ChemEd 2005, Vancouver BC, July 31 - August 4, 2005

Chem Ed 2005 drew chemistry teachers to the campus of the University of British Columbia in Vancouver last summer for five days of beautiful weather and educational inspiration. Kudos to the co-chairs, Chris Toth and Gordon Bates, and their hard working team for putting together an outstanding program.

Co-chairs Chris Toth and Gordon Bates

The usual ChemEd fare included the Reg Friesen Memorial Lecture by Ariel Fenster (see page 2), a Mole Run, the Wednesday morning Mole Breakfast, the Wednesday evening Barbecue and the Thursday morning closing lecture (pages 2-3). Unique to this setting was the outstanding Celebration of Light 2005 Fireworks Competition, on Wednesday evening, over English Bay. But the main reason for attending was the broad menu of talks, demonstrations, teaching ideas and opportunities to renew old friendships and make new ones.

Elaine Woo (Volunteers Coordinator) and Rosamaria Fong (Webmaster)

In the next pages we report on some of the presentations and activities. You can view many of them on the ChemEd 2005 website at *http://nobel.scas.bcit.ca/chemed2005/welcome.htm* and click on ChemEd 2005 Trading Post near the top right.

The next ChemEd, ChemEd 07, will be held July 29 – August 2, 2007 at the University of North Texas, Denton, TX. See *www.chem.unt.edu/chemed07/*, and plan to attend.

The traditional April Logical Chemical Puzzle by Carlos Mauricio Castro-Acuña is on page 12. Try it!

INSIDE:

ChemEd 2005 special lectures

Reg Friesen Memorial Lecture

Ariel Fenster, *Fascinating Aspects of Chemistry*

The 2005 Friesen Memorial Lecture was given by **Ariel Fenster**, who is affiliated with Vanier College and McGill University, both in Montreal. An adjunct professor at McGill, Fenster is attached to the Office of Science and Society, which is dedicated to disseminating up-to-date information in the areas of food, food issues, medications, cosmetics and health topics in general. This information is specifically directed towards the public, educators and students.

Fenster's lecture included a number of very interesting chemical facts about our eating habits.

- North Americans drink 160 L of soft drinks per year, on average.
- 3-5 people per year are killed because they shake vending machines in frustration causing the machines to fall on them.
- Natural ≠ safe; for example, sassafras leaves contain safrole, a carcinogen.
- Wine contains the vitamin niacin, but you would need to drink 10 bottles to get the recommended daily amount.
- Hangover indexes have been determined for vodka (1.0), white wine (4.0), red wine (9.0), Scottish whiskey (10.0), North American whisky (4.5). Scottish whiskey is aged longer than North American whisky.
- In Swiss cheese the holes are created when lactic acid ferments, giving carbon dioxide; the propionic acid that is also produced is a natural preservative, found at levels ten times as great as is added to bread for the same purpose.
- In Canada 30% of men and 38% of women prefer chocolate to sex.
- Cherry chocolates are made by packing the cherry in a mixture of sugar, a small amount of water, and the enzyme invertase. This solid mass is dipped in chocolate; in time, the invertase causes the sucrose to hydrolyze to glucose and fructose which are more soluble, giving the sweet, thick syrup surrounding the cherry.
- Truffles give off a fragrance that is similar to that of androstanol, the sex pheromone produced by male pigs, which explains why female pigs are good at finding truffles (see *http://www.salk.edu/news/releases/details.php?id=53*).
- Kissing consumes 6-12 calories.

You can find more of these interesting aspects of chemistry at the website of McGill University's Office of Science and Society at *www.oss.mcgill.ca*.

Closing Plenary Lecture

Penny Le Couteur, *Chemophobia — Are we the problem? Can we be the solution?*

The Dean of Arts and Sciences, and formerly a chemistry professor at Capilano College in North Vancouver, BC, Penny Le Couteur has recently co-written the book entitled, *Napoleon's Buttons: 17 Molecules that Changed History.* In this closing lecture she considered examples of bad media reporting on chemicals and set the record straight on much of the paranoia that is so prevalent regarding "bad" chemicals.

"Are you getting enough oxygen?" is the headline Le Couteur showed us from a full page advertisement in a local newspaper. The ad goes on to claim that "the oxygen content of our atmosphere has dropped from 35 percent a few hundred years ago to its current level of only 21% today." Well, the 21% today is correct, but it has been at that level for thousands of years. Will the average reader know that? →

Publishing CHEM 13 NEWS

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Media stories about dangerous chemicals frequently get it wrong, damning substances that often have very little effect at the levels at which they occur in our environment. Paracelsus had it right in about 1538, when he said, “All substances are poisonous, there is none which is not a poison; the right dose differentiates a poison from a remedy.”

The Great Myth, Le Couteur stated, is that "natural is good, manmade is bad." This is a new manifestation of the concept of Vitalism that was debunked nearly 200 years ago by Wöhler. She listed the seven most toxic chemicals known, five of which are produced in nature. If a natural chemical kills you, "it might be natural, but you are just as dead," she said. "Perhaps it's comforting to know that you died naturally." The list is shown in the box below. The LD_{50} value is the mass of the toxin (in mg) per kilogram of body weight that will kill half the subjects in a toxicity test — usually performed on rats or mice. The best chemists can do is dioxin which is only one millionth as toxic as nature’s best, botulinum toxin A. Of the ten next most toxic substances, five are natural and five synthetic. Clearly, “nature’s poisons outrank in number and toxicity anything chemists can do,” says Le Couteur.

The seven most deadly chemical compounds

Compound	LD_{50}/(mg/(kg body weight))
Botulinum toxin A	3×10^{-8}
Tetanus toxin A	5×10^{-6}
Diphtheria toxin	3×10^{-4}
Dioxin* (contaminant in 2,4,5-T)	3×10^{-2}
Muscarine	2×10^{-1}
Bufotoxin	4×10^{-1}
Sarin* (nerve gas)	4×10^{-1}
* Indicates synthetic compound	

From The Extraordinary Chemistry of Ordinary Things*, by Carl H. Snyder, John Wiley & Sons, Inc., New York, 1992.*

Ed Doadt’s column will return next month

Many natural toxins are found in the food we eat. The following table gives some from Le Couteur’s list of such toxins.

Natural toxins in food

Chemical	Food source	Hazard
Allyl isothiocyanate	brown mustard, horseradish, garlic	tumours
Cyanides	bitter almonds, cashews, lima beans	stomach cancers
Glycyrrhizic acid	licorice	hypertension/heart
Hydrazines	raw mushrooms	cancer
Myristicin	nutmeg, parsley, dill, carrots, celery	hallucinations
Oxalic acid	rhubarb, spinach	kidney damage/ death
Tannins and tannic acid	black tea, coffee, cocoa	cancers/throat and mouth
tetrodotoxin	puffer fish	paralysis/death

From The Extraordinary Chemistry of Ordinary Things*, by Carl H. Snyder, John Wiley & Sons, Inc., New York, 1992.*

Le Couteur pointed out that banning DDT has resulted in 50 million deaths worldwide from malaria. Spraying with DDT once each year inside huts and homes is a very effective way of controlling the mosquitoes that spread malaria. If malaria came back to North America (Ottawa, for example, used to have summer malaria epidemics), would we use DDT?

Le Couteur challenged her listeners to respond to the chemophobia and misleading information that is so often carried by our media. Talk about this with your students, your buddies, your church group. Give talks at Rotary Club meetings. Write letters and op ed articles for your local newspaper. We have a responsibility for public education. So often the important fact that "the dose makes the poison" is not made clear. The ChemEd 2005 website for the Trading Post has Penny's reading list of books on this topic. Go to *http://nobel.scas.bcit.ca/chemed2005/welcome.htm* and click on ChemEd 2005 Trading Post near the top right. ■

ChemEd 2005 Committee Members

Congratulations and thanks to these ChemEd 2005 planners for their hard and successful work!

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Webmaster: **Rosamaria Fong**

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Chemical Demonstrations Coordinator: **Winnie Chu**

Reports on presentations at Chem Ed 2005

Reports by **Andy Cherkas**, Stouffville District High School, Stouffville, ON

Lemon Shake

Presenter: Laura Slocum
University High School of Indiana

Concept: Acid base chemistry, neutralization

Set this up in a drug store soda glass. Place some $NaHCO_3$ and flaked soap into the bottom of the glass. Cut a lemon open and squeeze the lemon juice into the cup while stirring rapidly. The citric acid in the lemon reacts with the sodium hydrogen carbonate to produce carbon dioxide gas, which, with the rapid stirring and the soap, cause a foam to form so that the mixture magically looks like a lemon ice cream soda.

Smart Materials, Nanotechnology

Presenter: Mordechai Livneh, Bar-Ilan University, Israel and
Metodija Najdoski, University of Skopje, Macedonia

Concept: Materials Science

Different types of energy can cause certain materials to change crystal form and thus colour. Light changes the colour of photochromic materials, heat changes thermochromic substances, and electricity changes electrochromic materials.

An example of photochromism is the lens for glasses which become sunglasses outside. In this case silver chloride is added to the lens material. Light causes the silver chloride to form silver and chlorine, and the silver darkens the lens. Since the silver and chlorine are trapped in the solid matrix of the lens, the silver and chlorine can recombine to make colourless silver chloride, so under these conditions, the reaction is reversible.

$$AgCl \cap Ag + \frac{1}{2}Cl_2$$

You may be familiar with mood rings that change colour with temperature. This is an example of thermochromism. The mood ring material is based on liquid crystals derived from cholesterol. Thermochromic materials can be made in the high school lab from a mixture of silver nitrate, mercury(II) nitrate and potassium iodide. The resulting preparation changes from yellow to orange upon heating. Using a copper(II) salt in place of the silver salt gives a thermochromic compound that changes from purple to red.

If paper is coated with the correct thermochromic compounds in the correct way, by heating the paper with a blow dryer, a change from one flag to another can be shown, such as a US flag to a Canadian flag. If you are worried about the presence of mercury in the compound, you can laminate the paper, thus sealing the mercury in.

Tungsten(VI) oxide in the presence of hydrogen ions will change from colourless to blue if an electric current is present. Using the compound over a wire and a nine volt battery, electrochromic messages can be read.

Chemical Humour

Presenter: David Katz
Pima Community College, Arizona

To maintain the interest of students in class, do not hesitate to use cartoons, jokes and songs that are related to the topic being studied. Sources of science cartoons are found in daily newspapers or collections of such comic strips as B.C., Calvin and Hobbes, Mother Goose and Grimm, Foxtrot, Farside. Also look for science cartoon collections, such as those by Sidney Harris.

Science songs can be found on various albums, for example the “NaCl Song” is found on “The McGarrigle Hour” and the “First and Second Law of Thermodynamics” is found on the Flanders and Swan collection.

Copper Quarter

Presenter: Doug De La Matter, Box 655, Barry’s Bay, ON
douglela@magma.ca, www.magma.ca/~dougdela/

US quarters are a copper sandwich. If you heat the quarter to red heat in a high temperature flame and drop the hot metal into a beaker of methanol, the methanol will bubble, but at the end the copper will have diffused to the surface of the quarter, giving the appearance of brass or gold.

Criminal Metallurgy

Presenter: Ron Perkins (retired)
Greenwich High School, USA

Concept: Materials science, forensics

Properties of metals can be changed by heating and cooling them differently. Use three hair pins as the metal piece to heat and cool. Heat the first pin to glowing, then cool it slowly in and above the flame. This softens the metal. Heat the second pin but quench it in cold water while it is still hot. This pin becomes very brittle, and breaks easily. Repeat the heating and quenching with the third pin. Use some sand paper to remove any scale from the heated pin. Reheat this pin in the cooler part of the flame, and allow it to cool slowly. The pin returns to its original form. The crystal form of the iron changes in each case.

…continues on page 6

Put the Body to It

Presenter: Bob Perkins
Kwantlen University College, British Columbia

Show chemical concepts using your body. What happens to electrons when energy is added to an atom? The electrons move to a higher energy level. To illustrate this, have someone throw you a photon [a coloured ball to represent this quantum of energy] and jump onto a table [a quantum leap]. To return to the floor, throw the ball [photon] back and jump off the table.

To represent single, double and triple bonds place an elastic between two fingers, wrap the elastic around twice for double bond, and thrice for a triple bond. What happens to the distance between the fingers? What happens to the strength needed to hold the elastic taut?

Experiments and Demonstrations to Get and Keep your Students' Interest

Presenter: Steve Smith
Roanoke Valley Governor's School, USA

Concepts: Gas laws, gas solubility

Place a one-litre bottle of chilled root beer in a large plastic tray. Open the root beer and stopper it with a rubber stopper. Heat a steel cylinder that will fit through the bottle opening, in a burner flame until glowing. Remove the stopper and drop the hot cylinder into the root beer. How much gas was dissolved in the cold root beer? [Try this one outside first!]

The following reports are by **Debbie Herrington**, Grand Valley State University, Allendale, MI

Guided Inquiry for High School Chemistry

Presenter: Laura Spencer, Manheim Township High School, laura_spencer@mtwp.net

Inquiry activities are not just for the lab. Guided inquiry activities present students with a model followed by a set of critical thinking questions, allowing students to actively engage in the understanding of key chemistry concepts. Two sample guided inquiry activities were presented.

The first activity used buttons and beads to examine classes of matter. At the beginning of the lesson each group of four students is given nine samples, each contained in a small clear container, and an activity sheet with the critical thinking questions. Given the definition of pure substance and mixture, students classify each sample as a pure substance or a mixture. Examples of samples include: red beads and buttons (mixture), just gold beads (pure substance – element), or a gold bead and a button wired together (pure substance – compound). Each sample is also labeled with a code such as: R & B, Gb, or GbB. This activity teaches students about pure substance, elements, compounds, and mixtures. Additionally, the critical thinking questions get students to think about chemical symbols and the particulate nature of matter.

For the second activity, *Cracking the PT Code*, each group of students receives a piece of paper with the electron configurations for all the elements in a chemical family, and an activity sheet. Each group must locate their elements on a blank periodic table, and then identify some patterns concerning the elements' locations on the periodic table and their electron configurations. As each group has a different set of elements, the groups then share their information to identify additional patterns.

When implementing these activities group management is important. Some hints included: assigning group member roles such as manager, recorder, presenter, and encourager; allowing only the group manager to ask the teacher a question; and stopping periodically to get reports from all the group presenters.

Mixed Media Tests

Presenter: Sue Klemmer, Camden Hills Regional High School, Rockport, ME, sue_klemmer@fivetowns.net

Students learn to value what we test, so if we value laboratory procedures and data analysis skills why not test them? Sue presented a number of ways that laboratory skills can be incorporated into each test, rather than being relegated to a lab practical at the end of a course. In addition to the benefit of students paying more attention to laboratory skills because they know they will be tested on them, she also found that incorporating these activities alleviates test anxiety, provides more opportunities for hands-on learners, and appeals to students' sense of fairness. Some examples of these hands-on test problems include: (1) asking students to enter data into a computer graphical analysis program, generate a regression line, and answer questions about the graph; (2) having students write their names on a piece of construction paper with chalk ($CaCO_3$) and find the mass of oxygen in their signature or the number of oxygen atoms; (3) given a calibration curve, determining the concentration of an unknown sample using a spec 20; (4) testing the properties of a material to determine whether it's a metal, nonmetal, or metalloid; or (5) when using room temperature and pressure in a question, requiring students to read the thermometer or barometer.

Some things to think about if you plan to incorporate these activities into your tests are: it takes time to create and set up these activities; they take more time to grade because all students have unique data; you cannot test everything, so choose essential and testable skills; ensure the tasks have a narrow focus, requiring only a few skills; think about safety when planning activities; and, as students have to get up and move around, think about where to set things up for minimal distraction.

Are You Gellin'?

Presenter: Gina Barrier, outreach coordinator, The Science House, North Carolina State University, Lenoir, NC, gina_barrier@ncsu.edu
website: www.science-house.org

Students are placed in the role of scientists as they investigate the properties of polymers and try to design a replacement for Dr. Scholl's gellin' inserts. First, each group of four students is given a baggie containing a polymer. They are asked to make observations about the polymer without taking it out of the bag. Based on these observations all the groups appear to have the same polymer; however, once students take the polymers out of the baggies they quickly find each polymer has some unique properties — some bounce, some break, some feel oily, they smell different, etc. These polymers have been made with water and cornstarch or water/glue and borax. Additionally, some of the polymers also contain oil, talcum powder or calcium carbonate as an additive.

After this exploration phase, students are then challenged to design a replacement insert. As a whole group, students decide on the properties they want to look for in their insert, for example, texture, elasticity, resilience, viscosity, etc. Once these have been decided on, each group makes a series of polymers with different additives and designs methods to test their polymers for each of these properties. Students are responsible for design of the test, collection and organization of data, and analysis and presentation of results.

Gina suggests, in order to encourage cooperative groups for this activity, that you assign students the roles of lead scientist, quality control manager, research chemist, and data analyst. Furthermore, to assist with classroom management she suggests you limit the materials that students may use to conduct their tests and that you set time limits.

The following reports are by **Marie-Claude Dupuis**, 76 5th Avenue #301, Pincourt QC, J7V 5K7, mcdupuis02@hotmail.com.

Teaching in Three Dimensions

Presenter: Doug De La Matter, Box 655, Barry's Bay, ON
dougdela@magma.ca, www.magma.ca/~dougdela

Doug De La Matter, a retired teacher, reflected on his teaching experience and shared his observations about how students learn. After a quick trip through different popular theories of how the brain learns, Doug showed that there is a lot of debate about how best to address differences in students and he wondered if the emphasis on gender differences might be missing an underlying cause. Some students are comfortable dealing with two-dimensional representations of concepts. These students are generally good at reading and writing. Others are better thinking in three-dimensions and are "good with their hands." They are comfortable building things, moving around the room, using lab equipment and understand things best when they can see and manipulate objects. He concluded that using Piaget's approach might be the simplest and most practical way to distinguish between these general types of learners in a classroom setting.

A series of demos and experiments were given and he explained how to classify students into two- or three-dimensional thinkers by their reaction to those activities. Specific techniques were suggested in order to help the students develop both methods of thinking by assigning individual students different types of tasks while performing common experiments. He also suggested that since students come to school to gain new perspectives, it is important for them to try to learn new ways of doing things or at least to notice that there are other ways of thinking and doing things around us that are equally valuable. Too often, the 2-D thinkers have academic success while the 3-D thinkers become frustrated.

He pointed out that science classrooms are often the only sites in school where both two-dimensional activities (reading, writing, calculating, etc.) and three-dimensional activities (manipulating equipment, measuring masses and volumes, etc.) can have equal status. This explains why having students actually DO experiments is such an important practice. He urged us to organize our lessons so students who work best by thinking in three-dimensions are not disadvantaged by our dependence on two-dimensional "paper" activities.

For more information, visit Doug's website, *www.magma.ca/~dougdela*, and click on the ChemEd 2005 conference link.

Creative chemistry from Kansas City

Presenter: Rhonda Reist, Olathe North High School, Kansas
rreiston@olatheschools.com

Rhonda shared several dynamic glowing demos with us. She prepared a photography demonstration based on the photo-chemistry of silver halide salts. It had to stay under the sunlight for 20 minutes; after washing the results in the dark, she showed us, in the light, a blueprint of a picture she had previously taken. She suggested that this demo could be used in discussing the oxidation state of iron, or internet research on "Cyanotype", etc.

Next, she put three polystyrene foam cups with a little water into a pressure cooker and heated them for 10 minutes. When it was opened everything had shrunk. She showed us other materials that she had shrunk — a polystyrene head and a cooler. She suggested that this activity could be used to explain that polystyrene foam is actually filled with a gas that escaped when heated to a high temperature under pressure.

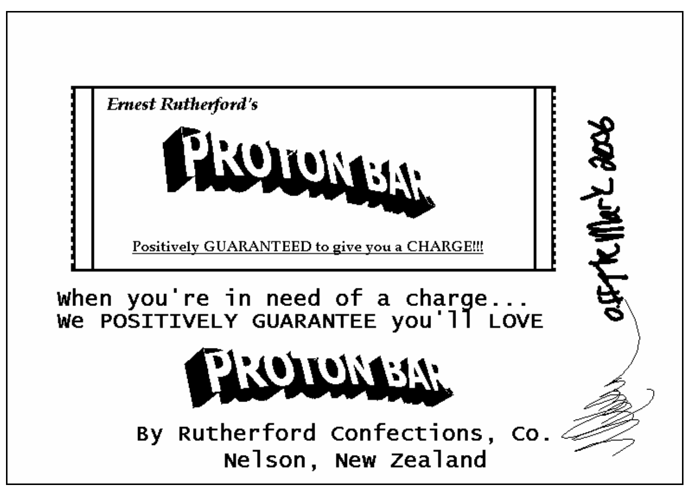
A small amount of liquid nitrogen was placed into a blue (painted with latex paint) polystyrene cup and the cup was then placed into a vacuum chamber. After the vacuum pump was turned on the liquid nitrogen boiled briefly and then solidified into a fluffy white mass of solid nitrogen (bp -195.8°C, mp -209.9°C). It was suggested that the demo could be used to discuss triple point, critical point, normal boiling point, normal melting point, Boyle's law, change in temperature and pressure.

She also shared that she had had very good results by asking students to "draw out" or "cartoon" the lab procedure. The students rebelled at first but their good results convinced them to do it again.

The demo that kindled her passion for chemistry when she was only a teenager was the instant light. Flinn Scientific sells it as a kit. It is an easy chemiluminescence demonstration.

Rhonda's last demo was called "Liquid Lightning Bug". Three liquids, two clear and one green, are mixed in a beaker. The color of the liquid begins to oscillate between orange and green with a period of about 10 seconds. When the room is darkened and a black light is shone on the container, the solution oscillated between dark and emitting a bright orange glow! The oscillations will continue for up to 3 hours. It is incredibly cool! The details are available from Rhonda, at her e-mail address (given above. ■

Off the Mark



Thanks to Mark Rosengarten,
Washingtonville High School, Washingtonville NY