRX13at Xp22.3-q21.22	XL		
MRX14 at Xp11.3-q13.3	XL-14	300062	Mental retardation, type 14.
MRX15	XL		
MRX19 at Xp22			
MRX20 at Xp11-q21	XL-20	300047	Mental retardation, type 20.
MRX21 at Xp21.1-p22.3	XL-21	300143	Mild retardation.
MRX22.	XL		
MRX23 at Xq23-q24	XL-23	300046	
MRX26			
MRX27, MRX30, MRX35, ***MRX47*** all at Xq22.3-q24.	XL	300046	Mental retardation.
MRX29 at Xp22.3-p21.3, or at Xp21.2-p22.3	XL-29	300077	Mental retardation type 29. Genes for other ***MRX*** entities also map in this vicinity.
MRX30 at Xq21.3	XL		
MRX31 at Xq24	XL		
MRX32 at Xp21.2-p22	XL		
MRX36 may have a mutations in ***ARX*** at Xp22.1-p21.3	XL		Gene also reported to be at Xp21.2-p22.1.
MRX38 at Xp21.1-p22.13.	XL		
RABGD1A, GDI1, MRX41, MRX48 at Xq28	XL	300104	Non-specific mental retardation. Many subtypes of XLMR.
MRX49 at Xp22.3-p22.2	XL-49	300114	Possible alleles are ***MRX19, MRX24,*** and ***MRX37***.
MRX50 at Xp11.3-p11.21	XL-50	300115	Non-specific mental retardation.
MRX51 at Xp11.3-p11.23.	XL		
MRX58 gene is ***TM4SF2*** at Xp11.4.	XL-58	300096	Affected males have mild mental retardation, but carrier females are normal.
MRX60, OPHN1 at Xq11.4-q12	XL-60	300127	Oligophrenia-I
MRX73 at Xp22.2	XL		
ATRX at Xq13	XL	300032	Alpha thalassemia and mental retardation.
XLMR at Xp11.4-p22.11	XL	300114	Mental retardation and infantile spasms. See ***MRX49.***

Name	Gene	Comments
MERRF syndrome. (Mito) MIM 545000	***MTTK*** at 8295-8364, ***MTTL1*** at 3230-3304	Mitochondrial encephalomyopathy, lactic acidosis, ataxia, spasticity, muscle weakness, ragged red fibers, epilepsy, ptosis, pigmentary retinopathy, and optic neuropathy.
Meskers dystrophy. (AR, rarely AD) MIM 169150, 179605	***RP7, RDS*** at 6p21.1-cen	Maculoreticular dystrophy of the RPE. Butterfly-shaped dystrophy with macular degeneration, or with fundus flavimaculatus, or drusen of Bruch membrane, or bull's eye macular degeneration. Compare with Deutman dystrophy. (MIM 169150).
metachromatic leukodystrophy. (AR, AD). MIM 250100	***PSAP*** at 10q21-q22, ***ARSA*** at 22q31-qter	Prosaposin or arylsulfatase A deficiency, sulfatide lipidosis, hepatomegaly, myoclonus, dementia, oculomotor disorders, and optic atrophy. Late inf antile, juvenile, and adult forms have been reported.
Metalloproteinase inhibitors are zinc-dependent. (XL). MIM 305370.	***TIMP1*** at Xp11.4-p11.23	Have erythroid potentiating activity. No reported diseases but a suggested relation to colon cancer.
(AD). MIM 188825	***TIMP2*** at 17q25	Retinal degeneration and often deleted in breast cancers.
(AD). MIM 188826	***TIMP3*** at 22q12.1-q13.2	***TIMP3*** is synthesized by the RPE and deposited in Bruch's membrane. Mutation may cause Sorsby fundus dystrophy but see ***SFD*** (AD), (MIM 136900).

MIM 601915	***TIMP4*** at 3p25	Inhibits tumor growth. (A deletion from 3p25-pter just outside the ***TIMP4*** locus can cause an atrioventricular septal defect.)
metaphyseal chondrodysplasia,. (AD). MIM 156500	***COL10A1*** at 5q21-q22.3 (MIM 120110)	**MCDS** Schmidt type. Short stature, tibial bowing, and waddling gait. For an AR metaphyseal dysostosis see MIM 250400.
metatropic dwarfism	Gene	Non-lethal (AD), (MIM 156630). Non-lethal (AR) MIM Lethal (AR) (MIM 245190). See ***COL2A1*** at 12q13.11-q13.2 Type 2 is Kniest disease (MIM 156550).
3-methylglutaconic aciduria. (AR). MIM 250950.	Gene	Four subtypes. Spastic paraparesis, dementia, and optic atrophy. See (MIM 250951, 258501, 302060).
3-hydroxy-3-methyl glutaric acidemia (AR). MIM 246450	Gene at 1pter-p33	Lyase deficiency. Fever, aciduria, and early death.
2-methylacetoacetyl CoA thiolase deficiency. MIM 203750	***ACAT*** at 11q22.3-q23.1.	Have a 3-oxothiolase deficiency, metabolic acidosis, and vomiting.
methylmalonic acidemia. (AR). MIM 251000	***MUY, MCM*** at 6p21	Three subtypes. Have methylmalonic CoA mutase deficiency, growth retardation, osteoporosis, and fractures.
Meyer-Schwickerath-Weyers syndrome-1	Gene	Dysplasia oculodentodigitalis, brown teeth, digital anomalies, microphthalmia, iris pathology, and glaucoma.
Meyer-Schwickerath-Weyers syndrome-2. (AD, AR). MIM 164200, 257850.	***ODDD*** at 6q22-q24	Oculodentodigital dysplasia, dyscraniopygophalangie, abnormal cerebral white matter, polydactyly, and microphthalmia. See ***ODOD, ODDD*** gene at 6q22-q24
Michels syndrome. (AR). (MIM 257920).	Gene	An oculopalatoskeletal syndrome with craniosynostosis, cleft lip, blepharophimosis, blepharoptosis, epicanthus inversus, and a stromal corneal opacity. May relate to ***BPES*** at 3q22-q23 (MIM 110100).
Microcephaly affects about 1/250,000 children. McKusick lists 18 AR and 6 AD subtypes or microcephaly syndromes. Most have other anomalies, some are mentally retarded. Some have seizures, renal anomalies, spinal muscular atrophy, cardiomyopathy, ataxia, deafness, cleft lip/palate, microphthalmia, chorioretinopathy, cataracts, nystagmus, or optic atrophy. Microcephaly with lymphedema is inherited AD. (MIM 156580).		
microcephaly. (AR, AD, XR).	***MCPH5*** at 1q31	Or duplication of a gene at 7q22-q31.2. See also MIM 309590. For an XL type see Renpenning syndrome. (XL). MIM 309500).
microcephaly. (AR). MIM 251200	***MCPH1*** at 8pter-p22	Often with mental retardation and other anomalies.
microcephaly, microphthalmia, cataracts, and joint contractures. (AD, AR)	***ODDD*** at 6q22-q24	Shortening of muscle fibers, scar tissue over joints. Retinal degeneration with hypopigmentation. See MIM 164200 and 257850.
microcephaly, deafness, mental retardation. (AD). MIM 156620.	Gene	Facial asymmetry occurs in this microcephaly-deafness syndrome.
microcephaly with chorioretinopathy. (AR). MIM 251270	Gene	Mild mental retardation or normal IQ, have cataracts. Some do not have chorioretinopathy. Some similarity to toxoplasmosis. May relate to an infection. See also MIM 175100. Gardner syndrome.
microcephaly with chorioretinopathy. (AD). MIM 156590	May depend on an Infection. .	Mild mental retardation with chorioretinopathy. Some have toxoplasmosis.
Bieber syndrome (XR). MIM 312190	Gene	Hydrocephalus, mental retardation, agenesis of the corpus callosum, radial aplasia, imperforate anus, microphthalmia, ptosis, cataracts, and retinal dysplasia.
Warburg microsyndrome. (AR). MIM 600118	Gene at 17q12-q21.33.	Adhalin deficiency. Hypoplasia of the corpus callosum, microcephaly, short stature, hypogonadism, severe mental retardation, muscular dystrtophy, microcornea, ptosis, atonic pupils, congenital cataracts, and optic atrophy. Differentiate from these syndromes: **CAMFAK** (MIM 212540), **COFS** (MIM 214150), Martsolf (MIM 212720), Neu-Laxopva (MIM 256520), and Rutledge (MIM 268670).
microcephaly, hiatus hernia, and the nephrotic syndrome. (AR). MIM 251090	***MUT*** at 6p21.2-p12	Galloway-Mowat syndrome with psychomotor retardation, hypotonia, and early death from renal failure.

Nijmegen breakage syndrome (AR). MIM 251260, 602667	***NBS1*** at 8q21	An ataxia-telangiectasia variant. Microcephaly, bird-like facies, and short stature. Are immunodeficient and subject to infections, and predisposed to malignancy. Compare with Berlin breakage syndrome.(AR) (MIM 600885) where the patient has breakages in chromosomes 7 and 14, microcephaly, and IgA deficiency, but no ataxia and no telangiectasia. Differentiate from these syndromes: **COFS** (MIM 214150), Martsolf (MIM 212720), and Neu-Laxova (MIM 256520).
Desmosterolosis with congenital anomalies. (AR) See MIM 602398.	***DHCR24***	Deficiency of delta 24-dehydrocholesterol reductase, developmental delay, agenesis of the corpus callosum, microcephaly, club foot, and patent ductus arteriosus. Compare with these syndromes: Raine (AR), a lethal osteosclerosis (MIM 259775), and Smith-Lemli-Opitz syndrome-1 (MIM 270400).
microcoria, congenital. (AD)	***MCOR*** at 13q31-q32	Small pupils in eyes with myopia.
microcornea, glaucoma, and absent frontal sinuses. (AD) MIM 156700, 107450.	***IFNAR1*** at 22q22.1	Quadriplegia, muscular atrophy, degeneration of the spinal cord. Also have thick skin, epicanthus, and cupping of the optic nerve head.
microcornea, see the Nance-Horan syndrome. (XR)	***NHS*** at Xp22.13	Cataract-dental syndrome often occurs in eyes with these small corneas. (MIM 302350, 302200).
microphthalmia, congenital (AR). MIM 309700	***MCOP*** at 14q32	Have sclerocornea, and other anterior segment abnormalities sometimes including anophthalmia. Best VA may be perception of light. See Norrie disease. (MIM 310600).
microphthalmia, linear skin defects, and sclerocornea (S, XR). MIM 309801	***MLS, MIDAS*** at Xp22.31	Loss of holocytochrome C- type synthetase. HCCS. Corpus callosum agenesis and respiratory distress. See Waardenburg syndrome-II A. (MIM 193510).
Lenz dysplasia. (XR). MIM 309800	***MAA*** at Xp22.31 or Xq27-q28	Affects only females. Severe renal dysgenesis, severe speech impairment, linear skin defects, digital anomalies, microphthalmia, strabismus, nystagmus, and colobomas. Eye problem can be unilateral.
microphthalmia, anophthalmia, and coloboma.	***MAC***	An optic fissure closure defect affects 19/100,000 in Scotland. Relates to ***OFCD,*** (MIM 601354). See ***FRYNS*** bilateral anophthalmia (AR). (MIM 600775).
microphthalmia with myopia and corectopia. (AD). MIM 156900	Gene	Have myopia, and a displaced pupil and may have glaucoma and cataract.
microphthalmia, nanophthalmia, (AD). MIM 600165	***NNO1*** on chromosome 11p.	High hyperopia (average 9D), microcornea, angle-closure glaucoma. See ***PAX6*** at 11p13, (AD), (MIM 106210). Compare with the Weill-Marchesani syndrome.(MIM 277600).
microphthalmia-associated transcription factor. MIM 156845	***MITF, WS2A*** at 3p13	See also Waardenburg syndrome. WS-2A (MIM 193510). ***PAX3*** (AD) at 2q35 (MIM 193500) regulates ***MITF.***
microphthalmia and mental deficiency. (AR). MIM 251500	Gene. Some are inherited AD.	Spastic cerebral palsy, severe mental deficiency, corneal opacities, glaucoma, and hyperopia.
microphthalmia, pigmentary retinopathy, and glaucoma (AD). MIM 157100	Gene Some are inherited AR.	With this microphthalmia some have pigmentary retinopathy and some have glaucoma.
microphthalmia with cataract. (AD, AR). MIM 156850	***CATM*** at 16p13.3	Congenital cataracts with microphthalmia.
microphthalmia with cataract and nystagmus. (AR). MIM 212550	Gene	Miosis, cataract, and nystagmus. See also ***CATM*** at 16p13.3.(MIM 156850).
microphthalmia, high hyperopia, and glaucoma. (AR, AD). MIM 251600	One AR gene is at 14q32 .	Primary anophthalmia.
microphthalmia (AD). MIM 257850.	See the ***ODDD*** or ***ODOD*** syndrome at 6q22-q24..	Meyer-Schwickerath-Weyers syndrome type 1 oculodentodigitalis, camptodactyly, severe microphthalmia, may get glaucoma. Type 2 is a dyscraniopygophalangic type with polydactyly.

microspherophakia with inguinal hernia. (AD). MIM 157150	Gene	A connective tissue disorder often with glaucoma and myopia, lens may be dislocated upward, and some have retinal detachment.
microspherophakia. R). MIM 251750	Gene	Have a small round crystalline lens.
MIDAS syndrome (XL). MIM 309801	***MLS*** may be at Xp22.31	With anomalies of the X chromosome they have dermal aplasia, microphthalmia, sclerocornea, and corneal opacities. May be lethal in hemizygous males. Compare wkith Goltz-Gorlin syndrome. (MIM 305600).
Mietens-Weber syndrome. (AR). MIM 249600	Gene	Growth failure, mental retardation, IQ about 75, elbow contracture, digital defects, hypertrichosis, ptosis, nystagmus, strabismus, and bilateral corneal opacities.

Many **anti-migraine drugs** bind to a serotonin (5-hydroxytryptamine) receptor ***HTR1A*** at 5q11.2-q13. See also ***HTR1B*** at 6q13, ***HTR1D*** at 1p36.3-p34.3, ***HTR1E*** at 6q14-q15, ***HTR1F*** at 3p12, ***HTR2A*** at 13q14-q15 or 13q14-q21, ***HTR2B*** at 2q36.3-q37.1, ***HTR2C*** at Xq28 activates phospholipase C, ***HTR3*** at 11q23.1-q23.2, ***HTR4*** at 5q31-q33, ***HTR5A*** at 7q36.1, ***HTR6*** at 1p36-p35, and ***HTR7*** at 10q21-q24 are adenylate cyclase coupled. There are at least a dozen different serotonin receptors. See also ***HaNDL***?????????? .

The MIDAS migraine liability assessment questionnaire includes 35 questions on: health status, physical activity, insecurity, emotional reaction, dependency, diet, and concern over medication and side effects.

migraine, susceptibility. (XD)	***MFTS*** at Xq.24-q28	Familial. migraine affects three times as many women as it does men.
migraine, familial hemiplegic type. (S, AD). MIM 141500	***MHP1, CACNA1A*** at 19p13.	Mutations in this calcium channel gene cause a vascular headache, often unilateral, often with nystagmus. The aura may include: visual, sensory, aphasic, and motor symptoms. Migraineurs who have an aura are three times more likely to have a stroke than those who have no aura. ***TNFB2*** is increased in migraine without an aura. Some use topiramate to treat migraine.
Mikulicz syndrome	Gene	Mikulicz-Sjögren syndrome. Usually their lacrimal glands continue to function.
Miller or Miller-Fisher syndrome. MIM 104620	Gene may be ***ACY1*** at 3p21.1	May be an immune reaction. Is a variant of Guillain-Barré syndrome.(MIM 139393). Have aniridia and Wilms tumor. See ***WAGR*** syndrome. (MIM 194072). More than one gene.
Miller-Dieker lissencephaly syndrome. (S, AD, AR, C) MIM 247200	Deletion from ***LIS1, PAFAH*** at 17p13.3.	See lissencephaly. Most of the affected children die a few months after they are born.

Mitochondrial inheritance depends on genes in the circular mitochondrial genome. More than 70 different mutations occur in mitochondrial DNA. They are inherited from the mother.. Mitochondrial encephalomyopathies can produce optic neuropathy, retinal degeneration, decreased ocular motility, ptosis, and progressive bilateral loss of vision. There are five respiratory chain complexes. Point mutations of mtDNA can cause Alpers syndrome (MIM 203700), Leber hereditary optic neuropathy (**LHON**) (MIM 535000), Leigh syndrome (MIM 256000), Kearns-Sayre syndrome (**KSS**) (MIM 530000), chronic progressive external ophthalmoplegia (**CPEO**) (MIM 258450), cardiomyopathy with ophthalmoplegia (**ARCO**), mitochondrial neuropathy with gastrointestinal encephalomyopathy, ***MNGIE*** (AD), (MIM 550900) mitochondrial neuropathy, gastrointestinal disorders, and encephalopathy syndrome, relates to a gene at 22q13.22-qter, myoclonus epilepsy with ragged red fibers (***MERRF***) (MIM 545000), Wilson disease, Friedreich's ataxia and the mitochondrial myopathy known as ***MELAS*** (MIM 540000) with encephalopathy, lactic acidosis, ataxia, and stroke-like episodes. A mutation in ***MiMyCa*** causes myopathy and cardiomyopathy. For mitochondrial myopathy with lactic acidosis see MIM 251950, 255125, and for mitochondrial myopathy with cataract, see MIM 160550. See also one type of diabetes mellitus with deafness.(MIM 520000). See also Leigh syndrome (MIM 256000), Luft syndrome (MIM 238800), ***NARP*** (MIM 551500), Pearson syndrome (MIM 557000), and Treft syndrome (MIM 165490).

Disorders of mitochondrial fatty acid oxidation may involve short chain acyl-CoA dehydrogenase deficiency, gene at 12q22-qter (MIM 201470), medium chain acyl-CoA dehydrogenase deficiency, gene at 1p31 (MIM 201450), or long chain CoA deficiency, gene at 2q34-q35 (MIM 201460), or long chain 3-hydroxy acyl CoA deficiency, (MIM 143450).

Name	Gene	Comments
Miyoshi dystrophy. (AR). MIM 254130	***MM*** at 2p13	This dysferlinopathy produces a progressive, distal, myopathy with early adulthood onset, especially affecting the forearm and lower leg. Seems to be allelic with ***LGMD2B*** (MIM 253601). See also MIM 600119 and 603009.
Möbius-I syndrome. (AD)	***MBS1*** at 13q12.2-q13	Damage to CNIII, skeletal defects, mental retardation, and headache.
Möbius-II syndrome. (AD)	***MBS2*** at 3q21-q22	Possibly due to decreased blood supply from the subclavian artery. Congenital facial diplegia, paralysis of CNVI and CNVII, weakness of facial muscles, skeletal defects, deafness, ptosis, and esotropia, are unable to abduct the eye.
Poland-Möbius syndrome MIM 173750	Gene may be at 1p22. Some have a combination of two syndromes.	Affects 1/500,000. Seems to be a combination of two syndromes.. Paralysis of CNVI and CNVII, hand anomalies, absence of the pectoralis muscle, facial diplegia, speech difficulty, vertical nystagmus, congenital esotropia, diplopia, keratitis, and corneal ulcers. See also MIM 173800 and 157900.
MODY syndromes. Maturity-onset diabetes of the young. Non-insulin dependent. NIDDM. See diabetes.		
Mohr syndrome. (AR). MIM 252100		See oral-facial-digital syndrome-II. Mohr-Clausen syndrome with deafness, polysyndactyly, and often tachypnea.
molybdenum cofactor deficiency. (AR) MIM 252150.	***MOCOD*** at 6p21.3	Xanthine dehydrogenase deficiency, muscle spasms, and ectopia lentis.
monoamine oxidase deficiency. (XR)	***MAOA*** and ***MAOB*** both at Xp11.4-p11.23 Gene	Mild mental retardation but may be violent and aggressive.
Moore-Federman syndrome. (AD). MIM 127200		Dwarfism with stiff joints, glaucoma, cataracts, hyperopia, and retinal detachment. May be the same as acromicric dysplasia (MIM 102370).
Morgagni-Stewart-Morel syndrome. (AD). MIM 144800	***MSM***	Hyperprolactinemia type IV. Optic nerve is injured by a bony protrusion into the optic canal. Most are females, disease onset about age 45, hyperostosis frontalis interna, hypertension, obesity, arteriosclerosis, diabetes mellitus, menstrual disorders, headache, and cataract.
morning glory disc syndrome. (AD).	***PAX2*** at 10q25	Renal hypoplasia, deafness, and optic nerve colobomas.
Morquio syndromes (AR)	Type A ***GALNS*** at 16q24.3, Type B ***GLB1*** at 3p21.33, Type C	See under the mucopolysaccharidoses, type A (MIM 253000), type B (MIM 253010), and type C (MIM 252300). See also (MIM 230500).
mortality factor. (AR)	***MORF4*** at 4q33-q34	May act as a cancer suppressor.
Mowat-Wilson syndrome MIM 602595	Mutations in ***SIP1*** at 2q22	Agenesis of the corpus callosum, Hirschsprung disease, heart disease, hypospadias, genitourinary anomalies, and short stature.
Moynahan syndrome. (AR). MIM 203600	***XTE***	Xeroderma, talipes, and an enamel defect. Alopecia, coarse hair, cleft palate, oligophrenia, epilepsy, and lack lashes on the lower lid. Compare with the **AMR** syndrome (AR) (MIM 203650), signs are alopecia, deafness, seizures, and mental retardation.
Mucolipidoses, oligosaccharidoses (AR). Mucolipidosis is a form of neuraminidase deficiency and is the same as sialidosis-II. Over 200 genes can be involved. Affects 4.5/100,000 liveborn. A mutation in the gene ***PPGB*** at 20q13.1 causes Goldberg-Cotlier galactosidase deficiency. With this late-onset, infantile mucolipidosis the signs are dwarfism, heart disorders, mental retardation, seizures, and corneal clouding. The early progressive neurologic deterioration resembles that of the sphingolipidoses. Now included in the mucolipidoses is the cherry-red spot myoclonus-epilepsy syndrome (AR), sialidosis-I. ***GNPTA*** at 4q21-q23. (MIM 252500).		
mucolipidosis type-I. MIM 256550	***NEU*** at 6p21.3	Spranger syndrome. Deficiency of alpha-N-acetyl-neuraminidase, with progressive mental retardation, progressive myoclonus, macular cherry-red spot, and reduced vision. Sialidosis-II.
type-II. MIM 252500	***GNPTA*** at 4q21-q23	N-acetylglucosamine-1-phosphotransferase deficiency affects 2 per 100,000 liveborn. Signs shortly after birth. Sialidosis-I, I-cell, or LeRoy disease with dwarfism, valvular heart disease, hepatomegaly, deafness, mental retardation, hip dislocation, and mild corneal clouding.

type-III. MIM 252600	***GNPTA*** at 4q21-q23	Deficiency of mannose-6-phosphate, decreased level of N-acetylglucosamine phosphotransferase. Signs aappear shortly after birth. Claw hands. Type-IIIC is a variant pseudo-Hurler polydystrophy with hip abnormalities. Compare with these conditions: sialidosis-III, carpal tunnel syndrome, and Maroteaux-Lamay syndrome.
type-IV MIM 252650		Ganglioside and hyaluronic acid accumulate in skin fibroblasts. Berman sialolipidosis syndrome with abnormal neuraminidase, severe neurologic and ophthalmologic abnormalities, corneal clouding., strabismus, photophobia, and myopia. Mostly occurs in patients of Jewish descent.
Salla disease. (AR). MIM 269920	***SLD*** at 6q14-q15	A sialic acid storage disease with demyelination of central and peripheral nervous systems, mental retardation, hepatosplenomegaly, sialuria, and a coarse face.
Muckle-Wells syndrome. (AD). MIM 191900	***MWS*** at 1q44	Periodic fever often with deafness. See familial cold urticaria.

Mucopolysaccharidoses are now called the **glycosaminoglycans** (AR, XR, AD). Affect 4.5/100,000 liveborn. See Goldberg disease, (AR) gene ***PPGB*** at 20q13.1. Deposit long-chain sugars chondroitin throughout the body. Dwarfism, joint deformities, mental retardation, seizures, deafness, corneal clouding, cerebromacular degeneration, and macular cherry-red spot. Their ERG is extinguished.

Those with glycosaminoglycans types IH, IIA, III, and VII are severely retarded. Those with types IS, IIB, IV, and VI have near normal intelligence. Corneal clouding is a prominent feature in types IH and IS but is less severe in types IV, VI, and VII. Pigmentary degeneration of the retina occurs in types IH, IS, II, and III, but not in types IV and VI. Optic atrophy occurs in all glycosaminoglycan types except VIB.

MPS type-I (AR). MIM 252800	***IDUA, IDA*** at 4p16.3. **IH, IS**, and **IH/S**. **IH/S** produces a disorder of intermediate severity with clinical signs by 2 years of age.	Hurler **IH** and Scheie **IS** syndromes and a combined **IH/S** syndrome affect 1.19/100,000 live born. Deficiency of alpha-L-iduronidase activity produces signs at 6 to 24 months of age. Signs of IH are dwarfism, large head, hydrocephalus, noisy breathing, cardiac disorders, joint stiffness, mental retardation, corneal opacities at birth or soon after, glaucoma, esotropia, and retinopathy. Life expectancy less than 20 years. Scheie type **IS** seen after 5 years of age is milder, have excess chondroitin sulfate B in urine, psychosis, aortic valvular disease, carpal tunnel syndrome, night blindness, scotomata, corneal clouding, glaucoma, and optic atrophy but normal intelligence and an almost normal life expectancy
MPS type-II. (XR). MIM 309900	***IDS, SIDS*** at Xq27.3 type II A is severe and II B is milder.	Hunter syndrome boys have a deficiency of iduronate-2-sulfatase. Signs appear at age 2 to 4 years, dwarfism, stiff joints, deafness, heart disorders, possible mental retardation, (a few have normal intelligence), ptosis, corneal clouding, optic atrophy, contracted fields, and night blindness. Some die before age 16 but a few live to age 60 or more.
MPS type-IIIA (AR). MIM 252900	***MPS-IIIA*** at 17q25.3	Sanfilippo-Good syndrome A affects 1.16/100,000. Deficiency of heparan-N-sulfatase causes signs about age 2 to 6 years, with mild dwarfism, deafness, seizures, mental retardation, claw hands, and night blindness. Most die by their second decade.
MPS type-IIIB (AR). MIM 252920	***NAGLU*** at 17q21	Sanfilippo syndrome B is usually milder than type A. Deficiency of alpha-N-acetylglucosaminidase.
MPS type-IIIC (AR). MIM 252930	***MPSIIIC, GNS, GGS*** at 12q14 or on chromosome 21 or 14.	Sanfilippo syndrome C. Deficiency of acetyl coenzyme A-alpha-glucosaminide-N-acetyltransferase., mental; retardation, deafness. A pseudo-Hurler polydystrophy. Most Sanfilippo patients live for 14 to 20 years.
MPS type-IIID (AR). MIM 252940.	***MPSIIID, NAGLU*** at 17q21.	Sanfilippo-Good syndrome D. Deficiency of N-acetylalpha-D-glucosamide-6-sulfatase. Mental deficiency and night blindness.
MPS type-IVA (AR). MIM 253000	***GALNS, MPS4A*** at 16q24.3 The gene may be on chromosome 3.	Morquio syndrome A. Deficiency of galactosamine-6-sulfate sulfatase. with dwarfism, deafness, mental retardation, slight corneal clouding, ptosis, and miosis. Onset between 4 and 10 years of age. Some have normal intelligence and most live for 30 or 40 years.
MPS type-IVB (AR) MIM 253010, 253500	***GLB1*** at 3p21.33	Beta galactosidase deficiency. Deafness and corneal opacities but normal intelligence. See Morquio syndrome B (MIM 253010) and Morquio syndrome C (MIM 252300). See also (MIM 230500). MPS IVB (AR). Some refer to MPS type V and to Scheie syndrome.
MPS- V	***IS***	For Scheie syndrome see ***MPS-I.***

MPS type-VI. (AD, AR). MIM 253200	***ARSB*** at 5q11-q13	Maroteaux-Lamy syndrome is a lysosomal storage disease. Deficiency of arylsulfatase B activity, onset age 2 to 5 years, deafness, heart disease, hepatosplenomegaly, joint stiffness, carpal tunnel syndrome, glaucoma, retinitis pigmentosa, and hazy corneas but normal IQ. Mild, intermediate, and severe subtypes occur. Life expectancy 20 or 30 years, most die of heart failure.
MPS type-VII. (AR). MIM 253220	***GUSB*** at 7q21.11	Sly syndrome, beta-glucuronidase deficiency with hepatosplenomegaly, dwarfism, skeletal deformity, hernia, mental retardation, pulmonary infections, corneal opacities. Combines some features of Morquio (MIM 253000) and Sanfilippo syndromes (MIM 252900).
MPS type-VIII. (AR). MIM 253230	Gene	Said to have a deficiency of glucosamine-6-sulfate sulfatase. Mental retardation and hirsutism. Di Ferrante syndrome is no longer accepted.
rheumatic mucopoly-saccharidosis. (AR)	Gene	Has been reported.
Shy-Drager syndrome. (S, AD). MIM 146500	Giant abnormal mitochondria. ***PAF*** for a platelet activating factor.	May habve failure of beta-hydroxylation of dopamine. Causes 7% of spinocerebellar degeneration cases. Adult-onset progressive spinocerebellar degeneration with autonomic nervous system dysfunction, normal intellect or mental retardation, hypotension, ataxia, bladder and bowel incontinence, external ophthalmoplegia, hypotelorism, and ptosis. Patient may be helped by vasopressin.
Winchester disease. (AR). MIM 277950	Gene	A non-lysosomal connective tissue disease with osteoporosis, joint contractures, and peripheral corneal opacities.
Muir-Torre syndrome. (AD) MIM 120433, 120435, 158320..	Gene may be ***MSH2*** at 2p16 or ***MLH1*** at 3p23-p21.3.	Increased risk of multiple primary malignancies. Related to Lynch cancer family syndrome-II. (MIM 114400)
mulibrey nanism. (AR)	***MUL*** at 17q21-q24	Pericardial constriction, hepatomegaly, choroidal hypoplasia, alternating esotropia and exotropia, hypoplasia of the choriocapillaris, yellow spots in the fundus, and pigment clusters in the mid-periphery.
multi-infarct dementia MIM 125310	Mutations in ***NOTCH3*** affect ***CADASIL*** (AD) at 19p13.1	Cause 10% of all dementias. Occlusions, cerebrovascular infarcts, seizures, strokes, and depression. (MIM 600276).
multiple endocrine deficiency. (AR)	***PBFE, EHHADH*** at 3q26.3-q28	his peroxisomal disorder causes many diverse signs
multiple endocrine neoplasia. (AD, S). MIM 131100.	***MEN1*** at 11q13, ***MEN2A, MEN2B, MEN3*** at 10q11.2	Zollinger-Ellison or Wermer syndrome. Peptic ulcer, diarrhea, and adenomas of pituitary, parathyroids, and pancreas. ***MEN2A***, Sipple syndrome (MIM 171400). Some risk of medullary thyroid cancer. ***MEN2B*** (MIM 162300) Have mucosal neuromas, some have medullary thyroid carcinomas, and 45% have pheochromocytomas.
multiple epiphyseal dysplasia. (AR)	***EDM1, MED*** at 19q12	Ribbing and Fairbanks subtypes. Hip dysplasia, osteoarthritis, and short limbs.
multiple evanescent white dot syndrome	Gene for lipoprotein lipase is at 8p22.	Recurrent granularity in the macula, uveitis, and choroidal neovascularization. See hyperlipoproteinemia. (MIM 238600). See the multiple lentigines syndrome. (MIM 151100)
multiple exostoses. (AD). MIM 158345	***EXT1*** at 8q23-q24, ***EXT2*** at 11p11-p12, ***EXT3*** on chromosome 19p ***EXT4*** at 1p36.1.	The multiple cartilaginous exostoses and bony protuberances at the ends of the long bones produce nerve compression. Generally these genes have a tumor-suppressor function. Some have an increased risk of malignant transformation. ***EXTL1, EXTL2,*** and ***EXTL3*** genes have been identified.
multiple lentigines syndrome. (AD). MIM 151100	Gene may be allelic with ***NF1*** at 17q11.2 (MIM 162200)	**LEOPARD** syndrome, focal hyperpigmented skin spots, cardiac anomalies, pulmonary stenosis, respiratory insufficiency, genital anomalies, deafness, mental retardation, hypertelorism, exophthalmos, strabismus, and nystagmus. Compare with these syndromes: No onan (S, AD) (MIM 163950) and Watson (AD) with café au lait spots and pulmonic stenosis. (MIM 193520)..
patterened lentiiginosis (AD). MIM 151001	Gene	Hyperpigmented macules on face, lip, and buttocks, but internal abnormalities are rare.
multiple myeloma oncogene (S). MIM 601900	***MUM1, IRF4*** at 6p25-p23	Kahler disease patients have a neoplasm of B cells and seem to have circulating anticoagulants. In 20% of patients with multiple myeloma a translocation t(4;14)(p16,3-p32) deregulates two genes at 4p16.3, namely ***FGFR3*** (fibroblast growth factor receptor) (AD) and ***WHSC1/MMSET*** (transcription factor and other interferon regulatory factors.

multiple myeloma syndrome. (S, AR). MIM 254500	A translocation t(4;14)(p16.3;q32) occurs in 20% of myeloma patients.	The translocation deregulates two genes at 4p16.3, ***FGFR3*** (a fibroblast growth factor receptor) and ***WHSC1/MMSET*** (a transcription factor). Affected patients have circulating anticoagulants. May involve the **cyclin D1** oncogene ***PRAD1, CCND1*** at 11q13-q13.4.
multiple pterygia. (AR).	Pterygia appear with many syndromes.	Arthrogryposis, pulmonary and cardiac hypoplasia, hypertelorism, and epicanthus. Can be lethal.
multiple sclerosis, susceptibility to. (AD). MIM 126200	***MS1*** at 18q22-qter	Affects 5/10,000, average age of onset is 33. Possibly 50,000 Canadians have MS. CNS demyelination, disseminated sclerosis, vertigo, incoordination, deafness, ptosis, nystagmus, optic neuritis, optic atrophy, pupillary abnormalities, uveitis, paralysis of CNIII or CNVI, and losses from the visual fields. Herpes virus 6 may have a role. Risk to a first degree relative of an affected is 2% to 3%. Compare with Schilder's myelinoclastic diffuse sclerosis (AR), (MIM 272100), Balo's concentric sclerosis. ***HMN22*** (MIM 158590), Krabbe disease (AR) (MIM 245200), and metachromatic leukodystrophy (AR, AD) (MIM 250100).
multiple sulfatase deficiency. (AR). MIM 272200, 250100	***ARSA*** at 22q13.31-qter	Austin metachromatic leukodystrophy. Infantile, juvenile, and adult-onset types, motor symptoms, muscle weakness, rigidity, unsteady gait, mental deterioration, and psychosis. Many do not live beyond 10 years of age.
multiple synostosis-I syndrome. (AD)	***SYNS1*** at 17q21-q22	Synostosis of elbows, fingers, wrists, and feet with deafness.
MURCS association. (AR). MIM 223340	May have a 13q12 deletion. Gene.	Patients the MURCS associaation have Mullerian duct and renal aplasia, cervical somite dysplasia, arm and rib abnormalities, thrombocytopenia, and some of these females are deaf. Can be lethal. Compare these syndromes DK-phocomelia and the von Voss-Cherstvoy
muscle, eye, brain disease. (AR). MIM 253280	***MEB*** at 1p32-p34	Increased serum creatine phosphokinase, hydrocephalus, and myoclonic jerks. Severe, early-onset muscle weakness, mental retardation, congenital glaucoma, retinal hypoplasia, and congenital myopia. Resembles Walker-Warburg syndrome. (MIM 236670).
muscle glycogenosis. (XL).	***PHKA1*** at Xq13	Middle-age onset of distal muscle weakness and cramps.
Mutations in DNA repair genes, some examples are: Bloom syndrome, Cockayne syndromes, Rothmund-Thompson syndrome (AR) (MIM 268400) dermatosis, telangiectasia, and juvenile cataracts. See MIM 270240 with skin atrophy, sun sensitivity, skeletal dysplasia, and iris dysgenesis. See Morquio syndrome, trichothiodystrophy, Werner syndrome, and xeroderma pigmentosum.		
Multiple system atrophies (MSA-P) are progressive, adult-onset disorders with autonomic dysfunction, parkinsonism, and ataxia. The type with cerebellar ataxia (MSA-C) is based on olivopontocerebellar atrophy.		

Muscular Dystrophies, including the limb-girdle dystrophies Congenital muscular dystrophies (AR) (MIM 253550 to 254130) have their onset in infancy but are not progressive. The severe variant is Fukuyama disease (AR) gene is ***FCMD*** at 9q31. For a congenital muscular dystrophy with a rigid spine the gene is ***RSMD1*** at 1p35-p36. They are merosin positive, have hypotonia, scoliosis, and respiratory insufficiency. Ullrich muscular dystrophy can be caused by AR or AD mutations in ***COL6A2*** or ***COL6A3***. Dominant mutations in ***COL6*** genes cause the milder Bethlem myopathy.

For dystrophin-associated glycoprotein-1 the gene is ***DAG1*** at 3p21. For dystrophin-related protein-2 which is mostly in the brain and spinal cord the gene is ***DRP2*** at Xq22. For AR congenital muscular dystrophy with cataract and hypogonadism. See MIM 254000. In females ovarian dysgenesis and in males Klinefelter syndrome and infantile cataract. Scapuloperoneal dystrophy (XL) (MIM 312850) The myopathic forms present between the second and fourth decade and cause gait disturbances.

For congenital muscular dystrophy with involvement of the CNS see: HARD syndrome, Fukuyama dystrophy (MIM 253800), muscle-eye-brain disease (MIM 253280), and congenital muscular dystrophy with deficiency of merosin (MIM 156225).

See also peroneal muscular atrophy (AD) (MIM 600361) with lesions of upper motor neuron and visual pathway, foot-drop, ptosis, irregular pupils, and iris atrophy.

Ocular muscle dystrophy (AD) (MIM 158800). Ptosis with onset at any age.

Gene	How inherited	MIM number	Description
BMD, DMD at Xp21.2	XR	310200	Deletion causes dystrophin deficiency with the Becker and Duchenne types of muscular dystrophy, onset about 4 years of age, lose ability to walk by age 13, and die before age 25. The XL Becker type occurs in about 1/25,000 births. Can also cause Oregon eye disease. (MIM 276600).
EMD, EDMD at Xq28	XR	310300	Emery-Dreifuss muscular dystrophy.

FSHMD1A, FSHD, FRG1 at 4q35	AD, AR	158906 601278	Facio-scapulo-humeral dystrophy-IA is slowly progressive but relatively mild.
FCMD at 9q31-q33	AR	253800	Fukuyama congenital, progressive muscular dystrophy, rigid spine, mental retardation. Some are deficient in merosin and some in dystrophin. See ***LAMA2*** at 6q22-q23, (MIM 156225.)
KNS	AD	183800	Karsch-Neugebauer syndrome. Split hand/foot, congenital nystagmus, strabismus, cataract, and fundus changes.
One gene is ***SMN1*** at 5q13 MIM 600354 .	AR, AD, XL	158600 253300 253400 253550	Kugelberg-Welander syndrome patients have slowly progressive proximal atrophy, juvenile spinal muscular dystrophy. Have elevated serum creatine kinase. Onset in childhood or adolescence. May have ophthalmoplegia, ptosis, and exotropia.
distal muscular atrophy	AD	158800	Usual onset is in adults but a few cases manifest in childhood.
One gene is ***LGMD*** at 17q11-q12	AR	601173	Seven or more types of severe limb-girdle muscular dystrophy with onset before 5 years of age. See ***LGMD2G.*** (MIM 601954).
LGMD1A at 5q22.3-q31.3.	AD	159000	Limb-girdle-IA dystrophy.
LGMD1B at 1q11-q21	AR, AD	159001 253600	Limb-girdle-IB dystrophy, Emery-Dreifuss muscular dystrophy (AD), one gene ***EDMD*** is at Xq28, but this dystrophy can be inherited AD.
CAPN3, LGMD2A at 15q15.1	AR	114240 253600	Erb limb-girdle-IIA dystrophy. Gene calpain is a muscle-specific member of a calcium-activated protease family. Four genes 2C, 2D, 2E,and 2F coding for sarcoglycanopathies cause mild or severe dystrophies. ***LGMD*** genes causing the milder types are 2A, 2B, 2G, and 2H..
LGMD2B at 2p13	AR, S	253601	Limb-girdle-2B dystrop hy is a mild disease. The gene for dysferlin (AR) ***DYSF*** at 2p31, causes a rapidly progressive muscular dystrophy. (Note Miyoshi myopathy, gene **MM** at 2p13, is another dysferlinopathy.)
LGMD2C, DMDA1 at 13q12	AR	253700	Limb-girdle-2C is a Duchenne-1 like dystrophy. Have a deficiency of adhalin.
LGMD2D, SGCA at 17q12-q21.33	AR	600119	Adhalin mutation causes limb-girdle-2 D dystrophy which is a Duchenne-like-II muscular dystrophy.
LGMD2E at 4q12	AR	600900	Limb-girdle-2 E dystrophy.
LGMD2F at 5q33-q34	AR	601287 601411	Defect in the sarcoglycan delta gene causes limb-girdle-2 F dystrophy.
LGMD2G at 17q11-q12	AR	601954	Limb-girdle-2 G dystrophy. Gene is telethonin. See Kugelberg-Welander disease. See ***LGMD***. (MIM 601173).
LGMD2H at 9q31-q34 or at 9q31-q11	AR	254110	Mild muscular dystrophy of the Hutterite type.
LGMD21 at 19q13.3	AD	162040	Mild muscular dystrophy. ***NGFG*** is probably here too. (MIM 162040).
Gene. is probably ***NGFG*** at 19q13.3	AR	277320	Oculogastrointestinal muscular dystrophy with degeneration of the posterior columns, neuropathy, myopathy of the smooth muscle of the stomach and intestines, chronic diarrhea, muscular weakness, intestinal obstruction, external ophthalmoplegia, and ptosis. Death before age 30, See MIM 155310 for an AD condition with a megaduodenum, visceral myopathy, megacolon, and subject to gastrointestinal obstruction.
OPMD at 14q11.2-q23	AD	164300 602279	Oculopharyngeal muscular dystrophy. Progressive myopathy, of facial muscles, dysphagia, ptosis, and rarely retinitis pigmentosa. Onset late in life. An AR type (MIM 257930) depends on this same gene.
DM, DMPK at 19q13.3	AD, S	160900 600963	Curschmann-Steinert progressive myotonic muscular dystrophy.
DM2 at 3q21.3	AD	602668	Myotonic muscular dystrophy is the commonest adult muscular dystrophy. Have multisystem disorders, and expanded CTG repeats in the 3´ untranslated region beyond protein kinase gene ***DMPK.*** (MIM 160900).
MM, LAMA2 at 6q22-q23	AR	156225	Muscular dystrophy with congenital merosin or laminin deficiency. Compare with Fukuyama congenital muscular dystrophy (AR) gene ***FCMD*** at 9q31-q33 (MIM 253800) with mental retardation, seizures, hydrocephalus, and cardiac fibrosis. Resembles Walker-Warburg syndrome. (MIM 236670).
DYSF at 2p31	AR	603009	Mutation in dysferlin causes a rapidly progressive muscular dystrophy. See ***LGMD2B*** and Miyoshi dystrophy. (MIM 254130).
MDRS1 at 1p36-p35	AR	602771	Congenital muscular dystrophy, early spine rigidity.
PLEC1, PLTN at 8q24	AR	226670 601282	A plectin deficiency causes muscular dystrophy with epidermolysis bullosa simplex.
MDRV at 19p13.3	AD	601846	Muscular dystrophy with rimmed vacuoles.
MEB at 1p32-p34	AR	253280	Muscle-eye-brain disease. Mental retardation, congenital glaucoma, high myopia, is similar to Walker-Warburg syndrome. (MIM 236670).
TMD at 2q31	AD	600334	Tibial muscular dystrophy.

Gene at 17q12-q21.33	AR	600118	Warburg microsyndrome, adhalin deficiency, severe childhood muscular dystrophy, microcephaly, and optic atrophy. Compare with these syndromes: **CAMFAK** (MIM 212540), **COFS** (MIM 214150), Martsolf (MIM 212720), Neu-Laxova (MIM 256520),. and Rutledge (MIM 268670).

Name	Gene	Comments
myasthenia gravis, familial, infantile. (AR)	***FIMG*** at 17p13	Neonatal respiratory distress, episodic apnea, ptosis. See Pena-Shokeir-I syndrome. (MIM 208150) Erb-Goldflam syndrome with the presence of antibodies against acetylcholine receptors, includes muscle fatigue, ptosis, and diplopia.
myasthenia, neonatal, transient. (AD)	***ACHRG*** at 2q32-qter	Mutation in the gene for a cholinergic receptor.
myasthenic syndrome, congenital, slow channel. (AD).	***CHRNA1*** at 2q24-q32, ***CHRNB1*** at 17p12-p11, ***MDS1*** at 3p26, ***CHRNE*** at 17p13.1.	Ocular, trunkal, and limb-muscle myasthenia.
myelinated optic nerve fibers. (AD). MIM 159500	Gene	White area adjacent to the optic disc. Do not confuse with pseudopapilledema. (MIM 177800).
myelomeningocoele (M, AR). MIM 235000	Gene	Incidence 2/10,000 live births. In this common disorder faulty closure of the neural tube allows protrusion of the meninges, spinal cord or nerve roots. May have hemihypertrophy , hemihyperplasia. Compare with Proteus syndrome. (MIM 176920).
myeloperoxidase deficiency. (AR)	***MPO*** at 17q21.1	They are unable to kill bacteria.
myopathy. (S, AD, AR, Mito) MIM 600857, 185470, 600649, 261670, 600536, 125660, 160500.	***SDH*** at 1p22.1-pter, ***SDHB*** at 1p36.1-p35, ***CPT*** at 1p32, ***PGAM2*** at 7p13-p12.3, ***ITGA7*** at 12q13, ***DES*** at 2q35, ***MPD1*** on chromosome 14q.	See also Bethlem myopathy (AD), which is a benign muscular dystrophy. See page 20. The Welander or Swedish type, is inherited AD. Their distal, myopathy has a late onset, usually after age 20. See MIM 160500 and several other syndromes.
myopathy-1, myotubular. (XL)	***MTM1, MTMX*** at Xq28	Signs are hypotonia, cardiomyopathy, congestive heart failure, ptosis, strabismus, external ophthalmoplegia, death in infancy.
myopathy, nemaline-2. (AR, AD). MIM 256030	***NEM2*** at 2q21.2-q22	Causes weakness, lordosis, scoliosis, and heart failure. ***NEM1*** is at 1q23-q24. (MIM 191030).
myopathy, hypogonadism, cataract syndrome. (AD, Mito). MIM 157640	***PEO, PEO1*** at 10q23.3-q24.3	Mitochondrial DNA breakage causes progressive external ophthalmoplegia with cataract. ***PEO*** with hypogonadism is described in MIM 603280. See ***PEO2*** and ***PEO3.***
myopathy (AD). MIM 601226.	***PEO2*** at 3p21.2-p14.1	Mitochondrial deletions. Progressive external ophthalmoplegia with ptosis.
myopathy (AD). MIM 601227	***PEO3*** mitochondrial deletion	mt DNA abnormalities. Progressive external ophthalmoplegia.
myopathy (AR). MIM 160550	Multiple mitochondrial DNA deletions.	Mitochondrial anomalies are inherited from the mother Progressive external ophthalmoplegia, weak inferior oblique muscle, with severe cardiomyopathy and early-onset cataracts .
myopathy, hereditary, neurologic type (AD). MIM 162100	***HNA*** at 17q25	Recurrent attacks of painful brachial neuropathy.
myopia, infantile severe. (AR). MIM 255500	Gene	See also microphthalmia with myopia and corectopia. (AD). (MIM 156900 and MIM 160700). See also Stickler syndrome-I at 12q13.1-q13.3, Stickler-2 at 6p21.3, Marfan syndrome at 15q21.1, and juvenile glaucoma at 1q21-q31.
myopia. (XR) MIM 310460	***MYP1*** at Xq28	Bornholm eye disease. Short stature.
myopia, high. (S, AR, AD, XR) MIM 160700	***MYP2*** at 18p11.31.	In one AR condition with severe myopia other signs are inguinal hernia, diverticula of bowel or bladder, esotropia, and retinal detachment. Have superior intelligence.
myopia (AD). MIM 603221	***MYP3*** at 12q21-q23	Those with myopia are more likely to develop glaucoma.
myopia-ophthalmoplegia syndrome. (XR). MIM 311000	Carried by females, manifests in males. ***OPEM***.	Have spina bifida, cardiac defects, lack some reflexes, have ptosis, external ophthalmoplegia, myopia, and progressive retinal and choroidal degeneration.

myosin, light polypeptide-I, alkali, skeletal, fast.	***MYL1*** at 2q32.1-qter, ***MYL2*** at 12q23-q25.3, for cardiac, slow, ***MYL3*** on chromosome 3, ***MYL4*** or ***CM H 8*** on chromosome 17.	Myosins help maintain cell shape and cellular management. . Myosin VIIA is at 11q13.5, see ***USH1B***. The gene for a heavy polypeptide in the skeletal muscle of adults is ***MYH8*** at 17p13.1. The gene for the heavy polypeptide N in smooth muscle is at 16p13.13-p13.12. ***MYBPH*** for myosin-binding protein H is at 1q32.1.
myosin, non-muscle, heavy chain 9. MIM 160775	***MYH9*** at 22q11.2.	For non-muscle myosin, one gene is ***MYH 10*** at 17p13. MIM 160776.
myotonia congenita. (AD, AR). MIM 160800	***CLCN1*** at 7q35, ***SCN4A, HYPP, NAC1A*** at 17q23.1-q25.3	Thomsen syndrome (AD) of three or more subtypes. May produce too much acetylcholine. Manifest before age 5 years, Muscle paresis affecting limbs and eyelids briefly. Onset of the AR type is between the ages of 4 and 12 years.
myotonic dystrophy. (AD, S). MIM 160900	***DMPK, DM*** at 19p13.2-cen	***DMPK*** regulates myosin-II phosphorylation. Progressive muscular atrophy with onset about age 20. Speech disturbances, and loss of corneal sensitivity. Curschmann-Steinert disease affects about 1/8000 newborns causing muscle wasting, distal weakness, heart block, cataracts, and possibly optic atrophy. Have CTG trinucleotide repeats. Mostly inherited from the mother.
myotonic dystrophy-2. (AD). MIM 602668	***DM2, PROMM, PDM*** at 3q21.3	Ricker syndrome with proximal weakness and CCGT repeats. Have DNA expansion. This is the most common form of muscular dystrophy in adults.
myotubular myopathy (XL). MIM 310400	***MTM1*** at Xq28 may code for a tyrosine phosphatase.	Both vinmentin and desmin persist. Cardiomyopathy, death in infancy. A less severe AR form (MIM 255200) and a mild AD form also exist. (MIM 160150).
scapuloperoneal spinal muscular dystrophy. (AR). MIM 271220	Gene	The myopathic form presents between the second and fourth decade and causes gait disturbance. The Ryukyuan type (MIM 158600, 253400) resembles Kugelberg-Welander disease and also limb-girdle muscular dystrophy. For similar conditions see: MIM 181350, 181400, 181405, and 181430.
N.		
Naegeli syndrome. (AD). MIM 161000	***NFJ*** at 17q11.2-q21	Naegeli-Franceschetti-Jadassohn syndrome. Is related to Bloch-Sulzberger syndrome (MIM 308300, 146150) have reticular skin pigmentation by 2 years of age, hypohidrosis, lack sweat glands, lack dermatoglyphics, have nystagmus, strabismus, and optic atrophy.
Nager acrofacial dysostosis. (AD). MIM 154400	***AFDN*** at 9q32	Malar and mandibular hypoplasia, cleft palate, and deafness. Eyelashes missing from the medial third of the lower lids.
nail-patella or **HOOD** syndrome. (AD). MIM 161200	***NPS1, LMX1B*** at 9q34	Turner-Kieser, Little, or osteo-onycho dysplasia syndrome with nail dysplasia, hypoplastic patella, nephropathy, deafness, cleft lip/palate, hypertelorism, ptosis, microcornea, keratoconus and cataracts. Some have unusual iris pigmentation, some develop glaucoma.
NAME syndrome. (AD)	Gene	Myxomas may be cardiac, cutaneous or mammary, spotty skin pigmentation, endocrine overactivity. May have spots on conjunctiva, caruncle, or iris. See Carney syndrome. (MIM 160980).
Nance-Horan syndrome. (XR). MIM 302350	***NHS*** at Xp22.13 or at Xp21-p22.	Have developmental delay, dental anomalies, microcornea, and posterior sutural cataract in females and zonular cataract in males. For ***CCT*** (XL) with congenital cataracts see MIM 302200.
nanophthalmia. (AD). MIM 600165	***NNO1*** on chromosome 11p	Bilateral microphthalmia, high hyperopia, and usually angle-closure glaucoma. Note ***PAX6*** maps to 11p13.
nanophthalmia. (AR). MIM 267760.	Gene possibly at 4q32.	Cystic macular degeneration, angle-closure glaucoma, and retinal degeneration.
NARP syndrome. (Mito). MIM 551500	8993 mutation	Neurogenic weakness, ataxia, seizures, dementia, retinitis pigmentosa, and gradual visual field constriction.
nasal nerve syndrome	Gene	Charlin syndrome, neuritis of the nasal branch of the trigeminal nerve, pain, rhinorrhea, photophobia, conjunctivitis, anterior uveitis, and corneal ulcers.
nerve growth factors MIM 162000, 162040.	For the beta type ***NGFB*** is at 1p13.1, For the gamma type ***NGFG*** is at 19q13.3.	They regulate the growth and differentiation of sympathetic and some sensory nerves. The receptor gene ***NGFR*** is at 17q21-q22.

nerve growth factor. (AR). MIM 191315	***NTRK1*** at 1q21-q22 or at 1q23-q24 or at 1q32-q41	A tyrosine kinase receptor is involved. Loss of tendon reflexes. Mutation causes **HSAN-II**. (MIM 201300).
MIM 600456	***NTRK2*** at 9q22	Codes for a tyrosine kinase receptor in medullary thyroid carcinoma. It is **not** the gene for familial dysautonomia.
MIM 191316	***NTRK3*** at 15q25	Medulloblastoma is the most common malignant brain tumor in children. Fusion of ***NTRK3*** and ***ETV6*** at 12p13, t(12;15)(p13;q25) leads to malignancies including congenital mesoblastic neuroma.
MIM 601312	***NTRK4, DDR*** at 6p21.3	For tyrosine kinase receptor E the gene **TRKE** is at 6p21.3. .
Netherton syndrome. (AR). MIM 256500	***SPINKS*** at 5q32	Ichthyosiform erythroderma, trichorrhexis invaginata, and atopy. Bamboo hair, ichthyosis, skin scales. Have a high level of IgE. Mostly affects females. Can be lethal in infancy.
Neu-Laxova or cerebro-oculo-facio-skeletal syndrome. (AR). MIM 256520	***NLS*** at 1q23 or at 16q13	Lissencephaly, CNS developmental defect, cerebroarthrodigital syndrome (CAD), microcephaly, Dandy-Walker malformation, growth retardation, syndactyly, ectodermal dysplasia, edema, hypertelorism, microphthalmia, exophthalmos, and cataract. Is lethal in neonates.
neuralgic amyotrophy (AD). MIM 162100	***HNA*** at 17q25	Hereditary recurrent attacks of painful brachial neuropathy.
neural retina leucine zipper. MIM 162080.	***NRL, D14S46E*** at 14q11.1-q11.2	Probably does **not** cause retinal degeneration.
neuraminidase deficiency with beta galactosidase deficiency (AR). MIM 256540	***PPGB*** at 20q13.1 and a gene at 10pter-q23.	Goldberg syndrome with cathepsin A deficiency, dwarfism, heart defects, hemangiomas, deafness, mental retardation, seizures, macular cherry-red spot, and corneal clouding.
neurocutaneous melanosis syndrome. (AR). MIM 249400	Gene	Multiple large pigmented nevi, lepto-meningeal melanomas, mental retardation, seizures, hydrocephalus, cranial lipomas, colobomas of iris and choroid, nystagmus, keratoconus, nevi on eyelids, corneal vascularization, and some have an optic glioma. Death early in childhood.
neuropathy, brachial plexus type. (AD). MIM 162100	***NAPB*** at 17q25	Neuritis.
Neurofibromatosis, von Recklinghausen or **Watson syndrome**. May have a pheochromocytoma, acoustic neuromas, optic gliomas, hypertension, mental retardation, café-au-lait skin spots, and Lisch nodules (hamartomas) on the iris, proptosis, elephantiasis of the lids, glaucoma, cataracts, and optic atrophy. Types V and VI have been reported. The NF genes are tumor suppressors.		
NF-I. (AD, S). MIM 162200	***NF1, VRNF, WSS*** at 17q11.2	Incidence 1/3000. Peripheral neurofibromatosis, ptosis, cataracts, optic atrophy, café-au-lait spots on the trunk or on the fundus, congenital glaucoma, and iris Lisch nodules. See Watson syndrome, MIM 193520. ***NF1*** is known to be a tumor suppressor.
NF-II. (AD, S). MIM 101000	***NF2*** at 22q12.2	Incidence 1/50,000. The gene is merlin for this central neurofibromatosis, deletion causes bilateral acoustic neuromas. masses on the eighth nerve. The **ERM** family of proteins includes ezrin, radixin, and moesin, all are related to merlin.
NF-III. (AD). MIM 162260	***NF3A*** and ***NF3B*** on chromosome 12. ***NEFM***	Mixed central and peripheral or Riccardi type ***NF3A***. Multiple CNS tumors and see also a subtype ***NF3B*** with intestinal tumors. (MIM 162220). Early death.
NF-IV. (AD). MIM 162270.	***NF4***	In this Riccardi type they have no Lisch nodules on the iris. ***NF5*** is recognized as a segmental type.
neural tube defects		See Alzheimer diseases.
Neuronal ceroid lipofuscinoses. (AR, AD). NCLs are the most common neurodegenerative diseases of childhood. Mean age at death is 17 years. Lipopigments accumulate in the lysosomes producing progressive encephalopathies in children. Nearly a dozen variants are known including the Parry type. (AD). (MIM 162350). The gene for a congenital juvenile probably AR type is ***PPT*** at 16p12. Compare ***CLN3***. (MIM 204200).		
infantile. (AR). MIM 256730	***CLN1*** at 1p32	Santavuori-Haltia or Hagberg-Santavuori syndrome with psychomotor deterioration, mental retardation, blindness in infancy and die by age 5.
late infantile. (AR). MIM 204500	***CLN2*** at 11p15.5	Jansky-Bielschowsky late-infantile (age 2 to 5 years), cerebroretinal degeneration with convulsions, mental retardation, deafness, ataxia, and optic atrophy.

juvenile. (AR). MIM 204200.	***CLN3*** at 16p12.1-p11.2	Juvenile Vogt-Spielmeyer or Batten-Mayou disease has its onset between the ages of 5 and 8 years.
Kufs-Hallervorden disease. (AR, AD). MIM 162350, 204300	***CLN4, ANCL***	Kufs disease is an adult-onset lipofuscinosis, a Tay-Sachs variant, a deficiency of leukocyte peroxidase, lipid accumulates in brain cells, have cerebral degeneration, seizures, muscular atrophy, dementia, skin lesions, failure to thrive, microphthalmia, colobomas of lids, iris, and choroid, and corneal vascularization. Also called Parry lipofuscinosis with onset about age 31. Compare with ***GM2*** type2. (MIM 272750).
late infantile. (AR). MIM 256731	***CLN5*** at 13q31-q32	Late infantile onset, Finnish variant with a sleep disturbance.
a late infantile variant. (AR). MIM 601780	***CLN6*** at 15q21-q23	An early juvenile, non-Finnish variant. Lipofuscinoses, types 7 and 8 have also been reported.
neuro-degeneration, late infantile. (AR)	***NBIA1*** at 20p13- p12.3	Iron accumulates in the brain, patient has anomalies of speech, motor anomalies, mental retardation, seizures, tremors, optic atrophy, and retinitis pigmentosa. See Hallervorden-Spatz disease.(AR, AD) (MIM 234200).
neuropathy, brachial plexus type (AD). MIM 162100	***NAPB*** at 17q25	Neuritis.
neuropathy, hereditary motor and sensory **LOM** type. MIM 310490.	***NAMSD, CMT2D, NADMR*** at 8q24	With deafness and mental retardation. See Charcot-Marie-Tooth syndrome ***CMTX1*** (MIM 302800).
neuropathy sensory radicular type 1. (AD). MIM 162400	***HSAN-I, SPTLC1*** at 9q22.1-q22.3.	Mutation in the gene encoding serine palmitoyltransferase long chain subunit-I. Onset at age 15 to 36 years, loss of foot sensation, shooting pains, foot ulcers, and deafness. ***HSAN1*** is the most common hereditary disorder of peripheral sensory neurons. ***HSAN-II*** (AR) MIM 201300), ***HSAN-III***(AR) (MIM 223900). Compare with ***CMTX1***. ***HSANIV*** (AR).(MIM 256800). Gene ***NTRK1,TRKA*** at 1q32-q41 or 1q23-q24 or 1q21-q22 (MIM 191315). Mentally retarded. See also ***NTRK2, TRKB*** and ***NTRK3***, ***TRKC*** (MIM 191316).
neuropathy, peroneal	Many subtypes.	See Charcot-Marie-Tooth syndromes.
neuropathy. (AD). MIM 601097	***PMP22*** at 17p11.2-p12	Mutation causes hereditary neuropathy with risk of pressure palsies. **HNPP** is caused by a deletion from ***PMP22***. See ***CMT-IA*** and ***HMSN-IV***

Nevi. Nevi (birthmarks) appear with many syndromes. See the linear nevus sebaceus of Jadassohn which may be inherited AD. MIM 163200. May have seizures, mental retardation, eyelid colobomas, nystagmus, and corneal vascularization. One congenital RPE nevus is called a torpedo nevus because of its shape. It is located in the temporal part of the macula. See also the Ward syndrome.(AD) and the Proteus syndrome.

The gene ***pCMa1*** at 11p15.1-p2 is said to have a role in melanocyte cell transformation for melanocytes. The pigmented hairy epidermal nevus of Becker is sometimes seen on the shoulders of males.

See the neurocutaneous melanosis syndrome (AR) (MIM 249400). Linear hair follicle nevi often occur with epidermal nevus-like lesions.

For Goltz-Gorlin focal dermal hypoplasia (XD) gene ***DHOF*** at Xp22.31, (MIM 305600). Signs include angiofibromas, syndactyly, colobomas of choroid and iris, microphthalmia, ectopia lentis, and strabismus. Lethal in utero to males.

For the Cogan-Reese iris nevus syndrome (AD) see the ICE syndrome (MIM 146720, 601359). Note that the Chandler and the iridocorneal endothelial syndromes seem to be related or their manifestations overlap.

basal cell nevus syndrome. (S, AD). MIM 109400	***BCNS, NBCCS*** at 9q22.3-q31, ***PTCH*** at 9q22.3-q31	The Gorlin-Goltz syndrome is a nevoid basal cell carcinoma. Some depend on mutations in a gene on chromosome 1. Onset usually at puberty, facial involvement, kyphoscoliosis, strabismus, congenital cataracts, choroidal colobomas, and glaucoma.
Bean blue rubber bleb nevus (S, AD). MIM 112200	***BRBNS*** may be on chromosome 9p	Onset after birth, vascular bladder-like hemangiomas, mostly cutaneous or gastrointestinal but can be anywhere on the body Some have subconjunctival hemorrhages. Compare with: ***VMCM*** (AD) on chromosome 9p (MIM 600195) for venous malformations. For cavernous hemangiomas of CNS and retina (AD) ***CCM1*** at 7q11-q21 (MIM 116860), ***CCM2*** is at 7p15-p13, and ***CCM3*** is at 3q25-q27..
dysplastic nevus, BK mole syndrome. (AD, S). MIM 155600	***CMM1*** at 1p36, ***MG50*** at 2p25.3, ***CMM2*** at 9p21, ***CMM3*** at 6q22-q23, ***CDK4*** at 12q13-q14	Familial multiple mole melanoma (FAMMM). Some show cyclin D1 over expression. Large irregular nevi may be called melanocytic nevi. Some develop into malignant melanoma. Melanomas can metastasize to any part of the eye.

epidermal nevus syndrome . (AD). MIM 163200.	***JNP,*** (no reported familial cases.)	Linear epidermal nevus sebaceus of Jadassohn. Anomalies of bone formation, anomalies of the CNS, vitamin D-resistant rickets, mental retardation, epilepsy, seizures, alopecia, nystagmus, esotropia, corneal opacities, and down-slanting lid fissures.
nevus of Ito. (S, AD, XL) MIM 146150, 308300	***ITO*** at 15q11-q13 or 9q33-qter, ***IPA, IP1*** at Xp11.21, ***IP2*** at Xq28	A lysosomal storage disease that affects about 1/9,000. Patterned hypopigmentation anywhere on the body. See the nevus of Ota. About 50% have non-cutaneous abnormalities, CNS dysfunction, seizures, or musculoskeletal abnormalities. May have iris heterochromia, microphthalmia, slow eye movements, nystagmus, strabismus, corneal opacity, choroidal atrophy, cataract, or retinal detachment.
nevus of Ota (AD) MIM 117350, (AR) MIM 271322	Gene	Oculodermal melanocytosis is more common in Orientals. Affects 4 times more females than males, often unilateral. Pigmentation of the skin of the temples, nose, or malar region. Blue-black, slate color, or brown mostly in the area supplied by the first and second divisions of the trigeminal nerve. Slow eye movements. May have pigmentation of the conjunctiva, iris, or fundus. Some are given laser treatment or cryotherapy. See the Wadai-Swami syndrome. (MIM 117350)
NEVO syndrome (AR). MIM 601451	Gene	Delayed motor development, hypotonia, wrist drop, and hyperbilirubinemia. Compare with Sotos syndrome (MIM 117550).
Ward syndrome (AD)	Gene	Basal-cell nevi nodules on face, trunk, and eyelids, hypertelorism, corneal opacities, and congenital cataracts. Compare with ***ORW3*** (MIM 601101). See Romano-Ward syndrome. (MIM 220400).

Niemann-Pick disease is a lysosomal storage disorder of sphingomyelin with defects in cholesterol trafficking. Sphingomyelin accumulates in reticuloendothelial cells and kills ganglion cells in the CNS.

In this lysosomal storage disorder lipid is deposited in the body and CNS. Most have hepatosplenomegaly, seizures, deafness, aa cherry-red foveal centerand psychomotor signs. This sphingomyelinase deficiency with sea-blue histiocytes, has been classified in five or more subtypes.

A. infantile acute neuronopathic, B. chronic visceral without nervous system involvement,
C. juvenile or chronic neuronopathic, D. Nova Scotian type, and E. an adult non-neuronopathic variety.

Niemann-Pick histiocytosis types A and B. (AR). MIM 257200	***SMPD1, NPD*** at 11p15.4-p15.1	Sphingomyelinase deficiency causes anemia, coronary artery disease, hepatosplenomegaly, jaundice, mental retardation, seizures, and a cherry-red macula surrounded by grey lipid-laden ganglion cells.. Most die before reaching 3 years of age.
type IIB. (AR). MIM 257220.	***NPC1*** 18q11-q12	A defect of cholestrerol esterification causes subacute variety that manifests later in life. Have no neurofibrillary tangles.
type IIC. (AR). MIM 257250	***NPC, NPC1*** at 18q11-q12.	A chronic type. Some have an (AR) mutation in ***NPC2***. (MIM 601015). In types IIB and type D they have no neurofibrillary tangles.
type C. (AR) MIM 257220, 601015	Gene may be ***NPC1*** at 18q11-q12.	Cholesterol accumulates in cell bodies due to mutations in ***NPC1***. But some do not have a mutation here. This potentially fatal lipid storage disease produces hepatosplenomegaly and neurodegeneration. Some have tau protein. Type C2 is a minor type.. They have no neurofibrillary tangles.
type D. (AR)	***NPC1*** at 18q11-q12.	See type IIB and type C, with many different mutations.
an XL variety	Gene at Xp11.3.	

Night-Blindness. Poor night vision, hemeralopia, or impaired ability to dark-adapt can accompany many other conditions. See Oguchi diseases MIM 180381 258100, 181031.

Mutation in ***NR2E3, PNR*** at 15q23 (AR) causes an enhanced S-cone syndrome with increased sensitivity to blue light, some visual loss, and night blindness early in life. See also ***FKHL15*** at 9q22. Mutation in ***EFEMP1*** at 6q14 affects dark adaptation. Some have mutations in ***RHO*** at 3q21-q24, or in ***RP2***, or in ***OA2,*** or in several other genes. Mutations in ***ARRB beta2***, ***ARRB2*** at 17p13 cause night blindness. (MIM 107941).

See also Forsius-Eriksson syndrome, Aland Island eye disease, a form of albinism, gene ***OA2, AIED*** at Xp11.4-p11.23. (XR). Congenital night blindness, prematurity, deafness, epilepsy, mental retardation,, microphthalmia, nystagmus, tapetoretinal degeneration, foveal hypoplasia, dyschromatopsia, astigmatism, and myopia.

See Fuchs gyrate atrophy of choroid and retina, ***OAT*** at 10q26. See also Bietti syndrome (AR) ***BCD4*** at 4q35-qter (MIM 210370) and the fleck retina of Kandori (AR) (MIM 228990).

Gene	How inherited	MIM number	Description
NYX, CSNB-I at Xp11.3	XL	310500	Congenital, stationary, complete, night blindness-1 with myopia.
CSNB-II, CSNB-X at Xp11.4 or at Xp21.1	XL	300071	Mutation in a calcium channel alpha-1-subunit gene for congenital, stationary, incomplete, night blindness-II. Compare with ***CACNA1F*** (MIM 300110) and ***RP2*** (MIM 312600).

Gene	AD, AR	113400 210350	Biemond syndrome, type 1 hypophyseal infantilism, hydrocephalus, mental retardation, cerebellar ataxia, facial dysostosis, polydactyly, obesity, genital anomalies, retinal pigment degeneration, colobomas, nystagtmus, strabismus, and night blindness. For Biemond-2 (AR) the features are obesity, mental retardation, hypogenitalism, postaxial polydactyly, and iris colobomas. Three more subtypes are reported.
For ***CSNB-III,*** the gene is ***PDE6B*** at 4p16.3	AD	180072 163500	Codes for the beta subunit of rod cGMP-phosphodiesterase. Causes congenital stationary night blindness-III. See also Nougaret night blindness and ARRP. (MIM 310500).
For ***CSNB-IV*** the gene is ***RHO*** at 3q21-q24	AD	180380	Some have ADRP or ARRP.
DOD1 at Xp11.4-p11.3	XL	126200	***DODI*** is for a type of multiple sclerosis. Complete stationary night blindness with reduced central acuity and high myopia. See ***CSNB-II.*** MIM 300071).
SAG at 2q37.1	AR	181031 258100	Codes for arrestin. Binds to phosphorylated rhodopsin and inhibits interaction with transducin. Mutation causes Oguchi-I syndrome with stationary night blindness and ARRP (MIM 258100). See ***ARRB2*** at 17p13 (AR) (MIM 107941).
RHOK at 13q34	AR	180381 181031 258100	Initiates inactivation of rhodopsin by phosphorylation. A mutation in the gene for rhodopsin kinase can cause Oguchi-II congenital, (AR), stationary, night blindness, with a grey-yellow-brown fundus, the Mizuo phenomenon. Have extra potassium in the retina because of decreased scavenger activity by the Muller cells.
GNAT1 at 3p22-p21.3	AD	139330	Nougaret night blindness with a mutation in the gene for the alpha subunit of rod transducin. See ***CSNB-III.*** (MIM 163500, 180072).
GNAT2 at 1p13	AD	139340	Nougaret night blindness. The mutated gene is in the cones.
RBP4 at 10q23-q24	AD	180250	Mutation here causes degeneration of the RPE and poor night vision. The gene ***PDE6C*** also maps here. (MIM 600827).
RPGR, RP3, CSNB-X at Xp21.1	XR, AD, AR	312610	Mutation causes 20% of XLRP cases and causes congenital stationary night blindness.
BCD4 at 4q35-qter	AR	210370	Bietti crystalline tapetoretinal degeneration with progressive night blindness.
PRG1 at 10q22.1	AD	177040	Mutation in the gene for the leucine-rich proteoglycan nyctalopin causes congenital, stationary night blindness. ***PRG1*** may be acted upon by the tumor suppressor ***p53***. (MIM 191170).
MPZ at 1q21.1-q23.3	AD, AR	145900 601097	Uyemura syndrome, Affects both sexes. Fundus albipunctatus, white spots in the fundus, with night-blindness (hemeralopia), and conjunctival xerosis. May lack vitamin A. See Charcot-Marie-Tooth diseases.
SFD at 22q13.1-qter	AD	136900	Sorsby pseudoinflammatory fundus dystrophy causes night blindness. An AR pedigree was identified in Finland.
RDH5 at 12q13-q14	AR	601617	This 11-cis-retinol dehydrogenase catalyzes the final step in visual chromatophore production, namely the oxidation of 11-cis-retinol to 11-cis-retinal. A problem here causes poor night vision, delayed dark adaptation, cone dystrophy, white dots in the retina, fundus flavimaculatus, and mottling of the RPE. The rod responses are more impaired than the cone responses.
CACNA1F at Xp11.23-p11.22	XL	300110	Mutation in a retinal L-type calcium channel gene causes retinal dystrophy (XL) with congenital, incomplete, night blindness. See ***CSNB-II***. (XL), (MIM 300071).
NINJ1 at 9q22		602062	Ninjurin may have a role in nerve regeneration after injury. See ***HSN1.*** (MIM 602062). Hereditary sensory neuropathy.

Name	Gene	Comments
Berlin breakage syndrome (AR) MIM 600885	Breakages in chromosomes 7 and 14. **(NOT** linked to 11q22-q23)	A variant of ataxia telangiectasia. Louis-Bar syndrome (AR) (MIM 208900). Microcephaly, immunodeficiency, and a predisposition to malignancies.
Nijmegen breakage syndrome. (AR). MIM 251260, 602667.	***NBS1*** at 8q21.3	Growth retardation, microcephaly, and cancer predisposition. Compare with the Berlin breakage syndrome.
Nonne-Milroy-Meige syndrome. (AD). MIM 153400	Gene	Chronic hereditary lymphedema, seen in females at birth or after 35 years of age. Congenital heart defect, unilateral or bilateral ankle edema, rough skin, ptosis, lid edema, distichiasis, strabismus, ectropion, and corneal ulcers. See other lymphedema conditions.

Noonan syndrome. (S, AD) MIM 163950 .	***DTX1*** at 12q24 or a deletion from ***NS1*** at 12q22-qter	Incidence 1/20,000. Syndrome with heart defect, short stature, neck webbing, pulmonic stenosis, von Willebrand disease, coagulation disorders, patent ductus arteriosus, mild mental retardation, crryptorchidism, hypertelorism, ptosis, and down-slanting lid fissures. Partial factor XI deficiency , easy bruising and bleeding. Differentiate from these syndromes: Baraitser-Winter (MIM 243310), cardio-facio-cutaneous **CFC** (MIM 115150), fetal aalcohol, LEOPARD (MIM 151100), Turner (MIM 312760), Watson (MIM 193520), and Williams (MIM 194050).
Norrie retinal dysplasia, Episkopi blindness. (XR, S). MIM 310600. .	***NDP, ND*** at Xp11.4-p11.3. Some have a translocation.	Andersen-Warburg syndrome. Gene product is norrin. Congenital bilateral pseudoglioma, (pseudoglioma resembles retinoblastoma), mental retardation, corneal degeneration, risk of retinal detachment, cataract, and late-onset deafness. Lethal in affected males.
North Carolina macular dystrophy (AD) MIM 136550	***MCDR1*** at 6q14-q16.2	Compare with progressive bifocal choroidopathy, for which the gene is ***PBCRA*** at 6q14. See central areolar choroidal dystrophy. ***CACD*** (AR, XL) on chromosome 17p. (MIM 215500).
central areolar pigment epithelial dystrophy. (AD)	***CAPED*** at 6q14-q16.2.	Their foveal dystrophy is similar to North Carolina macular dystrophy. (MIM 136550).
Norman-Roberts lissencephaly. (AR). MIM 257320	Gene at 17p13.	Microcephaly and type-1 lissencephaly.
Norum disease. (AR). MIM 245900	***LCAT*** at 16q22.1	Lack alpha and beta ***LCAT,*** have anemia and corneal opacities. Those with fish-eye disease lack alpha ***LCAT***. Gene is ***FED*** (AD) (MIM 136120)

Nystagmus is a component of many syndromes, see for example Lenoble-Aubineau syndrome (may be XD) with myoclonus. See also albinism. Nystagmus is common in the Bardet-Biedl syndromes. See the Karsch-Neugebauer syndrome (AD) (MIM 183800).

Most nystagmus is horizontal but some show vertical eye movement (AD) often with ataxia and strabismus.

Congenital syphilis causes luetic-otitic-nystagmus or Hennebert syndrome and they may have deafness, a saddle nose, and Hutchinson teeth.

In the nystagmus blockage syndrome (**NBS**) the horizontal oscillations increase on abduction and decrease on adduction. Patients with nystagmus compensation syndrome (**NCS**) have congenital head posture toward the adducted fixating eye.

Lenoble-Aubineau syndrome. (XD, AD, AR) MIM 310700.	***NYS1.*** Some have 45X/46XX mosaicism.	A nystagmus-myoclonus syndrome affecting males in childhood, tremors of head and limbs, dental anomalies, and congenital nystagmus.
nystagmus, congenital. (AD). MIM 164100	***NYS2*** at 6p12. See ***PAX6*** at 11p13.	Can accompany many conditions and may be accompanied by spasmus nutans.
nystagmus , vertical. (AD). MIM 164150	Gene	Likely to have mild ataxia and strabismus as well as OA -2 albinism. Some have horizontal nystagmus too.
nystagmus. (AR). MIM 203200	***P, PED, D15S12*** at 15q11.2-q12	May be associated with albinism and myopia.
nystagmus, split hand-split foot syndrome. (AD)	Gene	Deformities of hands and feet, nystagmus, strabismus, cataract, and fundus changes. See Cornelia de Lange syndrome ***CDL1*** (AD) at 3q26.3 but is most often sporadic. (MIM 122470).

O.

obesity, susceptibility to	***ADRB2*** at 5q32-q34	Has a signalling role in obesity and in hypertension.
obesity (AD)	***LEPR*** at 1p31, ***MSTN*** at 2q32.1, ***PPAR-g*** at 3p25, ***CCKAR*** at 4p15.1, ***CPE*** at 4q28, ***UCP1*** at 4q31, ***NPYR5*** at 4q31-q32, ***PC1*** at 5q15-21, ***TNFA*** at 6p21.3, ***OBS*** at 7q31, ***LEP*** at 7q31.3, ***ADRB3*** at 8p11.1-p12, ***UCP2*** and ***UCP3*** at 11q13, ***MC4R*** at 18q21.3-q13.2, ***S1P*** at 20q11.2-q12, ***MC3R*** at 20q13, ***OQTL*** at 20q13.11-q13.2.	See also Cohen syndrome (MIM 216550) and ***BBS4*** at 15q22.3-q23. One gene for leptin is ***LEP*** at 7q31.3. The gene ***QTL*** at 22p21 (MIM 601694) affects serum levels of leptin.
obesity, red hair, and adrenal insufficiency. (AD)	***POMC*** at 2p23.3	Early-onset endocrine disorder.

obesity-cerebral-ocular-skeletal anomalies syndrome. (AR)	Gene	Microcephaly, mental retardation, syndactyly, microphthalmia, strabismus, colobomas, mottled retina, down-slanting lid fissures, and myopia. Compare with these syndromes: Laurence-Moon (MIM 245800) and Prader-Willi (MIM 176270, 182279).
obesity and deafness.		See choroideremia.
occipital horn syndrome (XL). MIM 304150	***ATP7A*** at Xq13.3.	Formerly called Ehlers-Danlos syndrome IX. See cutis laxa. See also Menkes disease. (MIM 300011, 309400).
oculo-auriculo-fronto-nasal dysplasia. MIM 601452.	***OAFNS***	Agenesis of the posterior corpus callosum, frontonasal malformation, ear anomalies, cleft lip, micrognathia, and hypertelorism. Compare with: frontonasal dysplasia (MIM 136760, 305645). and frontofacionasal dysplasia (MIM 229400).
oculo-auriculo-vertebral dysplasia. (S, AD). MIM 164210	***HFM, OAVS, FAV*** on chromosome 7p.	Hemifacial microsomia, unilateral deformity of the external ear, and small ipsilateral half of the face. Affects 1/45,000 in Northern Ireland. More risk to the child if the mother has diabetes. Child may have deafness, vertebral anomalies, facial palsy, 20% risk of cardiac anomalies, renal and limb malformations, microphthalmia, and colobomas of the upper eyelid. An expanded Goldenhar complex. See Goldenhar-Gorlin syndrome (MIM 164210) and see CHARGE association. (MIM 214800).
oculo-cerebro-articulo-skeletal syndrome. (AD, AR). MIM 250600	Gene. One AR type is lethal. Other AD and AR types are not lethal.	Matsoukas syndrome with small stature, metatropic dwarfism, joint dislocations, kyphosis, mental retardation, microphthalmia, cataract, conjunctival pigmentation, and myopia. Many die young. Compare with these syndromes: Morquio, achondrodysplasia, metatropic dwarfism type 2, and Kniest disease, (AD) MIM 156550.
oculo-cerebro-facial syndrome. (AR). MIM 244450	Gene	Kaufman syndrome, growth retardation, mental retardation, microcephaly, hypertelorism, nystagmus, amblyopia, up-slanting lid fissures, ptosis, and myopia.
oculocerebral syndrome with hypopigmentation. (AR). MIM 257800	Gene	Cross or Kramer syndrome. An Amish oculocerebral syndrome with hypopigmentation, growth retardation, Dandy-Walker cyst, spastic diplegia, silver-gray hair, mental retardation, developmental defects, microphthalmos, nystagmus, ectropion, corneal opacities, and bilateral optic atrophy.
oculocerebro-cutaneous syndrome. (S, AD). MIM 164180	***OCCS***	Delleman or Delleman-Oorthuys syndrome, agenesis of the corpus callosum, focal dermal hypoplasia, punched-out skin lesions, (usually on the left side) skin appendages, epilepsy, unilateral congenital anophthalmia or microphthalmia, orbital cyst, is usually unilateral. Affects more males than females. Some overlap with Goldenhar syndrome. (MIM 164210).
oculocerebral hypopigmentation. (AR). MIM 257790	Gene	Preus syndrome, growth retardation, psychomotor retardation, hypopigmentation, anemia, and cataracts. Compare with Cross syndrome (MIM 257800).
oculo-cerebro-renal syndrome. (XL)	***OCRL*** at Xq24-q26	For this Lowe-Terry-MacLachlan syndrome see under kidney. ***OCRL1***. (MIM 309000). High serum cholesterol, foam cells in bone marrow, and lipid deposits in the cornea.
oculo-dento-digital dysplasia . (AD). MIM 164200	***ODDD, ODOD*** at 6q22-q23.2	Gene may be ***GJA1*** (connexin 43) at 6q22-q23.2 Signs are dental anomalies, syndactyly-III, microphthalmia, cataract, glaucoma, and retinitis pigmentosa. Some lack middle phalanges of the toes or fingers. For an AR type see MIM 257850. Compare with these syndromes: Meyer-Schwickerath-Weyers (MIM 154200) and Peters (MIM 106210).
oculofaciocardiodental syndrome. (AD or XD) MIM 601354.	***OFCD***	An atrial septal defect, ventricular septal defect, syndactyly of toes, cleft palate, facial dysmorphism, dental anomalies, some are deaf, microphthalmia, congenital cataracts, ectopia lentis, secondary glaucoma, and ptosis. Lethal in males.
oculo-osteocutaneous syndrome. (AR). MIM 211370, 121014.	Gene may be ***GJA1*** (connexin 43) at 6q22-q23.2.	Short stature, brachydactyly, scanty hair, mental retardation, strabismus, nystagmus, myopia, distichiasis, and lens opacities.
oculopalatocerebral dwarfism. (AR). MIM 257910	***OPC, PHPV***	Microcephaly, mental retardation, short stature, cleft palate, asthma, microphthalmia (usually unilateral), persistent hyperplastic vitreous, leukokoria. Compare with Norrie disease. (MIM 310600).
oculopalatoskeletal syndrome. . (AR) MIM 257920	Gene	Michels OPC dwarfism.. Skeletal anomalies, short stature, spina bifida, craniosynostosis, abnormal occipital bone, cleft lip, mental retardation, blepharophimosis, ptosis, epicanthus inversus, persistent hyperplastic primary vitreous, and stromal corneal opacities. See ***BPES1*** (AD) at 3q23. (MIM 110100).
oculorenal syndrome.		See under kidney.

oculo-reno-cerebellar syndrome. (AR)		See under kidney.
O'Donnell-Pappas syndrome. (AD). MIM 136520	Gene may be ***PAX6*** at 11p13. MIM 106210	Foveal hypoplasia, presenile cataract, congenital nystagmus, peripheral corneal pannus, and reduced acuity. May have aniridia.
Oguchi-I syndrome (AR). MIM 181031, 258100	***SAG*** at 2q37.1	Congenital hemeralopia, yellow-grey fumdus lesions, Mizuo phenomenon.
Oguchi-II syndrome (AR). MIM 180381	***RHOK*** at 13q34	Night blindness.
OHAHA syndrome. (AR). MIM 258120	Gene	Polyneuropathy, temor, diabetes mellitus, vascular occlusions, medulloblastoma, ataxia, loss of balance, hypoacusis, sudden onset of deafness at age 10 to 18 months, open mouth, ophthalmoplegia, strabismus, and a spasm in branches of the ophthalmic artery.
Okihiro syndrome. (AD). MIM 126800	***DRRS*** at 20q13, or ***SALL4*** at 20q13.13-q13.2 .	Signs are Duane retraction syndrome, cardiac defects, mental retardation, some are deaf, have urinary problems, and some have pineal tumors. Most narrow their palpebral fissures when performing adduction. The Duane anomaly includes absent abduction and global retraction on adduction.
Oliver-McFarlane trichomegaly syndrome. (AR). MIM 275400	Gene Is this partial trisomy 13 ?	Anterior pituitary deficiency. Mental retardation, dwarfism, hypogonadism, trichomegaly, pigmentary degeneration of the choroid and retina and nystagmus. Excessive growth of eyelashes and brow hair.
Olivopontocerebellar atrophy, (MSA-C) (eight subtypes) is a cerebellar variant of multiple system atrophy. The protein is ataxin-1. With MSA-P they have striatonigral degeneration and are refractory to L-dopa. No effective treatment is known.		
type I. (AD). MIM 164400	***OPCA1*** at 6p23	Menzel disease. See ***SCA-I*** under ataxia. (MIM 601556). Gene product is ataxin-1.
type II. (AD). MIM 2583	***OPCA2*** at 12q23-q24.1	Fickler-Winkler atrophy resembles Déjérine-Sottas syndrome, a cerebello-parenchymal disorder with onset about age 50, have cerebellar ataxia, albinism, dysarthria, and head tremor. **HMSN-III.** See ***SCA-II*** at 12q23-q24.1.(MIM 183090).
Déjérine-Thomas type. (AR). MIM 258300	***OPCA2*** at 12q23-q24.1	Olivopontocerebellar atrophy of the Fickler-Winkler type.
type III. (AD). MIM 164500	***OPCA3*** at 3p21.1-p12	Cerebellar ataxia, ophthalmoplegia, and macular degeneration. They have multiple CAG repeats. See ***SCA-VII*** at 3p21.1-p12 for spinocerebellar ataxia-2.
type IV. (AD). MIM 164600	***OPCA4*** is allelic with ***OPCA1***	See ***SCA1*** at 6p23. (MIM 164400, 601556). Spinocerebellar ataxia (AD) at 6p23.
type V (AD). MIM 164700	***OPCA5, OPCAV***	Dementia, cerebellar ataxia, chorea, rigidity, and extrapyramidal signs.
Déjérine-Sottas syndrome. (AD). MIM 145900, 159440, 601097	Gene may be ***MPZ*** at 1q21.1-q23.3 or ***PMP22*** at 17p11.2-p12.	Hypertrophic neuropathy with muscle weakness and kyphoscoliosis.
Holmes atrophy (AD). MIM 117210.	***SCA12*** at 5q31-q33 .	Cerebello-olivary spinocerebellar degeneration. See Holmes cerebellar ataxia..
Ollier dyschondroplasia syndrome. (S, AD). MIM 166000	Gene	Delayed ossification in the epiphyseal region, excessive formation of cartilage, osteochondromatosis, joint deformities, scoliosis, gliomas, ophthalmoplegia, retinal pigmentation, optic atrophy. Risk of malignant transformation. Chondrosarcoma. See Maffucci syndrome if a hemangioma is present. (MIM 166000).
omphalocele (AR, XL) MIM 164750, 310980	Gene	Incidence 1/5000. Herniation of the abdominal contents into the umbilical stalk. Surgery is required. Compare with Beckwith-Wiedemann syndrome (MIM 130650, 192500, 602631, 603240). Have a duplication in the region 11p13-pter or a contiguous gene duplication of 11p15. 5. See also Shprintzen-Goldberg syndrome (MIM 182210).
oncogenes, numerous	One oncogene is ***ELK1*** at Xp11.2 (MIM 311040)	This oncogene increases the risk of synovial sarcomas.

Ophthalmoplegia can be external or internal or both. Can be progressive or non-progressive. The external type can involve CN III, IV, or VI. Strabismus is seen in 1% to 5% of the population. Paralysis of CNIII affects the recti muscles but not the ciliary body or the pupil. Paralysis of CNIV is usually accompanied by a head tilt, a common cause is head trauma. Paralysis of CNVI causes esotropia. Because of its long intracranial course many conditions can cause paralysis of CNVI. Vascular disease or tumors for example. There are many subtypes. Mutations in ***ARIX*** at 11q13 affect CNIII and CNIV. For ophthalmoplegia with arthrogryposis (AD) (MIM 108145), oculomelic amyoplasia.

See also EOM fibrosis. Congenital extraocular muscle fibrosis syndromes include ***CFEOM*** and Duane syndrome ***DURS***. With AD ophthalmoplegia some have myopathy, mental deficiency, deafness, nystagmus, and optic atrophy. Those with the AR type may have myopathy, cerebellar ataxia, mitral valve prolapse, or ptosis and miosis. ***CPEO*** (multiple mtDNA deletions) refers to chronic progressive external ophthalmoplegia. It can be associated with many other conditions. Thyroid ophthalmoplegia with exophthalmos is due to hypertrophy of the extraocular muscles.

Ophthalmoplegia can be a mitochondrial disorder of four subtypes. Kearns-Sayre, **MERRF** myoclonus epilepsy with ragged red fibers, **MELAS** mitochondrial encephalopathy, and Leber optic atrophy.

Paralysis of CNIII causes Benedikt tegmental syndrome. Bielschowsky-Lutz-Cogan syndrome is an internuclear ophthalmoplegia possibly due to demyelination or ischem ia. Miller-Fisher syndrome is a variant of Guillain-Barré syndrome, an acute idiopathic polyneuritis with ophthalmoplegia, ataxia, and areflexia but a good prognosis. The ***OHAHA*** syndrome (MIM 258120) includes ophthalmoplegia, hypotonia, ataxia, deafness, athetosis, hemiplegia, tremor, diabetes, strabismus, and nystagmus.

See MIM 603280 for a progressive external ophthalmoplegia with hypogonadism, myopathy, weakness, and cataract. For olivopontocerebellar ataxia with ophthalmoplegia (AD) the gene is ***SCA7*** at 3p21.1-p14. Childhood onset of progressive external ophthalmoplegia, scoliosis, nystagmus, ptosis, and facial myokymia. Progressive ophthalmoplegia (AR) may be called ophthalmoplegia plus. (MIM 258450).

Benedikt tegmental syndrome	Gene	Homolateral paralysis of CNIII. Contralateral tremor. Can be caused by a lesion of the inferior nucleus ruber, occlusion of branches of the basilar artery, hemorrhages in the mid-brain, or by a tumor.
Bielschowsky-Lutz-Cogan internuclear ophthalmoplegia. (AR)..	Gene	Lesion in the medial longitudinal fasciculus causes spastic ataxia and paralysis of convergence. Possible causes can be multiple sclerosis, a vascular lesion, or demyelination. Compare with spastic ataxia (MIM 270500.
Bing-Neel syndrome	Gene	Excess production of gamma M globulin, macroglobulinemia, Encephalopathy due to lymphoplasmocystoid infiltration, CNS symptoms, anemia, EOM paralyses, ptosis, dilated retinal veins, retinal hemorrhages, and mild papilledema. See Waldenstrom macroglobulinemia.(AD) (MIM 153600).
chronic progressive external ophthalmoplegia (Mito). MIM 530000	***CPEO, KSS*** Similar deletions occur in Pearson syndrome. Mitochondrial deletions are mostly inherited from the mother.	Myotonic dystrophy, Kearns-Sayre syndrome, Stephens syndrome, and oculopharyngeal dystrophy with ragged red fibers, cardiomyopathy, deafness, and pigmentary retinal degeneration. Usually bilateral. See Pearson syndrome. (MIM 557000). Disorders that only rarely cause ophthalmoplegia include abetalipoproteinemia, Refsum disease, EOM fibrosis, Möbius syndrome, progressive infranuclear paralysis, endocrine exophthalmos, myasthenia gravis, and multiple sclerosis.
Claude syndrome.	Cause may be a vascular lesion.	Inferior nucleus ruber syndrome. Paralysis of ipsilateral nerves CNIII and CNIV.
double elevator palsy	Gene	Weakness of the superior oblique and superior rectus in the same eye.

Ocular muscle fibrosis syndromes result from defects in nuclear development of muscles supplied by CNIII, IV, and VI. The cchild with ***CFEOM1*** at 12q13.2-q24.1 (AD) (MIM 135700) is born with bilateral ptosis, eyes fixed in down gaze, and absent upgaze. Those with **CFEOM2** at 11q13.1 (AR) (MIM 602078) have bilateral ptosis and exotropia. Others have **CFEOM3.**

Fisher or Miller-Fisher syndrome. MIM 104620	***ACY1*** at 3p21.1	Ophthalmoplegia, severe ataxia, and areflexia. Acute idiopathic polyneuritis, dizziness, ptosis, almost complete ophthalmoplegia. Most make a full recovery.
mitochondrial ophthalmoplegia. (Mito)	***MTTN*** at 5657-5729, ***MTTC*** at 5761-5826	May have scoliosis. An early sign is ptosis.
Nothnagel syndrome.	Gene	Ophthalmoplegia and cerebellar ataxia. Lesion of the superior cerebellar peduncle, red nucleus, and oculomotor fibers, possibly caused by a pineal tumor or a vascular lesion. Oculomotor paralysis or internal or external ophthalmoplegia.
ophthalmoplegia. (AD)	***FEOM*** at 12p11.2-q12	Nonprogressive, congenital EOM fibrosis. Eyes fixed in downgaze. See ***CFEOM1*** (AD) on chromosome 12q13.2-q24.1 (MIM 135700).
ophthalmoplegia. (AR)	***FEOM2*** at 11q13.1.	Congenital fibrosis of the extraocular muscles. (MIM 602078).

ophthalmoplegia with multiple myopathy. (Mito, AR). MIM 530000	***KSS*** for a mitochondrial anomaly and ***TFAM*** at 10q21	Regulates transcription and replication of mtDNA. Deletion causes Kearns-Sayre chronic progressive ophthalmoplegia, deafness, cardiomyopathy, and pigmentary retinopathy.
ophthalmoplegia syndrome (AD). MIM 157640, 601226, 601227, 603280	***PEO*** at 10q23.3-q24.3	Progressive external ophthalmoplegia. Also have ataxia, deafness, hypogonadism, myopathy, cataract, and optic atrophy. There are at least two other progressive external ophthalmoplegias.
ophthalmoplegia, progressive external. (AD, AR). MIM 157640, 258450, 601226, and 601227.	***PEO1*** at 10q23.3-q24.2 ***PEO2*** at 3p21.2-p14.1 congenital, and ***PEO3*** with deletions from mtDNA.	Have abnormalities in mitochondrial DNA with ataxia, heart block, muscle weakness, retinitis pigmentosa, cataract, and early death.
ophthalmoplegia external with myopia and retinal degeneration. (XR). MIM 311000	***OPEM***	Barnard-Scholz syndrome, weakness of facial, neck, shoulder, and eyelid muscles, hearing defect, heart block, and retinitis pigmentosa. Onset at any age. Have spina bifida, ptosis, pupillary anomalies, chorioretinal degeneration, and myopia. See MIM 258400 for an (AR) type with strabismus, amblyopia, ptosis, and miosis. A few are inherited AD.
ophthalmoplegia, painful	***PGA***	Polyglandular autoimmune syndrome. Some also have Tolosa-Hunt syndrome, an inflammatory lesion of the cavernous sinus that affects CNIII, IV, VI, and the first division of CNV with episodes of retroorbital pain, ptosis, scotomata, and optic neuritis. See Tolosa-Hunt syndrome. ***THS*** See Schmidt polyglandular autoimmune syndrome-2. (MIM 269200).
ophthalmoplegia with cerebellar ataxia (AR). MIM 212900	Gene	Infantile-onset external ophthalmoplegia
ophthalmoplegia. (AD). MIM 164500	***OPCA3, (SCA7)*** at 3p13-p12.	Have CAG repeats. See also ***ADCA*** type2 at 3p13-p12. Spinocerebellar ataxia. (AD).
paralysis of upward and downward gaze	May be due to infection by *Rochalimea henselae.*	Parinaud's syndrome can be caused by a tumor of the pineal gland. Cat-scratch disease is a bacterial infection.
rretraction syndrome. (AD). MIM 126800	***DUS*** at 8q13-q21.2	Duane syndrome, inability to abduct the eye caused by anomalous innervation, was once considered to be due to fibrosis of the lateral rectus.
(AD). MIM 601471	***MBS2*** at 3q21-q22	Möbius-II syndrome with abduction deficit, facial diplegia, and microglossia. Palsy of cranial nerves VI and VII. Weakness of facial muscles.
superior oblique tendon sheath syndrome	May be inherited AD or AR or not be inherited .	Brown syndrome patients cannot elevate the eye above the horizontal plane. Have ptosis.
WEBINO syndrome	Gene	Wall-eyed bilateral internuclear ophthalmoplegia with exotropia. May be associated with multiple sclerosis in young patients ϕ with myasthenia gravis or vascular accidents.
Opitz BBB syndrome. (XL). MIM 300000	***BBBG1, OGS1*** at Xp22.3 or duplication in the 5p13-p12 region.	Hypospadias, cryptorchidism, cleft palate, mental retardation, heart defect, epicanthus, strabismus, ptosis, and telecanthus.
Opitz C syndrome, trigonocephaly. (AR). MIM 211750	Gene may be on chromosome 4.	This rare oculo-facio-cardio-dental syndrome OFCD causes trigonocephaly, severe mental retardation, polysyndactyly, heart defect, hypertelorism and strabismus. Early death is usual.
Opitz G syndrome-I. (XL). MIM 145410	***MID1, FXY*** at Xp22.3, ***MID2*** at Xp22.3.	Abnormal closure of midline structures with mental defect, dysphagia, hypertelorism, and strabismus.
Opitz G syndrome-II. (AD). MIM 145410	***OGS2, BBBG2, GBBB2*** at 22q11.2.	Esophageal abnormality, hypospadias, and hypertelorism. Gene ***LIFR*** may be at 5p13-p12.
opsin, red		Present in the RPE. See color vision.

Optic atrophy. The gene ***NR2E3*** at 15q23 regulates development of M and L cones from S cones.

Optic nerve hypoplasia (AD) can be bilateral or unilateral, with cerebral malformation, hypertension, nystagmus, strabismus, ptosis, glaucoma, microphthalmia, small optic disc, colobomas, and aniridia.

Optic atrophy reduces acuity, impairs color vision, and causes nystagmus.

Four disorders of particular ophthalmic importance are Kearns-Sayre, myoclonus epilepsy (**MERRF**), mitochondrial encephalopathy (**MELAS**), and Leber neuropathy.

Dominant optic atrophy patients are likely to have myopathy in mid-life but their hearing loss occurs early in life. Thompson syndrome is (AD) (MIM 139400) with nystagmus, optic atrophy, and blindness. Compare with the **FG** syndrome for which the gene may be at Xq12-q21.31.

For the optic atrophy (AD, AR, XL) with hearing loss and peripheral neuropathy see MIM 165199. For optic atrophy with peripheral neuropathy, and peroneal atrophy (AR, possibly AD) (MIM 601152). For hereditary motor and sensory neuropathy-IV see Refsum disease (MIM 266500).

One type of (XL) optic atrophy is associated with degeneration of the CNS and spastic paraplegia.

Kjer juvenile optic atrophy (AD). MIM 165500	***OPA1*** at 3q28-q29	Encodes a mitochondrial dynamin-related protein. Onset between ages 4 and 8 years, mostly occurs in girls. Acuity is usually between 6/12 and 6/60. May have a role in normal tension glaucoma.
optic atrophy (XL). MIM 311050	***OPA2*** at Xp11.4-p11.21	Early-onset mental retardation, tremor, gait disorders, and optic atrophy. See ***XLOPT.***
optic atrophy (XL)	***XLOPT*** at Xp11.4-p11.2	Mutations here can cause three subtypes of optic atrophy often with deafness. See ***OPA2***. See the oncogene ***ELK1*** (MIM 311040)
optic atrophy with ataxia. (AR). MIM 258501	***MGA3, CALM3*** at 19q13.2-q13.3	Costeff syndrome with 3-methylglutaconicaciduria, type 3. Calmodulin mutation causes chorea, paraplegia, and ataxia. This infantile optic atrophy mostly affects females and has been reported more frequently in Iraquai-Jewish patients.
Behr optic atrophy. (AR). MIM 210000	Gene	Some have 3 methyl-glutaconic aciduria. Atrophy in the cerebellum produces pyramidal signs. Onset of bilateral optic atrophy between the ages of 1 and 9 years. Most have ataxia and 50% have nystagmus. Some are retarded and a few have epilepsy or spasticity,. VA is likely to be 6/60 .
(AR). MIM 230740	Gene	**GAPO** syndrome is a connective tissue disorder, some have a partially empty sella, may manifest at 6 months of age, growth retardation, choanal stenosis, alopecia, hypogonadism, hepatomegaly, pseudoanodontia (failure of tooth eruption), glaucoma, keratoconus, myopia, and progressive optic atrophy.
(AD). MIM 258500	***OPA4*** at 18q12.2-q12.3. Can also be AR.	**OAK** syndrome is a dominant Kjer type optic atrophy with myopathy, dystaxia, deafness, ptosis, and myopia. They may have degeneration of the ganglion cells.
(AD, AR)	***RPE65*** at 1q31, ***CRB1*** at 1q31.3, ***RPGRIP*** at 14q11, ***GUCY2D*** at 17p13.1, ***AIPLI*** at 17p13.1, ***CRX*** at 19q13.3.	Leber optic atrophy is an adult-onset type with ataxia, hemiparesis, dysarthria, leg weakness, dense central scotoma, but no nystagmus. Some have mitochondrial mutations.
(AD). MIM 165300	Gene	Optic atrophy, cataract, and neurologic disorder.
(AD). MIM 126800	***SALL4*** at 20q13.13-q13.2, or ***DRAS*** at 20q13.	Okihiro syndrome, Duane retraction syndrome with mental retardation, craniofacial abnormalities, and enophthalmos. See also acrorenoocular syndrome (AD) (MIM 102490).
(AR). MIM 258650	Gene	Optic atrophy with degeneration of acoustic and optic nerves. Compare Rosenberg-Chutorian syndrome (MIM 311070).
optic atrophy with deafness. (AR)	***WFS1*** at 4p16.1. Some have a mitochondrial form.	Wolfram or DIDMOAD syndrome (MIM 222300, 598500) with diabetes mellitus, anemia, and nystagmus.
optic atrophy with deafness. (XL).	***TIMM8A, DDP, DFN1*** at Xq22.	Also have mental deficiency and myopia.
susceptibility to Leber optic atrophy. (XL). MIM 308905	Gene	See Lesch-Nyhan syndrome. (MIM 308000). See also ***MTND4*** (Mito) MIM 516003.
oral-facial-digital syndrome-1. (AD, XR). MIM 311200	***OFD-1*** at Xp22.2-p22.3.	Incolidence 1/50,000. Mental retardation, cleft lip/palate, syndactyly, and bilateral polycystic kidneys. Lethal in utero to males.
oral-facial-digital syndrome-II. (AR). MIM 252100	***OFD-2***	Mohr-Claussen syndrome with cerebellar atrophy, often normal IQ but some have mental retardation, cleft palate, polydactyly, deafness, epicanthus, colobomas. Compare with MIM 311200 and 258850. See Majewski syndrome. (MIM 263520).

oral-facial-digital syndrome-III (AR). MIM 258850	***OFD-3***	Mental retardation, postaxial polydactyly, exotropia, and blepharospasm..
(AR). MIM 258860	***OFD-4***	Mohr-Majewski syndrome with tibial anomalies.
(AD). MIM 174300	***OFD-5***	Thurston syndrome with postaxial polydactyly. and cleft lip, They have six digits on all four limbs.
(AR). MIM 277170	***OFD-6***	Varadi-Papp syndrome with cerebellar anomalies, polydactyly, cleft lip, and psychomotor retardation.
(AR). MIM 222690	***OFD-7***	Whelan syndrome with dibasic aminoaciduria.
(AR, XR). MIM 258865	***OFD-8***	Mild mental retardation and retinal anomalies.
(AR)	***OFD-9***	With retinochoroidal lacunae.
(AR). MIM 258865	***OFD-11***	Has been reported.
oral-facial-cleft syndrome-I . (AD)	***OFC1*** at 6p23	Cleft lip with or without cleft palate, and also pits in the lower lip.
oral-facial-cleft syndrome-II (AD)..	***OFC2*** at 2p13	Non-syndromic, orofacial cleft malformation.
oral-facial-cleft syndrome-III (AD)..	***OFC3*** at 19q13	The affected person is mentally retarded. A gene for a nerve growth factor also maps here.
Orbeli syndrome	Deletion from a gene at : 13q14.3-q21.1 or a translocation	Gene for ATPase. Copper transportation. (MIM 277900). Congenital cystic eye. Compare with: Wilson disease (MIM 277900) and Patau syndrome, trisomy 13.
Oregon eye disease, tyrosinemia-II. (AR). MIM 276600	***TAT*** at 16q22.1-q22.3	Patients with tyrosinemia have palmar and plantar keratitis. See Richner-Hanhardt syndrome (AR). (MIM 276600).
ornithine amino transferase deficiency. (AR). MIM 258870	***OAT*** at 10q26.	See Fuchs gyrate atrophy of the choroid and retina. Myopia, night blindness, and reduced peripheral vision. See also ***OATL1*** at Xp11.3-p11.23, ***OATL2*** at Xp11.22-p11.21, and ***OATL3*** at 10q26.
ornithine transcarbamylase deficiency. (XD)	***OTC*** at XP21.1, ***CPT1*** at 1p13-p11	Hyperammonemia-II with mental deterioration, coma, and ataxia.
orocraniodigital syndrome (AR). MIM 216100	***JHS***	Juberg-Hayward syndrome with mental retardation, growth hormone deficiency, horseshoe kidney, microcephaly, cleft lip/palate, abnormal thumbs, hypertelorism, and ptosis. Compare with the Malpuech orofacial clefting syndrome.(AR). (MIM 248340).
orotic aciduria, type-1 (AR). MIM 258900	Gene	Severe anemia, immunodeficiency, and failure to thrive. Type-2 is (AR). (MIM 258920).
oromandibular dystonia, neuroaxxonal dystrophy, (AR, AD). MIM 234200	***HSD*** at 20p13-p12.3	Hallervorden-Spatz disease, accumulate iron in the brain, and demyelination of nerve fibers .
Osler-Rendu-Weber syndrome-II. (AD). MIM 600376	***ORW2, HHT2*** at 3p22, ***ACVRL1*** at 12q13	Telangiectases, jaundice, and hepatic cirrhosis.
Osler-Rendu-Weber syndrome-III. (AR). MIM 601101	***ORW3, HHT3***	Piantanida syndrome. Hemorrhagic telangiectasia. Compare with Ward syndrome.
osteitis deformans. (AD)		See hyperphosphatemia. See Paget disease. (MIM 157250, 602080).
Atelosteogenesis imperfecta type 1 (AD).(MIM 108720) Lethal chondrodysplasia, hypoplasia of humeri and femurs, cleft palate, and absent fibulae. Stillborn or early death from respiratory distress. See also atelosteogenesis type 2 (MIM 256050), and type 3 (MIM 108721).		
Osteoarthritis is the most common form of arthritis. Progressive destruction of the cartilage matrix. The degeneration of joint cartilage leads to progressive loss of function. Many have Heberden nodes especially middle-aged women. Heberden nodes are inherited AD in females and AR in males. These nodes start with subchondral ossification then develop tidemark flaking.		
Osteochondrosis-osteopetrosis. (AD). Signs are brachycephaly, small stature, crowded teeth, fractures, and exophthalmos. Gene.?????????? See also Blount disease (AR) (MIM 259200) familial infantile osteosclerosis deformans tibiae. Bow legs.		
Osteodysplasty. Type 2 osteodysplasty is usually inherited AR but one variety is XL.		
Albright-I. (AD). MIM 103580	***AHO-I, GNAS1*** at 20q13.22-q13.3	Mental retardation and seizures.
Albright-II. (AD). MIM 103581	***AHO-II*** at 15q11-q13	Osteodystrophy-II with short stature, obesity, mental retardation, and seizures. See also ***GNAS1*** at 20q13.2-q13.3. (MIM 139320)

Albright-III. (AD). MIM 600430	***BDMR*** at 2q37	Mental retardation and brachydactyly.
Melnick-Needles osteodysplasty. (XD). MIM 309350	***MNS*** may be at Xq28	Compare with frontometaphyseal dysplasia (MIM 305620) or otopalatodigital syndrome-II, and Erdheim-Chester disease. Signs include, osteoarthritis, deafness, and exophthalmos.
osteogenesis type 1 (AD). MIM 120150	***COL1A1*** at 17q21.31-q22.05	Incidence 1/17,500. Decreased production of procollagen. Osteogenesis imperfecta, fractures, deafness, and blue sclerae.
osteogenesis type 2 (AD). MIM 166210, (AR). MIM 259400	Gene	Incidence 1/40,000. Undermineralization of bones, death from respiratory insufficiency. About 80% die in their first month. Paternal age is usually advanced.
Osteogenesis imperfecta, the brittle bone diseases. Form insufficient bone matrix, defective mesenchymal structure. Often have mutations in ***COL1A2*** at 7q22.1. Mutations in genes ***COL2A1*** at 12q13.11-q13.2, ***COL3A1*** at 2q31, and ***COL4A1*** may also be involved. Multiple fractures are usual. Their corneas are thin and can rupture from minor trauma. Have a blue sclera and a white limbus. Some have megalocornea or keratoconus. See van der Hoeve syndrome. Those with osteogenesis types V and VI do **NOT** have mutations in ***COL1A1*** or in ***COL1A2***. In the Sillence (AD, AR) type with over hydroxylation of type 1 collagen components (MIM 113450, 259440) signs are short-limb dwarfism, multiple bone fractures at birth, pectus excavatum, and bow legs.		
type IA. (AD). MIM 166240	***COL1A1*** at 17q21.31-q22.05	Defect in the α-I chain of type I procollagen. Opalescent teeth. For type 1 see also MIM 166200 (tarda type with blue sclerae), MIM 166230 (with opalescent teeth and wormian bones, but no fractures), and MIM 166260 (Levin type with unusual skeletal lesions).
type IB. (AR) MIM 259450	***COL1A2*** at 7q22.1	Bruck syndrome. Osteogenesis imperfecta, congenital joint contractures.
type IC (AR). MIM 259400	***COL1A2*** at 7q22.1	Lethal, perinatal, short-limb dwarfism.
type II. (AD). MIM 166210	***COL1A2*** at 7q22.1	Two subtypes are known. Affects 1/55,000. Most severe.
type III. (AD, AR). MIM 259420, 259450	***COL1A1*** at 17q21.31-q22.05, ***COL1A2*** at 7q22.1	In the AD type patients have mutations in the genes for polypeptides of collagen type 1 chain. Some have osteogenesis imperfecta but others have osteoporosis, fractures at birth, deafness, cataracts, blue sclerae, and keratoconus. In one AR type the progressive deforming skeletal disorders are more severe. Dental anomalies, deafness, and respiratory insufficiency. With congenital osteogenesis imperfecta (AR) (MIM 259410), the signs are microcephaly, cataracts, and neonatal death. Compare with the Sillence syndrome (MIM 113450).
type IV. (AD, AR). MIM 166220	***COL1A2*** at 7q22.1	Lobstein type. Defect in genes for procollagen, short stature, scoliosis, and pulmonary insufficiency. Multiple fractures but have normal sclerae.
osteolysis, familial, expansile. (AD).	***OFE*** at 18q21.1-q22	Painful, disabling bone deformity with deafness. "Vanishing" bones.
osteo-onycho dysplasia. (AD).	***NPS1*** at 9q34	Nail-patella or Turner-Kieser syndrome with nephropathy, edema, and cleft lip/palate.
osteopetrosis, lethal. (AR). MIM 259720	Gene	Severe, hydrocephaly, lethal in utero. For a mild variety see Kahler type (MIM 259710). (AD, AR, XR).
osteopetrosis with renal tubular acidosis (AR). MIM 259730	Gene	Marble bone disease. For carbonic anhydrase deficiency see ***CA2*** at 8q22-q13. (MIM 259730).
osteopetrosis, infantile. (AR). MIM 600329	Gene Relates to infantile neuraxonal dystrophy MIM 256600.	Agenesis of the corpus callosum, fractures, visual impairment, and early death. They need stem cell transplantation. For an AD and milder type of osteopetrosis, the genes ***ADO1*** and ***ADO2,*** can be a component of many syndromes.. An intermediate type depends on ***CLCN7*** at 16p13 for a chloride channel gene.
osteopetrosis-I. (AR, some AD) MIM 259700	***CSF1, MCSF*** at 1p21-p13. ***OPTB1*** at 11q12-q13. (AR)..	Albers-Schönberg disease. Infantile osteopetrosis. Marble bones with hydrocephaly, bone sclerosis, dental problems, deafness, anemia, strabismus, and nystagmus, the compression of CN II causes blindness. Death by age 20.
osteopetrosis-II (AD). MIM 166600	***OPTA2*** at 1p21	Osteosclerosis, nephrosplenomegaly, and anemia. Osteopetrosis, infantile neuroaxonal dystrophy. Have normal intelligence.
osteopetrosis. (AR). MIM 259710	***TCIRG1***	Gene encodes a proton pump. Mutation causes infantile malignant osteopetrosis. See also the ***LRP5*** gene.

Kahler osteopetrosis. (AR). MIM 259710, 259700	Is usually a mild AR osteopetrosis but can be AD or a lethal AR type. Gene.	Hepatosplenomegaly, multiple fractures, dental anomalies, facial paralysis, optic atrophy, blindness. [Note the Kahler multiple myeloma syndrome is inherited (S, AR), gene ***LSIRF*** at 6p25-p23.]
osteoporosis-pseudoglioma (AR). MIM 259770	***OPPG*** at 11q12-q13	Osteoporosis onset in childhood or adolescence, short stature, most have normal IQ, corneal opacity, secondary glaucoma, vitreous hyperplasia, and blindness.
osteoporosis and cutaneous hypopigmentation . (AR). MIM 601220.	***OOCHS*** or ***OOCH***	Osteoporosis but they have no cerebral defects. Compare with these syndromes: Cross (MIM 257800) and Preus (AR) (MIM 257790).
osteoporosis, osteochondrosis. (AD)	Gene	Small stature and exophthalmos.
Bamatter syndrome. (XL or AR). MIM 231070	***GO***	Geroderma-osteodysplasticum, Walt Disney dwarfism, osteoporosis, osteodysplasia, microphthalmia, microcornea, glaucoma, and corneal opacities. Some overlap with DeBarsy progeria.(MIM 219150), and with cutis laxa (MIM 219200).
otomandibular dysplasia, anomalies of the ear and mandible	Gene	This auricular-mandibular-maxillary hypoplasia is usually unilateral. From 12% to 50% have facial palsy. Compare with Goldenhar-Gorlin syndrome (M, S, AR, AD), ***OAVS, GHS, FAV*** on chromosome 7p. (MIM 164210).
oto-palato-digital syndrome-I . (XD, AR). MIM 311300	***OPD1*** at Xq28	Taybi syndrome. See frontometaphyseal dysplasia.
oto-palato-digital syndrome-II, or cranio-oro-digital syndrome (XD). MIM 304120	***OPD2*** at Xq28.	Or facio-palato-osseous syndrome. Syndactyly and deafness. Gene may be allelic with the gene for frontometaphyseal dysplasia (XD) at Xq28 or for Melnick-Needles osteodysplasty at Xq28 or with ***OPD1*** at Xq28. ***OPD2*** is more severe.
ovarian failure-1, premature (XL).	***POF1*** at Xq26-q28	Often caused by a deletion.
ovarian failure. (AD)	***POF*** at 3q22-q23	See also ***FOXL2*** for **BPES-1** at 3q23. See ***FMR1*** for ovarian failure with the fragile X syndrome. (MIM 309550)
Oxalosis. (AR, AD). Deficiency of serine pyruvate aminotransferase. Oxalic acid ($C_2H_2O_4$) is a toxin released by *Aspergillus niger* and some other fungi. With hyperoxaluria the patient may develop choroidal neovascularization and some get nephrolithiasis, renal insufficiency, and renal calculi.		
type I. (AR). MIM 259900	***AGXT, SPAT*** at 2q36-q37 PH1 depends on deletion from the ***AGXT*** gene.	Defect of 2-oxoglutarate/glyoxylate carboligase. Renal failure, heart block, and claudication. Two subtypes occur. Recurrent urolithiasis. Need kidney and liver transplantation.
type II. (AR). MIM 260000	Genes at 16q13 and at 6p21.3. For PH2 the gene is ***GRHPR*** on chromosome 9.	Defect of D-glyceric dehydrogenase. Deficiency of the enzymes glyoxylate reductase, and hydroxypyruvate reductase (***GRHPR***). Type-II L-glyceric aciduria is often a milder disease. Diagnosed by the age of 2 years. Renal calculi. Nephrocalcinosis due to hyperoxaluria.
Oxidative phosphorylation disorders can be caused by defects in nuclear DNA. Complex 1 myopathy, complex 2 encephalomyopathy, complex 3 myopathy, complex 4 myopathy and encephalomyopathic types see Leigh, ***MNGIE***, and Alpers syndromes, and complex 5 myopathy. See also deficiencies of coenzyme Q_{10}, defects in intergenomic signalling, and multiple mtDNA deletions.		
oxycephaly. (AD, AR, S, M) MIM 123100	***CRS1, CSO*** at 7p21.3-p21.1	Acrocephaly or tower skull.
oxytocin receptor MIM 167055	***OXTR*** at 3p25	Especially in the uterus.

P.

Paget disease		See hyperphosphatemia.
Paine cerebral palsy syndrome. XL). MIM 311400	Gene	Microcephaly, retarded physical and mental development, excess amino acids in CSF, spastic diplegia, myoclonic fits, optic atrophy. Occurs only in males most of whom die in their first year. May include Seemanova syndrome-1 with epilepsy and spastic tetraplegia.

Pallister-Hall syndrome. (AD). MIM 146510 165240	***PHS, GLI 3*** at 7p13-p12.3 or at 2q32-q31	Hypothalamic hamartoblastoma with hypopituitarism, imperforate anus, renal anomalies, and postaxial polydactyly. Hypertelorism, miosis, iris atrophy, and optic atrophy. Often neonatally lethal. See also Greig (AD) cephalopolysyndactyly syndrome ***GCPS*** at 7p13-p12.3. Other related genes are ***GLI1*** at 12q13, ***GLI2*** at 2q14, and ***GLI4*** at 8q24.3. Similar syndromes are :Smith-Lemli-Opitz-2 (MIM 268670, orofacialdigital syndrome VI (MIM 277170), and holoprosencephaly-polydactyly (MIM 264480).
Pallister-Killian syndrome. MIM 601803	Mosaic distribution of an additional isochromosome 12p. Tetrasomy 12p. ***PKS*** at 12pter-p12.3	Diaphragmatic hernia, short limbs, profound mental retardation, seizures, and an abnormal facial profile. Hypertelorism, epicanthus, ptosis, iris atrophy, cataracts, nystagmus, and optic atrophy. Their fibroblasts have 47 chromosomes. See Fryns syndrome (AR). (MIM 229850, 600776)..
palmoplantar keratoderma. (AD). MIM 244850	***PPKB*** at12q11-q13, or ***KRT1*** at 12q13.	Bothnia type but there are several subtypes. Can develop in a variety of syndromes.
Pancreatic disorders include: cystic fibrosis, Johanson-Blizzard syndrome, Shwachman-Diamond syndrome, Pearson syndrome, and pancreatic agenesis, as well as enzyme deficiencies and malignancies.		
pancreatic lipase deficiency. (AR)	***PNLIP*** at 10q26.1	A gene for pancreatic protein maps to 2p12.
panhypopituitarism. (XL).	***PHP, GHDX, PHPX*** at Xq25-q26	Formerly called pituitary dwarfism.
Papillon-Lefèvre syndrome. (AR). MIM 245000	***PALS*** at 11q22 or 11q14-q21 .	Skeletal, dental (lose their teeth), and digital anomalies and nystagmus. Onset between the ages of 1 and 4 years. The gene for cathepsin C is ***CTSC*** at 11q14.1-q14.3. (MIM 602365).
paramyotonia congenita . (AD). MIM 168300	***SCN4A, HYPP, NAC1A*** at 17q23.1-q25.3	Eulenberg disease. Their myotonia is precipitated by cold.
paraplegia, hereditary, spastic	. Gene	See spastic paraplegia, numerous subtypes..
paraplegin . MIM 602783	***PGN, SPG7*** at 16q24.3	Deletions cause spastic paraplegia.
Parathyroid disorders. The parathyroid hormone ***PTH*** helps to maintain physiologic concentrations of serum calcium and calcitrol.		
parathyroid hormone MIM 168450	***PTH*** at 11p15.3-p15.1	Other genes that map in this vicinity include: ***INS*** at 11p15.1 (AD) (MIM 176730), ***HRAS*** at 11p15.5-p15.1 (MIM 190020), and ***HBB*** at 11p12 (MIM 141900).
parathyroid hormone-like hormone.	***PTHLH*** at 12p12.1-p11.2	May have hypercalcemia of malignancy.
parathyroid hormone receptors. MIM 168468.	***PTHR1*** at 3p21.3-p21.2, ***PTHR2*** at 2q33	See Jansen syndrome, chondrodysplasia. See ***PAHX***,***PHYH*** on chromosome 10. (MIM 602026).
neonatal hyperparathyroidism (AR). MIM 239200.	***HSPH, NHPT***	For an AD hyperparathyroidism with hyperclcemia, onset near puberty, see MIM 145000.
neonatal hypoparathyroidism	AD. MIM 146200, AR. MIM 241400, XL. MIM 307700.	
pseudo-hypoparathyroidism. (AD, XL ,AR) MIM 103580.	***PHP, AHO1*** at 20q13.22-q13.3	End organ unresponsiveness to ***PTH***. Type Ia Albright osteodystrophy (AD), Type Ib may be sporadic. Type II. (MIM 203330). Signs include hypocalcemia and hyperphosphatemia.
hereditary hypocalciuric hypercalcemia. (AD). MIM 145980	***HHC1*** at 3q21-q24	Defective G protein receptor . Hypercalcemia. ***CASR*** at 3q13.3-q21 is the gene for a calcium sensing receptor.
Parinaud's oculoglandular syndrome	Cause can be an infection by *Francisella tularensis* or by *Rochalimaea henselae.* .	Was called the dorsal midbrain syndrome. May relate to cat-scratch disease. Some have a pineal tumor. Unilateral granulomatous conjunctivitis, painful preauricular and submandibular lymphadenopathy, general malaise, and fever. Treat with intramuscular streptomycin
Parinaud divergence paralysis syndrome	Gene	Signs include ataxia, ptosis, some EOM paralyses, divergence paralysis, mydriasis, and papilledema.

parotid aplasia. (AD). MIM 180920	Gene	Aplasia of the parotid and salivary glands with absence or severe dysfunction of the lacrimal glands, dental caries, xerostomia, and dry eyes. Can occur with Down syndrome. For congenital alacrima (AD) see MIM 103420. Alacrima also occurs with anhidrotic ectodermal dysplasia (MIM 305100), and with dysautonomia (MIM 223900), and with other conditions. See MIM 103420.

Parkinson Disease and **Parkinsonism.** Parkinson disease affects 1/1000, usually onset is between the ages 40 and 70. With adult-onset parkinson disease have degeneration of cells in the substantia nigra, atrophy of the globus pallidus and putamen, and have Lewy bodies. Signs of Parkinson disease include paralysis agitans, shaking palsy, and some have epidemic encephalitis. Some Parkinson subtypes depend on mutations in mitochondrial genes. See also amyloidosis and Alzheimer diseases.

Parkinsonism differs from Parkinson disease. In parkinsonism there is less tremor and no response to levodopa.. For juvenile parkinsonism (AR) the gene product is parkin. For adult-onset parkinsonism (mostly AD) the gene product is alpha synuclein. One in six boxers gets Parkinsonism.

For Waisman parkinsonism, a basal ganglion disorder, the gene ***WSN*** is at Xq28. (MIM 311510.)

Striatonigral degeneration, a form of multiple system atrophy (MSA-P). ***SND*** is a parkinsonian variant with rest tremors. These patients can be helped with L-dopa replacement.

Gene	How inherited	MIM number	Description
CYP2D@, CYP2D, P4502D at 22q13.1	AR	124030	A mutation increases susceptibility to Parkinson disease and to cancer of the bladder and lungs.
DYT3 at Xq13	XR	314250	Filipino parkinsonism with torsion dystonia and deafness.
DYT12	AD	128235	Rapid-onset dystonia with parkinsonism in juveniles.
PPND at 17q21	AD	168610	Parkinsonism dementia with pallidopontonigral degeneration.
WSN, BGMR at Xq28	XL	311510	Waisman syndrome is a basal ganglia disorder. Early-onset parkinsonism with mental retardation.
Gene	AD, AR, XL	118301	Parkinsonism with Charcot-Marie-Tooth syndrome, mild dementia, muscle weakness, and ptosis. (MIM 172700).
MAPT, MSTD, DDPAC at 17q21.11	AD	601630 157140	Frontotemporal parkinsonism with dementia. See Pick disease (AD). (MIM 172700).
SNCA, PARK1 at 4q21-q23	AD	601508 168600 163890 168601	Mutation in the gene causes alpha synuclein The result is Parkinson disease-1. Paralysis agitans. Some have (AD) Lewy body dementia. (MIM 127750).
PARK2 at 6q25.2-q27	AR	602544 600116	Mutation in the gene for parkin causes juvenile-onset Parkinson disease.
PARK3 at 2p13	AD	602404	Mutation here causes Parkinson disease-3.
IBSN	AR	271930	Infantile bilateral striatonigral degeneration is a form of multiple system atrophy (MSA-P) (**SND**). Mental retardation, seizures, quadriparesis, cerebellar atrophy, atrophy of one side of the face, and abnormal eye movements. Can be a poststreptococcal autoimmune neuropsychiatric condition with onset after middle age. In this parkinsonian variant they have rest tremor, cerebellar ataxia, seizures, and mental dullness. Affects 1.5% of those with spinocerebellar degeneration. Patient can be helped by L-dopa replacement.
GCH1 at 14q22.1-q22.2	AR, AD	128230	Segawa syndrome with parkinsonism and progressive dystonia, undergoes daily variations.

Name	Gene	Comments
Paired box homeotic genes regulate complex functions.		
MIM 167411	***PAX-1*** at 20p11	May act on the parathyroid glands.
MIM 167409	***PAX-2*** at 10q24.3-q25.1	Have iris coloboma and optic nerve colobomas.
MIM 136533	***PAX-3*** at 2q35	Regulates ***MITF*** which regulates ***TYR.***
MIM 167413	***PAX-4*** at 7q22-qter	Helps the differentiation of insulin-producing cells in the pancreas.
MIM 167414	***PAX-5*** at 9p13	.
AD. MIM 106210	***PAX-6*** at 11p13	Controls morphogenesis of the eye. Can cause AD aniridia.
AR. MIM 167410	***PAX-7*** at 1p36	See lung carcinoma.
MIM 167415	***PAX-8*** at 2q12-q14	See iris coloboma.
MIM 167416	***PAX-9*** at 14q12-q13	Mutations may cause spondylocostal dysplasia.
paroxysmal nocturnal hemoglobinuria. (XR)	***PIGA*** at Xq22.1	Hemoglobinuria.

Parry-Romberg syndrome . (AD, ?). MIM 141300	***HFA***	In this connective tissue disease the eyeball and other orbital contents atrophy. Progressive hemifacial atrophy, onset in second decade, localized scleroderma, epilepsy, alopecia, poliosis, trigeminal neuralgia, migraine-like headaches, enophthalmos, EOM paralyses, scleral melting, choroidal and retinal folding occur, iritis, miosis, and cataracts. Lack nasal portion of the eyebrows. See Rasmussen syndrome. ***GLUR3*** at Xq25-q26. (MIM 305915).
Partington syndrome (XR). MIM 309510	***MRXS1*** at Xp22.2-p22.1.	**PRTS** may depend on a mutation in ***ARX*** at Xp22.1-p21.3.. Have ataxia, mild mental retardation, and dysarthria.
Patau syndrome		Mental retardation. (MIM 309580).
Pearson marrow-pancreas syndrome (S, Mito). MIM 557000	Gene is mitochondrial.	A non-lysosomal leukodustrophy. Have 3-methylglutaconic aciduria, sideroblastic anemia with marrow cell vacuolization and endocrine pancreatic fibrosis. Some progress to Kearns-Sayre syndrome (MIM 530000) and some have zonular cataract. Many die in infancy.
Pelizaeus-Merzbacher disease. (XR, AD, AR) MIM 312080, 260600.	***PLP, PMD*** at Xq13-q22 .	Abnormal myelin sheath structure. Cognitive delay, quadriparesis, ataxia, nystagmus, retinitis pigmentosa, optic atrophy.
pelota gene	***PELO*** at 5q11.2	Active in cell cycle regulation.
pelviuretric junction obstruction or misalignment. (AR) MIM 265380	***PUJO*** may be on chromosome 6p	Abnormal pulmonary vasculature, pelviuretric junction obstruction. Causes pulmonary hypertension and early death of the newborn.
pemphigus, chronic, benign (AD). MIM 169600	***BCPM, HHD*** at 3q21-q24	Hailey-Hailey disease with recurrent skin vesicles. Antigen-1 maps to 6p12-p11.
pemphigoid , bullous antigen-1. MIM 113810	***BPAG1*** at 6pter-q15	***BPAG2*** is at 10q24.3, (MIM 113811). See ***COL17A1***.
pemphigus foliaceus MIM 125670, 125671 169615	***DSG1*** at 18q12.1. ***DSG2*** at !8q12.1, ***DSG3*** on chromosome 18	Cazenave disease, have antibodies to intercellular cement substance, attacks at any age, skin scales, lesions of the eyelids, infiltration of the cornea and iris, and cataract. Desmoglein-1 is the antigen target of ***DSG1***. With ***DSG3*** have antibodies against cadherin.
pemphigus vulgaris. (AD). MIM 169610	Gene Have antibodies to ***DSG3*** desmoglein 3.	Blistering autoimmune disease with skin blisters, bullous eruptions, conjunctival blisters. Can be life threatening. May be associated with HLA-DR4. See ***DSG1*** (MIM 125670), ***DSG2*** (MIM 125671), and ***DSG3*** (MIM 169615).
Pena-Shokeir syndrome-1. (AR). MIM 208150	Gene may be ***FADS*** or ***AMC*** at 5qter.	Arthrogryposis multiplex, fetal akinesia, motor neuropathy, cardiac hypoplasia, pulmonary hypoplasia, camptodactyly, multiple ankyloses, facial anomalies, cleft palate. May develop in a child whose mother has myasthenia gravis.
Pena-Shokeir syndrome-2 (AR). MIM 214150	***NLS*** at 1q23 or at 16q13 .	Cerebrooculofacioskeletal (**COFS**) syndrome with osteoporosis, arthrogryposis, kyphoscoliosis, and hypotonia. Compare with the **CAMAK, CAMFAK,** Marden-Walker, Neu Laxova, and **COFS** syndromes.
pepsinogen. MIM 169700	***PGA*** at 11pter-q12	Secretes pepsin-1.
perforin MIM 170280.	***PRF1*** at 10q22	A pore-forming protein of cytolytic T cells and NK cells.
periodic paralysis-I. (AD)	***HOKPP1*** at 1q31-q32	May have mutations in genes for potassium, sodium, or calcium. Episodic weakness and paralysis. Some have thyroid disorders too.
periodic paralysis-II. (AR)	***HYPP*** at 17q23.1-q25.3	Hyperkalemic paralysis, muscle weakness, and risk of sudden cardiac death.
periodic paralysis-III. (AD). MIM 170600	Gene	This normokalemic periodic paralysis responds to sodium chloride.
Andersen's periodic paralysis. MIM 170390, 600681	***KCNJ2, HHIRK1*** at 17q23 encodes the inward-rectifying potassium current Kir 2.1.	A sodium channel problem. Cardiodysrhythmia but potassium sensitive. See ***LQT 7***. See ***KCNJ1*** (MIM 600359), ***KCNJ4*** (600504), and ***KCNJ5*** (600734). Mutation in ***KCNE3*** a potassium channel gene is associated with thyrotoxic hypokalemic periodic paralysis.
periodontitis, juvenile. (AD)	***JPD*** at 4q11-q13	Severe gingival infections, loss of teeth.
peripherin. (AD). MIM 170710	***PRPH*** at 12q12-q13	This protein is in the rim of the outer segment discs of the photoreceptors. See ***RP7*** (MIM 179605).

peroneal muscular atrophy . (AD). MIM 600361	***DHMNVP*** at 2q14	Peroneal muscular atrophy is the most common inherited disorder of the peripheral nervous system. Lesions of the upper motor neuron and visual pathway. Distal weakness muscle atrophy, vocal cord paralysis, visual pathway lesions, ptosis, irregular pupils, lack of pupillary response to light or near vision. Compare with **HMSN 5.** (MIM 600361) and ***CMT5*** (MIM 600361).

Peroxisome biogenesis disorders (AR) affect about 1/25,000, are lethal, neuronal, hepatic, and renal abnormalities with severe mental retardation. See these syndromes Zellweger, infantile Refsum (MIM 266510), neonatal adrenoleukodystrophy (MIM 202370, 300100) at Xq28, and rhizomelic chondrodysplasia punctata (MIM 215100). Many of the affected children die in their first year of life. Adrenoleukodystrophy is the most frequent peroxisomal disorder. ***PXR1*** at 12p13.3 (MIM 600414) is the gene for a peroxisome receptor. Compare with acatalasemia (MIM 115500) at 11p13, and pseudoZellweger syndrome (MIM 261510) at 3p23-p22..

The three subgroups of peroxisomal disorders are:

Group 1 have a defect in formation of peroxisomal membrane, reduced number of peroxisomes. Most are AR but adrenomyeloneuropathy is AD and ***AMN*** is inherited XL. Group 1 includes neonatal Zellweger syndrome, infantile Refsum syndrome, and hyperpipecolic acidemia. They have multiple enzyme deficiencies.

Group 2 have intact peroxisomes but defects in more than one enzyme. See a Zellweger-like syndrome and rhizomelic chondrodysplasia punctata.

Group 3 have a defect in a single enzyme. Examples are adrenoleukodystrophy (***ALD***) and adrenomyelopathy (***AMN***), pseudoneonatal (***ALD***), bifunctional enzyme deficiency, hyperoxaluria type 1, acatalasemia (catalase deficiency), and glutaryl-CoA oxidase deficiency.

	PEX-1 at 7q21-q22.	For complementation group 1 peroxisomal disorders.
MIM 170993	***PEX-2*** at 8q21.3	See Zellweger-3.
	PEX-3 at 12p13	See ***PXR1*** for peroxisome receptor-I (MIM 600414).
MIM 600414	***PEX-5*** at 12p13	See Zellweger syndrome.
MIM 601498	***PEX-6*** at 6p22-p11.	Mutation can cause AD aniridia.
MIM 601757	***PEX-7*** at 6q22-q24.	
	PEX-8	
	PEX-9	
MIM 602859	***PEX-10*** at 7q22	See Zellweger syndrome.
	PEX-11	
MIM 601758	***PEX-12***	Interacts with ***PEX5*** and ***PEX10.*** See Zellweger syndrome.
	PEX-13	
	PEX-14	
	PEX-16	Like ***PEX3*** and ***PEX19*** is required for peroxisome biogenesis.
	PEX-19	Interacts with ***ALDP*** at Xq28.
Peters oculodental syndrome. (S, AR, AD). MIM 106210	***PAX6, AN2*** at 11p13	Short-limb dwarfism, oligodontia or microdontia, mental retardation, polycystic kidneys, heart disease, corneal opacity, ectopia lentis, cataract, aniridia, and high myopia. Peters is mostly inherited AR, resembles Rieger syndrome and Meyer-Schwickerath-Weyers syndromes, and Rutherfurd syndrome (AD) (MIM 180900), with mental retardation, gum hypertrophy, and corneal dystrophy.
Peters anomaly or Peters plus syndrome. (AD, AR). MIM 116150, 261540	Gene	Krause-Kivlin syndrome may be the result of abnormal neural crest development. Short-limb dwarfism, deafness, cleft lip, mental retardation, microcornea, corneal clouding, cataract, and anterior chamber anomalies. Compare with Reese-Ellsworth syndrome. (MIM 141900).
Pettigrew syndrome 5 MIM 220210, 220220, 304340	***PGS***	Note the relation to Dandy-Walker malformation
Peutz-Jeghers or Peutz-Touraine syndrome. (AD). MIM 175200, 602216	***STK11, PJS*** at 19p13.3	Mutation causes circumoral polyps and brown spots in skin or mucosa of infants. The mucocutaneous spots contain melanin and can occur on the eyelids, conjunctiva, or sclera.
Pfeiffer or Noack syndrome (AD). MIM 101600	***FGFR2*** at 10q25.3-q26	Acrocephalosyndactyly-V. Compare with the Apert and the Crouzon syndromes. Three subtypes: Type 1 AD normal intelligence. Syndactyly of second and third toes and second and fourth fingers, hypertelorism, and up-slanting palpebral fissures. Have extreme exophthalmos, most die soon after birth. Type-II more severe, cloverleaf skull, elbow ankylosis, affects CNS, most soon die. Type-III hydrocephalus, seizures, apnea, developmental delay, intestinal nonrotation, ocular proptosis.
phenylalanine hydroxylase. (AR).	***PAH*** at 12q24.1	Phenylalanine hydroxylase deficiency causes mental deficiency, microcephaly, seizures, abnormal postures, and cataracts.

pheochromocytoma. (AD). MIM 164761, 171300	***PCHC*** on chromosome 1p	This adrenal medullary tumor can also be caused by a mutation in the ***RET*** gene at 10q11.2 (MIM 164761) or by a mutation in other genes. It often occurs with other tumors. About 10% are familial and associated with multiple-endocrine neoplasia-2, (***MEN-2***) (MIM 171400,162300), von Hippel-Lindau syndrome (***VHL***) (MIM 193300), or neurofibromatosis-1 (***NF1***) (MIM 162200). Signs may include hypertension, congenital heart failure, hypercalcemia, congenital cataracts, and white fibers in the corneal stroma.

Phenylketonuria (PKU), formerly Følling disease. (AR). A deficiency of phenylalanine hydroxylase the enzyme that converts phenylalanine to tyrosine, affects 1/23,000 in USA. They have an inborn error of amino acid metabolism and may present an albino-like aappearance.

A type of phenylketonuria called locus heterogeneity is caused by abnormalities in two genes. See also the gene ***DCOH*** (AD) at 10q22 which causes mild hyperphenylalanemia. Hyperphenylalanemia causes brain damage and eczema, evident before the child is one year old.

type I MIM 261500	***PAH, PKU1*** at 12q24.1	Microcephaly, mental retardation, epilepsy, psychiatric disorders, blue irides, and cataracts.
type II MIM 261630	***QDPR*** at 5p15.31	Progressive retardation.
type III MIM 261640	***PTS*** at 11q22.33-q23.3	Severe mental retardation.
type IV MIM 261630.	***QDPD, DHPR*** at 4p15.31	Dihydropteridine reductase deficiency has been called PKU-II.
MIM 233910	Gene at 14q22.1-q22.2	Phenylketonuria GTP cyclohydrolase deficiency. (MIM 600225), severe mental deficiency. Resembles ***DYT5.*** See also Segawa syndrome (AD) (MIM 128230).
phosducin is a G protein regulator. MIM 171490 Other phosducin-like proteins are known.	***PDC*** at 1q25-q31.1	Phosducin from the pineal gland is the principal protein of the photoreceptors. It regulates the phototransduction cascade. Phosducin is phosphorylated in a dark-adapted retina and dephosphorylates in response to light. May relate to ***ARRP*** (MIM 602772) and to ***USH-II,*** three subtypes.

Phosphodiesterase in retinal rods consists of one alpha, one beta, and two gamma subunits. Phosphodiesterases regulate the cellular concentration of cyclic nucleotides. Calcium calmodulin regulates the phosphodiesterases. Phosphodiesterase interacts with transducin. In the dark-adapted retina the phosphodiesterase in rod outer segments is phosphorylated. It becomes dephosphorylated in response to light.

MIM 171890	***PDE1A*** at 2q32, or on chromosome 4.	May interact with apo A-1. Calmodulin dependent. See also ***PDE2A*** (MIM 602658) and ***PDE1C***. (MIM 602987).
MIM 171891	***PDE1B*** at 12q13	May be at 16p13.3 or at 16pter-p11.
MIM 602987	***PDE1C*** or ***HCAM3***	Calmodulin regulated, promotes proliferation of arterial smooth muscle.
MIM 602047	***PDE3B*** at 11p15	cGMP inhibited.
MIM 600126	***PDE4A*** at 19p13.2	cAMP-specific and calcium independent
MIM 602127	***PDE4B*** at 1p31	cAMP-specific, may have a role in leukemia
MIM 600128	***PDE4C*** at 19p13.1	Dunce-like of Drosophila.
MIM 600129	***PDE4D*** at 5q12	cAMP-specific
MIM 603310	***PDE5A*** at 4q25-q27	cGMP- specific
MIM 180072	***PDE6A*** at 5q31.2-q34	Codes for the alpha subunit of rod cGMP-gated PDE. Can cause ARRP.
MIM 180073	***PDE6B, CSNB3*** at 4p16.3 .	Codes for the beta subunit of rod cGMP PDE. Converts cGMP to 5' GMP. Can cause ARRP and congenital stationary night blindness.
MIM 600827	***PDE6C*** at 10q24	Gene for the alpha prime subunit of cone phosphodiesterase.
MIM 602676	***PDE6D*** at 2q36	Codes for the delta subunit in rods.
MIM 180073	***PDE6G, TIMP2*** at 17q25	Codes for the gamma subunit of rod cGMP PDE. Can cause ARRP..
MIM 601190	***PDE6H*** at 12p13	Codes for the gamma subunit of cone PDE.
MIM 171885	***PDE7A, HCP1*** at 8q13-q22	See also ***PDE7B, PDE8A*** (MIM 602972)***, PDE8B***, and ***PDE9A*** (MIM 602973).
phosphofructokinase deficiency. (AD)	***PFKL*** at 21q22.3	Mutation can cause hemolytic anemia.
phosphoglucomutase-I MIM 171900	***PGM1*** at 1q12-q21	Risk of spontaneous abortion. See ***PGM2*** (MIM 17200), ***PGM3*** (MIM 172100), ***PGM4*** (MIM 172110), and ***PGM5*** (600981).
phosphoglycerate kinase, deficiency. (XL)	***PGK1, PGKA*** at Xq13, ***PGK2*** at 6p21.1-p12..	Mutations can cause hemolytic anemia and variable mental retardation. A pseudogene ***GK1P2*** is on chromosome 6.

phosphoglycerate kinase, gamma-I of muscle. (AD)	***PHKG1, GCPS*** at 7p13-p12.3.	Cephalopolysyndactyly, peculiar skull shape, hip dislocation, and syndactyly. ***PHKG2*** is at 16p11.2-p12.1. (MIM 172471). Compare with Greig syndrome (AD) at 7p13-p12.3 (MIM 175700).
phosphoglycerate kinase, deficiency in liver and muscle (AD)..	***PHKB*** at 16q12-q13.1	Causes a glycogen storage disease.
phosphomannomutase MIM 601786	***PMM1*** at 22q13	See also ***PMM2*** (MIM 601785)
phytosterolemia beta sitosterolemia (AR) MIM 210250	***STSL*** at 2p21	Have xanthomas, atherosclerosis, anemia, and arthralgia.
Pick disease (AD) MIM 172700	***MAPT*** at 17q21.11. In one family the gene was on chromosome 3.	Arnold Pick syndrome, atrophy of the frontal and temporal lobes of the brain, cortical atrophy, signs appear after age 40, aphasia, agnosia, apraxia, and progressive dementia. See tau (MIM 157140). Compare with Alzheimer diseases.
piebaldism or piebald trait		See albinism.
Pierre-Robin syndrome. (AR, XL). MIM 261800	Some may not be Mendelian.	Incomplete development of the first branchial arch. Micrognathia, bird-like face, glossoptosis, cleft palate, microphthalmia, ptosis, glaucoma, retinal detachment, and high myopia. Compare with: trisomy 18 or Wagner syndrome (MIM 143200), and Stickler syndromes.(MIM 108300.
pigment dispersion syndrome-I .MIM 600515.	***GPDS1*** at 7q35-q36	A cause of open-angle glaucoma. The AD type is **NOT** linked to 1q21-q31.
pigment epithelium derived factor. (AD) .	***PEDF*** at 17p13.3.	See MIM 172860. Inhibits angiogenesis. A deficiency leads to choroidal neovascularization. May have a protective role in the brain in amyotrophic lateral sclerosis. See ***RP13.*** (MIM 600059).
pigmentary retinopathy with mental retardation. . (AR). MIM 268050	Gene on chromosome 6.	Mirhosseini-Holmes-Walton syndrome with severe mental retardation, scoliosis, hyperextensible joints, microcephaly, cataract, and keratoconus. Treatable. Gene may be allelic to that of Cohen syndrome (AR), (MIM 216550).
Pillay syndrome. (AD). MIM 164900	***OMMD*** or ***OMM***	Ophthalmomandibulomelic dysplasia, short forearms, temperomandibular joint fusion, and corneal opacities.
pilodental dysplasia with refractive error. (AR). MIM 262020	Gene	Hypodontia, abnormally shaped teeth, ectodermal dysplasia, hypotrichosis, skin pigmentation, hyperopia, and astigmatism.
Pingelapese color blindness		See color vision.
Pitt-Rogers-Danks syndrome. (AR). MIM 262350	***PRDS*** at 4p16	Deletion here causes growth retardation, microcephaly, developmental delay, seizures, and unusual palmar creases.

Pituitary anomalies, deficiency of growth hormones affect 1/7000. Most cas es are sporadic. There are 5 types of pituitary dysfunction ***CPD*** of which 4 are inherited AD. The gene for X-linked agammaglobulinemia is at Xq21.3-q22 (MIM 307200, 300300). Growth hormones are synthesized in the anterior pituitary gland. Regulators of G protein include genes at MIM 600861, 602189, 602512, 602513, 602514, and 602516. See also ***RGS3*** at 9q31-q33 (MIM 602189). See also ***GH1*** at 17q23-q24 (MIM 139250), ***GH2*** (MIM 139240), and ***GH3*** (MIM 139250).

pituitary transcription factors. (AD, AR). MIM 173110	***PIT1*** at 3p11 ***POU1F1*** at 3p11	POU transcription factors regulate mammalian development. Growth hormone deficiency can cause dwarfism, hypothyroidism, and sexual immaturity. ***PIT1*** at 3p11 is the same as ***GHF1***. (MIM 173110)
pituitary aplasia. (XR, S). MIM 312000	***CDKN3*** at Xq21.3-q22	Pituitary dwarfism. Panhypopituitarism affects 8,000 people in USA. For an AR type pituitary dwarfism-III see MIM 262600 and for a rare XL type see MIM 312000
pituitary gigantism MIM 138850, 139190	***GRHR*** at 4q13-q21.1	Overproduction of growth hormone causes pituitary gigantism, muscle weakness, headache, mental retardation, optic atrophy, and field defects.
pituitary growth hormones. MIM 139250	***CSL, CSA, GHV, CSB*** at 3q28, 11p15.5, 12q24.1-q22 or 20p11.23-q12.	***GH1, GHN*** is at 17q23-q24. (MIM 139250). All the other growth hormone genes are expressed only in the placenta. ***CSH1*** (MIM 150200) is at 17q21-qter (MIM 139240).
pituitary dwarfism (AR). MIM 262700	Gene	Have a small sella turcica. Panhypopituitary dwarfism affects over 8,000 people in USA. For (AR) pituitary dwarfism see MIM 262600.and for the rare XL type see MIM 312000.. Laron dwarfism with growth hormone insensitivity is (AR) (MIM 262500).

hypopituitarism (AR). MIM 262710	Gene	Have a large sella turcica. See also MIM 262600 and 262700.
panhypopituitarism (AD, XL). MIM 312200	***PHP*** at 20q13.22-q13.3 ***GHDX*** at Xq21.3-q22	See also ***CDKN3*** at 4q21.3-q22. For AR panhypopituitary dwarfism see MIM 262600.
pituitary aplasia, type 1A. (AR). MIM 262400	Mutation in ***GH1*** at 17q23-q24.	Growth hormone deficiency. Pituitary dwarfism-I. For ***GHI*** see (MIM 139250). For ***GH2*** see (MIM 139240) and for ***GH3*** see (MIM 139250). ***CSH*** is at 17q21-qter (MIM 139250). ***CSH1*** (MIM 150200).
type 1B. (AR). MIM 262400	Gene	Growth hormone deficiency. Pituitary dwarfism.
type 2 (AD). MIM 173100	***GHF1***	Growth hormone deficiency. Pituitary dwarfism. ***RGS3*** at 9q31-q33 (MIM 602189) regulates G protein signalling.
type 3 (AR). MIM 307200	Gene	Fleischer syndrome, hypogammaglobulinemia.
type 4 (may be AR). MIM 262650	Gene	Mutation in growth hormone ***GH III*** (MIM 139250). Gene becomes biologically inactive. ***GH I*** is at 17q23-q24.
Sheehan or Simmonds-Sheehan syndrome. (Mostly XL) MIM 311850	***PRPS1*** at Xq22-q24, ***PRPS1L2*** at 9q23-q24, ***PRPS2*** at Xp22.2-p22.3	Pituitary necrosis caused by occlusion of a vessel supplying the anterior lobe of the pituitary. Signs are dry skin, lethargy, weakness, myxedema, premature aging, weight loss, cutaneous hyperpigmentation, hypotrichosis of the eyebrows, loss of lashes, uveal depigmentation, impaired vision due to vascular insufficiency. Diabetic retinopathy tends to improve after the development of this syndrome.
pituitary and eye development	Gene at 14q22.	See ***CG1*** at 14q22. (MIM 600361) and ***CMT5***. (AD) (MIM 600361).
pituitary hormone deficiency, combined type. (AD).	***PIT1, POUF1*** at 3p11, ***THR1*** at 3p24.3.	***GHF1*** (MIM 173100) is identical to ***PIT1***.at 3p11. ***GH3*** (MIM 139250)
Laron dwarfism. (AR)	Type 1. MIM 262500. Type II. MIM 245590	Have abnormal receptors for growth hormone. Signs include short stature and obesity.
PIV syndrome (S, AD). MIM 174100	***PIV***	Polydactyly, imperforate anus, and vertebral anomalies. Probably **not** a valid entry. Note the overlap with these syndromes: Pallister-Hall and VACTERL.
panhypopituitarism. (AD, XL).	***PHP*** at 20q13.22-q13.3, ***GHDX*** at Xq21.3-q22	See Albright diseases (MIM 103581, 203330, 300800, 600430).
de Morsier syndrome MIM 147450, 147460,. 185490.	***SOD1*** at 21q22.1. ***SOD2*** at 6q25.3-qter. ***SOD3*** at 4pter-q21.	Absence of the septum pellucidum, agenesis of the corpus callosum, optic nerve hypoplasia, pituitary insufficiency, diabetes insipidus, optic disc hypoplasia, nystagmus, bitemporal hemianopia, and poor vision. See Kallman syndrome. (MIM 208700)
placental lactogen deficiency. (AD).	***CSH1, CSA, PL*** at 17q22-q24.	Chorionic somatotropin hormone-1.
plasma lecithin deficiency-cholesterol acyltransferase deficiency. (AR). MIM 245900	***LCAT*** at 16q22	Storage of lipids, anemia, corneal stromal grey dot opacities, and retinal hemorrhages.
platelet-derived growth factors	***PDGFC*** at 4q32, ***PDGFD*** at 11q22.3-q23.2	Understood to have a role in arteriosclerosis.
poikloderma, congenital bullous. (AR). MIM 173650	***FERM*** at 20p12.3	Kindler syndrome, photosensitivity, syndactyly, nail dystrophy, hand deformities, cutaneous and oral inflammation, congenital blisters, and bleeding gums.
Poland disruption sequence. (Usually S) MIM 173800.	Rarely familial.	The subclavian artery fails to supply enough blood to distal limb and pectoral areas.
poliomyelitis susceptibility. (AD).	***PVS*** at 19q13.2-q13.3	
polyarteritis or periarteritis nodosa. (AD, Mito) MIM 109100	***PAN*** may be mitochondrial.	A group of autoimmune disorders including Kussmaul disease with progressive autoimmune necrotizing angiitis affecting the small and especially the medium size arteries. Fever, myopathy, myalgia, hypertension, cataract, EOM paralyses, and possible occlusion of the central retinal artery.
polybinding proteins	***PAPB1*** at 8q22	See also inducible ***iPAB1*** probably at 1p32-p36 and ***PAPB3*** at 13q11-q12. Four pseudogenes are known; 1 is on chromosome 4, 2 is on chromosome 14, 3 location is not known, and 4 is on chromosome 15.

polychondritis, relapsing. (AD). MIM 165670	Gene associated with HLA-DR4 .	von Meyenberg-II disease with ossified ear cartilage, severe respiratory involvement, deafness, liver hamartomas, and ocular signs in 60%, paresis of CN III or CN VI, chorioretinitis, exudates, hemorrhages, and keratitis. Can accompany several diseases e.g. alkaptonuria.
polycythemia rubra vera. (AR). MIM 263300	***PRV-1*** at 19q13.12 or deletion from 20q11 or from 7q11.2 or from a gene on chromosome 9 p?	Erythrocytosis. One of the chronic myeloproliferative disorders. Some progress to myeloid metaplasia or to acute leukemia.
polydactyly, preaxial-I. (AD). MIM 174400	Gene may be at 7q36.	Thumb polydactyly of several types. Type 1 MIM 174400, type 2 (MIM 1174500, type 3 (MIM 174600), type IV (AD) (MIM 174700).
polydactyly, postaxial A1 MIM 174200	***PAPA1*** at 7p13	Extra digit on ulnar or fibular side. See also syndactyly. See ***GLI3*** an oncogene .(MIM 165240).
polydactyly, postaxial A2. MIM 602085	***PAPA2*** at 13q21-q32	
polydactyly type 3, postaxial (AR). MIM 263510	***SRPS-III.***	Verma-Naumhoff syndrome may be related to Jeune syndrome-2 on cchromosome 12p. (MIM 208750). Have chondrodystrophy.
polydactyly, postaxial. (AD). MIM 174310	***PMS***	With progressive myopia. Compare with the Bardet-Biedl syndromes.
postaxial polydactyly, retardation, and cortical blindness. (AR). MIM 218010	Gene	Severely retarded growth and psychomotor development, cortical blindness, and early death.

Autoimmunity has a role in many conditions including: alopecia areata (MIM 104000), pernicious anemia (MIM 170900), autoimmune hemolytic anemia (MIM 205750), hypoadrenocorticism with hypoparathyroidism and moniliasis (MIM 240300), Schmidt syndrome (MIM 269200), Sjögren syndrome (MIM 270150), systemic lupus erythematosus (MIM 152700), and thyroid autoantibodies (MIM 140300). See also (MIM 109100).

polyglandular autoimmune diseases. ***PGA-I.***(AR) MIM 240300.	***PGA-I, AIPS1, APECED, AIRE-1*** at 21q22.3	Polyendocrinopathy-candidiasis-ectodermal dystrophy-Addison disease. With **PGA-I** the person has at least two of Addison disease, hypoparathyroidism, mucocutaneous candidiasis. See ***APE, APEX, APE1*** at 14q11.2-q12. (MIM 107748).
PGA-II. (AR, AD, M) MIM 269200	***PGA-II, APSII***	With **PGA-II** the person (mostly middle-aged females) has Addison disease, with thyroid disease and/or insulin dependent diabetes mellitus. Onset in adults. HLA-B8 associated. Some have myasthenia gravis. Compare with Schmidt syndrome (MIM 269200), see ***AIRE-1*** at 21q22.3. (MIM 240300). This transcription regulator can undergo at least 45 mutations.
PGA-III. MIM 169710	***PGA-III, APSIII*** Pepsinogen-I second locus.	With **PGA-III** the person has autoimmune thyroid disease, and one or more other autoimmune diseases but no Addison disease.
polyposis, juvenile, intestinal. (AD).	***JPS, JIP, PJI*** at 10q22.3-q24.1	See ***PST1*** at 1q21-q23. The gene for a juvenile variant is ***MPSH*** at 6q16. See also ***SMAD4, DPC4*** at 18q21.1.
polyposis coli, adenomatous. (AD)	***APC, FPC*** at 5q21-q22	See Gardner (MIM 175100) and Turcot (MIM 276300) syndromes.
Pompe disease. (AR). MIM 232300	***GAA*** at 17q25.2-q25.3.	Lack of acid maltase causes generalized glycogenosis, a type IIa glycogen storage disease. with muscular hypotonia, anorexia, retarded growth, dyspnea, large heart, convulsions, cortical blindness, and death before age 1 year.
popliteal pterygium syndrome. (AD). MIM 263650.	***IRF6*** at 1q32-q41	Affects 1/300,000 live born. Popliteal webbing, cleft lip, syndactyly, and genital anomalies. May be allelic to van der Woude syndrome. See multiple pterygia. (MIM 178110).

Porphyria of various subtypes. Those affected excrete much uroporphyrin in their urine, have fragile skin, and are subject to photosensitive dermatitis.

Gene	How inherited	MIM number	Description
ALAD at 9q34	AD	125270	Deficiency of dehydrogenase. Acute attacks of hepatic porphyria. See ***CPO*** (AD) at 3q12.
EPP, FECH, FCE at 18q21.3	AD, AR	177000	Acute hepatic porphyria, childhood onset erythropoietic protoporphyria.
HMBS, PBGD, UPS at 11q24.1-q24.2	AD	176000	Acute intermittent hepatic porphyria, affects 1/15,000, onset after puberty.
PORC at 11q23.1	AD	176010	Chester porphyria.
UROS at 11q25.2-q26.3	AD	263700	Congenital erythropoietic porphyria, Gunther disease.

CPO at 3q12	AD	121300	Coproporphyria. See ***ALAD***. (MIM 125270)
UROD at 1p34	S, AD	176100	Porphyria cutanea tarda.-I. May have hepatitis C, hepatoerythropoietic porphyria. Erythropoiesis EPP.
PCT at 1p34	AD	176090	Porphyria cutanea tarda-II. Deficient in uroporphyrinogen. (Two subtypes). HEP onset can be in childhood or in adulthood. Light-sensitive dermatitis, hyperpigmentation, hypertrichosis, keratitis, optic atrophy, brown pigmentation, retinal hemorrhages.
VP, PPOX at 1q23	AD	176200 600923	South African porphyria variegata. See ***PPO***. (MIM 600923). For interferon alpha-inducible protein see ***IFI27*** at 14q32. (MIM 600009).
PPO at 1q22-q23	AD, AR	176200	Acute hepatic porphyria variegata. May be the same as ***PPOX.*** (MIM 600923)

Name	Gene	Comments
Potter or Holzgreve syndromes. (This designation is not widely used.) (AD). MIM 236110	***PDK*** at 16p13.11 to 16p13.33	Potter facies, renal agenesis, hypertelorism, squashed nose, receding chin, and large ears deficient in cartilage. Four subtypes with cystic kidneys, heart defects, cleft palate, and polydactyly.
Prader-Labhart-Willi syndrome. (C, AR, Mito). MIM 176270, 182279	The deleted paternal genes are ***PWCR, PWS*** at 15q11.2-q12, or 15q11-q13, ***SNRP*** at 15q12	If part of paternal chromosome 15 is deleted the child will have Prader-Willi syndrome. This is a type of imprinting. Incidence 1/15,000. Signs are short stature, mental deficiency, and obesity. Hypertelorism, strabismus, exotropia, glaucoma, cataracts, myopia, and diabetic retinopathy. If they also have diabetes it is called Royer syndrome. If part of maternal chromosome 15q is missing the child will have Angelman syndrome. (MIM 105830, 234400, 601623). See also ***D15S227E, PR1*** and ***D15S226E, PAR5, SNRPN*** and ***IPW***.
precocious puberty, male . (AD)	***LHCGR*** at 2p21	Cryptorchidism.
presenilins 1 and 2.		See the Alzheimer diseases.
Preus syndrome (AR). MIM 257790	Gene	Psychomotor retardation, hypochromic anemia, high-arched palate, small teeth, oculocerebral hypopigmentation, and cataracts. Compare with Cross syndrome (MIM 257800).
prion diseases. (AD). MIM 176640	***PRNP*** at 20p12.	Prions can be transmitted by inoculation or inherited. They lack nucleic acids. Diseases are Creutzfeld-Jakob disease. (MIM 123400); kuru (MIM 245300); Gerstman-Straussler-Schernker disease (MIM 137440); fatal familial insomnia (MIM 600072); and a variant of Creutzfeld-Jakob disease, gene ***vCJD.***

Progeria, premature ageing, many types. One (AD) premature ageing syndrome causes branchial clefts, a characteristic facies, growth retardation, imperforate nasolacrimal ducts, malformed ears , and strabismus. See also leprechaunism (MIM 246200). Mulvihill-Smith progeroid syndrome (AD) (MIM 176690) includes microcephaly, mental retardation, short stature, deafness, pigmented nevi, keratoconus, and conjunctivitis. These males are immunodeficient, (low IgG).

Pseudoprogeria (AR) is a progressive spastic quadriplegia with microcephaly and mental retardation. They have glaucoma and lack eyelashes and eyebrows.

Bamatter syndrome. (AR). MIM 231070	***GO***	Walt Disney dwarfism with precocious ageing, geroderma osteodysplasticum, multiple fractures, bone malformation, osteoporosis, vertebral compression, microphthalmia, glaucoma, microcornea, and corneal opacity.
Berardinelli-Seip syndrome. (AR). MIM 269700, 272500.	***BSCL1*** at 9q34 or 11q13..	Congenital lipodystrophy, hyperlipidemia, hepatomegaly. and diabetes.
Bloom syndrome. (AR). MIM 210900	***BLM*** at 15q26.1	Dwarfism, heart defect, skin spots, learning disability, and defective immunity. See Werner syndrome.
Cockayne syndromes types 1, 2, and 3.	Genes	See Cockayne syndromes. (MIM 216400 to 216411).
De Barsy syndrome. (AR, S). MIM 150240	***LAMB1*** at 7q31.1-q31.3	Cutis laxa with Marfanoid phenotype. Short stature, joint dislocations, hypodontia, congenital corneal opacification with loss of the Bowman layer, cataracts. Early death.
Hallermann-Streiff or oculo-mandibulo-facial syndrome. (AR, S). MIM 234100	***HSS***	François dyscephalic syndrome with brachycephaly, dwarfism, mental deficiency, bird-like face, narrow upper airway, hypotrichosis, dental anomalies, microphthalmia, retinal folds, and congenital cataract which may reabsorb spontaneously. Some have strabismus, nystagmus, blue sclera, uveitis, or secondary glaucoma. Most have normal mentation in this potentially lethal disease.

Hutchinson-Gilford progeria syndrome . (AD). MIM 176670	***HGPS, B4GALT3*** may be at 1q21-q23.	Ectodermal dysplasia, deficit may be in fibroblasts. These children have progeria of a fatal type. Elevated hyaluronic acid, short stature, arteriosclerosis, bone fractures, microphthalmia, microcornea, hypotrichosis, and cataract. Have normal intelligence but die in their teens.
Penttinen premature aging syndrome. (AR?). MIM 601812	Gene	Delayed bone maturation, slow dental development, normal intellect, deafness, hard skin lesions, and hyperopia. Elevated thyroid stimulating hormone. (MIM 188540).
Wermer syndrome (AD). MIM 131100	***MEN1*** at 11q13	Onset in fifth decade. Skin changes, diabetes mellitus, aged face, arteriosclerosis, and cataract. May have a pituitary tumor or a pancreatic tumor. See Zollinger-Ellison syndrome. (MIM 131100).
Werner syndrome. (AR). MIM 277700	***WRN*** at 8p12-p11.2	Progeria infantum, tend to acquire atherosclerosis, diabetes mellitus, coronary artery disease, and cataract.. ***WRN*** is in the RecQ helicase family and acts as a tumor suppressor. See Bloom syndrome. (MIM 210900).
progressive bifocal chorioretinopathy. (AD). MIM 600790	***PBCRA, CRAPB*** at 6q13-q21, or at 6q14-q16.2	Compare with North Carolina macular dystrophy. (AD). (MIM 136550, 600790).
progressive foveal dystrophy (AD). MIM 136550	***MCDR1*** at 6q14-q16.2.	Onset of this North Carolina type is about age 9, aminoaciduria, increased glycine levels, foveal dystrophy, and drusen in the macula.
progressive inherited tortuosity of retinal arterioles. (AD). MIM 180000	Gene	More likely to have retinal and foveal hemorrhages.
progressive pseudo-rheumatoid arthropathy of childhood. (AR)	***PPAC*** at 6q22	Signs appear about age 3 years.
properdin, factor P deficiency (XL). MIM 312060	***PFC, PFD*** at Xp21.1-p11.23	Deficiency increases susceptibility to meningococcal disease. Properdin regulates the alternative pathway of complement activation. Lectin activates the classical complement pathway. For factor B the gene is ***BF*** at 6p21.3.
propionic acidemia. (AR)	type A pccA at 13q32 type B pccB at 3q21-q22.	Mental retardation, hypotonia, thrombocytopenia, and hypogammaglobulinemia. Type A (MIM 232000), and type B (MIM 23205\0)
proptosis or exophthalmos. (S, AD, Mito) MIM 207410, 112240	Deletion of a gene on chromosome 4p or inherited AD with craniosynostosis and hydrocephalus.	A type of osteogenesis imperfecta with bone fragility, hydrocephalus, and proptosis. May die in childhood. Some have a mass in the orbit or a frontal sinus problem. See Antley-Bixler syndrome ***ABS*** (AR). (MIM 207410). See ***FGFR2*** at 10q25.3-q26. (MIM 201000).
prostaglandins. (AD). MIM 176802, 176806, 176804.	***PTGER1*** at 19q13.1 ***PTGER2*** at 5p13.1, ***PTGER3*** at 1p31.2.	The genes for the receptors are: ***PTGFR*** at 1q31.1, ***TBXAR2*** at 19p13.3, and ***PTG1R*** at 19q13.3. The E receptor is at 1p31.2, and the F receptor is at 1q31.1.
prostate adeno-carcinoma-1 MIM 601188	***PAC1*** may be at 10pter-q11	This gene appears. to act as a tumor suppressor.
prostate specific antigen (AD). MIM 176820	***APS, PSA*** at 19q13	Prostate carcinoma. See the prostate anomalies.
protein C inhibitor deficiency. (AR)	***PCI, PLANH3*** at 14q32.1.	Also inhibits plasminogen activators.
protein C deficiency. (AD, AR)	***PROC*** at 2q13-q14	Inactivates factors Va and VIIIa and causes congenital thrombotic disease with thrombophlebitis, cerebrovascular accidents, myocardial infarction, adrenal hemorrhages and retinal hemorrhages.
protein C kinase . MIM 600899	***MCM4, PRKDC*** at 8q11.2	At least ten subtypes. Kinases require a divalent metal for their activity. For the alpha polypeptide the gene is ***PRKCA*** at 17q22-q23.2. May be involved in severe combined immunodeficiency.
protein S alpha deficiency. (AD) MIM 176880	***PROS1*** at 3p11.1-q11.2	Depends on vitamin K. Inhibits blood clotting. This deficiency leads to venous thrombosis and pulmonary embolism.
proteinase inhibitor-3	***SKALP, WAP2*** at 20q12-q13.1	The gene elafin, a member of the trappin family, is present in skin, lung, prostate, and esophagus. Have inflammatory skin disease.
protein kinase leucine zipper. MIM 601422.	***LUZP*** at 1p36	See also ***TCF11*** at 17q22. (MIM 600115). ***GT199*** is a specific cofactor that interacts with nuclear receptors.

Proteus syndrome. (S, AD). MIM 176920	Gene One patient had a mutation in ***PTEN*** at 10q23.3	A hamartoneoplastic disorder with gigantism of hands and feet, scoliosis, hemangiomas, lipomas, nevi, and macrocephaly. One eye may be enlarged, nystagmus, strabismus, colobomas, cataract, myopia, and retinal detachment. About 20% have some mental retardation. Both mild and severe subtypes occur. Lethal in the non-mosaic state.
pseudo-achondroplastic dysplasia. (AD)	***PSACH*** at 19p13.1-p12	Dwarfism, lumbar lordosis, bow legs, and brachydactyly.
pseudoexfoliation of the lens. (AD).	***PAX6*** at 11p13	Develops after age 40. Grey particles on the trabecular meshwork may relate to secondary glaucoma.
pseudo-hermaphroditism, male. (XL,AD,AR).	***LBH*** at 19q13.32 (?)	Many subtypes reported. Have gynecomastia. Classification not agreed upon.
pseudo-hermaphroditism. (AR).	***EDH17B3*** at 9q22	Male usually with gynecomastia.
pseudo-hypoaldosteronism. (AD)	***MLR*** at 4q31.2, ***PHA2A*** at 1q31-q42, ***PHA2B*** at 17q21-q22, ***SCN1A*** at 2q24, ***SCN1B*** at 19q13.1-q13.2, ***SCN1G*** at 16p13-p12	Type 1 (MIM 145260, 177735, 264350). Hyperkalemia, salt wasting, and febrile seizures. See Gordon syndrome (AD) (MIM 114300). The gene for pseudo-hypoaldosteronism type-II (AD) may be at 1q31-q42, or at 17p11-q21, or at 12p13.3. See the salt wasting conditions under S.
pseudopapilledema. (AD) MIM 177800	Gene	May have buried drusen on the nerve head, usually in both eyes, conjunctivitis, and some have retinitis pigmentosa, or neurofibromatosis-2, and some have headaches. Pseudopapilledema can occur with Leber optic neuropathy, neurofibromatosis, intracranial hypertension, acro-oto-ocular syndrome, Scheie syndrome, or be a case of nerve head drusen.
pseudopapilledema, hypertelorism, blepharophimosis and hand anomalies. (AR) MIM 264475	Gene	Also have a broad space between the first and second toes, deafness, blepharophimosis, and epicanthus.
pseudo-hypo-parathyroidism (XD, AD, XR, AR). MIM 139320	***AHO1, GNAS1*** at 20q13.22-q13.3	See Albright-I osteodystrophy. End organ resistance to parathyroid hormone, have short stature, and brachydactyly. Chronic renal tubular insufficiency (AD), obesity, seizures, short stature, brachydactyly, strabismus, blue sclera, cataracts, and papilledema. For Albright-II osteodystrophy the deletion is from the gene ***AHO2*** at 15q11-q13. (MIM 103581).
pseudorheumatoid arthropathy of childhood. (AR). MIM 208230	***PPAC*** at 6q22	Progressive arthropathy with onset at age three years, short stature, and joint stiffness. See ***COL10A1*** at 6q21-q22.3. (MIM 120110).
pseudo-TORCH syndrome (AR?). MIM 600158	Gene	Also called Baraitser-Reardon syndrome. Intrauterine infection-like condition, intracranial calcification, microcephaly, and seizures. Toxoplasma, rubella, cytomegalovirus, or herpes simplex viruses may be involved. Compare with Aicardi-Goutiere syndrome. (MIM 225750).
pseudovitamin D dependency, rickets-I. (AR).	***PDDR, VDD1*** at 12q14	Motor retardation.
pseudoxanthoma elasticum. (AR, AD).	***PXE***, ***ABCC6, ARA*** at 16p13.1	See Grönblad-Strandberg syndrome. (MIM 264800). Angioid streaks occur with this and with other conditions.
psoriasis, susceptibility. (P, AD). MIM 177900, 601454, 602723	***PSORS1*** at 6p21.3, ***PSORS2*** at 17q25 ***PSORS3*** at 2q34 or chromosome 4qter, and ***PSORS4*** at 1q21.	Psoriasis is a skin condition affecting about 2% of Caucasians. Red patches with silvery scales, keratitis, iritis, and corneal ulcers. Have HLA associations. Some psoriasis patients develop arthritis. Other genes may be on chromosomes 3q21, 8q, 14q31-q32, 16q, 19p143.3, or 20p.
Pterygia are wing-like formations that can appear at many sites. Pterygia can develop in the neck (pterygium colli), or in the popliteal or antecubital areas, or in the conjunctiva. They tend to develop later in life especially in outdoor workers. For an AR lethal multiple pterygium syndrome see (MIM 265000). See also AD popliteal pterygia ***IRF6*** at 1q32-q41 (MIM 119500) often with syndactyly. Gene may be allelic with van der Woude syndrome at 1q32 (MIM 119300. See also Bartsocas-Papas popliteal pterygia syndrome (AR) (MIM 263650) a lethal type..		

pterygium of conjunctiva and cornea. (AD). MIM 178000	Gene	Many subtypes and many associations.
ptosis, congenital-I. (AD). (MIM 601649)	***PTOS1*** at 1p34.1-p32	Ptosis can have many causes and accompany many conditions.
ptosis, blepharoptosis, and epicanthus inversus. (AD, AR, S). MIM 110100)	***BPES1*** at 3q23	***BPES2*** is on chromosome 7p and see ***PTOS1*** (MIM 601649).
	Gene	PUGH syndrome seems to relate to Stickler-I syndrome (MIM 108300, 120140).
pupil, oval shaped. (AD). MIM 178800	Gene	Usually these enlarged egg-shaped pupils react poorly to constricting stimuli.
pupillary membrane, persisting. (AD). MIM 178900	Gene	Irregular tissue in the pupil, corneal edema, may get glaucoma, keratoconus, cataracts or Rieger syndrome. (MIM 180500). Gene may be ***PITX2*** at 4q25 (MIM 601542).
purine nucleoside phosphorylase deficiency. (AD). MIM 164050.	***PNP*** at 14q13.1. Other genes may be on chromosomes 4q or 6p.	Immunodeficiency, spastic diplegia, malignant lymphoma, lymphopenia.
pyloric stenosis. MIM 179010.	***NOS1*** at 12q24.2-q24.31	Deficiency of neuronal nitric acid synthase ***NOS1*** (MIM 163731). Incidence 1/500. These babies eat well but vomit promptly, need surgery.
pyruvate carboxylase deficiency (AR). MIM 266150	***PC*** at 11q13.4-q13.5	Growth retardation, mental retardation, and ataxia. Clinically similar to pyruvate decarboxylase deficiency (MIM 208800). See also Leigh encephalopathy. (AR) (MIM 256000).
pyruvate carboxylase or kinase deficiency. (AR, XR)	***PDHA1, PHE1A*** at Xp22.2- p22.1, ***PKM2, PK3*** at 15q22-qter, ***PKLR, PK1*** at 1q21	Polycythemia with elevated adenosine triphosphate. Pyruvate kinase–3 maps to 15q22-qter.. ***PKLR, PK1*** is in the liver and in erythrocytes.
pyruvate dehydrogenase	E1 alpha subunit deficiency at Xp22.2-p22.1 (MIM 312170) E1 beta subunit deficiency at 13p13-q23. (MIM 179060).	For the gene for E2 deficiency see (MIM 245348). Tthe gene for E3 deficiency is at 7q31-q32. (MIM 246900).
beta subunit deficiency (AD)	***PDE1B*** at 3p13-q23	The ***PC*** gene for pyruvate carboxylase is at 11q13.4-q13.5.

Q.

Quincke angioneurotic edema. (S, AD). MIM 106100.	***C1NH*** at 11p11.2-q13.	Episodic edema of skin, laryngeal edema, respiratory distress, nausea, and vomiting.

R.

Rabson-Mendenhall syndrome. (AD)	***INSR*** at 19p13.2	Pineal hyperplasia, acanthosis nigricans, insulin-resistant diabetes mellitus, hirsutism, and abdominal distension.
radial dysplasia. (AR)	Gene	Incidence 1/33,000. See Jeune syndrome (MIM 208500).
Raeder ciliary neuralgia syndrome.	Gene	Interruption of the sympathetic and involvement of CNV or ischemia of the Gasserian ganglion, can cause Horton headache, cluster headache, facial pain, and unilateral miosis.
ragweed sensitivity. (AD, S).	***RWS*** at 6p21.3	Ragweed hay-fever is a specific form of atopy.
Ramsay-Hunt syndrome. (AD). MIM 159700	Possibly caused by a herpes infection.	Have facial paralysis, myoclonus, and ataxia.. See epilepsy. This designation is not widely used. Compare with the AEC syndrome. (MIM 106260).
Rapp-Hodgkin syndrome. (AD) MIM 129400	***RHS***	Anhidrotic ectodermal dysplasia, mid-facial hypoplasia, cleft lip/palate, hypodontia, alopecia, pili canaliculi, and ptosis.
Raynaud syndrome (XL). MIM 300123	***MRGH*** may be at Xq22-q27.1.	XL mental retardation, with growth hormone deficiency, progressive systemic sclerosis, and biliary cirrhosis. Occurs mostly in females. See ***CRST*** syndrome. Raynauds often occurs as part of another syndrome. Raynaud's phenomenon is a spasm of the digital arteries that produces blanching and numbness of the fingers.
REAR syndrome. (AD). MIM 107480	***TBS*** at 16q12.1. Another gene is ***SALL1*** at 16q12.1.	Townes-Brock syndrome with anal atresia, renal abnormalities, deafness, and radial or digital dysplasia. See ***SALL2*** at 14q11.1-q12.1, ***SALL3*** at 18q23, and ***SALLIP*** at Xp11.2.

Recoverin is a calcium binder. (AD)	***RCV1*** at 17p31.1	Cancer-associated retinopathy.
red cone opsin.		See color vision.
Reese-Ellsworth syndrome. (AD). MIM 141900	***HBB*** at 11p15.4-p15 An Infectious and autoimmune reaaction	Anemia with painful crises and splenomegaly. Severe anomalies of the anterior chamber of the eye, glaucoma, cataract, and corneal opacities. See Peters plus syndrome. (MIM 116150).
anterior chamber cleavage syndrome. (Often AD). MIM 601427.	Gene	Shallow anterior chamber, increased IOP, 80% bilateral. Some have dental anomalies, mental retardation, endocrine abnormalities, cleft palate, craniofacial dysostosis, cerebellar hypoplasia, hypothyroidism, and tracheal stenosis. Compare Peters plus syndrome (MIM 116150, 261540).
refractive errors, myopia-I. (XL). MIM 310460	***MYP1, BED*** at Xq28 or at 10pter-p11.2	Bornholm syndrome. See also ***MYP2*** and ***MYP3***. (MIM 150700, 603221). Compare with hyperopia and astigmatism.
Refsum syndrome. (AR). MIM 266500, 602026.	***PAHX/PHYH*** at 10p13. However not all are linked to this gene.	**HMSN-IV**. Disorder of lipid metabolism, deficiency of phytanic acid hydroxylase, onset between the ages of 4 and 7 years. Deficiency of phytanol-coenzyme A and phytanic acid oxidase and excess pipecolic acidemia. Show cerebellar signs, neuritis, deafness, ataxia, heart block, nystagmus, night blindness, progressive external ophthalmoplegia, and retinitis pigmentosa. Need a diet low in phytol and phytanic acid.
adult Refsum disease. (AR). MIM 600964	***RDPA*** possibly at 10pter-p11.2.	Phytanic acid oxidase deficiency with increased pipecolic acidemia, deafness, miosis, ptosis, and retinitis pigmentosa.
Infantile Refsum disease. (AR). MIM 266510	***PEX1*** at 7q21-q22,. ***PXR1*** at 12p13.3, ***PEX10***. at 7q22	With this infantile phytanic acid storage disease and peroxisomal deficiency the signs are mental retardation, peripheral neuropathy, deafness, and retinitis pigmentosa. (MIM 602859).
Reifenstein syndrome. (XR). MIM 312300.	46XY karyotype	Androgen insensitivity, male, pseudohermaphroditism.
Reis-Bucklers corneal dystrophy.		See corneal dystrophy
Reiter syndrome (AD). MIM 133600	Probably a combined infectious and autoimmune reaction.	Reactive arthritis, exostosis of the heel, lesions on the soles of the feet, skin erythema, urethritis, fever, conjunctivitis, iritis, EOM paralyses, and secondary glaucoma. More susceptible if they have HLA-B27. (MIM 142800).
renal-coloboma syndrome.		See kidney.
renal-retinal dystrophy.		See kidney.
Rendu-Osler-Weber syndrome.		See Osler-Rendu-Weber disease.
Renpenning syndrome. (XL). MIM 309500	***MRXS8*** at Xp11.4-p11.2	Signs are microcephaly, short stature, mental retardation, and up-slanting lid fissures.

Reticular dystrophy includes: Deutman butterfly dystrophy (AD) at 6p21.1-cen (MIM 169150, 179605), fundus pulverulentus (AD) (MIM 179605), maculoreticular dystrophy of Mesker (AD)(MIM 169150, 179605), reticular dystrophy of the retinal pigment epithelium (MIM 179840), and Sjögren reticular dystrophy of the posterior pole (AR) (MIM 267800).

Retinal dystrophies and degenerations. Mutations at 126 locations have been reported to cause retinal degeneration. Reticular dystrophy is inherited AD. See also cone and cone-rod dystrophies. See mutations in genes causing Usher syndromes, and those causing Leber amaurosis congenita. One type **ADCA2** depends on the gene ***SCA7*** at 3p13. See also ***NRL*** at 14q11.1-q11.2, ***AIPL1*** at 17p13.1, ***USH1C*** at 11p15, ***NR2E3*** at 15q23 regulates the development of M and L cones from S cones, and ***CACNA1F*** a calcium channel gene at Xp11.23-p11.22. See retinal degeneration with nanophthalmia, cystic macular degeneration, angle-closure glaucoma, pigmentary retinal degeneration, and night blindness (MIM 267760). For inflammatory vitreoretinopathy see ***FEVR*** at 11q23. ***ABCR*** protein transports vitamin A. Increased tortuosity of retinal arteries can be inherited AD but occurs with many other conditions.

adult foveomacular dystrophy. (AD, AR)	***RDS, RP7*** at 6p21.1-cen	Peripherin mutation causes slow degeneration. Mutations here can also cause butterfly dystrophy, bull's eye macular dystrophy, and other dystrophies.
retinal degeneration. (AR)	Mutations in ***RPE65*** at 1p31	Cause at least 10% of early-onset retinal degenerations.
retinal degeneration. (AR)	***TIMP2, PDE6G*** at 17q25 or 17q21.1	Phosphodiesterase 6G cGMP-specific rod gamma.
retinal degeneration. (AR)	***PROML1*** on chromosome 4p.	
retinal degeneration. (AD). MIM 180040	***RD3*** may be on chromosome 1q.	

retinal degeneration and spastic paraplegia. (AR). MIM 270700	Gene	Mentally dull. Onset after age 30. Macular and peripheral retinal degeneration.
retinal degeneration (AR). MIM 251700	Gene	Also have dental anomalies, microphthalmia, macrophakia, glaucoma, and hyperopia.
retinal degeneration, lattice type. (AD). MIM 150500	Gene	With this form of degeneration they may have retinal detachment but are not myopic. Some are inherited AR.
retinal degeneration with epilepsy. (AR). MIM 267740	Gene	Seizures, cystic macular degeneration and nanophthalmia.. (See also MIM 267760).
retinal degeneration, late onset. (AD, AR). MIM 107741	Gene may be ***APOE*** at 19q13.2.	Acquire deposits beneath the RPE, patients become symptomatic after age 50.
retinal cone degeneration. (AD) MIM 180020	***RCD1*** at 6q25-q26.	Can produce a bull's eye macular lesion, photophobia, poor color vision, night blindness, field losses, and progressively reduced acuity.
retinal dysplasia, primary (XL). MIM 312550.	***PRD*** at Xxp11.4-p11.23.	Compare with Norrie disease.
butterfly, slow degeneration (AD, XL). MIM 179605	***RDS, RP7*** at 6p21.1-cen.	Deutman dystrophy. There are 3 or more AD forms and 2 or more X-linked types. Compare with Meskers dystrophy (MIM 179605).
Bothnia dystrophy. (AR)	***RLBP1, CDALBP*** at 15q26.	The gene encodes the cellular retinaldehyde-binding protein-I (cellular).
Doyne honeycomb dystrophy (AD). MIM 126600	***DHDR*** at 2p16.	Radial drusen. Drusen tend to impair dark adaptation. See also malattia Leventinese. (AD) ***EFEMP1*** at 2p21-p16.
drusen. (AD)	Genes	Encodes an extracellular matrix protein. Can impair dark adaptation. Mutations in many genes cause drusen formation. See MIM 126600, 126700.
fenestrated sheen macular dystrophy. (AD). MIM 153890	Gene	A golden sheen with tiny red fenestrations. Falciform detachment. A slowly progressive dystrophy described by O'Donnell and Welch in 1979. Some are inherited AR.
fundus albipunctatus. (AR)	***RDH5*** at 12q13-q14.	Cone dystrophy due to a mutation in 11-cis-retinol dehydrogenase, a calcium channel gene.
(AR)	***CRB1*** at 1q31-q32.1	See **RP12.** ARRP. (MIM 600105).
(AD)	***RP1*** at 8p11-q21	See **RP1**. (MIM 180100).
fundus flavimaculatus, FFM. (AR)	***STGD*** at 1p21-p13. Some have a mutation in ***RP7*** at 6p21.1-cen.	Age of onset is later than in Stargardt disease. See fundus pulverulentus.
fundus pulverulentus	Some have a mutation in ***RP7*** at 6p21.1-cen.	See fundus flavimaculatus.
North Carolina dystrophy. (AD) Sorsby pseudoinflammatory dystrophy. (AD, AR). MIM 136900	***MCDR1*** at 6q14-q16.2 ***SFD*** at 22q13.1-qter.	Progressive foveal dystrophy, macular pigmentary changes, and drusen. Dystrophy of choroid, fundus, and macula. See also ***TIMP3*** at 22q12.1-q13.2. (MIM 188825).
retinal dystrophy of another type. (AD). MIM 602225	Gene on chromosome 18. ***CRX*** at 19q13.3	Deletions cause severe retinal degeneration. ADRP.
late-onset retinal degeneration (AD, AR). MIM 107741	Gene may be ***APOE*** at 19q13.2.	They have deposits beneath the RPE and become symptomatic after age 50.
morning glory disc syndrome . (AD). MIM 120330.	***PAX 2*** at 10q25 , or at 10q24.3-q25.1.	Renal hypoplasia, deafness, and eye malformations. A better name might be papillorenal syndrome.
retinal arteriolar tortuosity, progressive. (AD)	Gene	Often with retinal hemorrhages. Can occur in many conditions.
retinal detachment falciform fold type. (AD, AR). MIM 180070, 221900.	Gene	Present at birth. May be described as non-attachment. Severe bone fragility, Some have microphthalmia, congenital cataract, malformed chamber angle, retinal dysplasia, and vitreous hemorrhages. Some are obese or have non-toxic goitre. Compare with retinal non-attachment.

retinal detachment. (AD). MIM 221900	Many are inherited XR but some are AR. Gene	Often with a congenital retinal hole or a tear. Some develop Schwartz syndrome with glaucoma. Lattice peripheral retinal degeneration with myopia, and retinoschisis may precede retinal detachment by 20 years. Compare with retinal non-attachment.(MIM 221900).
retinal dysplasia. (XL)	***PRD*** at Xp11.3-p11.23	See Norrie disease. (MIM 310600).
retinal vasculopathy (AD). MIM 192315	Gene	Cerebral vasculopathy, leukodystrophy, necrosis of brain white matter, dysarthria, seizures, forgetf ulness, retinal hemorrhages and exudates.
retinal necrosis, acute	**ARN** or **BARN** syndrome can be caused by a herpes type virus e.g. varicella zoster or by herpes simplex type 1.	Can lead to retinal detachment.
retinal non-attachment, congenital with mental retardation. (AR). MIM 221900	Gene	Affects both sexes. Have osteoporosis, hypotonia, dwarfism, microcephaly, and retinoblastoma. Retinal disinsertion can be accompanied by ectopia lentis, microphthalmos, and keratoconus. (MIM 180050, 312530). See also osteoporosis-pseudoglioma (MIM 259770), Norrie disease (MIM 310600, 268100), and pseudotrisomy 13 (MIM 264480).
retinal non-attachment. (AR).	***NCRNA*** at 10q21.	Congenital, non-syndromic, non-attachment.
Retinal pigmentary epithelium (RPE) disorders.		
adult pseudovitelliform. dystrophy. (AD, S)	***RDS*** at 6p21.1-cen	Slow degeneration.
Best vitelliform macular dystrophy. (AD, S). MIM 153700, 153840	***VMD2*** at 11q13, ***VMD1*** probably at 8q24.	Juvenile-onset macular dystrophy.
retina leucine specific zipper. (AR)	***NRL*** at 14q11.1-q11.2	This transcription factor affects retinal development. See reticulocalbin-2 ***RCN2*** at 15q23. (MIM 602584).
Meskers maculoreticular dystrophy. (AD, AR). MIM 179605.	***RD7***, ***RDS*** at 6p21.1-cen.	Butterfly-shaped dystrophy of the RPE. See also fundus flavimaculatus (MIM 179605), bull's-eye degeneration of the macula, and Sjögren reticular dystrophy (MIM 109092).
patterned dystrophy of the RPE. (AD). MIM 169150	***RDS*** at 6p21.1-cen.	Also called fish-net dystrophy and butterfly-shaped pigment dystrophy of the fovea. See also Deutman dystrophy (AR) (MIM 267800).
retinal pigment epithelium specific protein. (AR). MIM 180069, 204100, 535000	***RPE65*** at 1p31	Mutation here causes one type of ARRP and Leber amaurosis, LCA-II. (AR).
retinal vascular hypoplasia with persistence of the primary vitreous.	Gene	Congenital, pupils fixed and dilated, glaucoma, cataract, white opaque fibrovascular retrolental membrane, and retinal detachment. See Reese (AR) retinal dysplasia. (MIM 266400).
retinoic acid receptor MIM 1801990	***RARG*** at 12q13	Regulates APP (MIM 104300, 104700).

Atypical retinitis pigmentosa has been reported with the following AR conditions: abetalipoproteinemia (MIM 200100), Alström syndrome (MIM 203800), Bardet-Biedl syndrome ***BBS2*** (MIM 209900), Cockayne syndromes (MIM 216400), Laurence-Moon syndrome (MIM 245800), pallidal degeneration (MIM 260200), Refsum syndrome (MIM 266500), and Usher syndrome type1A (MIM 276900).

Retinitis pigmentosa or pigmentary retinopathy affects about 1 in 4,000 or 1.5 million people worldwide. Among those with retinitis pigmentosa from 7 to 14% inherit it in the XL manner and in 8 to 30% it is inherited AD. Possibly 10% are inherited AR and for over 40% inheritance is described as simplex. Average age of onset of the XL types is 5 years, but for the AD and AR types onset is in the twenties. Rarely digenic or mitochondrial inheritance is responsible

Mutations in more than 50 genes can be involved. Have night-blindness and about 12% have Usher syndrome, 11% are mentally retarded, and 5% have a Bardet-Biedl syndrome. Some have cone-rod degeneration.. Early-onset types are usually more severe than the late-onset types.

Those with metaphyseal chondrodysplasia and retinitis pigmentosa (AR) have defective cartilage and defective growth of long bones. One (AR) syndrome (MIM 268020) includes retinitis pigmentosa, deafness, mental retardation, glucose intolerance, and hypogonadism. They do not have polydactyly but may have nystagmus, keratoconus, and myopia. Resembles an Usher syndrome.

Other genes that when mutated can cause RP are ***PRKCG*** (AD) at 19q13.4, ***CRX*** (AD) at 19q13.3, ***NR2E3*** (AR) at 15q23, causes an expanded S cone syndrome (**ESC5**) with retinopathy and night blindness, ***USH2A*** (AR) at 1q41, and ***ABCA4*** (AR) at 1p21-p13. See also these AD genes at 17q25 (MIM 180073), at 4p16.3, (MIM 180072), and at 5q31.3-q34, (MIM 180071).

Symbol	Gene	Description
RP1, (AD). MIM 180100	***RP1*** at 8p11-q21	***RP1*** causes 6% to 10% of ADRP.
RP2, (XR). MIM 312600	***RP2*** at Xp11.3-p11.23	This severe RP may account for 15% of XLRP cases. See ***CSNBX*** at Xp21.1. (MIM 300071).
RP3, (XR). MIM 312610	***RP3, RPGR*** at Xp21.1	Gene encodes the guanine nucleotide factor of a retina-specific GTP-binding protein. A mutation occurs here in 20% of families with XLRP. Congenital stationary night blindness. ***RPGRIP1*** at 14q11 interacts with ***RPGR.***
RP4, (AD, AR). MIM 180380	***RP4, RHO*** at 3q21-q24	Rhodopsin mutations cause 20% of RP cases. Have rod photoreceptor dysfunction, dominant night blindness, ARRP, and some have retinitis punctata albescens.
RP5, (AD)	***RP5***	Not used, may be the same as RP4.
RP6, (XR). MIM 312612	***RP6*** at Xp21.3-p21.2	Mutation in a gene at Xp11.4-p11.23 has been blamed for this RP...
RP7, (AD, XL) MIM 179605	***RP7, RDS*** at 6p21.1-cen. Gene also said to be at 6q14-q21.	Causes 3% to 5% of ADRP. Can also cause adult vitelliform macular degeneration, retinal degeneration slow, and butterfly shaped pigment dystrophy. Adult-onset RP.
RP8, (AD, AR, XR) MIM 180103	***RP8*** at 10q13.4	Loss of peripheral fields, poor night vision, and deafness.
RP9, (AD). MIM 180104	***RP9*** at 7p15.1-p13	Constricted fields, ADRP, and night blindness.
RP10, (AD). MIM 180105	***RP10*** at 7q31.3	Constricted fields, ADRP, and night blindness.
RP11, (AD). MIM 600138	***RP11*** at 19q13.4	Mutation here is the second most common cause of ADRP. Some have a bimodal expressivity phenotype.
RP12, (AR). MIM 600105	***RP12, RGS****, **CRB1*** at 1q31-q32.1	The gene for phosducin also maps here. Drosophila crumbs are a transmission protein. Some have preserved para-arteriolar pigment epithelium, **PPRPE**
RP13, (AD). MIM 600059	***RP13, PEDF*** at 17p13.3	Mutation in ***PRPC8*** at 17p13.3, a pre mRNA splicing factor, may be responsible. Onset of night blindness at age 4 to 10 years. Retinal degeneration, retinitis pigmentosa, and constricted fields.
RP14, (AR). MIM 600132.	***TULP1*** at 6p21.3	Causes ARRP only rarely.
RP15, (XD). MIM 300029.	***RP15*** at Xp22.13-p22.11	Causes cone-rod degeneration. Signs overlap with those of ***RP3*** (MIM 312610) and ***COD1*** (MIM 304020).
RP16, (AR)	Gene is **NO**T at 14q11.	ARRP. But see ***RPGRIP1*** at 14q11.
RP17, (AD). MIM 600852.	***RP17*** at 17q22 or 17q25	**PDE** for the gamma subunit of cGMP is at 17q25. ADRP.
RP18, (AD). MIM 601414.	***RP18*** at 1p13-q21.	Mutation here causes ADRP and night blindness.
RP19, (AR). MIM 601718.	***RP19*** at 1p13-p21	Also the location of ***STGD1, ABCA4*** for AR Stargardt disease.
RP20. (AR). MIM 180069.	***RPE65*** at 1p31	Mutation here causes AR childhood-onset, severe, retinal dystrophy, Leber congenital amaurosis.
RP21 (AD). MIM 601850.	***RP21, RPD1*** 9q32-q34.	Mutation here causes ADRP with deafness.
RP22 (AR). MIM 602594	***RP22*** at 16p12.1-p12.3	Mutation here causes ARRP.
RP23, (XR)	***RP23*** at Xp22	XLRP.
RP24. (XR). MIM 300155.	***RP24*** at Xq26-q27	Causes XLRP. Some blame a gene at 6q14-q21.
RP25. (AR, AD)	***ELOVL4*** at 6cen-q14	Mutation here or at 6q14-q21 or at 6p11-q16 causes ARRP. See ***STGD-III*** (AD) at 6cen-q14 or at 13q34. The AR gene is on chromosome 1p.
RP26, (AD)	***MPP4*** at 2q31-q33	ARRP. The gene ***IDDM7*** for diabetes-7 maps to 2q31.
RP27, (AD). MIM 162080	***NRL*** at 14q11.1-q11.2	Gene codes for a neural retina-specific zipper, a bZIP leucine transcription factor. Can cause ADRP.
RP28, (AR)	***RP28*** at 2p11-p16	ARRP.
RP29, (AR)	***RP29*** at 4q32-q34	ARRP.
RP digenic (AD?). MIM 179605, 180721	***ROM1, ROSP1*** **at** 11p13-q13, ***RDS*** at 6p21.1-cen	Simultaneous involvement of the gene for a photoreceptor membrane protein and RDS. Causes ADRP.

RP--- (AR). MIM 180071.	***PDE6A*** at 5q31.2-q34	Gene for the alpha subunit of the rod cGMP-gated channel. Mutation here can cause ARRP.
RP--- (AR). MIM 180072.	***PDE6B, CSNB3*** at 4p16.3	Gene for the beta subunit of rod cGMP phosphodiesterase. Mutation causes ARRP. ***PDE6D*** maps to 2q35-q36.
RP--- (AD). MIM 180073.	***PDEG, PDE6G, TIMP2*** at 17q25.	Codes for the gamma subunit of rod cGMP phosphodiesterase.
RP---(AR). MIM 123825	***CNCG1, CNGA1*** at 4p12-cen or 4p14-q13..	Gene for the rod cGMP-gated channel protein. Mutation causes hyperpolarization of the photoreceptor.
RP, ---(AR)	***PCARP, AXPC1*** at 1q31-q32	Mutation here causes ataxia and ARRP.
RP, ---(AR). MIM 180090.	***RLBP1, CRALBP*** at 15q26	Mutation here causes ARRP. Newfoundland rod-cone dystrophy See Bothnia dystrophy.(MIM 187300)..
RP, ---(AD)	***ACHM3*** at 8q21-q22	Achromatopsia. See color vision.
RP,--- (XL). MIM 300030.	***DFN4*** at Xp21-q21	Mutation causes XLRP, mental retardation, and severe deafness.
RP, --- (AD). MIM 131195.	***ENG*** at 9q34.1	Mutation in endoglin causes ADRP and deafness.
RP, --- (AD). MIM 187300.	***HHT1*** at 9q33-q34.1	Mutation can cause hereditary hemorrhagic telangiectasia, ADRP, and deafness. See ***ORW-I*** at 9q33-q34.1
RP,---(AR)	***MERTK*** at 2q14.1	Mutation here can cause ARRP
RP, (AR, AD). MIM 600342.	***RGR*** at 10q23	Mutation in the gene that codes for a light-sensitive opsin homologue can cause ADRP and choroidal sclerosis.
RP,--- (XL). MIM 311800	***PGK1*** at Xq13.3	Phosphoglycerate kinase-I, myopathy, anemia, mental retardation and XLRP.
RP,---(AR)	Genes at 2p11-p16, 2q31-q24 or at 4q32-q34.	Mutations in these genes can cause ARRP. ***PNR*** at 15q22-q24 is a photoreceptor cell-specific nuclear receptor gene. Mutation here caused ARRP in a Jewish group in Portugal.
RP,--(AR).MIM 107940, 107941, 181031	***ARRB1*** at 11q13, ***ARRB2*** at 17p13, ***SAG*** at 2q37.1.	Mutations in the arrestin genes can cause ARRP. The gene ***ARR3*** for arrestin-3 is at Xcen-q21. (MIM 264800). ***SAG*** is the gene for S-arrestin.
Name	**Gene**	**Comments**
retinitis pigmentosa inversa. (AR, AD. S). MIM 268010.	Gene	More pigment around the nerve head and macula. These patients are not night blind but most are deaf. Decreased central vision while retaining peripheral vision. They prefer dim illumination. Vitamin A may help these patients.
retinitis pigmentosa, sector type. (AR, often AD) MIM 256100	***RHO*** at 3q21-q24 or ***NPHP1*** at 2q13 or at 9q22-q23.	Pigmentation especially in the inferior nasal fundus. With ***NPHP1*** (AR, AD) have nephronophthisis, short stature, sector RP and many die in childhood. The AD type ***MCKD*** at 1q21 was called salt-losing nephritis. (MIM 174000). Death in childhood. See the salt-losing syndromes. See also Loken-Senior syndrome (MIM 266900).
retinitis pigmentosa, sine pigmento. (AD, AR). MIM 180380.	***RHO*** at 3q21-q24 or at 3q21-qter.	Mutation here may be responsible.
retinitis pigmentosa, unilateral. (AD)	***URP***	Rarely seen.
retinitis pigmentosa with metaphyseal chondrodysplasia. (AR). MIM 250410	Gene	Defective cartilage and growth of long bones, shortening of the fingers, poor vision, and restricted fields.
retinitis punctata albescens. MIM 136800	***RDS/peripherin*** at 6p21.2, ***RHO*** at 3q21-q24	
HARP syndrome (AR). MIM 200150	***CHAC*** at 9q21	Symptoms appear in the age group 25 to 45 years. Hypobetalipoproteinemia, acanthocytosis, chorea, retinitis pigmentosa, and pallidal degeneration.
retinoblastoma-1. (AD, S). MIM 180200	***RB1, RB*** at 13q14.2	With several binding proteins Can also cause osteogenic sarcoma, pinealoma, and bladder cancer or small-cell lung cancer. Retinoblastoma occurs in 1/20,000 live born. In 75% of cases only one eye is affected. Some also have a pinealoma.
retinoblastoma-like syndrome. (AD). MIM 116957	***RBL1, CP107*** at 20q11.2	For type 2, the gene ***RBL2*** is at 16q12.2. (MIM 180203).
retinol-binding protein-4 deficiency, interstitial (AD). MIM 180250	***RBP4*** at 10q23-q24	RPE degeneration. See also ***RBP1*** (MIM 180201),. ***RBP2*** at 3q21-qter. (MIM 180280), ***RBP3*** at 10q11.2 (MIM 180290), ***RBP5*** (MIM 600697), and ***RBP6*** (MIM 600938)

retino-hepato-endocrinologic syndrome AR). MIM 268040.	***RHE***	Elevated creatine phosphokinase in the blood. Is more common in females. Degenerative liver disease, endocrine dysfunction, MODY diabetes mellitus, progressive cone dystrophy, total color blindness, and poor vision. Photopic vision is lost but scotopic vision is retained.
retinopathy, central serous (AD). MIM 134370.	***CFH*** at 1q32	Gene regulates complement. Mostly affects males.
Retinopathy with increased sensitivity to blue light (AR).	***NR2E3, PNR*** at 15q23	Enhanced S cone syndrome with some visual loss and night blindness early in life. See ***FKHL15*** at 9q22
MIM 551500	***NARP*** at nt 8993	Neurogenic muscle weakness, ataxia, mild mental retardation, and retinitis pigmentosa.
retinopathy, pigmentary with mental retardation. (AR) MIM 268050	Gene on chromosome 6.	Mirhosseini-Holmes-Walton syndrome. Severe mental retardation, scoliosis, microcephaly, and cataracts. Compare with the Cohen syndrome. (MIM 216550).
retinopathy of prematurity MIM 305390	See ***EVR2*** at Xp11.3.	Was called retrolental fibroplasia. May relate to oxygen given in the newborn period. Normally the temporal peripheral retina is the last portion to become vascularized.
retinoschisis. (XR, AD, AR, S) MIM 312700	***RS1, XLRS1*** at Xp22.2-p22.1	Mutation in retinoschisin causes retinal degeneration, vitreoretinal dystrophy, cataracts, and field defects. XR retinoschisis occurs mostly in males but the splitting may not manifest until mid-life and only rarely progresses to retinal detachment. Retinoschisis of the fovea (AR) is a rod-cone dystrophy with hyperopia and night blindness.
retinoschisis, juvenile (XL). MIM 312700	***RS1*** at Xp22.2-p22.1.	One gene has been given the symbol ***CHRS*** but this is also a symbol for the Christian syndrome ***MASD***, (MIM 309620).
Rett syndrome. (XD). MIM 312750	***RTT, RTS, MeCP2*** at Xp22.3	Affects 1/40,000 children or 1/15,000 girls. Mutation here causes encephalopathy, dementia, may reach an IQ of 45, seizures, autism decreases with age, and ataxia in females. Affected females die at an average age of 24 years. Rett is lethal in males..
Reye syndrome. (AR). MIM 212140, 603377	***SCD*** at 5q31.1	Carnatine deficiency, adrenal unresponsiveness. Progressive cardiomyopathy, skeletal myopathy, hypoglycemia, and hyperammonemia. Some have a secondary carnatine deficiency due to a defect involving enzymes of intramitochondrial beta oxidation of fatty acids. Treat with oral carnatine.
rhodopsin. (AD)	***RHO, RP4*** at 3q21-q24	Mutations here can cause night blindness and have a role in ADRP and in ARRP and so do mutations in ***ROM1, ROSP1*** at 11p13 for ADRP.
rhodopsin kinase MIM 180381.	***RHOK*** at 13q34	Oguchi-II disease, night blindness. Some report that the gene is at 13q14.
Richards-Rundle syndrome (AR). MIM 245100	***RRS***	Ketoaciduria, mental retardation, ataxia, and deafness. Compare with these syndromes: ***ADR*** (AR) (MIM 208850), Sylvester (MIM 245100), and Roussy-Levy (MIM 180800).
Richner-Hanhart syndrome (AR, AD). MIM 276600	***TAT*** at 16q22.1-q22.3	Those with the AR type have a tyrosine transaminase deficiency (tyrosinemia-2), and the cornea is involved. Those with the AD type have ectodermal dysplasia, dyskeratosis palmoplantaris, hypotrichosis, mental retardation, deafness, corneal lesions, cataracts, and nystagmus. Compare with the Oregon eye disease (MIM 276600) and the Schafer syndrome. (MIM 122780).
rickets, vitamin-D-dependent (AR). MIM 264700, 277420	***VDDR***	For the enzymatic type see MIM 264700. For those with a mutation in the receptor see MIM 277420
rickets, vitamin-D-resistant (AR). MIM 241520, 601769	***VDR*** at 12q12-q13.3	Lowe syndrome, have rickets, mental retardation, renal defects, cataract, glaucoma, and corneal opacities
rickets, vitamin- D- resistant (AD). MIM 193100	Gene	With hypercalcemia. For the type with hypocalcemia see MIM 193100. Compare with MIM 146350.
rickets, renal, now called hypophosphatasia (XD, XR, AR)	***HOPS*** at 1p36.1-p34	See juvenile Paget disease, see phosphatasia. For familial hypophosphatemic rickets the gene is at Xp22.. (MIM 307800).. See also MIM 600081.

Rieger anomaly is the Axenfeld anomaly including the iris anomalies but without the systemic features. The Axenfeld anomaly includes a prominent Schwalbe ring (posterior embryotoxon), usually cataract, iris strands to Schwalbe ring, hypoplasia of the anterior iris stroma, absence of iris crypts, and anomalies of the gonial angle.		
Rieger syndrome. (AD). MIM 180500	***RIEG1*** at 4q25 See also ***FOXC1*** at 4q25.	Irido-corneal dysgenesis. Often with myotonic dystrophy, pituitary hypoplasia, anal stenosis, malformed limbs, congenital heart defects, renal malformation, umbilical hernias, hypospadias, microdontia, skull malformation, facial flattening, maxillary hypoplasia, impaired hearing, and sometimes mental retardation. Microphthalmia, aniridia, corneal opacities, and ectopia lentis. About 50% develop glaucoma.
Axenfeld-Rieger syndrome. (AD, AR, S) MIM 109120, 601499	***RIEG/PITX2*** at 4q25, ***ASMD*** at 4q28-q31, ***RIEG2*** at 13q14	Some have an atrial septal defect and sensorineural hearing loss, with partially absent eye muscles, hydrocephaly, and psychomotor retardation.
Riley-Day syndrome.		See dysautonomia, familial. ***HSAN-III.*** (MIM 223900).
ring chromosome 6. (AD). MIM 601237	***ZNF179*** at 17p11.2	Agenesis of the corpus callosum, hydrocephalus, heart defect, mental retardation, anemia, seizures, hypertelorism, microphthalmia, aniridia, strabismus, ptosis, nystagmus, colobomas, corneal clouding, glaucoma, and optic atrophy. See Smith-Magenis syndrome. (AD). (MIM 182290).
ring D chromosome MIM 602045	***RING-1, RNF1*** at 6p21.3	Mosaic ring chromosome 22 a variant of the 13 deletion syndrome, have mental and physical retardation, cardiovascular anomalies, hypertelorism, epicanthus, microphthalmos, ptosis, strabismus, uveal colobomas, and retinoblastoma. See ***PMM1*** at 22q13 (MIM 601786) and DiGeorge syndrome at 22q11.2. See ***TRAF1*** at 9q33-q34 (MIM 601711), ***TRAF2*** (MIM 601895) and ***TRAF3*** (MIM 601896).
ring dermoid of the cornea syndrome. (AD). MIM 180550	Gene	Usually bilateral dermoid choristoma, conjunctival plaques, lipid deposits in the cornea, irregular corneal astigmatism, amblyopia, and strabismus. For corneal dermoids the gene ***CND*** is inherited XL (MIM 304730).
Robertsonian translocations are rearrangements of the acrocentric chromosomes 13-15 and 21-22. Chromosomes 14 and 15 contain imprinted genes. Abnormal phenotypes are also associated with uniparental disomy (UPD).		
Roberts syndrome. (AR, C). MIM 268300	***RBS*** occurs when chromosomes divide abnormally	Tetraphocomelia, short limbs, craniofacial abnormalities, and cleft lip/palate. Cataracts, glaucoma, and corneal vascularization. Normal intelligence. Most soon die. Compare with the **TAR** syndrome (MIM 274000) and with SC phocomelia. (MIM 269300).
Robinow syndrome. (AD, AR). MIM 268310, 180700	***RRS*** at 9q21-q23	Gene is for a tyrosine kinase. Patient has brachydactyly type B. Gene ***ROR2*** at 9q22. (MIM 120400).
Robinow-Silverman-Smith syndrome. (S, AD, AR).MIM 180700	***ACH*** at 4p16.3	Mutation here causes achondroplastic dwarfism, micrognathia, hypertelorism, and epicanthus.
Robinow-Sorauf syndrome. (AD) MIM 180750	Gene may be ***TWIST*** at 7p22-p21.	Acrocephalosyndactyly type-II woith broad great toes, hypertelorism, and strabismus. Resembles Saethre-Chotzen syndrome (MIM 101400).
Rochon-Duvigneaud syndrome	Gene	
rod and cone specific guanylate cyclase. (AD)	***CORD6, RETGC-1*** at 17p13.	Gene product is required to return cGMP levels to normal after exposure to light. See ***GUC2B*** at 1p34-p33.
rod monochromatism.		See color vision.
rod outer segment membrane protein-I. (AD).	***ROM1, ROSP1*** at 11p13-q13	See digenic RP. (MIM 179605, 180721).
Rokitansky syndrome (AR). MIM 277000	***RKH***	Congenital absence of the vagina. Vaginal atresia. Compare with Goldenhar syndrome. (MIM 164210).
Romano-Ward syndrome.		See the long QT interval syndromes.
Rosai-Dorfman disease	Gene	This thyroid disorder might be caused by excessive intake of vitamin A. Have sinus histiocytosis, lymphadenopathy, elevated spinal fluid pressure, sensory and motor losses, and cataract.
Rosenberg-Chutorian syndrome. (AD, AR, XL). MIM 311070	Gene	Polyneuropathy, distal muscular atrophy, poikiloderma, deafness, and optic atrophy. For this polyneuropathy see Charcot-Marie-Tooth syndromes (MIM 118300, 214303). See also MIM 258650, (AR), optic atrophy, deafness, and amyotrophy.

Rosenthal-Kloepfer syndrome. AD). MIM 102100	Gene	Onset in early childhood, are tall with acromegaly, large hands and feet, longitudinal skin ridges, cutis verticis gyrata, and corneal leukomas.
Rothmund-Thomson syndrome (AR). MIM 268400 See also MIM 270240.	***RTS*** on chromosome 8, or trisomy 8**.** See ***RECQ L4.*** See also MIM 270240 for a skeletal dysplasia with telangiectases, and dysgenesis of the iris.	A hereditary dermatosis, onset at age 2 to 6 months of age, More common in females. Poikiloderma atrophicans, skin atrophy, telangiectasia, saddle nose, short stature, hypogonadism, anemia, osteogenic sarcoma, iris atrophy, and juvenile cataract. ***RTS*** is a ***RECQL4*** helicase that can act as a tumor suppressor. Helicases unwind DNA. Humans have 5 of these proteins including: ***BLM*** for Bloom syndrome, ***WRN*** for Werner syndrome, and ***RTS*** for Rothmund-Thompson syndrome. All show premature aging. and have cancer predisposition
Roussy-Levy syndrome MIM 180800	Gene may be at 17p11.2.	Slow nerve conduction, tremor, and weakness of limb muscles.
Rubinstein-Taybi dwarfism. (M, S, AD) MIM 180849	***RSTS*** at 16p13.3	Dwarfism, mental retardation, agenesis of the corpus callosum, cardiac disorders, glaucoma, strabismus, ptosis, cataracts, and downslanting lid fissures.
Rud syndrome. (XR, AR). MIM 308200, 308700 Designation rarely used.	***RUDS*** may be at Xp22.3.	A neurocutaneous disorder, non-bullous ichthyosiform erythroderma (NBIE), hyperchromic macrocytic anemia, muscular atrophy, male hypogonadism, mental retardation, idiocy, seizures, epilepsy, anosmia, and retinitis pigmentosa. See ichthyosis and see Kallman-I syndrome. (MIM 308700).
Russell-Silver mandibulofacial dysostosis. (AD, AR, XR).	***RSS*** at 17q25 (AR). MIM 270057, (XL). MIM 312780	Have dwarfism and skeletal anomalies. See MIM 180860. More severe in males. See also Partington syndrome, (MIM 309510).
Rutledge syndrome. (AR) MIM 268670, 270400	Gene	Lethal multiplex congenital anomaly, dwarfism, cleft palate, heart defect, polydactyly, and cataracts. See Smith-Lemli-Opitz syndrome-2, gene ***SLOS*** at 11q13, (MIM 602858). See also ***DHCR7*** at 11q13. (MIM 602858).
Bannayan-Riley-Ruvalcaba disease . MIM 153840.	Gene may be ***PTEN*** at 10q23. (AD). MIM 601728	Hemangiomas, incordination, mild mental retardation, hypertension, and exotropia.
S.		
Sack-Barabas syndrome. (AD, AR, XR).	***COL3A1*** at 2q32.2	Is a variant of the Ehlers-Danlos syndromes.
Saethre-Chotzen syndrome (AD). MIM 101400	***SCS, TWIST*** at 7p22-p21	Acrocephalosyndactyly-III with facial asymmetry and telecanthus. A few have learning disability or mental retardation or a heart defect. With mutation in ***TWISTNB*** at 7p21 they have Saethre-Chotzen syndrome with learning disability. Compzre with these syndromes: Robinow-Sorauf (MIM 180750) and Gorlin-Chaudhry-Moss (MIM 233500).
Sakati-Nyhan-Tisdale syndrome. (AD) MIM 101120	Mutations in four genes can be involved.	See acrocephalopolysyndactyly-III. (MIM 101120).
Saldino-Mainzer conorenal syndrome. (AR). MIM 266920	***SMS*** at 2q13	This renal-retinal syndrome includes Leber amaurosis congenita, nephronophthisis, chronic renal failure, cerebellar ataxia, deafness, cone-shaped epiphyses of the hands (PhCSEH), and retinitis pigmentosa. Compare with Senior-Loken syndrome.
Salla oligosaccharidosis. (AR). MIM 269920	***SLD*** at 6q14-q15	Sialic acid storage disease. Delayed central and peripheral myelination, reduced velocity of nerve conduction, and mental retardation.

Salt-losing and related syndromes.

Adrenal hyperplasia-I (AR) ***CAH*** (MIM 201710, 600617).
See steroidogenic acute regulatory protein ***STAR*** gene at 8p11.2. (MIM 600617)
Adrenal hyperplasia-II ***HSD3B2*** at 1p13.1 or 1p13-p11. (MIM 201810).
See 11-beta hydroxylase deficiency (AR) ***CYP11B1*** at 8q21 and ***CA21H*** at 6p21.3
Chloride channels ***CLCNKA*** (MIM 602024), ***CLCNKB*** for Bartter syndtome-III (MIM 602023), are both at 1p36.
CLCN3 at 4q33 (MIM 600580), ***CLCN4*** (MIM 302910), and ***CLCN5*** (MIM 300008), Dent disease (XD).
Chloride diarrhea ***CLD*** at 7q31 (AR) (MIM 214700).
Medullary cystic kidney disease (AD) ***MCKD*** at 1q21 (MIM 174000). ostly develops after age 30.
Pseudohypoaldosteronism type-I (AD) ***HSD3B2*** at 1p13.1, (MIM 109715, 201810). See adrenal hyperplasia-II.
MLR at 4q31, mineral corticoid receptor, aldosterone receptor (MIM 600983)
PHA1 on 12p or 16p (AD, AR) (MIM 177735, 264350)
SCNN1A, alpha sodium channel (MIM 600228)
SCNNIB, beta sodium channel at 15q13.1-q13.2 (MIM 600760)
SCNNID, delta sodium channel (MIM 601328)
SCNN1G, gamma sodium channel at 16p13-p12. (MIM 600761)
Pseudohypoaldosteronism type-II (AD) ***PHA2A*** at 1q31-q42 (MIM 145260). See Gordon syndrome. (AR).(MIM 114300)
PHA2B (AR) at 2q24 or 17p11-q24 or 17p11-q21 or 17q21-q22 (MIM 601844)
PHA2C is on chromosome 12.
LAG3 at 12p13.3. (MIM 153337)
Retinitis pigmentosa, sector type (AR often AD) (MIM 256100). See also MIM 214700
Solute carrier ***SLC12A3*** at 16q13 (MIM 600968). See Gitelman variant of Bartter syndrome (AR) (MIM 263800).
Tumor suppressor ***DRA*** at 7q22-q31 (MIM 126650) this one is down regulated in adenomas and may affect ***CLCNKB***

Name	Gene	Comments
Sandhoff-Jatzhewitz-Pitz syndrome. (AR) MIM 268800.	***HEXB*** at 5q13	Megalencephaly, muscle weakness, ataxia, early blindness, and other signs.
Sanfilippo syndrome. (AR).	***NAGLU, MP53C*** at 17q21	MPS-III. Four subtypes: type A (MIM 252900), type B (MIM 252920), type C (MIM 252930), and type D (MIM 252940).
Sanger syndrome MIM 314700	***PBDX*** Xg is in the Xp2 region.	Mental retardation and deafness. A pseudogene is ***XGPY*** at Yq11.21.
S-antigen, S-arrestin. (AR).	***SAG*** at 2q37.1	In retina and pineal gland. See Oguchi-I disease. (MIM 181-031, 258100). Compare with the other arrestins.
sarcoidosis, Boeck's sarcoid. MIM 181000	Some familial predisposition but mostly non-genetic. .	Besnier-Boeck-Schaumann multisystem granulomatous disease with lymphadenopathy, pulmonary infiltration, muscle wasting, erythema nodosum, bone cysts, iridocyclitis, glaucoma, cataracts, too few tears, band keratitis, candle-wax retinal exudates, and optic atrophy. Some have HLA-DR5.
scapuloperoneal spinal muscular atrophy. (AD)	***SPSMA*** at 12q24.1-q24.31.	New England neurogenic muscular atrophy. See MIM 181405.
scapuloperoneal spinal muscular atrophy. (AD)	***SPMD*** at 12q13.3-q15.	A slowly progressive myopathic type. See MIM 181430.
Scheie syndrome		See MPS-I, MPS-V and the glycosamoinoglycans. (MIM 181430).
Schilder disease. (AR). MIM 272100	Gene	Lesions in the white matter of the brain (area 17). Sudanophilic cerebral sclerosis. Encephalitis periaxialis diffusa, of the Scholz type, affects males, progressive spastic paralysis, mental deterioration, deafness, nystagmus, EOM palsy, can affect the optic tract, optic atrophy, blindness. May relate to multiple sclerosis (MIM 126200), sudanophilic cerebral sclerosis (MIM 272100), Krabbe disease (MIM 245200), metachromatic leukodystrophy (MIM 250100), and (XL) adrenoleukodystrophy (MIM 300100).
Schindler disease. (AD). MIM 104170	***NAGA*** at 22q11 for types 1 and 2	Neuraxonal dystrophy due to deficiency of alpha-N-acetylgalactosaminidase. Progressive psychomotor retardation with seizures, strabismus, and optic atrophy.
Schmidt syndrome now called APS-II. (AD, AR, M). MIM 269200	May have a mutation in ***AIRE-1*** at 21q22.3 causing autoimmune-polyendocrineopathy - candidiasis-ectodermal dystrophy	Autoimmune polyglandular deficiency syndrome-II causes Addison disease (adrenocortical insufficiency), anemia, chronic pulmonary disease, Hashimoto thyroiditis (lymphocytic thyroiditis), cataracts, and band keratopathy. ***AIRE-1*** is an autoimmune regulator.

schizophrenia, susceptibility. (M)	***SCZD-I*** at 5q11.2-q13.3, ***DRD3*** at 3q13.3 ***SCZD-II*** (AD, P) at 19p13, ***SCZD-III*** at 6p23, ***SCZ D-IV*** at 22q11-q13	Affects 100/10,000, onset at an average age of 21. The organic brain syndrome is often due to degeneration. Delusions, hallucinations, disordered thinking, and social deterioration. Some are deaf, some are depressed, and some are paranoid. Onset acute or insidious. Other genes are at 1q32.2, 5q33.2, 8p21-p22, and probably at 11q23.3, and 20q12.1-q11.23, and possibly at 4q13-q31, and 11q23.3-q24 and ***CRNAT*** at 15q14.
schizophrenia, chronic. (M).	***APP, AAA, CVAP*** at 21q11-q13.	See Alzheimer diseases.
Scholz cerebral sclerosis, diffuse (XL). MIM 302700	Gene	May be a form of adrenoleukodystrophy (MIM 300100), onset at age 8 to 10 years, deafness, dementia, weakness, spasticity of the legs, and blindness.
Schwartz-Jampel-Aberfeld syndrome. (AR). MIM 255800	***SJS*** at 1p36.1-p34	Have progressive chondrodystrophy with myotonic myopathy, dwarfism, malignant hyperthermia, muscle hypertrophy, telecanthus, microphthalmia, blepharophimosis, exotropia, and myopia. See Marden-Walker syndrome (XL) (MIM 248700).
sclerocornea. (AD). MIM 181700, (AR). MIM 269400	Gene	The AD type is mild and the AR type is severe. May have cornea plana (MIM 121400, 217300) and other ocular conditions.
scleroderma familial, progressive. (AD). MIM 181750	***SSc***	With this chronic connective tissue disease, male/female ratio 1/4, they have Raynaud syndrome, telangiectasia, progressive systemic sclerosis, lung involvement, pulmonary hypertension, renal crisis, corneal ulcers, ptosis, uveitis, keratoconus, and occlusions of retinal veins. Are susceptible to arthritis, and renal failure. See ***CRST*** syndrome (MIM 181750).
SC phocomelia. (AR). MIM 269000	Gene	Was called pseudothalidomide. Allelic to Roberts (MIM 268300) and TAR (MIM 274000) syndromes. Signs include growth retardation, craniofacial abnormalities, scanty silvery-blond hair, hemangiomas, renal abnormalities, joint contractures, mental retardation, and bilateral corneal opacities.
Sebastian platelet syndrome. (AD). MIM 153640	***MYH9*** at 22q12.3-q13.2 or ***NMMHC-A*** gene	***MYH9*** encodes the heavy chain of non-muscle myosin IIA. Have thrombocytopenia, and congenital cataracts. Resembles these syndromes: Alport (MIM 104200, 203780, 308940), Fechtner (MIM 153640), and May-Hegglin (AD) (MIM 151100).
Seckel bird-headed dwarfism. (AR). MIM 210600	Gene	Dwarfism, low birth weight, short arms, genitourinary malformation, cardiac disorders, microcephaly, nanocephaly, mental retardation, beak-like protrusion of the face, hypertelorism, strabismus, nystagmus, and macular coloboma. Risk of myeloid leukemia. Need shelf acetabuloplasty. See Legg-Calve-Perthes disease (AD, M), (MIM 150600).
Seemanova syndrome-1.	Gene	Very similar to Paine syndrome (XL) (MIM 311400).
Segawa syndrome (AD). MIM 128230	Gene on chromosome 14q.	Progressive dystonia with diurnal variation, Parkinsonism, and exaggerated tendon reflexes.
Seitelberger-1 disease		See Pelizaeus-Merzbacher disease. (MIM 260600).
Seitelberger-2 disease. (AR). MIM 256600	***INAD***	These (mostly female) infants accumulate lipids and iron in the globus pallidus. Have infantile neuroaxonal dystrophy, muscular hypotonia, dementia, ataxia, seizures, nystagmus, degeneration of the optic pathway, and blindness. May be vitamin E deficient. Compare with: Pelizaeus-Merzbacher disease (MIM 260600), Hallervorden-Spatz disease (MIM 234200), Leigh syndrome (MIM 256000), and ***NDUFS8*** at 11q13.1-q13.3 (MIM 602141).
Senger syndrome (AR). MIM 212350	Gene	Muscular hypoplasia, cardiomyopathy, congenital cataracts, nystagmus, and strabismus.
sensory neuropathy-1. (AD).	***HSN1, HSAN1*** at 9q22.1-q22.3	Hereditary sensory and autonomic neuropathy. Disease onset at 15 to 36 years of age. Have deafness and foot ulcers. The gene ninjurin maps here too.
Senter syndrome	Gene	See KID syndrome of the AD type. (MIM 148210).
septo-optic dysplasia. (AD). MIM 602674	***HESX1*** at 3p21.2-p21.1	Deletion causes DeMorsier syndrome, pituitary insufficiency, a growth hormone deficiency with absent septum pellucidum and hypoplastic optic discs.
Seratonin (5-hydroxytryptamine) receptors of many types exist, see for example **1A** at 5q11.2-q13, **1B** at 6q13, **1D** at 1p36.3-p34.3, **1E** at 6q14-q16, **1F** at 3p12, **2A** at 13q14-q15, **2B** at 2q36.3-q37.1, **2C** at Xq21, **3** at 11q23.1-q23.2, **4** at 5q31-q33, **5A** at 7q36.1, **6** at 1p36-p35, and **7** at 10q21-q24. See migraine.		

Severe combined immunodeficiency. (**SCID**) (S, AD, AR, XL) and immunodeficiency generally.
See also protein kinase and the immunoglobulins, one gene is at 15q23-q24. For the severe combined immunodeficiency of the Athabascan type the gene ***SCIDA*** is on chromosome 10p. (MIM 602450). One gene for immunoglobulin kappa is at 2p12. The ***DSRAD*** gene for adenosine deaminase (AD) is at 1q21.1-q21.2. An IgA deficiency (MIM 137100). affects about 1/800 Caucasians. In those with **SCID** their B cells fail to differentiate into immunoglobulin-secreting plasma cells. Many also have a T-cell defect. Bruton agammaglobulinemia depends on tyrosine kinase ***BTK*** (XL), (MIM 300300). Those with a defect of the ***XLA*** gene at Xq21.3-q22 are subject to bacterial infections but resistant to viral infectious agents. For the cytochrome b alpha subunit (AR) the gene ***CYBA*** is at 16q24. (MIM 233690). For the cytochrome b beta chain (XL) the gene ***CYBB*** is at Xp21. (MIM 306400).

AD type immunodeficiency	***IL2*** at 4q26-q2	T cell immune regulator.
AR immunodefic ciency types. MIM 102700	***ADA1*** at 20q13.11, ***HYRC1*** at 8q11, ***RFX1*** at 19p13.1	Adenine deaminase deficiency causes severe combined immunodeficiency. With SCID they are unable to produce adenosine deaminase.
immunodeficiency-1. (XL)	***IMD1*** at Xq21.3-q22	See Bruton agammaglobulinemia. (MIM 300300).
immunodeficiency. (AD, AR)	***CD3G, CD3E*** at 11q23	Defect in CD3 gamma.
immunodeficiency with increased IgM. (XR). MIM 308230	***CD40LG, HIGM1, IGM, TNFSF5*** at Xq28	Have hyper IgM. CD40 ligand included.
T-negative, B-positive, NK negative, **SCID**. (AR).	***JAK3*** at 19p13.1	The Janus kinase acts on lymphocytes. Patients with SCID are unable to produce adenosine deaminase.
Swiss immunodeficiency. (XL). MIM 300400	***IL2RG, SCIDX1, IMD4*** at Xq13.1-q21.1	Interleukin-II receptor gamma.. IL-II acts on T, B, and NK cells. See ***SCI DX2*** (MIM 312863).
SCID2. (XR)	***SCIDX2*** at Xq13.1	Recurrent sinusitis, otitis media, bronchitis, and pneumonia.
Wiskott-Aldrich syndrome. (XR). MIM 301000	***WASP*** at Xp11.22 to Xp11.3. More than 150 mutations.	Affects 4 per million in USA. Expression of CD43 is defective, have immunodeficiency, thrombocytopenia, eczema, otitis media, periorbital, conjunctival, and retinal hemorrhages, papilledema, predisposition to leukemia and lymphoma, and die before age 10.
sex reversal. (XL)	***DAX1*** at Xp21	Duplication causes male to female sex reversal.
sex determining region Y. . MIM 480000	***SRY*** at 2p25, 6p23, and at many other loci.	Said to compete with ***DAX***. Numerous genes can be involved, see for example ***TDFA*** at 9p24 and genes at 3q25.3-q27 and at 13q34.
Sheehan syndrome. (mostly XL). MIM 311850.	***PRSP1*** at Xq22-q24, ***PRSP1L*** at 9q33-q34 ***PRSP2*** at Xp22.3-p22.2	Also called Simmonds-Sheehan syndrome. Post-partum hypopituitarism, with vascular occlusions, pituitary necrosis, lethargy, thyroiditis, loss of eyebrows, and uveal depigmentation.
short-rib polydactyly-III or Naumoff syndrome. (AR). MIM 263520 for type 2.	***SRPS*** at 4q13	Majewski syndrome. Lethal dwarfism with short ribs, gastrointestinal atresia, polycystic kidneys, hydrops fetalis, and polydactyly. Compare with Jeune syndrome. (MIM 208500).
short stature syndrome. (XR). MIM 312865.	***GCFX, SS*** at Xpter-p22.32.	See also the growth hormones. Compare with achondrodysgenesis. (AD) (MIM 222600)
short stature. (YL). MIM 475000	***STA*** at Yq12	***TSY*** and ***GCY*** also map here.
(AD). MIM 600946	***GHR*** at 5p13-p12	Gene is for a growth hormone receptor.
short stature (XL). MIM 312865	***SHOX, OG12*** at Xp22.3	Was called ***PHOG***.
SHORT syndrome. (AR). MIM 269880	Gene	Hyperextensible joints, hip dislocation, delayed speech, may have diabetes mellitus, deafness, teething delay, enophthalmos, Rieger anomaly, neonatal glaucoma, and ocular depression. Are subject to frequent illnesses.
short stature MIM 602504, 312865	***SHOX2, SHOT*** at 3q25-q26	Another relevant gene may be at 2q24-q32. See Leri-Weil or Leri pleonosteosis (AD) (MIM 115430) and Cornelia de Lange syndrome. (MIM 122470).
short stature, obesity (AR). MIM 269870	***SSOS***	Normal intelligence, fifth finger clinodactyly, and may have glaucoma.
short stature, valvular heart lesions, and ptosis. (AD). MIM 126190	Gene	Short legs, crowded dentition, and valvular heart disease.
short stature, asymmetric (AD). MIM 108450	Gene	One leg shorter than the other, scoliosis, esotropia, and hyperopia. Normal intelligence. Compaare with these syndromes: Russel-Silver (MIM 180860), and Hallermann-Streiff (MIM 234100).
short stature, macrocephaly (AD). MIM 600399	Gene	Pectus excavatum, developmental delay, and dysplastic nails.

short stature, auditory canal atresia. (AR, AD). MIM 602471	***SAMS***	Mandibular hypoplasia, and skeletal anomalies including humeral hypoplasia.
short stature, Brussels type. (AR, XL). MIM 601350	Gene	Horseshoe kidney and a relatively large head.
Shprintzen syndrome. (AD). MIM 182210	***VCF*** at 22q11	Velocardiofacial syndrome with cardiac anomalies, omphalocele, cleft palate, and learning disability.
Shprintzen-Goldberg marfanoid syndrome. (AR). MIM 182212	***MFS1, FBN1*** at 15p21.1. More than 6 mutations occur in ***FBN1***.	Genetic disorder of the elastic system Craniosynostosis, arachnodactyly, and abdominal hernias. See fibrillin-I (MIM 134797) and see Marfan syndrome. (MIM 154700).
Autonomic nervous system dysfunctions may be classified as: primary due to an unknown cause or as multiple system atrophy: with autonomic dysfunction, parkinsonism and ataxia. Secondary autonomic dysfunction can occur with diabetes mellitus, amyloidosis, dopamine beta hydroxylase deficiency, and drug toxicity.		
Shy-Drager syndrome. (AD). MIM 146500 Possibly this designation will be abandoned.	***PAF***	Adult-onset progressive degeneration of the CNS, autonomic failure, orthostatic hypotension, tremor, mental retardation, or normal intellect, muscle wasting, weakness, bladder and bowel incontinence, dizziness, external ophthalmoplegia, iris atrophy, defects of sympathetic and parasympathetic systems. Seen in 7% of the spinocerebellar degenerations. Some have HLA-Aw32.
Shy-Gonatas syndrome (AR). MIM 255140	Abnormal mitochondria are present from birth. Gene.	Lipid accumulates in muscles, weakness, cerebellar ataxia, ptosis, external ophthalmoplegia, keratopathy, and atypical retinitis pigmentosa. Resembles Refsum syndrome and Hunter syndrome.
sialidosis-I. (AR). MIM 262500, 256550, 256150	***GNPTA*** at 4q21-q23	Infantile I-cell or LeRoy disease or mucolipidosis-II is a lysosomal storage disease. A deficiency of lysosomal sialidase. Onset between age8 and 25 years, With this alpha-N-acetylneuraminidase deficiency they have ascites, hepatosplenomegaly, nephrosialidosis, skeletal anomalies, facial dysmorphism, inguinal hernias, seizures, dilated coronary arteries, a skin rash, tortuous retinal vessels, a cherry-red spot in the macula, horizontal nystagmus and decreased vision. Die as young adults.
sialidosis-II. (AR). MIM 256550, 256540	***NEU*** at 6p21.3	This early-onset neuraminidase deficiency was called mucolipidosis-I. Deficiency of beta galactosidase causes this dysmorphic Hurler-like type with dysostosis multiplex, mental retardation, skeletal dysplasia, ascites, and hepatosplenomegaly. A milder type has a later onset. Sanger syndrome patients (MIM 314700) have mental retardation and deafness. Gene may be ***PBDX*** and the pseudogene ***XGPY*** is at Yq11.21.
sialidosis-III (AR). MIM 252500, 252600	***GNPTA*** at 4q21-q23	Have a sialidase deficiency. A pseudo-Hurler polydystrophy. Compare with mucolipidosis-II or I-cell disease, and sialidosis I, and the cherry-red spot syndrome.
sialolipidosis. (AR) MIM 252650	Gene at 10pter-q13.	Mucolipidosis-IV. (AR). Berman syndrome. Psychomotor retardation, strabismus, corneal clouding in infancy, and myopia.
sicca syndrome. (AD)	***SSA*** at 19p13.2	Calreticulin. Sjögren syndrome, antigen A1.
Siegrist syndrome. (AR) .MIM 231950)	***GGT*** at 22q13.1. ***GGT1*** at 22q11.1-q11.2 ***GGT2***, and ***GGT3*** on chromosome 22q.	Malignant hypertension with onset at an advanced age, more common in females. Arteriosclerotic choroidal changes and pigmented spots along larger vessels. Compare with glutathionuria (MIM 231950) and Prader-Willi syndrome (MIM 176270).
Siemens disease (AD). MIM 146800	***IBS***	Ichthyosis bullosa is similar to MIM 113800. Compare with ***KRT2E*** at 600194.
Siemens keratosis follicularis spinulosa decalvans cum ophaisi. (XR, AD). MIM 308800	***KFSD*** at Xp22.2-p22.13	Mostly affects males, thick dry skin, wasting of hand muscles, mental retardation, streaks of baldness, loss of eyebrows, cataract, up-slanting lid fissures, aniridia, corneal degeeneration, and pupillary anomalies.
Siemens ichthyosis bullosa ***IBS*** . (AD) MIM 146800	***KRT2E*** (MIM 600194)	Ichthyosis bullosa Is similar to 113800.
Sillence syndrome (AD). MIM 113450	Mutation in ***COL1A1*** at 17q21.31-q22.05 or in ***COL1A2*** at 7q22.1.	Brachydactyly, distal symphalangism, club foot, and scoliosis. Compare with osteogenesis imperfecta congenita ***OIC*** (MIM 166210)
Silver syndrome. (AD)	***SS*** at 11q12-q14. Some have a deletion from chromosome 13.	Sponge kidney, Wilms tumor, and café-au-lait spots on the eyelids. Affects only one side of the face. Wasting of hand muscles.

Sipple syndrome. (AD, S). MIM 171400.	***RET*** or ***MEN2A*** at 10q11.2	Multiple endocrine neoplasia-II. May have thyroid or parathyroid tumors, neurofibromas, diabetes mellitus, and diarrhea. Dry eyes, thickened corneal nerves, and unusual refraction. Compare with Wermer syndrome. (MIM 131100).
situs inversus viscerum. (AD, AR). MIM 270100,	***SIV*** at 14q32 or on chromosome 6 or 12 or ***DNAH5*** at 5p15-p14.	Transposition of the major vessels, congenital heart defect. Compare with Kartagener syndrome. (MIM 244400) and Ivemark syndrome (MIM 208530).
Kartagener syndrome. (XL, AR, AD) MIM 244400	***ZIC*** at Xq25-q26 or a gene at 14q32 . **PCD** may depend on a mutation in ***DNAH11*** at 7p21.	Also called ciliary dyskinesia. Sinusitis-bronchiectasis-situs-inversus syndrome with dextrocardia, chronic headaches, immotile cilia, infertility, and many ocular anomalies. Compare with Ivemark syndrome, heterotaxy, and ciliary dyskinesia.
Sjögren syndrome. (AR). MIM 109092	***SSA1*** at 11p15.5, for antigen-I ***SSA2*** at 1q31 for antigen-II.	Gougerot-Sjögren syndrome with joint swelling, hepatomegaly, alopecia, keratoconjunctivitis sicca, and corneal ulcers and scars. See Mikulicz syndrome.
Sjögren-Larsson syndrome. (AR). MIM 270400	***SLS*** at 17p11.2	Torsten-Sjögren syndrome, loss of neurons from the grey matter, xerodermal idiocy, ichthyosis, epilepsy, spastic diplegia, and some have keratitis, chorioretinitis, retinitis pigmentosa, and maculopathy.
Sjögren reticular pigmentary retinal dystrophy. (AR). MIM 267800	***RP7, RDS*** at 6p21.1-cen.	Fishnet-like knots on the posterior pole of the retina, black pigmented lines, and drusen. Compare with Mesker syndrome.(MIM 169150, 179605) Gene is at this same locus..

Skin conditions. See also epidermal and ectodermal conditions and ichthyosis. Hereditary skin conditions with gastrointestinal symptoms fit in four groups (a) with intestinal polyps, (b) vascular dysplasias with intestinal hemorrhages, (c) connective tissue diseases, and (d) the AR condition acrodermatitis enteropathica with diarrhea.

For the procollagen of the skin the gene is ***COL1A1*** at 17q21.31-q22.05. See Clouston syndrome (AD) ***HED*** at 13q11-q12.1. See also palmoplantar keratoderma. (AD) (MIM 244850).

Ciliary dyskinesia is (AR), gene ***DNAH1*** at 7p21. Ciliary dysfunction, bronchiectasis, sinusitis, upper respiratory tract infections. Half have Kartagener syndrome (situs inversus). (MIM 242650).

With atopic dermatitis they have excess IgE, pruritus, itching, keratoconjunctivitis, keratitis, keratoconus, cataract, lid dermatitis, uveitis, glaucoma, and retinal detachment. Inherited bullous ichthyosiform erythroderma shows signs a week after birth, skin scales, keratopathy, keratitis, corneal lesions corneal scars, and lacrimation. See Klippel-Trenaunay-Weber syndrome (AD). Gardner and Peutz-Jeghers are examples of skin polyposis syndromes.

For café au lait skin spots, see Watson syndrome (AD), allelic with ***NF1***. (MIM 193520).

Children with the marble skin syndrome (cutis marmorata) have bluish-red mottling of skin, spasmodic contraction of arterioles, congenital hypothyroidism, congenital glaucoma, a thin cornea and sclera, corneal edema, cataracts, and optic atrophy.

Photosensitivity is more likely to occur in those with: atopic eczema, dermatitis herpetiformis, erythema multiforme, lupus erythematosus, pemphigus, porphyria, psoriasis, rosacea, Smith-Lemli-Opitz syndrome, and viral exanthemata.

more susceptible to UV radiation	***MCIR*** at 16q24.3.	Melanocortin-1 receptor.
cutis laxa, neonatal type. (XL). MIM 300011, 304150.	***ATP7A, MNK, OHS*** at Xq13.3	Have mild mental retardation. Compare with Menkes kinky hair disease, (XL) which is a more severe condition. (MIM 309400)
cutis laxa. (AR, AD) MIM 123700	***LAMB1*** at 7q31.1-q312.3	Marfanoid neonatal type.
cutis verticis gyrata. (XL or AR). MIM 304200, 219300.	***CVG/MR***	Thyroid aplasia and mental retardation, furrows and folds in the scalp. One patient had diabetes mellitus. Compare with Rosenthal-Kloepfer syndrome (MIM 102100). See Lennox-Gastaut epilepsy.
cutis verticis gyrata. (AD) MIM 102100	***ESS1*** maps to 9q31.	Acromegaloid changes, and corneal leukoma. With one type of cutis verticis gyrata they have microcephaly, mental retardation, deafness, cataracts, and retinitis pigmentosa. (MIM 219300). See also Rosenthal-Kloepfer syndrome. (MIM 102100).
cutis gyrata of Beare and Stevenson (AD) MIM 123790)	Gene may be ***FGFR2*** at 10q25.3-q26 MIM 176943.	Skin furrows, acanthosis nigricans, and anogenital anomalies. Compare with these syndromes: Apert (MIM 101200), Crouzon (MIM 123500), Jackson-Weiss (MIM 123150), Pfeiffer (MIM 101600), and Saethre-Chotzen (MIM 601622).

Degos malignant papulosis or Kohlmeier-Degos syndrome. (AD) MIM 602248,132800	***MSSE*** at 9q31	Male preponderance, necrotizing vasculitis, multiple cerebral infarcts, arterial occlusions including cerebral, CNS involvement, white skin lesions, anorexia, GI tract is involved in 50% of cases, diplopia, atrophy of eyelid skin, conjunctivitis, necrotic papules on the lids, conjunctiva, and episcleral tissue, and early death. Some can be helped with pentoxifylline and aspirin. A benign cutaneous papulosis has also been reported..
mal de Maleda syndrome. (AR). MIM 248300	**MDM** encodes ***SLURP-1*** at 8q23.	This palmoplantar keratoderma (PPK) affects 1/100,000, causing keratotic skin lesions, perioral erythema, brachydactyly, and nail anomalies.
pachyderma, thick skin. (AR, AD). MIM 167100	***PDP ?***	Touraine-Solente-Golé syndrome. Mostly affects males. Signs are pachydermoperiostitis, osteoarthropathy, finger clubbing, hyperhidrosis, hypertrophy of connective tissue, bone and joint pain, ptosis, and thick eyelids. May be treated with isotretinoin. See leprechaunism, (AR), gene ***INSR*** at 19p13.2.
Goltz-Gorlin focal dermal hypoplasia. (XD). MIM 305600	***DHOF*** at Xp22.31	Skin atrophy, skeletal and dental anomalies, basal cell nevus, angiofibromas, spina bifida, syndactyly, microphthalmia, strabismus, nystagmus, keratoconus, ectopia lentis, colobomas of choroid and iris. Lethal for males. Note the ***MIDAS*** syndrome (XL) gene also maps here. (MIM 309801).
Sluder syndrome	Gene	Sphenopalatine ganglion neuralgia, irritation of this ganglion causes attacks of unilateral orbital pain lasting minutes or days, dysfunction of the parasympathetic system, increased tearing, headache, and nasal congestion. Compare with Charlin syndrome. Clonazepam is used to treat Sluder patients.
Smith facio-skeleto genital syndrome. (AR).	Gene	More common in males, microcephaly, mental retardation, pedal syndactyly, ptosis, up-slanting lid fissures, and epicanthus.
Smith-Lemli-Opitz-I syndrome. (AR). MIM 270400, 602858	***SLAC, DHCR7*** at 11q12-q13. ***SPG4*** at 2p24-p21 and ***SPP6*** at 15q11.1 may be involved.	Inherited deficiency of 3 beta-hydroxysterol-delta 7-reductase which normally catalyzes the last steps of cholesterol biosynthesis. Incidence 1/30,000 births. Mutation causes this lethal cerebro-hepato-renal syndrome with mental retardation, heart defects, syndactyly, ptosis, cataracts, strabismus, and optic nerve demyelination. See also a trisomy 18-like syndrome (AR) (MIM 601161)..
Smith-Lemli-Opitz-II syndrome. (AR). MIM 268670	***SLO*** at 7q32.1	Rutledge lethal acrodysgenital syndrome. Some have mutations in ***DHCR7*** at 11q13, (MIM 602858)
Smith-Magenis syndrome. (AD). MIM 182290	***SMS, SMCR*** at 17p11.2	Deletion here causes mental retardation, strabismus, Wolfflin-Kruckman spots on the iris, retinal detachments, and high myopia. Note Brushfield spots occur only in Down syndrome.
Sorsby fundus or macular dystrophy. (AR, AD). MIM 136900	***SFD*** at 22q13.1-qter.	Among the three Sorsby dystrophies most are AD. May have dystrophy of the hands or feet, hyperopia, nystagmus, and a macular coloboma. A pseudoinflammatory dystrophy causes night blindness. Note that ***TIMP3*** is at 22q 12.1-q13.2.
Sotos cerebral gigantism syndrome. (S, AD). MIM 117550	Gene may be at 3p21, or at 5q35, or at 15q22	Affected child grows rapidly, has a large head, large hands and feet, some have a heart defect, down-slanting lid fissures, hypertelorism, nystagmus, strabismus, cataract, and a high refractive error, often hyperopia. Compare with the ***NEVO*** syndrome (AR) (MIM 601451).
SOX genes bind DNA especially in the CNS. MIM 602148	***SOX*** genes, numerous. ***SOX1*** is at 13q34.	Relate to ***SRY*** the sex-determining region on the Y chromosome.
Stevens-Johnson syndrome.	***SJS***	Mostly a drug reaction causing epidermal denudation, often complicated by sepsis and multiple organ failure. Affects mouth, skin, genitalia, eyes in 33%, and sometimes the esophagus and respiratory tract.
toxic epidermal necrolysis of Lyell. MIM 134637, 134638	***TEN, TNFRSF6, TNFSF6.*** An apoptosis gene ***FASL*** is at 1q23.	Medication-induced exfoliative dermatitis, skin scales, blisters, fever, shock, necrosis of areas of lids and cornea, corneal ulcers, entropion, and distichiasis. Kills about 30% of those affected. ***SLE*** gene may be at 1q41-q42. (MIM 152700). See also (MIM 601744).
wrinkled skin. (AR). MIM 278250	**WSS** at 2q32	Mental retardation, but not wrinkles of the skin of the face, microphthalmia, chorioretinitis, cataract, myopia, and optic atrophy.

Spastic Paraplegia, familial. Hereditary spastic paraplegia affects about 3.9% of those with spinocerebellar degeneration. See also Evan's syndrome. Hereditary spastic paraplegia with deafness depends on mutation in a gene at 13q14. Spastic quadriplegia with mental retardation and retinitis pigmentosa is inherited AR. Signs include some hearing impairment, pigmented retina, exotropia, ptosis, and nystagmus. (MIM 270950).
Hereditary neuralgic amyotrophy (AD) ***HNA*** gene is at 17q25 (see ***NAPB***) (MIM 162100). ***SPPX1*** is at Xq28, (MIM 312900).

Gene	How inherited	MIM number	Description
SPG1 at Xq28	XL	312900	Spastic paraplegia-1.
SPG2, SPPX2 at Xq21-q22	XL	312920	Little or infantile type, spastic paraplegia-2.
SPG3A at 14q11-q21, or at 14q11.2-q24.3	AD	182600	Strumpell disease, spastic paraplegia-3A. Gene product is atlastin.
SPG4 at 2p21-p22 or at 2p24-p21.	AD	182601	Gene product is spastin. Spastic paraplegia-4 accounts for 40% of AD spastic paraplegia. Mostly affects males. A few have epilepsy.
SPG5A at 8p12-q13	AR	270800	Spastic paraplegia-5A affects cranial nerves IX, X, and XII.
SPG5B at 16q24.3	AR	600146	Spastic paraplegia-5B. See ***SPG7.***
SPG6 at 15q11.1	AD	600363	Spastic paraplegia-6.
SPG7 at 16q24.3	Mito, AR	602783	Spastic paraplegia-7. Gene is paraplegin. See ***SPG5B.***
SPG8 at 8q24	AD		Gene is beta-1 syntrophin.
SPG9 at 10q23.3-q24.2			Have amyotrophy, persistent vomiting, and bilateral cataracts.
SPG10 at 12q13	AD		
SPG12 at 19q13.	AD		See ***OFC3*** at 19q13.2.
SPG20 at 13q12.3	AR		Gene is spartin. Troyer syndrome with spastic paraplegia is seen especially in Old Order Amish patients.
MGA3 at 19q13.2-q13.3	AR	258501	with chorea and optic atrophy.
KAL1 at Xp23.3	XR	308750	Kallmann syndrome, with ataxia, and anosmia.
Gene at 2q24-q34	AD		
Gene	AD	182830	with early dementia, optic atrophy, and poor color vision.
Gene	XL	311100	with Leber optic atrophy.
Gene	AR	270950	with mental retardation and retinitis pigmentosa.
Gene	AR	256840	with hereditary sensory neuropathy.
Gene	AR	600302	with macrocephaly.
Gene	AD	182800	with extrapyramidal signs.
Gene	AR	270700	with onset after age 30 years, mental dullness, and retinal degeneration.
Gene	AD	182820	with precocious puberty and mental retardation.
Gene	AD	182700	with amyotrophy of the hands. Silver disease.
Gene	AR?	603117	with microcephaly, optic atrophy and XY sex reversal
Gene	AR	270710	with brachydactyly type E
Gene	AR	270805	with myoclonus epilepsy and seizures
Gene	AR	270750	with cerebellar ataxia and skin pigmentation
Gene	AD	182610	with epilepsy and mental retardation
Gene	AR?	601608	Evans syndrome, with thrombocytopenia, anemia.
HNA at 17q25	AD	162100	hereditary neuralgic amyotrophy. See ***NAPB***. Brachial plexus neuropathy (AD) (MIM 162100).
Gene at 13q14	AD	182690	hereditary spastic paraplegia with deafness, mental retardation, and progressive nephropathy.
Gene	AR	246555	with limb defects and mental retardation. Jancar syndrome. (AR) (MIM 248400) mandibulofacial dysostosis, and mental deficiency.

Name	Gene	Comments
speech-language disorder-1. (AD). MIM 602081	***SPCH1*** at 7q31	With orofacial dyspraxia and some mental impairment.
specific language impairment	***SLI*** on chromosomes 16q and 19q.	Affects about 4% of English-speaking children.
Spielmeyer-Sjögren juvenile cerebral sphingolipidosis. (AR, rarely AD) MIM 204200	***BTS, CLN3*** at 16p12 or at 6p12.1-p11.2.	Accumulate autofluorescent hydrophobic material in the lysosomes. Batten disease has more than 30 mutations. Juvenile ceroid lipofuscinosis. Several subtypes. Intellectual and behavioral deterioration and they are subject to infections. ***CLN3*** is regulated by ***AZF1*** a glucose-dependent transcription factor.

spina bifida. (AD, XR). MIM 182940. See also MIM 183802, 206500, and 301410.	Gene at 6q27 or this translocation t(X;22)(q27;q12.1)	Occulta, cystica, and aperta subtypes. Rachischisis, progressive motor, sensory and trophic disturbances, hydrocephalus, microphthalmos, and optic atrophy. Almost 60% have strabismus, 84% have up-slanting lid fissures, and 75% have oblique astigmatism. When with anencephaly may be XR. See Kousseff syndrome with a deletion from 22q11.2. (MIM 245210).
spinocerebellar atrophy or ataxia. (AD)	Gene	See the ataxias.

Spinocerebellar degenerations affect more than 1/25,000. They may be classified in four subgroups.

1. Non-hereditary multisystem types including: olivopontocerebellar atrophy (but many are inherited AD), Shy-Drager syndrome (AD), and striatonigral degeneration (AR).
2. Hereditary multisystem diseases including: Menzel cerebellar ataxia (AD), dentatorubropallidoluysian atrophy (AD), and Machado-Joseph disease (AD).
3. Spinal types including: Friedreich ataxia (AR, AD) and hereditary spastic paraplegia (AD, AR, XL).
4. Cerebellar types including: Holmes cerebellar ataxia (AD) and late-onset cerebellar atrophy.

See also the atrophies and ataxias.

Spinal Muscular Atrophies are diseases of the lower motor neuron. They are the second most common lethal AR diseases in Caucasians. See also the atrophies, ataxias, and degenerations. Many more inherited muscular atrophies have been reported. The gene ***HAF5*** for spinal muscular atrophy maps to 5q12.2-q13.3.

Shy-Drager syndrome (MIM 146500).is an AD adult-onset spinocerebellar degeneration with orthostatic hypotension ataxia, rigidity, iris atrophy, and ptosis.

Argyll-Robertson syndrome is a form of spinal miosis, mostly caused by syphilis.

Gene	How inherited	MIM number	Description
SMA1, SMN1, NAIP at 5q13 or at 5q11.2-q13.3	AD, AR, XL	600355 253300 600354	The common, severe, childhood-onset type is Werdnig-Hoffman atrophy of spinal and respiratory muscles. **SMN1** refers to survival of motor neurons. Two or more genes may be involved. **SMN2** is 90% identical to **SMN1.**
SMNA at 7q22-q32 ***SMA2, HEXB*** at 5q13	AD AR	 268800 253550	Sensory/motor neuropathy with ataxia. Spinal muscular atrophy of intermediate severity.
SMA3 at 5q13	AD, AR	253400	Juvenile, mild type is Kugelberg-Welander syndrome. MIM 158600.
SMA4, HMN2 at 12q24 ***SMAL*** at 12q23-q24	AD AD	158590 600175	Adult spinal muscular atrophy-4. Congenital nonprogressive atrophy of the legs.
SMAD1 on chromosome 7p	AD, AR	600794 601595	Acts on ***TGF-beta***. Their distal muscular atrophy mostly affects the bones of the arms.
SPMD at 12q13.3-q15	AD	181430	Scapuloperoneal, myopathic, muscular atrophy.
SPSMA at 12q24.1-q24.31	AD	191405	New England scapuloperoneal muscular atrophy.
KD, SBMA, SMAX1 at Xq12	XR	313200 313700	Kennedy spinobulbar muscular atrophy, have an abnormal androgen receptor gene, with increased CAG repeats. The gene for the androgen receptor is at Xq11-q37. (MIM 313700). See Reifenstein syndrome (XL) at Xq11-q37, androgen insensitivity.
SMAX2 on hromosome Xp	XR	300021	Infantile, lethal, proximal, spinal muscular atrophy.
Kugelberg-Welander muscular atrophy ***KWS.***	AR, AD, or XL	158600 253400 253550	Incidence 1/300,000. Onset can be in childhood or in adulthood. For an AR type see ***SMA3*** at 5q13. (MIM 253400). See also (MIM 182970, 253300, and for ***SMN1*** MIM 600354)

Name	Gene	Comments
Split hand/split foot syndromes. Ectrodactyly malformation or lobster claw deformity.		
syndrome-I. (AD)	***SHMF1, SHFD1*** at 7q21.2-q21.3	Some have a deletion from ***DSS1*** at 7q21.3-q22.1. (MIM 601285).
syndrome-II. (XR)	***SHFD2, SHFM2*** at Xq26	Ectrodactyly.
syndrome-III. (AD)	***SHFM3*** at 10q24-q25	Ectrodactyly.
Spondyloepiphyseal dysplasia of many types, some with mental retardation, some with cataracts, and some with corneal dystrophy.		
spondyloepiphyseal dysplasia, congenita. (AD)	***COL2A1*** at 12q13.2	Dwarfism, scoliosis, deafness, mental retardation, retinal detachment, myopia.
spondyloepiphyseal dysplasia, tarda. (XR, AD, AR)	***SEDL, SEDT*** at Xp22.2-p22.1	Dwarfism, scoliosis, lumbar lordosis, and pain in the hips.

Stargardt juvenile macular degeneration, fundus flavimaculatus (FFM), juvenile-onset macular dystrophy, onset between age 8 and 14 years, with flecks or minimal fundus signs. Fundus flavimaculatus (AR) is also called Franceschetti disease. Stargardt disease is the most common hereditary macular dystrophy. They have abnormal color vision.

The ***ABCA4*** gene in foveal cones is a retina-specific ATP-binding transporter. ***ABCA4*** in the disc membranes of retinal rods transports vitamin A. See ***RP19.*** (MIM 601718) Mutations in ***ELOVL4*** at 6cen-q14 (AD) affect fatty acid biosynthesis and cause macular dystrophy. Compare with ***STGD3***.

AR type. MIM 248200	***STGD1, ABCA4, ABCR*** at 1p21-p13	Macular degeneration, central RP, fundus flavimaculatus.
AD type. MIM 153900	***STGD2*** at 13q34	Macular degeneration.
Often AD but some are inherited AR. MIM 600110	***STGD3*** at 6cen-q14, (AD) at 13q34, (AD) or (AR) gene on chromosome 1p.	Loss of central vision in childhood. See ***RP25.***
AD type	***STGD4*** on chromosome 4p	
startle disease, hyperexplexia. (AR, AD). MIM 138491	***GLRA1*** at 5q32	Exaggerated startle response and congenital hip dislocation.
steroid 5-alpha reductase. MIM 184753.	***SRD5A1*** at 5p15	For ***SRD5A2*** see MIM 264600.
Steiner syndrome MIM 262600	Gene. See pituitary dwarfism-III. See MIM 118850, 139250, 173110, 210400, 262700..	Unilateral facial enlargement, thickened skin, polydactyly, scoliosis, more often affects the right side, more often affects males. Pupil on affected side is dilated, may be eccentric and irides have heterochromia.
Steinert myotonic muscular dystrophy. (AD, S). MIM 160900	***DM*** , ***DMPK*** at 19q13.2-19cen	Curschmann-Steinert dystrophy with myotonia, polyneuropathy, cardiac anomalies, motor and mental retardation, and cataract.

Stickler progressive arthro-ophthalmopathy. (AD). See arthrogryposis. There are three forms of this arthro-ophthalmopathy. Stickler-1, gene ***COL2A1*** at 12q13.1-q13.3, (MIM 108300, 120140).
Stickler-2, gene ***COL11A2*** at 6p21.3, (MIM 120290).
Stickler-3, gene ***COL11A1*** at 1p21, (MIM 120280).

Sturge-Weber-Krabbe-Dimitri syndrome. (S, AD, ?). MIM 185300	***SWS*** may not be mendelian. May have partial trisomy 22.	Vascular port wine nevus, facial and unilateral choroidal hemangiomas, mental retardation, convulsions, obesity, secondary glaucoma in 50%, and optic atrophy.
submandibular, ocular, and rectal pain. (AD). MIM 167400	Gene	With skin reddening and jaw ache.. Differs from proctalgia fugax (AD) (MIM 105565).
superior oblique tendon sheath syndrome. (AD, AR)	May or may not be inherited. Gene	Brown syndrome. Unable to elevate eyes and have bilateral ptosis. Some cases are the result of trauma.
superior orbital fissure syndrome	Gene ?	Rochon-Duvigneaud syndrome may result from a metastatic tumor or from a vascular lesion or from trauma. Affects CNIII, IV, and VII. Decreased corneal sensitivity, papilledema, or optic atrophy.
supravalvular aortic stenosis. (AD). MIM 185500	***SVAS*** Some have a translocation.	May be the same as infantile hypercalcemia. (MIM 143880). See Williams syndrome ***WBS*** at 7q11.2. (MIM 194050). See the elastin gene ***ELN*** at 7q11.23. (MIM 130160).
Sylvester syndrome. (AR). MIM 245100	Gene	Ataxia, progressive hearing loss, leukemia, mental retardation, and optic atrophy. Compare with these syndromes: Roussy-Levy (AD)(MIM 180800), Richards-Rundle (AR) (MIM 245100), and ***ADR*** (AR). (MIM 208850).

Syndactyly (mostly AD) have webbing between the fingers and/or toes. It can be pre axial or post axial and can be a sign in many syndromes. See also polydactyly, clinodactyly, and acrocephalopolysyndactyly.

Name	How inherited	MIM number	Description
syndactyly-I	AD	185900	Webbing mostly between fingers III and IV and between toes II and III. Zygodactyly.
syndactyly type I with microcephaly, and mental retardation	AR	272440	Filippi syndrome with syndactyly of fingers III and IV and syndactyly of toes II, III and IV, heart defects, optic atrophy and poor vision. Some are retarded.
syndactyly type I with ectodermal dysplasia and mental retardation	AR	600906	Syndactyly of fingers III and IV and toes II and III, mouth constantly open, abnormal ears, and large palpebral fissures.

syndactyly-III. ***ODDD*** or ***ODOD*** at 6q22-q24	AD	164200 186100	Also caalled oculo-dento-digital dysplasia. Syndactyly between fingers III and IV and sometimes between fingers IV and V. Paternal age effect. Compare with the other Opitz syndromes.
syndactyly-IV	AD	186200	Haas polysyndactyly produces a cup-shaped hand. They also lack a tibia and have syndactyly of toes II and III.
syndactyly-V	AD	186300	Metacarpal and metatarsal fusion is most apparent between fingers III and IV and toes II and III..
syndactyly, short stature, blepharophimosis, and ptosis.	AD	600384	Produces partial aphalangia and syndactyly with metatarsal duplication, microcephaly, and dull intelligence.
syndactyly with renal and anogenital malformations.	AD	601446	Patients with this syndactyly also have anal stenosis and renal malformations.
syringomyelia.	AD, AR	186700 272480	Swedish amyloid neuropathy (MIM 176300) simulates syringomyelia. Some so-called syringomyelia patients actually have Denny-Brown hereditary sensory radicular neuropathy. (MIM 162400).
triphalangea thumb-polydactyly syndrome. ***TPT1*** at 7q36.	AD	190605	Preaxial polydactyly, many variations.

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Name	Gene	Comments
Tangier analphalipoproteinemia. (AR, AD). MIM 205400	***TGD, ABCA1*** at 9q31	Regulates HDL metabolism. Orange tonsils, enlarged lymph glands, atherosclerosis, hepatosplenomegaly, corneal infiltrates, and arcus senilis. May have a role in familial hypoalphalipoproteinemia. Compare with fish eye disease. ***LCAT*** (MIM 245900).
tapetoretinal degeneration. (XL).	***TCD, CHM*** at Xq21.2	See retinitis pigmentosa, with a ring scotoma.
TAR syndrome. (AR). MIM 274000	***TAR*** may be at 22q11 The c-mpl gene is for the thrombopoietin receptor.	Rare disease affecting 0.42/100,000 live-born infants. Thrombocytopenia, bleeding in infancy, and bilateral absence of the radius. Leg anomalies in 47%, cow's milk intolerance in 47%, and renal anomalies in 23%. Some are mentally retarded, perspire excessively, have a congenital heart defect, tetralogy of Fallot, anemia, eosinophilia, some have cataracts, glaucoma, or blue sclera. One third die in their first year.. Compare with Holt-Oram syndrome (MIM 142900).
Taybi oto-palato-digital syndrome-I. (XD, AD)	***OPD1*** at Xq28,	Bone dysplasia, scoliosis, cleft palate, and deafness.
faciopalatoosseous or craniooroditigal syndrome. (XL). MIM 304120	***OPD2*** at Xq28..	Gene may be allelic with ***OPD1*** but ***OPD2*** is a clinically more severe disease. Microcephaly, deafness, brain and digital anomalies.
Tay-Sachs amaurotic idiocy. (AR)	Gene	See gangliosidosis ***GM_2*** type 1. (MIM 272750). Gangliosides deposited in the CNS cause motor annd mental deterioration. May have a cherry-red macula.
telangiectasia. (AD). MIM 187260	Gene	Hereditary benign type is more frequent in women. No mucosal lesions, no hemorrhagic problems.
ataxia-telangiectasia		See Louis-Bar syndrome. (MM 208900).
telangiectasia, pigmentation, and cataract (AR) MIM 268400, 270240	***RTS*** on chromosome 8, or a mutation in ***RECQ4*** a helicase gene.	Rothmund-Thomson hereditary dermatosis with poikiloderma, small stature, large head, alopecia, may lack eyebrows, and have cataracts, strabismus, corneal lesions, and retinal hyperpigmentation. Helicase genes such as ***RTS, WRN,*** and ***BLM*** act as tumor suppressors. But can cause skeletal dysplasia, telangiectases, and mesodermal dysgenesis of the iris. Patients with the 270240 subtype (AR) also have skeletal dysplasia, and dysgenesis of the iris. The ***RTS*** symbol may refer to Rubenstein-Taybi syndrome (MIM 180849) or to Rothmund-Thomson telangiectasia. See also a gene for an AR condition with skeletal dysplasia, telangiectasia, and dysgenesis of the iris. (MIM 270240)
ataxia-telangiectasia with early death. (AR). MIM 208910	Gene at 11q22-q33.	Progressive neurodegeneration, ataxia, generalized skin pigmentation, and conjunctival telangiectasia. Early death. Have an increased risk of leukemia and other cancers
hereditary hemorrhagic telangiectasia of Rendu-Osler-Weber. (AD)	***HHT1*** at 9q33-q34.1, ***HHT2, ORW2*** at 3p22, ***ACVRL1*** at 12q13, and ***HHT3, ORW3***	The gene endoglin ***ENG, CD105*** at 9q34.1 is for a membrane protein in the vascular endothelium. ***HHT1*** (MIM 187300), ***HHT2*** (600376) may be on chromosome 12, and ***HHT3*** (MIM 601101). See also Ward syndrome. ***ORW3*** (MIM 601101).

Telecanthus means an excessive distance between the inner canthi.
Ocular **hypertelorism** occurs in many syndromes and is indicated by a large interpupillary distance.

Temporal arteritis, cranial arteritis, giant cell arteritis, Hutchinson-Horton-Magath-Brown syndrome (AD) mostly seen in females age 55 to 80. Throbbing headache, anorexia, otitis with deafness, transient ptosis, partial loss of vision on one side, retinal detachment, optic atrophy, EOM palsies, glaucoma, diplopia, and hemorrhage in or around the optic nerve head. See MIM 187360. Many have polymyalgia rheumatica		
terminal osseous dysplasia . (XD).	Gene	With pigmentary defects and distal limb anomalies, is lethal for a male fetus.
Terrien corneal dystrophy	Gene	
testicular feminization syndrome. (XR)	***AR, DHTR, TFM*** at Xq11-q12	Morris or Goldberg-Maxwell syndrome patients have androgen insensitivity.
tetralogy of Fallot (AD, AR). MIM 187500, 239711.	Gene may be at 22q11. Some have a deletion from 22q11.	Heart defects, preauricular pits, and fifth finger clinodactyly.
tetralogy of Fallot. with glaucoma (AD). MIM 187501	Gene	Can accompany frontonasal dysplasia. Have pulmonic stenosis, a ventricular septal defect, dextroposition of the aorta, right ventricular hypertrophy, and hypertelorism.
Thompson syndrome. (AD)	Gene	Congenital optic atrophy, nystagmus, blindness. Compare with these syndromes: Smith-Lemli-Opitz (MIM 213010), and Meckel . (MIM 249000).
Ascher syndrome. (AD). MIM 109900	Gene	Onset around puberty. Goitre, hypothyroidism, alopecia, doubled upper lip, blepharochalasis, and protrusion of the lacrimal gland.
athyrotic hypothyroidism. (S, AR). MIM 218700	Gene	Hypothyroidism, cretinism. Mutation may be in ***TSHB*** (MIM188540) or in the releasing hormone (MIM 275120)>
Basedow syndrome. (AR)	Gene	Diffuse toxic goitre, Graves disease, or Parry disease mostly seen after 15 years of age. See goitre.
familial goitre (AR). MIM 600635	***NKX2A, TTF1*** at 14q13.	Typically hypothyroidism manifests after age 40, affects 6% of women over age 65, causes bradycardia, fatigue, loss of energy, depression, dry skin, and goitre.
Pendred syndrome (AR). MIM 274600 thyroid carcinoma.	***PDS, DFNB4*** at 7q31	Gene is pendrin. Defective thyroxine biosynthesis, have goitre, deafmutism, mental retardation, retinal pigmentary degeneration, and macular degeneration. See under cancer and also under goitre.
thyro-cerebro-retinal syndrome. (AR). MIM 274240	Gene	Renal, neurologic, and thyroid disease, goitre, with thrombocytopenia, deafness, ataxia, seizures, retinal hemorrhages, and optic atrophy. Normal mentality.
thyroid stimulating hormone, beta polypeptide. (AD).	***TSHB*** at 1p22 or 1p13 ..	Resistance to thyroid hormones causes goitre, deafness, and learning disability. See goitre. The gene for its receptor is***TSHR*** at 14q31.
thyroglobulin. (AD, AR)	***TG*** at 8q24.2-q24.3	A precursor to the thyroid hormone.
thyroid hormone receptor. (AD)	***ERBA1*** at 17q21-q22	Cretinism, congenital hypothyroidism is present at birth. Treatment can allow normal physical and mental development. Sporadic cretinism indicates congenital hypothyroidism.
thyroid hormone receptor mutations. (AD)	***TRb1, THRB*** at 3p24.3, ***TSHR*** at 14q31	Mutations produce clinical effects. Graves' disease. (***TSHR*** at 14q31) (MIM 275200) also affects the ocular muscles
thyroid hormone resistance. (AD)	***THRB, ERBA2*** at 3p24.3 for hormone receptor beta.	Mild hyperthyroidism and deafness.
thyroid autoimmune disease.	***CD79a*** at 19q13.2	Thyroid ophthalmopathy antigen, Hashimoto antigen affects the thyroid and the eye muscles.
(AD)	***PAX8*** at 2q12-q14	Mutation here causes hypothyroidism.
Rosai-Dorfman thyroid disorder	Gene	
thyroid hypoplasia. (AR, AD).	***SLC5A5, NIS*** at 19p13.2-p12	See also goitre.
thyrohypophysial ophthalmopathic syndrome.	Gene	With this thyroid disorder the patient has exophthalmos and paralysis of the extraocular muscles.
thyroid iodine peroxidase deficiency. (AR).	***TPO,TPX*** at 2p25, ***TDPX1*** at 13q12.	Congenital goitre.
thyrotoxicosis, Graves' and Basedow diseases.	***TSHR*** at 14q31	Incidence 1/100. This autoimmune disorder with abnormal thyroid stimulating antibody affects more females than males.
thyrotropin-releasing hormone deficiency. (AR).	***TRH*** at 3p24.3.	The gene ***TRHR*** for the hormone receptor maps to 8q23.

Tissue inhibitors of the metalloproteinases include these 4 genes: They may suppress metastasis.		
(XL) MIM 305370	***TIMP1, RP2, EP A*** at Xp11.4-p11.23	No reported disease.
(AD) MIM 188825	***TIMP2, PDE6G*** at 17q25	Often deleted in breast cancer patients.
(AD) MIM 188826	***TIMP3*** at 22q12.1-q13.2	Compare with ***SFD*** at 22q13.1-qter.
See MIM 601915.	***TIMP4*** at 3p25	Present especially in the heart.
Tolosa-Hunt syndrome	***THS***	Pain can be unilateral ot bilateral, paralysis of one or more of cranial nerves CNIII to CN VI. Often have inflammation of the cavernous sinus. Corticosteroids usually give prompt relief. Compare with painful ophthalmoplegia **PGA.**.

Torsion dystonia causes severe functional disability. Some infants with neonatal dystonia gradually get better. One gene for AR dystonia maps to 11p15.

Gene	How inherited	MIM number	Description
DYT1 at 9q32-q34	AD	128100	Have a GAG deletion. Responsible for most cases of dystonia.
DYT2	AR	224500	Musculorum deformans-2 causes torticollis.
DYT3 at Xq13.1	XR	314250	Filipino dystonia with parkinsonism. Onset about age 35.
DYT4 on chromosome 9q	AD	128101	Musculorum deformans.
DYT5,GCH1 at 14q22.1-q22.2	AD	128230	Segawa syndrome can be AD or AR. Progressive dystonia with diurnal variations, DOPA responsive.
DYT6 at 8p21-q22	AD	602629	Adult onset dystonia.
DYT7 on chromosome 18p	AD	602124	Adult onset, focal dystonia, many have torticollis.
DYT8, PNKD at 2q33-q35	AR	118800	Paroxysmal dystonic choreoathetosis and ataxia.
DYT9, CSE at 1p21-p13.3	AD	601042	Choreoathetosis and spasticity.
DYT10	AD	128200	Familial, paroxysmal dystonia.
DYT11	AD	159900	Mutation produces a change in the dopamine receptor causing myoclonus dystonia. No dementia.
DYT12	AD	128235	Rapid-onset dystonia with parkinsonism.
DYT13 at 1p36.13-p36.32	AD		Cranial-cervical or upper limb onset dystonia.
Gene	AR	224600	Dystonia, periodic, kinesigenic.
Gene	AD	602554	Dystonia, onset in infancy.

Name	Gene	Comments
torticollis, keloids, cryptorchidism and renal dysplasia syndrome. (XL)	***TKCR, TKC*** at Xq28	Renal dysplasia, facial asymmetry, and pigmented nevi.
Touraine-Solente-Gole syndrome (AD). MIM 167100	***PDP, TSG***	This primary hypertrophic osteoarthropathy mostly affects males. They have pachydermo-periostosis, (MIM 201300), chronic pain in bones and joints, facial enlargement, drum-stick fingers, hyperhidrosis, thickened eyelids, and ptosis.
Tourette syndrome (AD, S)		See Gilles de la Tourette syndrome. (MIM 137580).
Townes-Brock syndrome. (AD)		See REAR syndrome. (MIM 107480).
Toxoplasma gondii **infections** may be present in 50% of the population. Most of those infected remain asymptomatic and will never be troubled by this infection.		
transducin. (AD)	***GNGAT2*** at 1p13 for the alpha subunit, ***GNGAT1*** at 7q21.3 for the gamma subunit.	Transducins are also called GMPases or G proteins. ***GNAT1*** at 3p22-p21.3 (MIM 139330) activates phosphodiesterase in retinal rods.
transforming growth factor alpha. (AD). MIM 190170	***TGFA*** at 2p11-p13	Multiple skin tags and acanthosis nigricans.
transforming growth factor beta-I. MIM 190180	***TGFB1*** at 19q13.1-q13.3	Important in wound healing. Controls differentiation, proliferation, and activation of many cells including immune cells.
transforming growth factor beta-1 induced. MIM 602353	***TGFB1I1*** at 5q31	
Treacher-Collins-Franceschetti-Zwahlen-Klein syndrome-I. (S, AD, AR). MIM 154500	***TCOF1, MFD1*** at 5q32-q33.1 and possibly a gene at 5q11 .	Mandibulofacial dysostosis with hypoplasia of the jaw, malformed ears, deafness, fish-like face, microphthalmia, down-slanting lid fissures, and colobomas of the lower lids and iris. The gene product is treacle, a phosphoprotein. Wyers-Thier syndrome is a unilateral variant with similar manifestations.

Treft syndrome. (AD). MIM 165490	Gene	Onset by age 11 years. Myopathy, balance difficulty, ataxia, deafness by age 14, ophthalmoplegia, ptosis, and progressive optic atrophy. Abnormal ERG. Compare with the Kearns -Sayre syndrome. (MIM 530000).
tremor essential-1, familial. (AD).MIM 190300	***ETM1*** at 3q13	Onset about age 50. For type 2 the gene ***ETM2*** is at 2p25-p22. (MIM 602134).
tremor, nystagmus, and duodenal ulcer. (AD). MIM 190310	Gene	The nystagmus may be congenital but these signs can appear in any sequence.
trichoepithelioma, multiple familial. MIM 600172.	***MTF1*** at 1p33	The metallothioneins bind heavy metals.
trichomegaly, mental retardation, dwarfism, and pigmentary retinal degeneration (AR). MIM 275400	Gene	Oliver McFarlane syndrome with a bulging cranium, dwarfism, mental retardation, horizontal nystagmus, excessive growth of eyelashes and brow hair, and pigmentary degeneration of the choroid and retina.
tricho-rhino-phalangeal dysplasia-1. (AD, AR).	***TRPS1*** at 8q24.12	Causes short stature and short fingers.
trigeminal neuralgia, tic douloureux. (AD) MIM 190400	Gene	Is often a senile neuralgia but can occur with multiple sclerosis.
triosephosphate isomerase deficiency. (AD).	***TP11*** at 12p13	Mutation here can cause hemolytic anemia.
triphalangeal thumb-polydactyly syndrome. (AD).	***TPT1*** at 7q36	Preaxial polydactyly.
triple A syndrome. (AR) MIM 231550	***AAA*** or ***AAAA*** at 12q13.	Also called the 4A syndrome. Autonomic deficiencies, achalasia, ACTH deficiency, Addisonianism, Allgrove syndrome, and alacrima.
trisomy 18-like syndrome (AR). (MIM 256120)	Gene	Also called Edwards syndrome. Have heart and gastrointestinal malformations, most soon die.
tristichiasis. (AD). (MIM 190800)	Gene	Compare with Alport syndrome (MIM 301050). Have three rows of eyelashes. Compare with distichiasis (MIM 126300)
tritanopia.		See color vision anomalies.
tuberous sclerosis. (S, AD) MIM 191100, 191092	***TSC1*** at 9q34, and ***TSC2*** at 16p13.3 . Gene product is tuberin.	Bourneville disease or epiloia, may be classified as a phacomatosis, with adenoma sebaceum (actually angiofibromas), Wilms tumor, seizures (in the first two years of life), mental changes, retinal tumors, (astrocytic hamartomas), depigmented nevi, renal cysts, kidney tumors, some have lacrimal duct obstruction, and some have mental retardation (about 40% have normal intelligence), cloudy corneas, lens opacities, papilledema, and yellow-white plaques in the retina. Many die before age 24.
tumor necrosis factor. (AD). MIM 191160	***TNFA*** and ***TNFB*** at 6p21.3-p21.1	Hemorrhagic tumor necrosis.
tumor necrosis factor receptor-1. MIM 191190	***TNFR1*** at 12p13.	On T and B cells.
tumor necrosis factor receptor-2. (AD). MIM 191191	***TNFR2*** at 1p36.3-p36.2	On circulating T cells.
Tunbridge-Paley disease		
Turcot syndrome. (AD, AR)	***APC*** at 5q21-q22 (MIM 175100), ***MLH1*** (MIM 120436), ***PMS2*** (MIM 600259).	Compare with Gardner polyposis coli. (MIM 175100).
Turner syndrome. (C). MIM 312760	***RPS4X, CCG2, SCAR*** at Xq13.1	This X0 syndrome occurs in 1/2,000 to 1/5,000 female neonates. Have mosaicism with two or more cell lines. Some have webbed neck, deafness, mental retardation, exophthalmos, ptosis, keratoconus, cataracts, down-slanting lid fissures, strabismus, choroidal anomalies, and male-type color vision deficiencies. Choroidal anomalies are common.
tylosis with esophageal cancer. (AD). MIM 148500	***TEC, TOC*** at 17q24	Palmoplantar keratoderma.

Tyrosinemia, three types, all AR. Many have keratopathy and cataract.		
type I. MIM 276700	***FAH*** at 15q23-q25	Deficiency of fumarylacetoacetate hydrolase. Hepatosplenomegaly, cardiomyopathy, and paralysis.
type II. MIM 276600	***TAT, RHS*** at 16q22.1-q22.3	Richner-Hanhart syndrome. Hypotrichosis, mild mental retardation, deafness, nystagmus, dendritic corneal lesions, cataract, and corneal vascularization. Need diet restrictions on tyrosine and phenylalanine. See Oregon eye disease. (MIM 276600).
type III. MIM 276710	***PPD*** at 12q14-qter	Deficiency of 4-hydroxyphenylpyruvate dioxygenase. Tyrosinosis often with ataxia, intermittent mild mental retardation, keratopathy, and cataract.
tyrosinase. (AR)	***TYR*** at 11q14-q21	See albinism.
tyrosine hydroxylase. (AD)	***TH, TYH*** at 11p15.5	Acts in adrenergic neurons. See Segawa syndrome (AD) (MIM 128230). Gene on chromosome 14 q.
Tyrosine kinases interact with fibroblast growth factors. See also the agammaglobulinemias and the hypogammaglobulinemias. Tyrosine kinase growth factor receptors include the ERBB family. ***ERBB1*** is also an epidermal growth factor receptor.		
type I, MIM 164761	***RET*** at 10q11.2	This oncogene codes for the receptor tyrosine kinases, and causes multiple endocrine neoplasia, and several other diseases.
MIM 151520	***TYK1*** at 15q15.1-q21.1	Leukocyte tyrosine kinase.
type II, MIM 176941	***TYK2*** at 19p13.2	The gene for another kinase is at 1p34-p33.
MIM 178942	***TYK3, FER*** at 5q21-q22	Is expressed in lymphoid cells.
MIM 601890	***PTK7*** at 6p21.1-p12.2	Protein tyrosine kinase-4 in colon carcinoma.
MIM 124095	***CSK*** at 15q23-q25	Cytoplasmic tyrosine kinase.
MIM 601212	***PTK2B*** at 8p22-p11.2	Protein tyrosine kinase.
MIM 600085	***SYK*** at 9q22	Protein tyrosine kinase.
MIM 600485	***NEP*** at 6p21.3	Neuroepithelial tyrosine kinase.
MIM 600408	***EMT*** at 5q31-q32	T-cell tyrosine kinase.
MIM 300300	***BTK*** at Xq21.3-q22	Bruton tyrosine kinase is crucial for B cell development. Agammaglobulinemia can be caused by a mutation here.
MIM 186973	***ITK*** at 5q32-q33	Expressed mainly on T cells.
MIM 601955	***STK1, FLT3*** at 13q12-q13	This is a FMS-like tyrosine kinase.

U.

UGH syndrome	Gene	With their defects of the anterior chamber and lens they have uveitis, glaucoma, and hyphemas. Can also be caused by an implanted lens. See also PUGH syndrome with a neovascular membrane covering the iris.
Ullrich congenital muscular dystrophy (AR). MIM 254090	Deficiency of ***COL6A1/2*** and ***COL6A1.***	With UCMD have joint contractures and hyperhidrosis.
ulnar-mammary syndrome MIM 181450	***TBX3***	See also ***TBX5*** (MIM 601620), and see (MIM 601621)
ultraviolet radiation damage, repair of (AD). MIM 192070	***UV24*** on chromosome 2	Sensitivity to UV radiation, can damage skin and eyes. See ***DDB1*** at 11q12-q13 and ***DDB2*** at 11p12-p11.
Unna hypotrichosis (AD). MIM 146550	Gene	Affects males and females. Scant growth of hair, teeth, and nails, they lack body hair, eyelashes, and eyebrows.
Unverricht-Lafora syndrome (AR). MIM 254780	***EPM2A*** at 6q23-q25	Progressive myoclonic epilepsy, grand mal seizures with onset about age 15, severe mental retardation follows.
Unverricht-Lundborg syndrome (AR). MIM 254800, 601145	***EPM1, CSTB*** at 21q22.3	Myoclonus or Baltic epilepsy with onset about age 10. Mental retardation and later cerebral ataxia.
Urbach-Wiethe lipoid proteinosis. (AR). MIM 247100	Gene	Hyaline deposits in skin, mucous membranes, and brain, intracranial calcification, seizures, and memory impairment. Waxy nodules in skin of face, dry mouth, hoarseness, and dry itchy eyes but some show epiphora. Drusen-like fundus lesions. Can be associated with diabetes mellitus.
uridine diphosphate galactose-4-epimerase deficiency. (AR) MIM 230350.	***GALE*** at 1p36.	Galactose-4-epimerase deficiency, mental retardation, deafness, jaundice, vomiting, and hepatomegaly.
urocanic acidemia (AR). MIM 276880	Gene	Urocanase deficiency, severe neonatal retardation, mental retardation, and short stature.

urogenital dysplasia, renal agenesis. (AD).	***BRA*** at 5q11.2-q13.3	See kidney for this bilateral renal agenesis.

Usher Syndromes. (AR, rarely XR). Most Usher patients have sensorineural hearing loss and progressive pigmentary retinopathy, some have multiple sclerosis. Usher syndromes types 1A, 1C, 1F, and 2A are usually severe. Half the deaf-blind people in USA have one of the Usher syndromes.

Gene	How inherited	MIM number	Description
USH1A at 14q32	AR	276900	Usher syndrome 1A is a French type with profound congenital deafness, vestibular dysfunction, and retinitis pigmentosa.
USH1B, MYO7A, DFNB2 at 11q13.5	AR	276903	Usher syndrome 1B is the most common type. Gene is myosin. They have non-syndromic deafness and vestibular dysfunction but no retinitis pigmentosa.
USH1C at 11p15	AR	276904	***USH1C*** is an Acadian type with deafness but no RP. The gene is harmonin. A Lebanese subtype has been reported. Compare with ***DFNB18***. at 11p14-p15.1 (MIM 602092).
USH1D, CDH23 at 10q21-q22	AR	601067 601386	***USH1D*** with deafness and RP is probably the second most common type. Mutation in this cadherin-like gene causes an Usher-like syndrome with non-syndromic deafness. See amyloidosis. Compare with ***DFNB12*** at 10q21-q22. (MIM 601386).
USH1E at 21q21	AR	602097	Usher syndrome 1E is regulated by retinoic acid and can be severe.
USH1F, PCDH15 at 10q21-q22	AR	602083	A severe type. Mutation in this protocadherin gene causes Usher syndrome 1F. But see ***USH1D***.
USH2A at 1q41 or 21q21	AR	276901	Gene is usherin. They have ARRP but some have no hearing loss.
USH2B at 3p24.2-p23	AR	276905	Have mild deafness and RP but no vestibular dysfunction. May relate to choroideremia.
USH2C at 5q14-q21	AR		See ***PAM*** (MIM 170270).
USH3A, USH3 at 3q24-q25	AR	276902	Usher syndrome, type 3, formerly called Hallgren syndrome. Progressive hearing loss, mental deficiency in 25%, schizophrenia-like symptoms in 25%, ataxia in 90%, cataract, retinitis pigmentosa, nystagmus in 10%, and optic atrophy.

V.

Name	Gene	Comments
VACTERL syndrome. (AR, rarely XR) MIM 276950, 314360, 314370	Some have a deletion from the 13q32 region.	Have vertebral anomalies, possibly hydrocephalus, anal atresia, tracheoesophageal fistula, cardiac, renal, and limb anomalies. Anorectal malformations occur in 1/2500 live born. Note the overlap with Pallister-Hall syndrome and with ***PIV*** which may not be a true syndrome. See VATER association. (MIM 1923550, 590050)
van Bogaert-Scherer-Epstein syndrome. (AD). MIM 143890	***LDLR*** at 19p13.2-p13.12.	Elevated serum cholesterol is bound to LDL. Familial hypercholesterolemia, xanthomatosis, atherosclerosis, cardiac problems, dementia, ataxia, arcus juvenilis of the cornea, cataract, and retinopathy.
van Buchem disease MIM 239100	***VBCH*** at 17q11.2	Adult hyperphosphatasemia. Headache and cranial nerve palsy.
van der Hoeve syndrome. (AD)	Gene	Osteogenesis imperfecta, brittle bones, deafness, glaucoma, keratoconus, blue sclera, cataract, retinopathy, and optic atrophy. More than 10 subtypes of osteogenesis imperfecta are recognized.
van der Woude syndrome (AD). MIM 119300.	***VWS, LPS, PIT*** at 1q32-q41.	Have cleft lip, cleft palate, lip pits, and hypodontia. Accounts for 2% of cases of cleft lip. Compare with popliteal pterygium (AD).
vasculitides	Gene	Can occur in children with Kawasaki disease (MIM 231005), or with Henoch-Schonlein purpura.(AR) (MIM 217000).
VATER association. (S). MIM 192350, 590050.	Gene. May have a mitichondrial anomaly.	Vertebral defects, anal atresia, renal anomalies, tracheoesophageal fistula, radial dysplasia. One had a mutation in ***PTEN*** at 10q23. See also VACTERL syndrome. (MIM 276950).
velo-cardio-facial syndrome. (AD). MIM 192430	***VCF, DGCR, DGS, VCFS*** at 22q11	Deletion causes the Shprintzen syndrome. Signs are microcephaly, heart defects, learning disability, psychotic illness, cleft palate, and almond-shaped lid fissures. Compare with DiGeorge syndrome-2. Genes for other velocardiofacial syndromes may be at 4q21.3-q25 or at 18q21.33.
very low density lipoprotein receptor. (AD). MIM 192977	***VLDLR*** at 9p23	Acts in triglyceride metabolism.
Vesell syndrome. (AD, AR). MIM 185800	***SYM1*** at 17q21-q22.	Have symphalangism, deafness, and strabismus .

vitamin A deficiency	Gene	Is the chief cause of infantile blindness in the world. Skin lesions, Bitôt spots, ocular xerosis, keratomalacia, corneal ulcers, retinal degeneration, night blindness. See also the hermit syndrome with squamous cell carcinoma of the conjunctiva.
vitamin A excessive intake	Gene	Elevates cerebrospinal fluid pressure, polyarthritis, loss of hair, yellow skin, yellow sclera, papilledema due to intracranial edema, severe headaches, congenital cataract, exophthalmos,and night blindness. See Rosai-Dorfman disease.
Vitamin B1 deficiency	Gene	Thiamine deficiency, beri-beri, confusion, delerium, polyneuritis, Wernicke-Korsakoff psychosis, disorientation, hallucinations, optic atrophy, and a central scotoma.
vitamin B2 deficiency	Gene	Niacin deficiency can cause GI and CNS dysfunction, mental deterioration, pellagra, skin rash, diarrhea, stomatitis, conjunctivitis, keratitis, cataract, and optic atrophy, and a central scotoma. See Hartnup disease (AR), gene ***HND*** at 11q13. (MIM 234500)
vitamin C deficiency	Gene	Hypoascorbemia (AR). Scurvy with increased capillary fragility, hemorrhages, skin rash, pain in the joints, teeth fall out, corneal scars, cataracts, and ocular hemorrhages including orbital hemorrhages,
vitamin D dependency. (AR)	Type I gene at 12q14 MIM 264700, Type II MIM 277420	Vitamin D deficiency.
vitamin D excessive intake	Gene	Increased intracranial pressure, hypercalcemia, band keratopathy, nystagmus, papilledema, iritis, cataract, sluggish pupil responses, and increased IOP.
Vitamin-D-resistant rickets, hypophosphatemia. (XD, XR, AR, AD).		
AR type	***VDR*** at 12q12-q14	Gene for vitamin D receptor.
AD, AR type	***ALPL, HOPS*** at 1p36.1-p34.	See juvenile Paget disease. (MIM 241500). For one AD type the gene is ***ADHR*** (MIM 193100).
XD type	***HYP, HPDR1*** at Xp22.2-p22.1	Hypophosphatemia, vitamin-D-resistant rickets.
XD type	***PHEX*** at Xp22	Formerly ***PEX.***
XD type	***GY, HYP1*** at Xp22	Hypophosphatemia with deafness..
vitamin E deficiency	Gene	Absent reflexes, mild weakness of limbs, ataxia, and some sensory loss in arms and legs.
vitiligo (AD, AR). MIM 193200	Three alleles may be interacting	Patchy depigmentation of the skin and hair, posterior uveitis, and retinal atrophy.
Vitreoretinal degenerations, dystrophies and vitreoretinopathy: See also vitelliform macular dystrophy, Goldman-Favre syndrome, and the Stickler syndromes. For vitelliform macular dystrophy the gene ***VMD2*** is at 11q13. (MIM 153700). ***VMD1*** may be at 8q24.3. (MIM 155840).		
Benson asteroid hyalitis (AD). MIM 182930	Gene	Hypertrophy of the sphincter of Oddi. Chronic pancratitis. Among the elderly who have diabetes, atherosclerosis, hypertension, and hyperopia some develop snowball vitreous opacities.
vitreo-retino-choroidopathy (AD). MIM 193220	***VRCP, ADVIRC***	Peripheral chorioretinal pigmentary disorders. retinal vascular incompetence, cystoid macular edema, nystagmus, presenile cataracts, glaucoma, myopia, and retinal detachments.
vitreoretinal degeneration . (AD). MIM 193230	Gene	Fibrillar degeneration of the vitreous. Small snowflake type with yellow-white dots in the retina, vitreous hemorrhages, vitreous detachment, retinal pigmentation, retinal detachment, corneal opacities, cataract, glaucoma, and astigmatism with either hyperopia or myopia. Compare with Wagner disease (AD) (MIM 143200).
vitreoretinopathy, familial, exudative. (XR, S)	***NDP, ND*** at Xp11.4-p11.3	Norrie vitreoretinopathy.
vitreoretinopathy, exudative, inflammatory-I. (AD, AR, XL). MIM 133780	***EVR1, FEVR*** at 11q13 or at 11q13-q23	Criswick-Schepens inflammatory degeneration, with disease of small blood vessels, vitreous hemorrhage, and retinal detachment. Similar to retrolental fibroplasia The gene ***VMD2*** for Best vitelliform macular dystrophy (AD) is at 11q13. See ***VRN1*** at 11q13. Compare with falciform retinal detachments (MIM 221900) and pseudoglioma (MIM 264200). The AR type is uncommon.
vitreoretinopathy, familial exudative (XL). MIM 305390	***EVR2, FEVRX*** at Xp11.3 or at Xp11.4-p11/23	May be allelic with the Norrie disease gene ***NDP*** at Xp11.4-p11.3. (MIM 310600). Compare with Coats' disease. (MIM 194300) and with retinopathy of prematurity.

vitreoretinopathy, familial exudative (AD). MIM 605750	***EVR3*** at 11p12-p13	Failure of peripheral retinal vascularization.
vitreoretinopathy neovascular, inflammatory. (AD). MIM 193235	***VRN1*** at 11q13	See ***EVR1*** at 11q13. For Best vitelliform macular dystrophy (AD) the gene is bestrophin (***VMD2*** at 11q13) in the plasma membrane of the RPE. (MIM 153700). Early in life they accumulate lipofuscin-like material (egg-yolk-like lesion) in the subretinal space of the macula. This can leave a macular scar or hole. ***VMD1*** may be at 8q24.3.
vitreoretinopathy, erosive (AD). MIM 143200	***WGN1*** at 5q13-q14, ***COL2A1*** at 12q13.11-q13.2	Wagner-I vitreoretinopathy with cataract, retinal detachment, and visual field defects.
chorioretinal, vitreo-retinal, or hyaloideo-retinal type. (AD)	***COL2A1*** at 12q13.11-q13.2	Wagner-II vitreoretinal dystrophy.
von Gierke glycogenosis. (AR). MIM 232200	***G6PT*** at 17q21.1, but other genes can be involved.	Glucose-6-phosphatase deficiency causes a glycogen storage disease, glycogenosis-1, with hypoglycemia, renal insufficiency, kidney stones, convulsions, arthritis, hypertension, hepatocellular carcinoma, corneal clouding, and yellow flecks in the retina. Simulates congenital glaucoma.
von Herrenschwand syndrome	Gene	Sympathetic heterochromia, with Horner syndrome, tumor of thyroid gland, or other causes. Exophthalmos, ptosis, miosis, one iris is paler than the other. Decreased sweating on one side of the face.
von Hippel-Lindau angiomatosis. (S, AD). MIM 193300	***VHL*** at 3p26-p25. ***VHL*** is a tumor suppressor.	Have cerebroretinal angiomatosis with renal cancer, epilepsy, psychic disturbances, secondary glaucoma, vitreous hemorrhages, retinal angiomas, and retinal detachment. Some have paralysis of CNVI.
von Hippel-Lindau binding protein-1	***VBP1*** at Xq28 (MIM 300133)	This gene works with ***VHL*** to transport it into the nucleus.
von Recklinghausen syndrome see neurofibromatosis **.** (MIM 101000, 1623200, 162260, and 162270.)		
von Reuss syndrome. (AR)	Gene	See ***GALK1*** at 17q24 for galactosemia-II (AR). (MIM 230200).
von Willebrand disease (AR, AD) MIM 277480, 193400.	***VWD*** at 12pter-p12	Abnormal platelet function, bleeding after minor truauma. May also have a coagulation defect (MIM 306700). Types Iic and III are inherited AR. Types I, IIA, IIB, IID, and IIE are inherited AD.
W.		
Waardenburg-Klein or **Klein-Waardenburg syndromes**. (AD, S, AR).		
type I. (AD). MIM 193500	***PAX3***, ***WS1, HUP2*** at 2q35	Mutation in ***PAX3*** the gene for a transcription factor causes rhabdomyosarcoma, cleft lip, unilateral deafness, partial albinism, white forelock, heterochromia iridis, telecanthus, hypoplasia of retina and choroid, and an albinotic fundus. See type-III.
type II A. (AD). MIM 193510.	***WS2A*** at 3p13 or at 3p14.1-p12.3	Often with deafness. See ***MITF***. (MIM 156845). They do **not** have telecanthus.
type II B. (AD). MIM 600193.	***WS2B*** at 1p21-p13.3	Deafness, partial ocular albinism, and heterochromia iridis. For Waardenburg type 2 w ith albinism, (AD, XL) see (MIM 103470).
type III. (AD). MIM 193500	***PAX3***, ***WS1, HUP2*** at 2q35	See type-II. Patient has unilateral ptosis.
type IV (AD, AR) Type IV is mostly inherited in the AR manner.	***EDN3*** at 20q13.2-q13.3 (MIM 131242), ***EDNRB*** at 13q22, (MIM 131244), ***SOX10*** at 22q13, (MIM 602229), ***RET*** at 10q11.2, (MIM 164761)	Mutation in the gene for endothelin-3 causes Waardenburg-Shah syndrome (MIM 277580) genes ***EDNRB*** or ***EDN3*** or ***SOX10*** with no deafness. Also called Waardenburg-Hirschsprung disease but some of these patients have deafness and collapsed distal ileum and colon. For Hirschsprung disease-I see ***HSCR*** (MIM 142623, 235760, 600837). A mutation in the gene ***EDNRB*** for endothelin receptor B causes Hirschsprung disease-II with aqueductal stenosis, cleft lip/palate, and absence of auditory canals.
Waardenburg-Shah syndrome. (AR)		MIM 277580
SOX10 is a ***MITF*** promoter and ***PAX3*** also affects ***MITF*** expression.		
Wagner syndrome. (AD). MIM 143200, 120140	***WGN1*** at 5p13-p14 ***WGN2*** gene ***COL2A1*** at 12q13.11-q13.2.	Facial anomalies, nystagmus, strabismus, corneal degeneration, choroidal sclerosis, cataracts, vitreoretinopathy, retinal pigmentation, and risk of retinal detachments.
Wagner-Unverricht syndrome	Gene may be ***EDNRB*** (MIM 131244), or ***EDN3*** (MIM 31242), or ***SOX10*** (MIM 602229)	An autoimmune dermatomucormyositis with onset before 10 years of age, erythema, muscle weakness, fever, and tachycardia.

Waldenstrom macroglobulinemia. (AD). MIM 153600	Some have a deletion from 6q21 but others have a translocation.	B-cell lymphoma secreting immunoglobulin M. Increased frequency of lymphoma. leukemia and adenocarcinoma of the lung. See Bing-Neel syndrome.
Walker-Warburg syndrome. (AR). MIM 236670 See also these syndromes ***HARD+/-E*** and ***COD-MD***.	***WWS, COD-MD*** at 9q31-q33 Gene may be ***POMT1.*** Note the overlap with other conditions.	Cerebro-ocular dysgenesis or HARD±E syndrome with lissencephaly, hypoplasia of nerve tracts, hydrocephalus, developmental retardation, seizures, mental retardation, hypotonia, microphthalmus, glaucoma, cataracts, myopia, and retinal detachment. Compare with the (AR) muscle-eye-brain disease, gene ***MEB*** at 1p32-p34. (MIM 253280). Muscular dystrophy, hydrocephalus, mental retardation, severe congenital myopia, and glaucoma. See also Fukuyama congenital muscular dystrophy (AR). The ***FCMD*** gene is at 9q31-q33. (MIM 253800). Most affected children have hydrocephalus but some survive into adolescence.
Wallenberg dorsolateral medullary syndrome.	***WS***	Caused by occlusion of the posterior inferior cerebral artery, usually after age 40, ataxia, ipsilateral loss of pain and temperature sense on face, trouble swallowing, trouble speaking, ptosis, nystagmus, and Horner syndrome.
Warburg microsyndrome. (AR). MIM 600118	Gene at 17q12-q21.33	Adhalin deficiency. See under microcephaly. Severe childhood muscular dystrophy.
Ward syndrome. (AD).	Gene	Basal-cell nevi nodules on face (jaw cysts), and trunk. Hypertelorism, nevi on eyelids, corneal opacities, and congenital cataracts. See ***ORW3.*** (MIM 601101) and Romano-Ward syndrome (MIM 220400).
Watson syndrome. (AD). MIM 193520.	***NF1, VRNF, WSS*** at 17q11.2.	This is a variant of neurofibromatosis. See MIM 162200. ***NF1*** von Recklinghausen disease.
Weaver or Weaver-Smith syndrome. (S) MIM 277590	***WSS***	Accelerated growth, psychomotor delay, hoarse voice, loose skin, loose joints, hernias, hypertelorism, epicanthus, and downslanting lid fissures. More often seen in females. Resembles Sotos syndrome (MIM 117550).
Weber cerebellar peduncle syndrome.	Gene	Various causes. Paralysis of CNIII.
Weber-Cockayne syndrome. (AD). MIM 131800	***KRT5*** at 12q11-q13, ***KRT14*** at 17q12-q21	Is a milder form of the Goldscheider syndrome (AD, AR). See epidermolysis bullosa. Lesions of skin and mucous membranes, keratitis, corneal opacities, cataract, and retinal detachment.
WEBINO syndrome		See ophthalmoplegia.
Wegener granulomatosis. MIM 600885, 177020, 602667, 251260	Depends on linkage disequilibrium in the serine protease inhibitor gene cluster at 14q32.1.	Pulmonary hemorrhage, glomerulonephritis, and death in the first year. The serpin gene and the gene ***TCL1*** map here Severe sinusitis, glomerulonephritis, exophthalmos, corneal ulcer, and optic atrophy. Compare with the: Berlin (AR) (MIM 600885) and the Nijmegen (AR) (MIM 251260) breakage syndromes.
Wegener autoantigen. (AD)	***PRTNS*** at 19p13.3	
Weill-Marchesan syndrome. (often AR) MIM 277600	***FBN1*** at 15q15-q21.1	Deletion of the gene for fibrillin causes mesodermal dysmorphodystrophy a connective tissue disorder. Affected child has brachydactyly, deafness, spherophakia, ectopia lentis, lenticular myopia, corneal opacity, pupillary block glaucoma, and optic atrophy. Compare with Marfan syndrome (MIM 154700), and with limb-girdle muscular dystrophy ***LGMD2A.*** (MIM 253600).
Weissenbacher-Zweymuller syndrome. (AR). MIM 277610	The gene may be ***COL11A2*** at 6p21.3.	Pierre-Robin syndrome with fetal chondrodysplasia, delayed skeletal maturation, deafness, cleft palate, glaucoma, and corneal clouding. May be a neonatal expression of Stickler-II syndrome. (MIM 184840).
Wermer syndrome MIM 131100	***MEN 1*** at 11q13	See multiple endocrine neoplasia. ***MEN1*** (AD) at 11q13. See also Zellweger-Ellison syndrome with gastritis, diarrhea, adrenocortical adenomas, and hyperparathyroidism For Sipple syndrome see ***MEN2*** (MIM 171400.
Werner syndrome. (AR). MIM 277700	***WRN*** at 8p12-p11	See progeria. Short stature, skin changes, diabetes mellitus, atherosclerosis, aged face, beaked nose, and cataracts.
Wernicke- Korsakoff syndrome, susceptibility to . (AR, AD)	***TKT*** at 3p14.3	Alcohol-induced encephalopathy. May lack vitamin B or thiamine.
West syndrome. (XL). MIM 308350	One gene is ***ISSX***. May have a mutation in ***ARX*** at Xp22.1-p21.3.	Brain malformation, abnormal genitalia, infantile spasms, mental retardation, and death in their first decade.

Whipple disease. (AR). MIM 602014	***HOMG*** at 9q12-q22.2	Caused by the gram positive bacterium *Tropheryma whippeli* in 30% of cases. Hypomagnesemia with secondary hypocalcemia.
Wieacker-Wolff syndrome. or Cogan-II syndrome (XL). MIM 314580	***WWS*** between Xp11.3 p11.23 and Xq11.2-q13. .	Have foot contracture, muscle atrophy, and mild mental retardation. Intestinal lipodystrophy, diarrhea, arthralgia, and CNS effect. Can affect the eyes uveitis, retinitis, optic neuritis, and papilledema. Treat with antibiotics.
Wildervanck syndrome or cervicooculoacoustic syndrome (XD) MIM 314600	Gene	Congenital deafness, Klippel-Feil anomaly (fused cervical vertebrae), and Duane syndrome.(abducens palsy with retractio bulbi). This cervicooculoacoustic syndrome affects females.
Williams-Beuren syndrome (S, AD). MIM 194050	***WBS*** at 7q11.23.	Often called Williams syndrome. Incidence 1/15,000. Supravalvular aortic stenosis SVAS. myocardial infarction, mental retardation, kidney anomalies, hoarse voice, some are very musical, stellate iris pattern, strabismus or esotropia are common. See also ***LIMK2*** (MIM 601329). May relate to the elastin gene ***ELN*** at 7q11.2 (MIM 130160).
type1. (AD). MIM 130160	***ELN*** at 7q11.2	Deletion of the gene for elastin causes infantile hypercalcemia, aortic stenosis, myocardial infarction, hypertension, kidney anomalies, short stature, and mental retardation.
type 2. (AD). MIM 131230	***WMS, ANX5, BNX2*** at 4q26-q28	Hypercalcemia, myocardial infarction, and mental retardation.
Wilms tumor (S, AD, C) affects 1/10,000 children. This is the most common intra-abdominal solid tumor of childhood. Some of those affected are mentally retarded and have neuroblastoma, renal failure, and aniridia. See **AWTA** (S, AD, AR) (also called Miller syndrome), for aniridia and Wilms tumor association. Possibly due to a deletion from a gene at 11p11. Another gene that may be involved is on chromosomes 1p. See also **ACY1** at 3p21.1, and the ***WAGR*** syndrome (MIM 137357, 194072) a contiguous gene syndrome.		
predisposition to Wilms tumor	***FWT2*** at 19q13.3-q13.4	
Wilms tumor. (AD). MIM 194070, 137357	***WT1*** at 11p13	This is a suppressor gene. Mutation in ***WT1*** results in genitourinary abnormalities. Compare with the Denys-Drash syndrome (MIM 194080) and the Frasier syndrome.
(AD). MIM 194071.	***WT2*** at 11p15.5	Compare with Beckwith-Wiedemann syndrome and ***MTACR1*** (AD) at 11p15.5 (MIM 194071). Adrenocortical carcinoma
(AD). MIM 194090.	***WT3*** at 16q13 or at 12q21.1-q23.	
(AD). MIM 601363	***WT4, FWT1*** at 17q12-q21	The tumor appears about age 5 years.
MIM 601583	***WT5*** at 7p21-p15 or ***WTSL*** at 7p15-p11.2.	Suppressor genes.
WAGR syndrome (AD). MIM 137357, 194072	mitochondrial or deletions from ***PAX6, AN2*** at 11p13, or from ***WT1*** at 11p15.5, or from one other gene.	A contiguous gene syndrome. Miller syndrome with Wilms tumor, genitourinary anomalies, mental retardation, and partial aniridia. Signs include aniridia, hemihypertrophy, and Wilms tumor. The W is for Wilms tumor ***WT1*** (MIM 194070), the A is for aniridia ***AN2*** (MIM 106210), the G is for genitourinary abnormalitiess, and the R is for mental retardation.
Wilson disease. (AR). MIM 277900	***ATP7B, WND*** at 13q14.3-q21.	Incidence 1/75,000. Defective copper metabolism and transportation, copper accumulates first in liver then in blood and cornea, hepatolenticular degeneration, jaundice, neurologic disorders, treemor, and ataxia. Look for a Kayser-Fleischer ring (yellow-brown-red) in the peripheral cornea. Treat with the chelating agent penicllamine. Some develop cataracts. First signs appear in teens or later. Compare with these syndromes: Meige lymphedema (AD) (MIM 153200) and Menkes kinky hair (XR) (MIM 300011).
Winter-MacDonald syndrome. (AR). MIM 136350	***(?) FGFR1*** at 8p11.2-p11.1	Winter syndrome with renal hypoplasia, and anomalies leading to early death.
Wiskott-Aldrich syndrome. (XR).	***IMD2, WAS, THC*** at Xp11.23-p11.22	Thrombocytopenia with eczema and immune deficiency. Death in first decade.
Witkop-von Sallmann tooth and nail syndrome. (AD)	***MSX1*** or ***HOX7*** at 4p16.1	Intraepithelial dyskeratosis, thickening of oral mucosa, conjunctival gelatinous plaques, corneal vascularization, impaired vision. Compare with dyskeratosis (AD) (MIM 127600).

Wolf Or Wolf-Hirschhorn syndrome. (C, S) MIM 194190, 602952	***WHSC1, WHCR*** at 4p16.3. ***ZNF*** at 4p16.3, and ***MSX1, HOX7*** at 4p16.1. Some have this translocation. t(4;8)(p16;p21).	Partial deletion of chromosome 4 causes heart and renal defects, microcephaly, mental retardation, agenesis of the corpus callosum, cleft palate, down-slanting lid fissures, nystagmus, strabismus, iris colobomas and retinal colobomas. One of the chloride channel genes, ***CLCN3*** at 4q33, for a voltage-gated chloride channel that may have a role. See the salt-losing syndromes.
Wolfram or DIDMOAD syndrome. (AR, Mito). MIM 222300, 598500	***WFS1*** at 4p16.1 May have deletions from a mitochondrial gene.	The gene codes for a transmembrane protein. Have diabetes mellitus, diabetes insipidus, mental retardation, anemia, deafness, nystagmus, cataracts, and optic atrophy. Compare with Tunbridge-Paley disease.
Wolfram-2. (AR)	***WFS2*** at 4q22-q24	Have a bleeding diathesis.
Wolf-Parkinson-White syndrome. (AD). MIM 194200, 600358	***WPW*** may be at 7q3	See glycogen storage disease IIb. Cardiomyopathy. Other genes may be on chromosomes 1, 11, 14, and 15.
Wolman familial xanthomatosis. (AR). MIM 278000	***LIPA*** at 10q24-q25	Deficiency of lysosomal acid lipase allows cholesterol esters and triglycerides to accumulate. Have hepatosplenomegaly, diarrhea, and cachexia.
Woody-Ghadimi hyperlysinemia syndrome. (AD, AR). MIM 238700	***AASS*** at 7q31.3.	Deficiency of lysine alpha-ketoglutarate reductase, hyperlysinemia causes severe mental retardation, convulsions, hepatosplenomegaly, strabismus, and ectopia lentis.
Woolf syndrome. (XR)	***ADFN*** at Xq26.3-q27.1	See Ziprowski-Margolis albinism. (MIM 300700).
Wyburn-Mason syndrome. MIM 193300	Gene	Have a cerebroretinal arteriovenous aneurysm, probably not inherited but rarely seems to be inherited AD. Compare with these syndromes: von Hippel-Lindau (AD) ***VHL*** at 3p26-p25 and Bonnet-deChaume-Blanc.

X. An X chromosomal deletion from the proximal part of the long arm at Xq21.1-q21.21 causes mental retardation, deafness, agenesis of the corpus callosum, nystagmus, choroideremia, poor night vision, optic atrophy, and myopia.

xanthinuria. (AR)	***XDH*** at 2p23-p22	Deficiency of xanthine oxidase, renal calculi.
xanthomatosis, cerebrotendinous . (AR). MIM 213700	***CTX, CYP27*** at 2q33-qter	Atherosclerosis, progressive neurological dysfunction, dementia, atherosclerosis, cerebellar ataxia, spinal cord paralysis, xanthomas, jaundice, occlusions, and juvenile cataracts.

Xeroderma pigmentosum. See also ***ADPRT, PPOL*** at 1q42. Pseudogenes may be at 13q34 and 14q24.

type A. (AR)	***XPA, XPAC*** at 9q22.3-q31	Defective DNA repair, skin photosensitivity, sensitivity to sunlight, extreme photosensitivity, early-onset skin cancer, ataxia, microcephaly, mental retardation, and keratitis. Risk of cutaneous basal and squamous cell carcinoma is increased 1,000 fold.
type B. (AD)	***XPB, XOPB, ERCC3*** at 2q23-qter	UV hypersensitivity.
type C. (AR)	***XPC, XPCC*** at 3p25	Required for nucleotide excision repair.
type D. (AD)	***XPD, EM9, ERCC2*** at 19q13.2-q13.3	The cerebro-oculo-facio-skeletal syndrome. COFS is AR. Have UV hypersensitivity.
type E. (AR)	***DDB1*** at 11q12-q13, ***DDB2*** at 11p12-p11.	Complementation group E, subtype 2. ***DDB2*** modulates UV-induced apoptosis.
type F. (AR)	***XPF, ERCC4*** at 16p13.2-p13.1	Is involved in excision repair.
type G. (AD)	***XPG, ERCC5*** at 13q32.3-q33.1	***ERCC6*** is CSB. UV hypersensitivity.

Z.

Zellweger cerebrohepatorenal syndromes Are more prevalent in females. Have aminoaciduria, renal cysts and many types have a hearing deficit. See also adrenoleukodystrophy, ***PXR1, PEX5, NALD*** at 12p13.3, ***PEX1*** at 7q21-q22, ***PEX10*** at 7q22, ***XALD*** at X28, and ***XALD1*** at 12q11-q12.
Zellweger may also depend on mutations in ***PEX2*** at 8q21.3, ***PEX6*** at 6p22-p11, or in ***PEX12***. (MIM 601758).

type I. (AR, Mito) MIM 214100	***ZWS1*** at 7q11.23	Hepatomegaly and kidney dysfunction.
type II . (AR)	***PMP70, PXMP1*** at 1p22-p21, ***PXMP5*** at 8q21.1	Mental retardation, seizures, heart defects, hepatomegaly, up-slanting lid fissures, cataracts, Brushfield spots, cloudy corneas, and early death.
type III. (AD)	***PXMP3, PAF1, PMP35*** at 8q21	Mental retardation, hepatosplenomegaly, seizures, cataracts, RP, and cloudy corneas.
pseudo-Zellweger or Woolf syndrome..(AR)	***ACAA*** at 3p23-p22	Hyperpipecolic acidemia.

Zinc finger encoding genes, possibly 300 to 500 genes, encode metal binding proteins that act as regulators of other genes.		
	ZNF 132, 134, 135, 137, 154, and 155, all at 19q13. ***ZNF*** 138 at 7q11.2	
	ZNF 139 at 7q21.3-q22.1	
	ZNF 143 at 11p15.3-p15.4	
	ZNF 151 at 1p36.1-p36.2	
Zinser-Cole-Engman dyskeratosis congenita. (XR). MIM 305000	***DKC1*** at Xq28	Have mental retardation, anemia, deafness, skin atrophy, cancers of mouth, anus or skin, raindrop pigmentation of the skin, are subject to infections, and have continuous lacrimation.
Ziprkowski-Margolis, or Woolf syndrome.		See albinism. ***ADFN, ALDS*** (MIM 300700).
Zollinger-Ellison or Wermer syndrome. MIM 131100	***MEN1*** at 11q13	Polyglandular adenomatosis. See multiple endocrine neoplasia. (AD, S).

Some Trisomies

Trisomy 2q, can be inherited AR or XL, short neck, scoliosis, low-set ears, hypertelorism, epicanthus, and glaucoma.

Trisomy 6p, low birth weight, psychomotor retardation, prominent forehead,low-set ears, heart malformation, and small kidneys.

Trisomy 6q, growth retardation, mental retardation, microcephaly, micrognathia, hypertelorism and down-slanting lid fissures.

Trisomy 8 mosaicism, affects both sexes, mild to moderate mental retardation, cardiovascular disorders, hydronephrosis, poor coordination, strabismus, hypertelorism.

Trisomy 9q syndrome, congenital mental retardation, short stature, clinodactyly, hypertelorism, and up-slanting lid fissures.

Trisomy 10q, microcephaly, mental retardation, micrognathia, long slender limbs, microphthalmia, epicanthus, optic disks are enlarged and grey, yellow deposits near the macula in both eyes.

Trisomy 13, trisomy D1, Patau or Reese syndrome, affects 1 in 4,000 to 10,000 liveborn. Trisomy 13 causes 75% of cases but some are due to translocations. Defects of midface and eyes, poor prognosis, 75% die within their first year. Microcephalus, seizures, mental retardation, apneic spells, deafness, affects heart, kidneys, respiratory, and gastrointestinal tracts. Microphthalmia, iris colobomas, cataracts, corneal opacities, optic atrophy, retinal detachments, and orbital cysts.

Trisomy 16q partial. Dry skin, hypotonia, micrognathia, short fingers, down-slanting lid fissures, hypertelorism, strabismus, epicanthus, congenital glaucoma, corneal edema, shallow anterior chamber, and Rieger anomaly. See McFarland syndrome (AR) gene at 16q22, joint and heart defects and hypertelorism.

Trisomy 17p, growth retardation, microcephaly, heart defect, severe motor and mental retardation, hypertelorism, and up-slanting lid fissures.

Trisomy 18, Edwards or E syndrome occurs in 1 per 8,000 live births, 3 times more common in females. Nearly 90% die in their first year. About 10% do not have trisomy but have mosaicism and live somewhat longer. Major facial and skeletal abnormalities, cardiovascular malformation, hernias, microcephaly, cleft lip, finger deformities, and are severely retarded. Unilateral ptosis, epicanthal folds, uveal colobomas, and glaucoma. See Smith-Lemli-Opitz syndrome-1. See Potter renofacial syndrome.

Trisomy 20, cardiac and vertebral anomalies, mild psychomotor retardation, poor coordination, speech impediment, strabismus, and up-slanting lid fissures.

Trisomy 21, trisomy G, Down syndrome occurs in 1/8,000 live births. Probably 75% of embryos with Down syndrome are aborted. About 80% of the live born Down syndrome patients live for 30 or more years. Have major facial and skeletal abnormalities, microcephaly, cleft lip, finger deformities, are severely retarded, and 95% have cardiovascular malformations. Have more risk of Alzheimer disease and leukemia. High refractive errors, esotropia, cataracts, Brushfield spots, and up-slanting lid fissures.

Trisomy 21q-. This deletion causes mental and physical retardation, micrognathia, malformed ears, blepharochalasis, and microphthalmia with persisting hypoplastic primary vitreous.

Trisomy 22 may be a very mild form of Down syndrome. Macrocephaly, hydrocephalus, micrognathia, facioauriculovertebral (Goldenhar) sequence, schizophrenia, and high myopia. See also Sturge-Weber syndrome.

Duplication 14q syndrome. Growth and mental retardation, hypotonia, microcephaly, micrognathia, and minor skeletal abnormalities, posteriorly rotated ears, hypertelorism, sparse eyebrows and eyelashes, ocular colobomas.

Duplication of 22q11 causes the cat eye or Schmid-Fraccaro syndrome with mild mental retardation, ear malformation, iris colobomas, and microphthalmia.

Some Deletion syndromes:

3p- syndrome. This deletion causes profound growth failure, psychomotor delay, micrognathia, mental retardation, telecanthus, ptosis, and down-slanting lid fissures.

4q- This deletion causes a short neck, depressed nasal bridge, cleft lip, micrognathia, cardiac defects, and mental retardation.

4 partial deletion. Wolf syndrome, microcephaly, mental retardation, seizures, hypotonia, ear malformation, cleft lip, hypertelorism, down-slanting lid fissures, ptosis, nystagmus, strabismus, and colobomas of the iris and retina. Short life expectancy.

5p- cri du chat, Lejeune syndrome. Severe retardation, hypotonia, micrognathia, simian palm crease, hypertelorism, epicanthus, strabismus, and down-slanting lid fissures.
Note that the cri du chat syndrome can be caused by deletions from chromosome 5p or from chromosome 11p or from chromosome 13q.

9p- syndrome. Sociable personality, mental retardation, flat nasal bridge, long fingers, may have seizures, down-slanting lid fissures, and often glaucoma.

10q- syndrome, intrauterine growth retardation, microcephaly, respiratory distress, craniofacial dysmorphism, and microphthalmia.

11p- see cri du chat syndrome. Retardation, genitourinary abnormalities, Wilms tumor, aniridia, glaucoma, nystagmus, ptosis, and foveal hypoplasia.

11q- syndrome, psychomotor retardation, depressed nasal bridge, keeled forehead, micrognathia, low-set ears, cardiac anomalies, renal agenesis, anal atresia, hand and foor anomalies, holoprosencephaly, female preponderance. Hypertelorism, colobomas of iris, choroid and retina, and rarely glaucoma or cyclopia. Abnormalities of retinal vasculature in both eyes.

13q- syndrome, holoprosencephaly, atrial septal defect, microcephaly, ambiguous genitalia, hypotonia, growth retardation, intestinal atresia, and mild mental retardation. May have retinoblastoma, hypertelorism, optic nerve hypoplasia, ptosis, esotropia, cataract, retinal dysplasia. A partial deletion produces many of the same effects.

The deletion related to cri du chat syndrome causes retardation, microcephaly, malformed ears, congenital heart disease, anomalies of the thumbs and of the feet, retinoblastoma, hypertelorism, microphthalmia, epicanthus, ptosis, colobomas, and cataract. See also ring D syndrome.

15q- deletions. If the deletion of part of the long arm is inherited from the mother the child will have Angelman syndrome. If the deletion from 15q11.2-q12 is inherited from the father the child will have Prader-Willi syndrome with short stature, mental deficiency, and obesity.

8p- syndrome, growth failure, muscular hypotony, hypoplastic male genitalia, mental retardation, microcephaly, round face, pterygium colli, low-set ears, hypertelorism, epicanthus, posterior keratoconus, and horizontal lid fissures.

18q- syndrome, short stature, short neck, microcephaly, hypotonia, hypothyroidism, diabetes mellitus, deafness, mild to moderate mental retardation, seizures, and chronic arthritis. Congenital glaucoma, cataract, optic disc abnormalities, retinal detachment and retinal degeneration. See De Grouchy syndrome. See MIM 601808. One type includes ectodermal dysplasia and many other effects.

21 chromosome, deletion of the short arm and part of the long arm. Antimongolism syndrome. Retarded growth, heart disease, mental retardation, large ear lobes. micrognathia, pyloric stenosis, blepharochalasis, sclerocornea, and down-slanting lid fissures.

Some Anomalies of the Sex Chromosomes:

XXXXX Penta X syndrome, retarded growth, hypertelorism, up-slanted lid fissures, epicanthus.

XXXXY Mental retardation, hypoplastic male genitalia, microcephaly, vertebral anomalies, parkinsonism, up-slanted lid fissures.

XXXY or XXY Klinefelter syndrome seen in 1% of retarded males, mental retardation, testicular hypoplasia, colobomas, corneal opacities.

XXX or Jacobs superfemale syndrome occurs in 0.3 to 1 per 1,000 female neonates. Clinical features are varied but include tall stature, often with coordination problems or awkwardness. Their intelligence can range from severe mental retardation to superior intelligence. All have a normal life span.

XX males with a sex reversal syndrome. (MIM 278850). Gene ***DAX1*** at Xp21.

XY Reifenstein syndrome. MIM 312000.This XR syndrome occurs in a male with a normal XY genotype, androgen insensitivity, a male pseudohermaphrodite.

XY female type, gene at Xq22.3-p21, see MIM 306100. Gonadal dysgenesis, have female phenotype.

XYY supermale syndrome occurs in 1 in 1,000 male neonates. Mild mental retardation, can be aggressive or antisocial, ocular colobomas. May show delayed mental maturation. Most are tall and physically active.

XO chromosome, Turner syndrome, short neck, congenital heart disease, genitourinary abnormalities, down-slanting lid fissures, ptosis, strabismus, blue sclera, male incidence of red-green color vision defects.

X chromosome deletion, corpus callosum agenesis, deafness, mental retardation, agammaglobulinemia, choroideremia, nystagmus, hyperpigmentation of the RPE and the choriocapillary layer. cleft lip, and myopia.

Deletion from Xq can include an area where there are genes for choroideremia, congenital deafness, optic atrophy, high myopia, and nystagmus.

Fragile X syndrome (XR) mostly affects males, mental retardation, epilepsy, strabismus, nystagmus, high myopia, adult-onset glaucoma, and optic atrophy. Some have hyperopia or astigmatism.

Y syndrome, see also inverted Y syndrome.