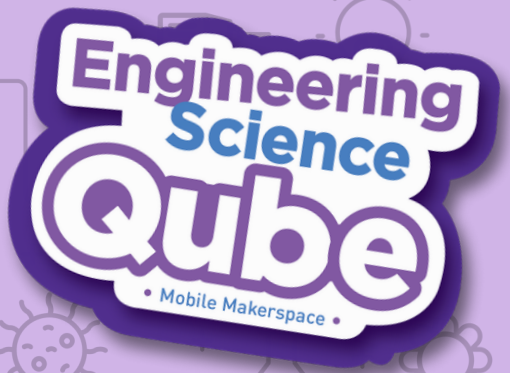




HIGH SCHOOL WORKSHOPS

ESQube is a Mobile Makerspace, operated by the Engineering Outreach team at the University of Waterloo. We are strong believers that sparking appreciation for Science, Technology, Engineering, and Math (STEM) at an early age is valuable, and ESQube wants to give ALL youth the opportunity to engage in these hands-on experiences.

ESQube is excited to offer FREE STEM workshops to students from Grade 9 to Grade 12. Look inside at our offerings and let us know if there are any programs your school may be interested in hosting.



**WATERLOO
ENGINEERING**

Grade	CODING	Discover and Apply		
Grade 9-10	Digital DaVinci	Pitch Black		Quantum Detectives, Shockingly Cell-f Sufficient
Grade 11-12		Wavefinder	Powering Up	
	Desmos Dapper Designer			

- All workshops run for 60 minutes and are designed for a maximum of 30 students
- All CODING workshops require students to have their own laptop/Chromebook with internet access.
- All materials will be provided for DISCOVER AND APPLY workshops. Please note Shockingly Cell-f Sufficient involves cups of water, and NanoBrick Builders requires a sink or bucket of water.
- All workshops are altered with simplifications and extensions to best support learning at each grade level.

CODING



Digital DaVinci| Grade 9-11

Students will create computer programs which generate dynamic pieces of art. Applying the same algorithm used for CGI in movies and video games, students will explore how colour, geometry, and images translate into digital spaces, and draw connections between patterns in art and mathematics. By the end of this workshop, students will have applied their knowledge of functions, variables, constants, and Boolean operators to create the program. Students will need a device to complete this workshop.

Curriculum Links:

MTH1W: Algebra (C2.1, C2.2), Geometry and Measurement (E1.2)

ICD2O: Computational Thinking and Making Connections (A3.3),

Programming (C1.1, C2.1, C2.2, C2.5, C2.6)

ICS3U: Programming Concepts and Skills (A1.1, A1.5, A4.1)

ICS3C: Programming Concepts and Skills (A1.1, A1.4, A3.2)

Engineering Pathways: [Computer](#), [Mechatronics](#), [Software](#), [Systems Design](#)

Desmos Dapper Designer | Grade 11-12

Students will explore the connection between mathematical equations and art by using linear, quadratic, and rational equations on the Desmos Graphing Calculator. By the end of this workshop, students will have created visually appealing art by manipulating equations and applying restrictions to form unique designs and patterns, while adjusting colors and line styles to distinguish between different functions and add an artistic touch. Students will need a device to complete this workshop.

Curriculum Links:

MCR3U: Characteristics of Functions (1.2, 1.3, 1.8, 2.3),

Exponential Functions (2.1, 2.4)

MCF3M: Quadratic Functions (2.1)

MHF4U: Polynomial and Rational Functions (1.1, 1.2, 2.1, 4.3)

MCT4C: Polynomial Functions (1.1, 1.2)

MAP4C: Mathematical Models (3.3)

Engineering Pathways: [Architectural](#), [Computer](#), [Civil](#), [Software](#), [Systems Design](#)

CODING



Wavefinder | Grade 11-12

Students will gain a deeper understanding of earth's magnetic field and how it interacts with navigation devices such as compasses. They will then apply this knowledge by programming a digital compass in Python using a Micro:bit, a small embedded computer. The goal is to combine principles of magnetism and coding to create a functional device that can detect direction, similar to how a traditional compass works. By the end of this workshop, students will be able to explain how earth's magnetic field is used in technology, including its environmental and social applications. They will also demonstrate the ability to apply constants, Boolean operators, comparison operators, conditional statements and correct syntax in programming. Students will need a device to complete this workshop.

Curriculum Links:

SPH3U: Scientific Investigation Skills and Career Exploration (A2.1), Electricity and Magnetism (F2.4)

SPH4U: Scientific Investigation Skills and Career Exploration (A2.1), Gravitational, Electrical, and Magnetic Fields (D1.1, D1.2, D3.3)

ICS3U: Programming Concepts and Skills (A1.1, A1.4, A4.1), Software Development (B1.2), Topics in Computer Science (D3.3)

ICS3C: Programming Concepts and Skills (A1.1, A1.4, A3.2), Computers and Society (D4.3)

ICD2O: Programming Concepts and Algorithms (C1.1, C1.3, C1.4, C1.5), Writing Programs (C2.1, C2.2, C2.3, C2.5)

Engineering Pathways: Computer, Electrical, Environmental, Civil, Geological, Mechatronics, Software





DISCOVER + APPLY



Pitch Black | Grade 9

In this workshop, students will learn the basics of electrical circuits, including definitions for electricity, voltage, current, resistance, series and parallel circuits. They will use these concepts to build simple circuits using a breadboard, batteries, resistors and LEDs. By the end of the workshop, students should know how to read circuit diagrams and identify basic series and parallel circuits as well as understand their impact on voltage and current.

Curriculum Links:

SNC1W: STEM Skills, Careers, and Connections (A1.1, A1.3, A2.1, A2.3), Physics Principles and Applications of Electricity (D1.1, D1.2, D1.3, D2.3, D2.7)

Engineering Pathways: **Electrical, Computer, Nanotechnology, Systems Design**

Powering Up | Grade 11-12

In this workshop, students will become electrical engineers. Students will learn about renewable energy and simulate solar and hydro energy with a breadboard. They will be tasked to create a microgrid that can store energy, send electricity to another community, and use renewable resources. By the end of this workshop, students will be able to formulate relevant scientific questions and build circuits to test their understanding, while exploring generators and renewable energy generation methods.

Curriculum Links:

SPH3U: Scientific Investigation Skills and Career Exploration (A1.1, A1.5), Energy and Society (D2.1, D2.7), Electricity and Magnetism (F1.2, F2.1, F2.2, F2.3, F3.3, F3.6)

SPH4U: Dynamics (B1.1, B1.2), Energy and Momentum (C1.2, C2.1, C2.3) Gravitational, Electric, and Magnetic Fields (D1.2, D2.1)

Engineering Pathways: **Electrical, Environmental, Mechatronics**

DISCOVER + APPLY



NanoBrick Builders | Grade 10-12

In this new workshop developed in collaboration with the University of Waterloo's Department of Nanotechnology, students will explore the fascinating world of nanofabrication and the processes used to create the microchips that power modern technology. Through a series of hands-on activities, students will investigate photolithography using UV light, assemble model logic gates that mimic components found in integrated circuits, and discover how microchips are used in everyday electronics. By the end of the workshop, students will gain an understanding of how engineers and scientists design and manufacture micro-scale technologies, while making connections between nanotechnology and the devices they use every day.

*Please note NanoBrick Builders requires access to a sink; if your classroom does not have a sink, we may be able to accommodate with a bucket of water. Students are welcome to bring small items to cyanotype print.

*This activity works best with Grades 11-12, or classes already familiar with circuits. Grade 10s will receive a slightly simplified version of the workshop.

Curriculum Links:

SNC2D: Scientific Investigation Skills and Career Exploration (A1.1, A1.2, A1.10, A2.1), Physics: Light and Geometric Optics (E1.1, E2.4, E3.1)

SNC2P: Scientific Investigation Skills and Career Exploration (A1.1, A1.2, A2.1), Physics: Light and Applications of Optics (E2.6, E3.1)

ICD2O: Digital Technology and Innovations in the Changing World (A1.2, A1.3, A3.1, A3.2, A3.3), Hardware, Software, and Innovations (B1.1, B4.2, B4.3)

SPH3U: Technologies that apply principles of energy transformations (D1.2, D2.7), Waves and Sound (E1.1, E2.1, E2.2, E2.4)

SPH4U: The Wave Nature of Light (E1.1, E2.1, E2.3, E3.2)

Engineering Pathways: Nanotechnology, Computer, Electrical, Chemical

DISCOVER + APPLY



Quantum Detectives | Grade 9-12

In this workshop developed by UW's Institute for Quantum Computing Outreach team, students will explore binary information, light interference, and spectroscopy to solve a crime in the quantum lab. They will learn how quantum mechanics is involved in some of the most important technologies of today and tomorrow. By the end of this workshop, students will apply the scientific experimentation process to conduct investigations focused on light and atoms. Through hand-on activities, students will make connections between theory and practice, and use their findings to solve a mystery.

Curriculum Links:

SNC1W: STEM Skills, Careers, and Connections (A1.2)

SNC2D: Scientific Investigation Skills and Career Exploration (A1.1, A1.2, A1.10, A2.1), Physics: Light and Geometric Optics (E1.1, E2.4, E3.1)

SNC2P: Scientific Investigation Skills and Career Exploration (A1.1, A1.2, A2.1), Physics: Light and Applications of Optics (E2.6, E3.1)

SPH3U: Technologies that apply principles of energy transformations (D1.2, D2.7), Waves and Sound (E1.1, E2.1, E2.2, E2.4)

SPH4U: The Wave Nature of Light (E1.1, E2.1, E2.3, E3.2) Revolutions in Modern Physics: Quantum Mechanics and Special Relativity (F1.2, F2.1, F3.1, F3.2)

SCH4U: Structure and properties of matter (C1.1, C1.2, C2.1)

Engineering Pathways: Nanotechnology, Computer, Electrical, Chemical



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IQC

Institute for
Quantum
Computing



DISCOVER + APPLY



Shockingly Cell-f Sufficient | Grade 9-12

In this workshop, students will explore the chemical engineering field and learn the various components and inner workings of an electrochemical cell. By the end of this workshop, students will apply the scientific experimentation process and use their knowledge of electrical circuits, chemistry, and electrochemistry to create a saltwater battery to power an LED, all while learning more about what chemical engineers do. Students will observe how different electrolytes affect variables via a demonstration after making their own batteries.

*Please note Shockingly Cell-f Sufficient involves cups of water; this workshop is best suited to a classroom with a sink.

Curriculum Links:

SNC1W: Scientific Investigation Skills and Career Exploration (A1.2, A1.5),

Physics D2 Investigating and Understanding Concepts (D2.2, D2.6, D2.7)

SNC2D, SNC2P: Scientific Investigation Skills and Career Exploration (A1.4)

SCH3U: Scientific Investigation Skills and Career Exploration (A1.4), Solutions and Solubility (E2.1)

SCH4U: Scientific Investigation Skills and Career Exploration (A1.4), Electrochemistry (F1.1, F2.5)

SCH4C: Scientific Investigation Skills and Career Exploration (A1.4), Electrochemistry (D2.1, D2.2)

Engineering Pathways: Chemical, Nanotechnology, Electrical, Environmental



UNIVERSITY OF
WATERLOO

Department of
Chemical Engineering

FAQ's ?

Is there a cost to book an ESQube School Workshop?

A: All workshops are provided for FREE within the program areas, noted below.

Where are the ESQube program areas?

A: ESQube workshops are delivered only to schools in Waterloo Region (Cambridge, Kitchener, Waterloo and Townships) & surrounding counties in Huron, Oxford and Perth within a 1.5-hour drive of UWaterloo Waterloo Campus. If you are unsure if your school qualifies, please email us with your school's name and address.

How long is a session?

A: The workshops require a 60 minute time slot.

How many workshops can I book in a single school day?

A: This will depend on your school's daily schedule and how much travel is needed, but we aim to schedule 2-4 workshops in a day.

How many days can my class book?

A: There is no limit on how many days you can book a workshop for your class.

How many students can participate in one session?

A: In order to ensure each student's learning can be supported by our two-person teaching team, we suggest booking single classes of up to 30 students per session.

ANY OTHER
QUESTIONS?



engoutreach1@we-connect.ca for ESQube booking questions, or engoutreach@uwaterloo.ca for general inquiries

WAIT...THERE'S MORE

Look forward to other UW Engineering Outreach programs for students including:

- **Leader in Training (LIT)** A volunteer opportunity for Grade 10-12 students to build leadership skills through mandatory training and the chance to gain their 40-hours of volunteering as an LIT; application based. The STEMpowered LIT program is free for self-identifying Black youth.
- **Catalyst** is a 2-week, unique, interdisciplinary program on STEM leadership and entrepreneurship for Grade 10-12 students; application based.
- **High School Conferences** Students will participate in hands-on workshops, tackle design challenges, and experience residence life at the University of Waterloo! Application based
- **Summer High School Leaders** Paid employment where staff will promote Science, Technology, Engineering, and Math (STEM) to youth by facilitating dynamic summer camps.
- & **more!** Keep your eye out for clubs, events, and workshops offered to high school students.

Visit uwaterloo.ca/engineering-outreach for details!

Stay updated by signing up to our mailing lists:

Engineering Outreach Teacher Mailing List:
mailchi.mp/uwaterloo/weo-educator-mailing-list

Engineering Outreach General Mailing List:
mailchi.mp/uwaterloo/engineering_outreach

ESQube School Workshops are supported by:



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