



University of British  
Columbia  
Vancouver, Canada

FACULTY OF EDUCATION

Department of  
Curriculum and Pedagogy

# Engaging Students in Physics: Innovative Outreach at UBC

*Aarhus University, Denmark*

**Dr. Marina Milner-Bolotin**

**Dr. Valery Milner**

Science and Mathematics Education Research Group

June 25, 2024, 10:30 am – noon

# No one Can Do STEM Outreach Alone



Ingen Rigtig Nok Til Undvære Nabo

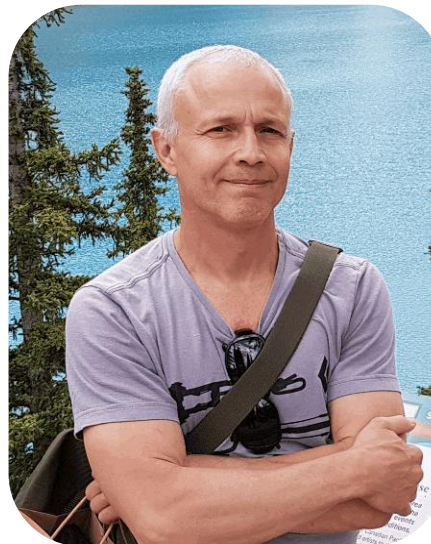
# Author Team Collaboration

**Dr. Marina Milner-Bolotin – UBC Faculty of Education:** A physics educator and researcher, works with in- & pre-service physics teachers, leads STEM outreach

[marina.milner-bolotin@ubc.ca](mailto:marina.milner-bolotin@ubc.ca)

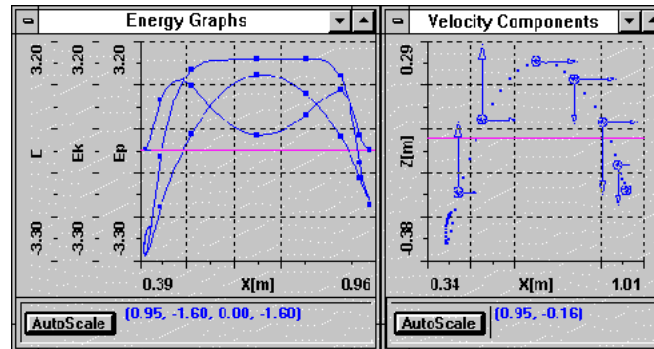
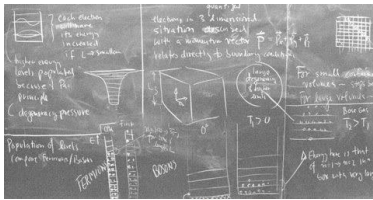
<http://blogs.ubc.ca/mmilner/>

**Dr. Valery Milner – UBC Faculty of Science :** A physicist, Atomic Molecular Optics researcher; physics educator, award winning instructor, aviator

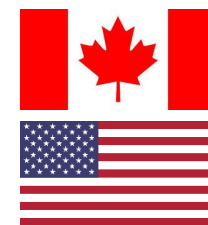


*Grew up in  
Physics  
Families in  
Kharkiv,  
Ukraine*

# Our Physics Education Journey



V-scope





# UBC (University of British Columbia)

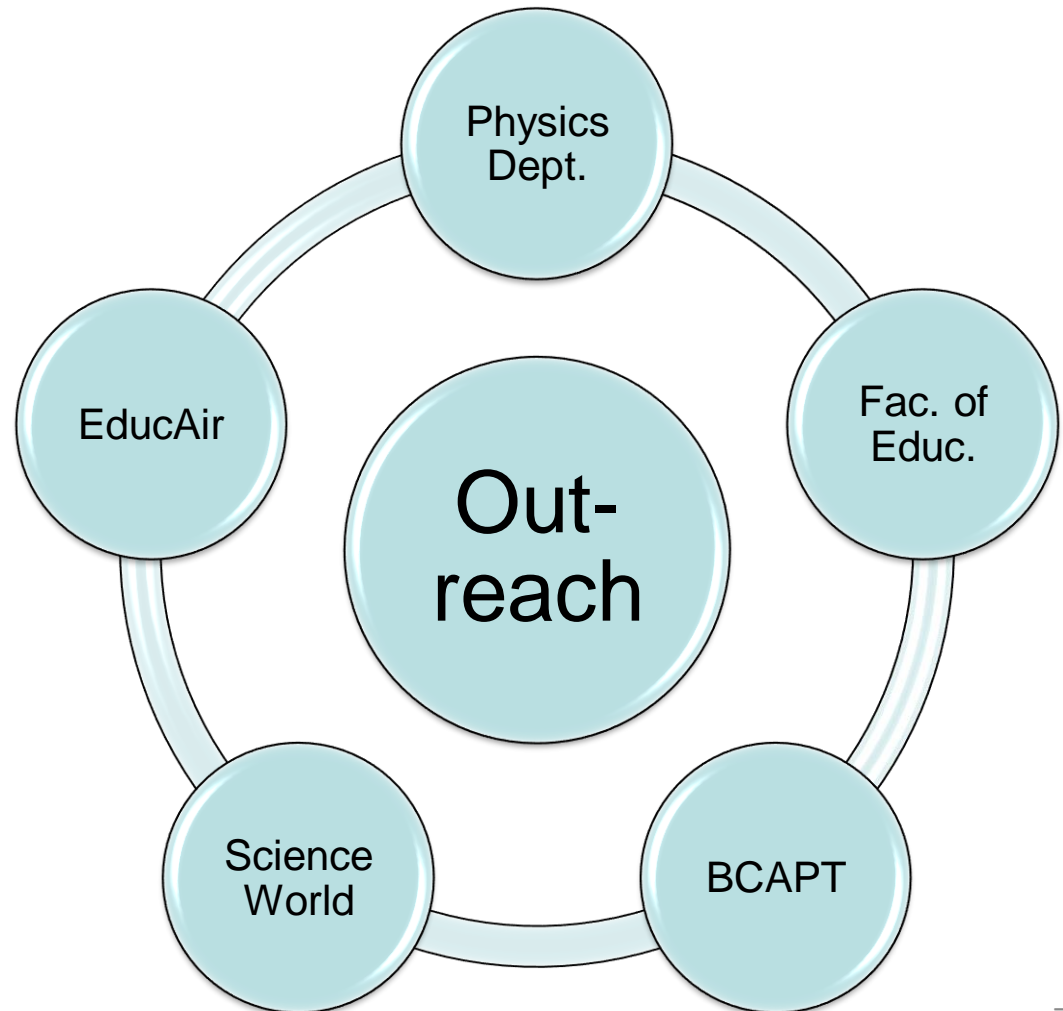


**16,188 international students  
from 140+ countries!**

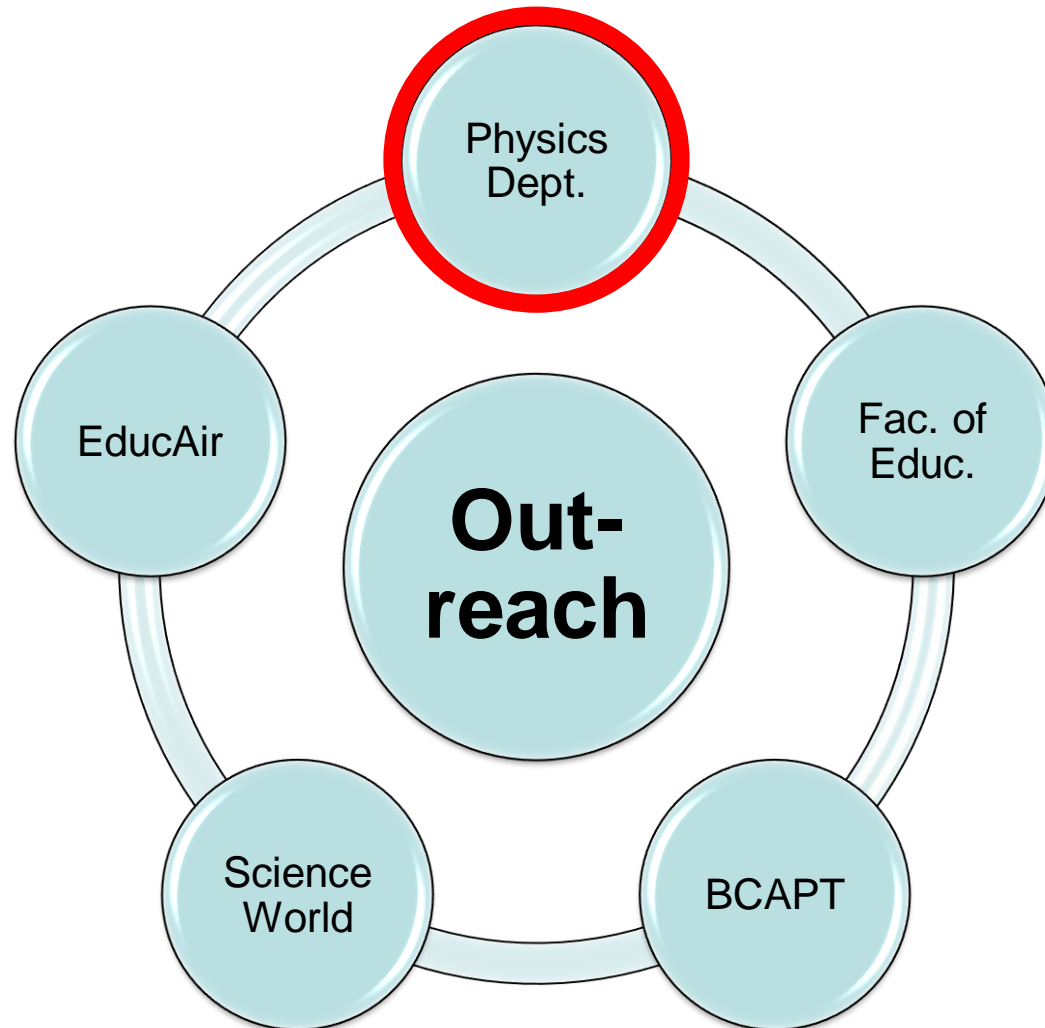
## **UBC Facts:**

- Public university
- Established: 1908
- 2 campuses: Vancouver & Kelowna
- ~65,000 students
- Academic staff: ~ 6000
- Acceptance rate: 64%
- International ranking – 35<sup>th</sup> (Best Global Uni. worldwide, #2 in Canada)

# Talk Outline



# 1. Physics Department





# 1 UBC Physics Olympics

Physics  
Dept.

Fac. of  
Educ.



THE UNIVERSITY OF BRITISH COLUMBIA

Vancouver Campus



Faculty of Science  
Physics Olympics at the University of British Columbia

Home Physics Olympics FAQ Registration 2024 Event Schedule Rule Books Results Participating Schools Gallery 2024 For Teachers About

Contact Us



## Welcome to UBC Physics Olympics Website

Congratulations to all who participated in the 46th Physics Olympics! What a tremendous amount of talent and skills we saw from students! We hope you all enjoyed the day, made friends, learned lots and now feel like the physics superstars that you are.

And thank you to BC Teachers and coaches who got your students involved in the pre-builds and prep for labs, Quizzics and Fermi questions events. Your support is what makes this competition a success!

We appreciate your feedback: our aim is to make this the greatest physics competition it can be, and this is done with your help. To share comments and ideas, please contact outreach@phas.ubc.ca.

*Thank YOU so much for all the hard work that went into making this happen. My students learned so much these past few*

### News

**NEW** March 4, 2024

The 2024 Rule Book has been updated with Addendums! Take a look on our rule books page.

**Feb 20 2024**

Cancellation Deadline for the 2024 Physics Olympics: February 21, 2024.

**Feb 16 2024**

Three weeks to go! We look forward to seeing you!

## Secondary BC Physics Students

70+ teams  
900+ student participants  
70+ teachers  
80+ volunteers

## Students compete in teams

6 different events  
2 events are pre-builds  
4 events at UBC (hands-on)  
Special event for physics teachers during the day

<http://physoly.phas.ubc.ca/>

1

# UBC Physics Olympics

Physics  
Dept.

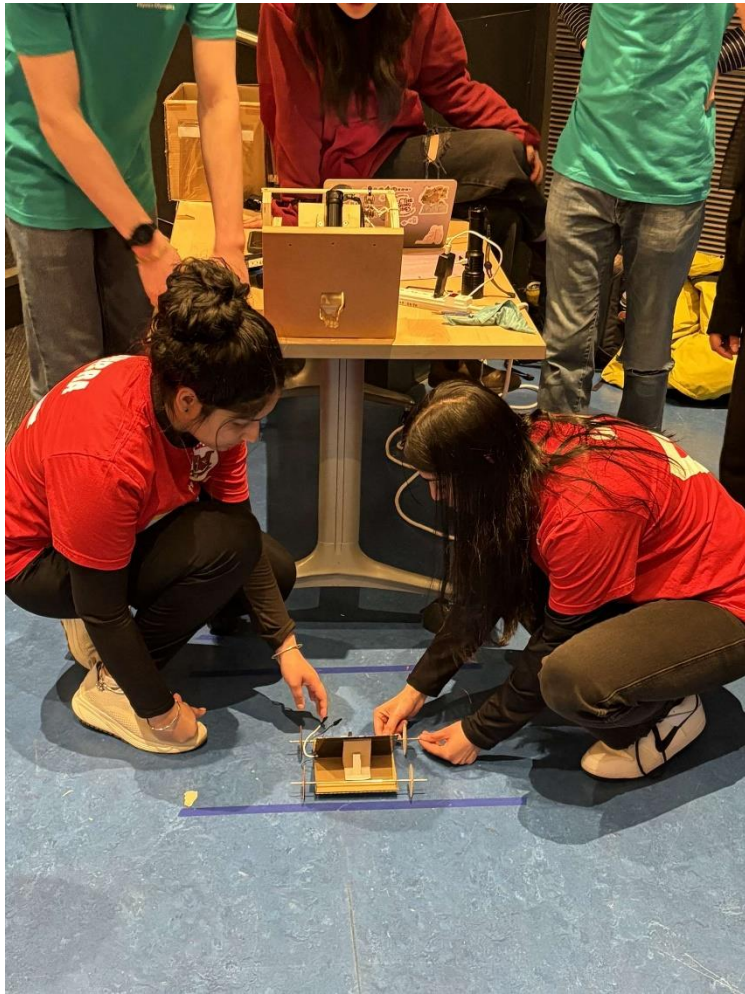


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# UBC Physics Olympics Pre-Build Challenges

Physics  
Dept.

<https://physoly.phas.ubc.ca/>



Students from West Kelowna Secondary School brought their Pre-Build challenges to UBC

1

# Phyphox in Physics Olympics – Since 2021



**Phyphox**: designed by Sebastian Staacks and Physics Educators at the University of Aachen, Germany

**Physics Phone Experiments = PHY PHO X**

**E-Mail:** [staacks@physik.rwth-aachen.de](mailto:staacks@physik.rwth-aachen.de)



<https://phyphox.org/>

1

# Physics Olympics – a Physics Teaching Community

Physics  
Dept.

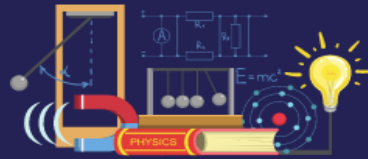
Fac. of  
Educ.



Teachers meet for a special Professional development opportunity during the UBC Physics Olympics: Teachers exchange ideas

# 2021 UBC Physics Olympics!

1



Organized jointly by

- UBC Dept of Physics and Astronomy, Faculty of Science &
- UBC Dept of Curriculum and Pedagogy, Faculty of Education

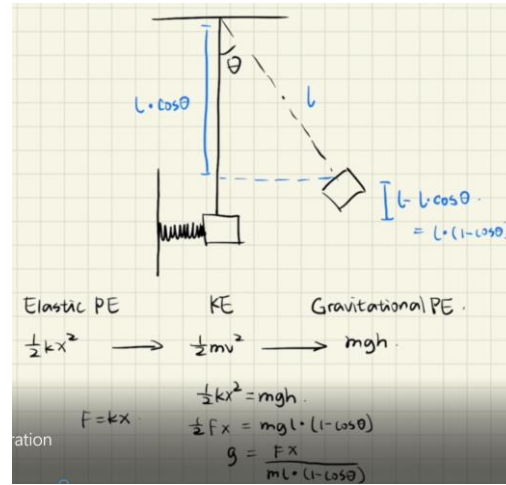
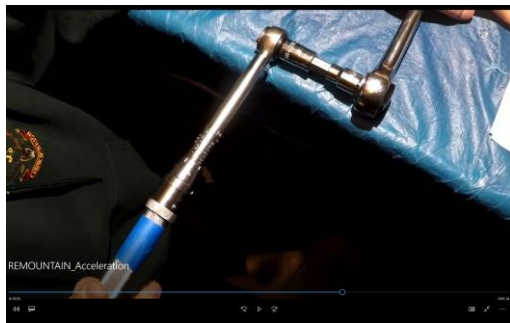
Physics Lab at Home Challenges. Students were asked to use a smartphone *Phyphox* App to **determine experimentally**:

1. Acceleration of Free Fall
2. Speed of sound at  $0^{\circ}\text{C}$



1

# Can students measure $g$ creatively?



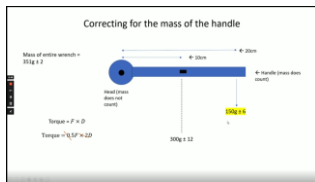
A spring collision



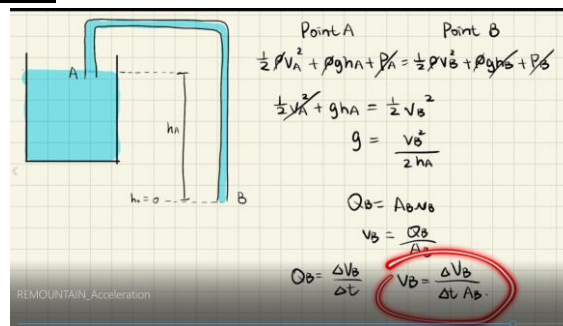
Acoustic stopwatch to measure free fall time



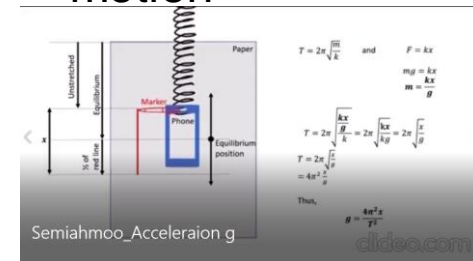
A plane in circular motion



A torque wrench and a bucket of water!



Bernoulli's principle



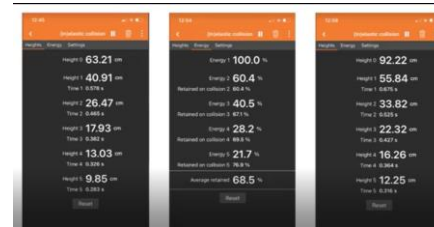
Phone oscillating on vertical spring

# 1

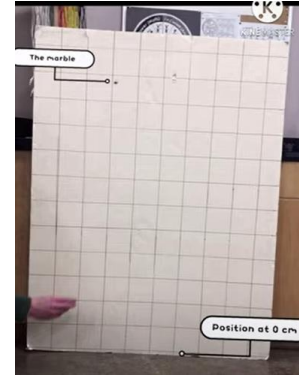
# Different methods and Sensors for determining $g$

1. Free fall ( $g$  components)
2. Free fall (absolute  $g$ )
3. Incline Plane
4. Projectile motion
5. Pendulum
6. Vertical spring
7. Elevator
8. Ball bounce (collisions)
9. Circular Motion
10. Motor – Potential energy
11. Pendulum – potential energy
12. Torque Wrench
13. Bernoulli's effect
14. Pressure

1. Accelerometer
2. Magnetometer
3. Acoustic sensor
4. Light sensor
5. Microphone
6. Video Analysis
7. External timers
8. Using other devices to collect data during the experiment

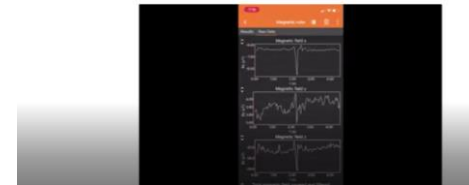


Inelastic collision

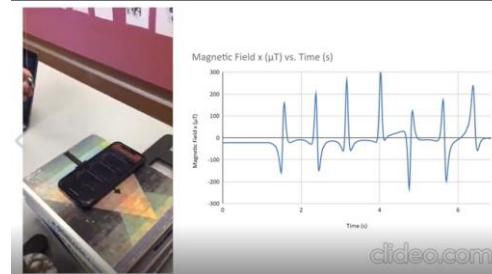


~~Video Analysis of projectile motion~~

Phyphox magnetic ruler



Magnetic sensor





# 1

# Faraday Science Shows

Physics  
Dept.

Free Christmas Public Physics Show for families presented by faculty and students at the Department of Physics and Astronomy



<http://outreach.phas.ubc.ca/events/faraday-show/>

**FARADAY SHOW 2023!**

## THE WONDERS OF SPACE!

The **Faraday show** is UBC's annual science lecture designed for children and presented by UBC Physics & Astronomy students, staff & faculty.

This year we are exploring the **wonders of space!** How do **rockets** get into orbit? How big are our **planets**? How explosive is **compressed air**? Can you make a **crater**? What do **black holes** eat?

All these questions will be answered through fun demos and hands-on activities. This show is for children of **ALL AGES** and adults who are young at heart!

**Pre-Show: 1:15pm-1:55pm**  
**Stage Show: 2:00pm-3:00pm**  
**Sunday, December 3rd, 2023**

**Cost: FREE!** Please bring non-perishable food items to support the GVFB's Kettle Society & its programs!

**Where:** UBC HEBB Theatre (2045 East Mall) on UBC campus!

**Parking:** The North Parkade is the closest parking lot to HEBB Theatre.

**Planning:** Plan a day on campus! Mention 'Faraday Show' to get 50% off admission at the **Beatty Biodiversity Museum** on Sunday Dec. 3rd between 10-5pm!

**FREE UBC SCIENCE EVENT FOR KIDS!**

*The Greatest Science Show in the Galaxy!*

THIS YEAR'S FARADAY SHOW IS PRESENTED BY:

UBC PHYSICS ASTRONOMY

For more info, email us at [outreach@phas.ubc.ca](mailto:outreach@phas.ubc.ca)

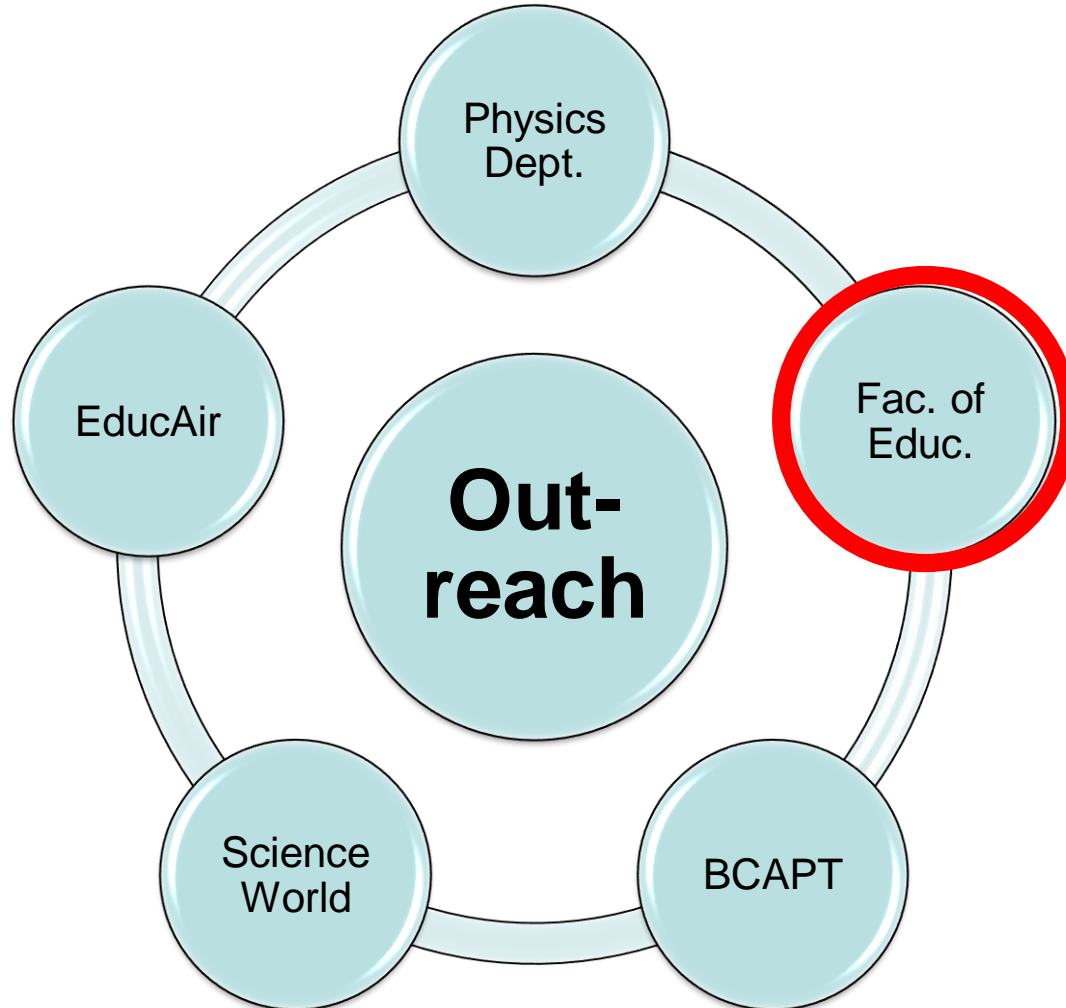
# 1

# Faraday Science Shows



<http://outreach.phas.ubc.ca/events/faraday-show/>

## 2. Faculty of Education



Bachelor Subject + B.Ed.

Elem

Secondary

B.A.

B.Ed.

B.Sc.

B.Ed.

2

# UBC Family Math & Science Day



Future  
teachers



Families



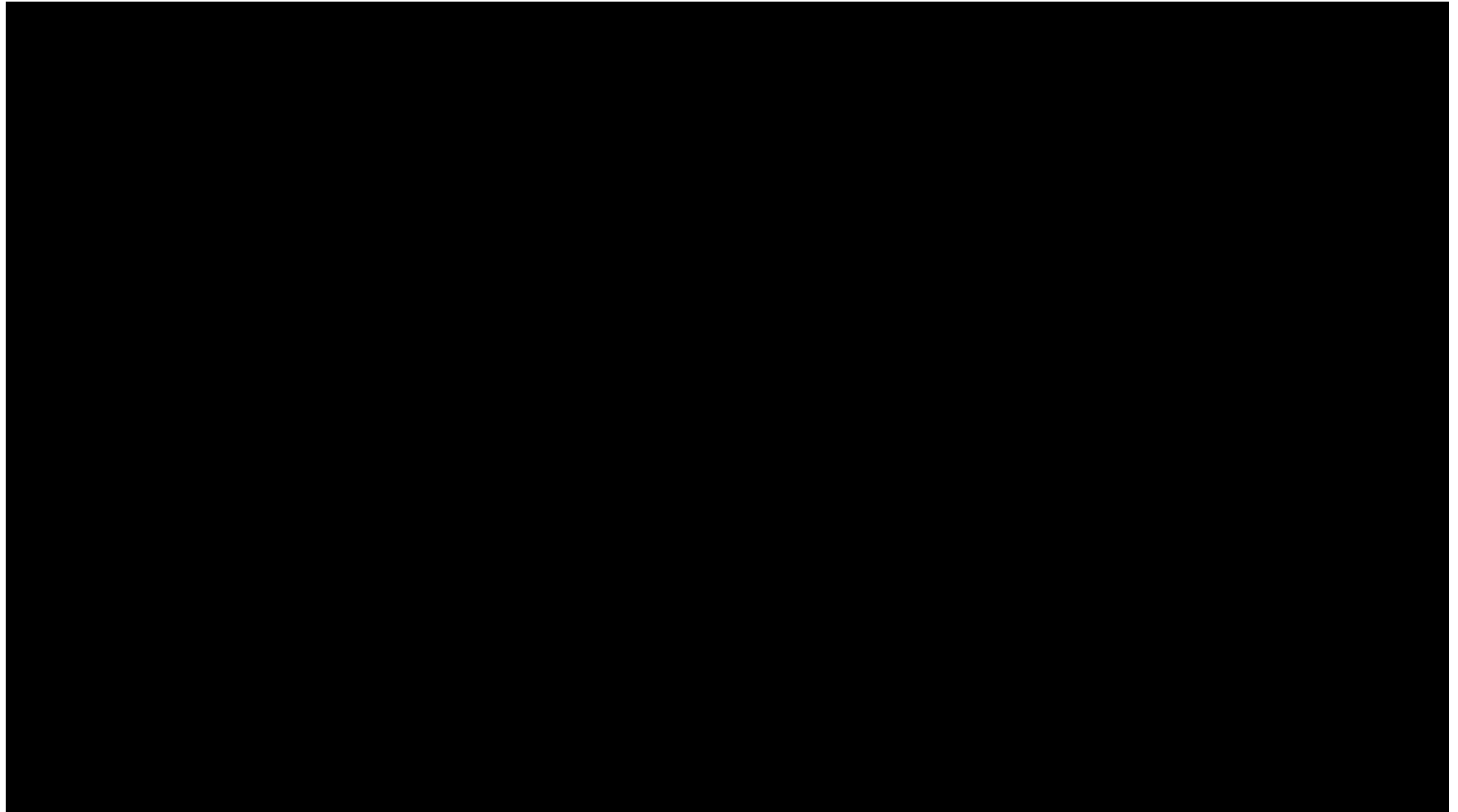
Faculty & staff

Students



2

# UBC Family Math & Science Day



# Collaboration in STEM Teacher Education

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loads ▾ PLAY ALL SORT BY

Intro to Google Tour for Educators  
1 views · 6 days ago

The Mystery of Sodium Polyacrylate  
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Atlas  
21 views · 1 year ago

Exploring the Colours of Birds' Feathers  
316 views · 1 year ago

Lichtenberg Figures - French Version  
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Lichtenberg Figures - English Version  
16 views · 1 year ago

Exploring Water Movement in Plants  
3 views · 1 year ago

Exploring Wimshurst Generator  
188 views · 1 year ago

Ice Cube Fishing Experiment  
66 views · 1 year ago

Exploring Surface Tension with Soap-Powered Boats  
202 views · 1 year ago

Lightbulbs and Circuits  
46 views · 1 year ago

Exploring Hidden Colours of the Fall Leaves with Paper...  
111 views · 1 year ago

The Magic (Cartesian) Diver  
7 views · 1 year ago

The Decomposition of Hydrogen Peroxide  
44 views · 1 year ago

Elephant Toothpaste  
13 views · 1 year ago

Exploring the Science behind Ocean Currents  
18 views · 1 year ago

Natural Frequency and Harmonics  
102 views · 1 year ago

Exploring Density With Oranges, Lemons and Limes  
48 views · 1 year ago

Exploring Surface Tension with Colours  
3 views · 1 year ago

Magical Candle  
18 views · 1 year ago

Aluminum Boats  
30 views · 1 year ago

Jar of Clouds  
28 views · 1 year ago

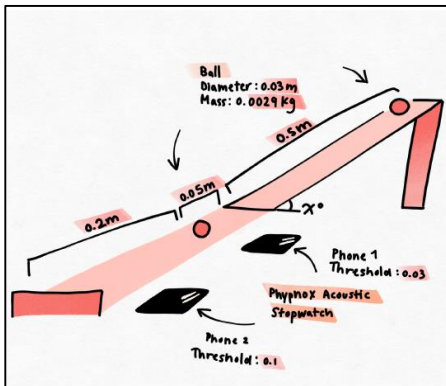
Strawberry DNA Extraction  
128 views · 1 year ago

Exploring buoyancy of Limes, Lemons and Oranges  
154 views · 1 year ago

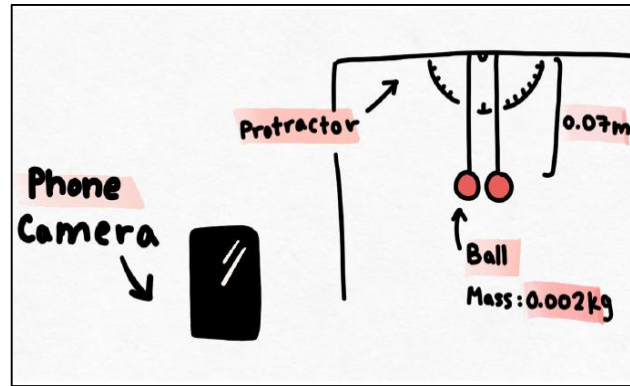
Future Teachers design videos of STEM experiments. We have more than 100 experiments matching BC curriculum



Future Physics Teachers mentored secondary students who used *phyphox* and PhET in their advanced physics lab projects.



(a)

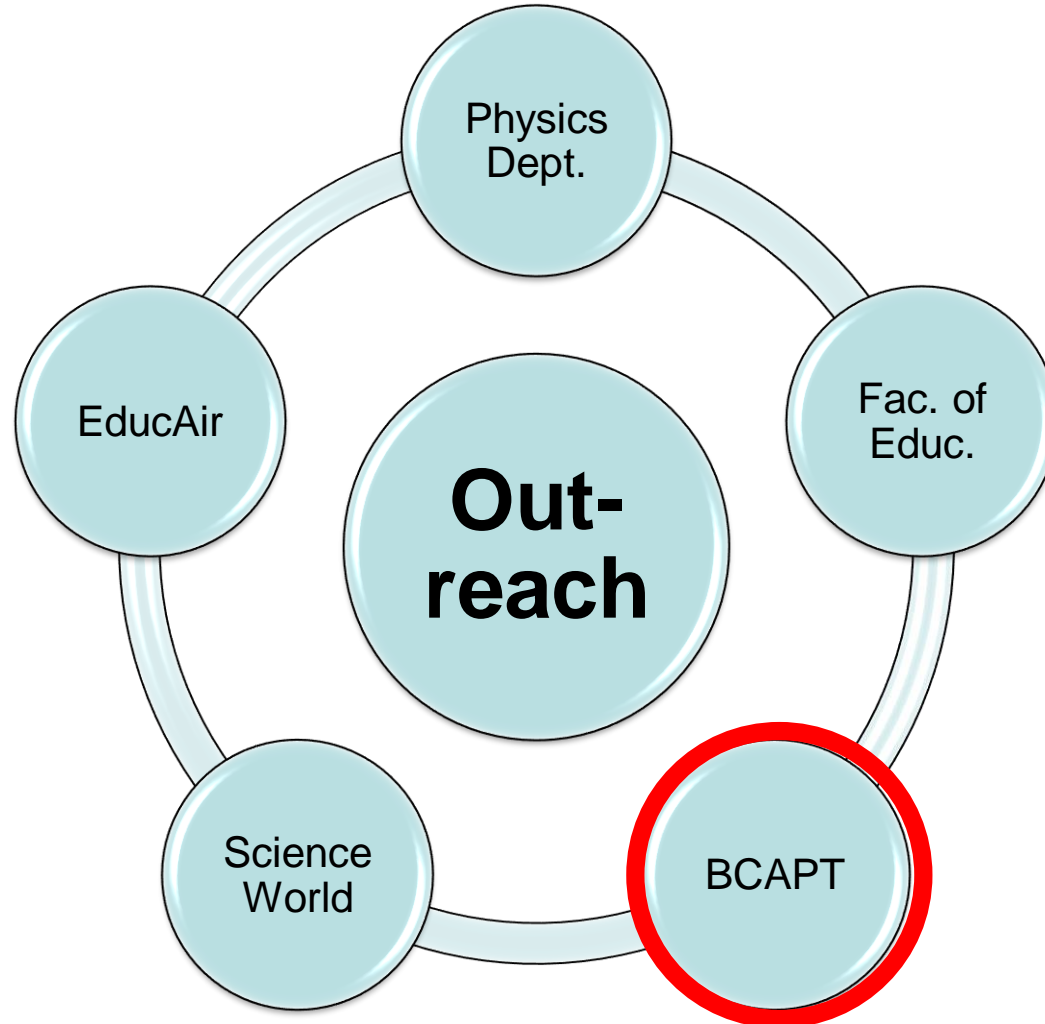


(b)

Experimental designs suggested by the students for testing the laws of momentum and mechanical energy conservation. (a) Collisions of two metal balls on a ramp; (b) Collisions of two pendulums.



# 3. BC Association of Physics Teachers - BCAPT



# BC Association of Physics Teachers

UBC THE UNIVERSITY OF BRITISH COLUMBIA

BC Association of Physics Teachers

Home Events/Pro-D Join BCAPT & AAPT! AAPT Spotlight Physics Teaching Resources Physics in Canada Physics Jokes



## Physics Olympics 2024

### Panel for Future Participants & Coaches

Find out how to get involved!  
Zoom session: **Nov 16<sup>th</sup>, 7- 8pm PST**



UBC Physics Olympics 2024 – Orientation Panel

Dear BC Physics Teachers, Students, and Parents: For more than four decades, UBC Department of Physics and Astronomy collaborated with the UBC Faculty of Education (Department of Curriculum and Pedagogy) in organizing UBC Physics Olympics – a hands-on physics team competition for British Columbia Secondary School students. This year, the event will take place on [...] [Read More](#)

8 / 10

[www.bcapt.ca](http://www.bcapt.ca)

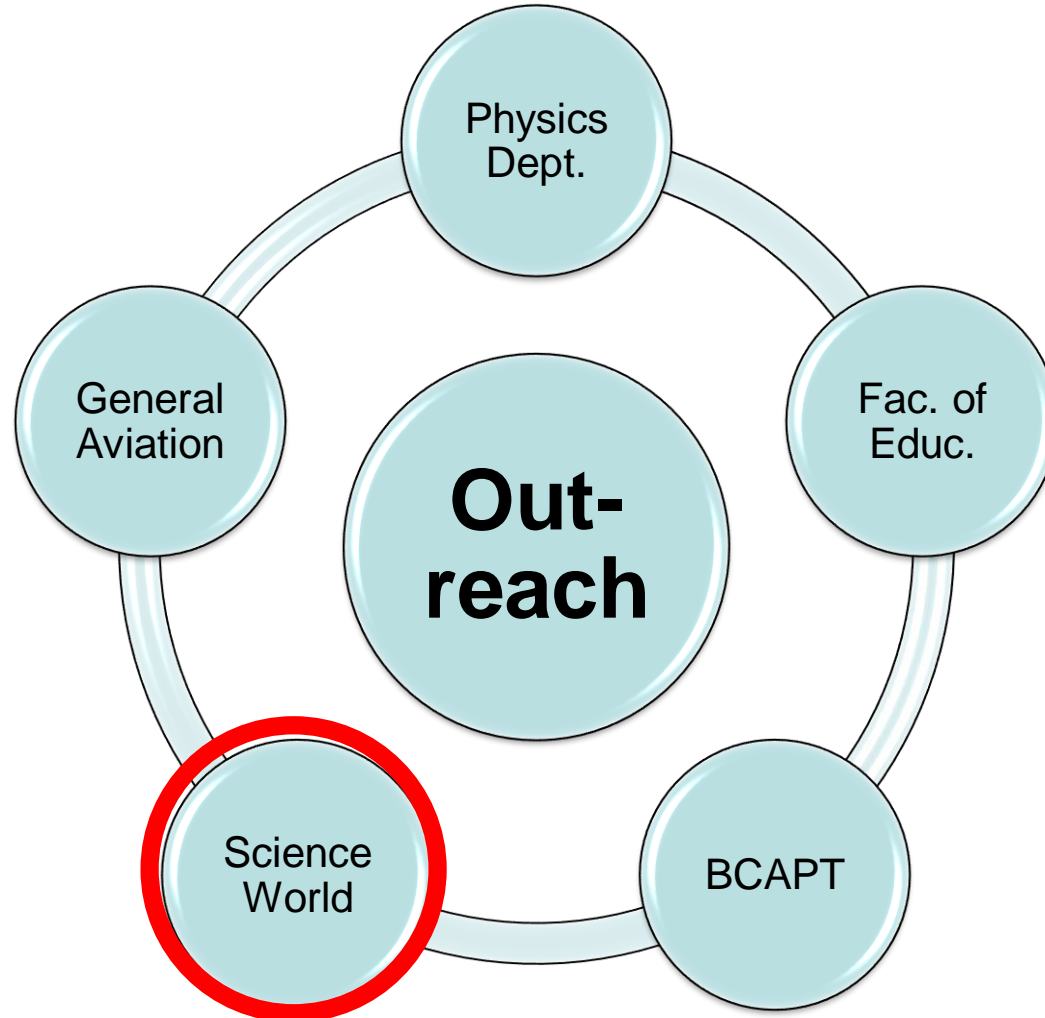
## Gordon Gore Prize for Excellence in Science Teaching



Gordon Gore Prize for Excellence in Science Teaching Nominations are now open! Dr. Gordon Gore (1937-2020) was an incredible force and inspiration in science teaching and learning in British Columbia. He affected the lives of thousands of students and teachers through his physics textbooks, inspirational teaching, demonstrations that he created, and, through his legacy with [...]

Home Feed	>
BCAPT Home	>
Join BCAPT & AAPT!	>
Events/Pro-D	>
AAPT	>
Spotlight	>

# 4. Science World: Scientists & Innovators in Schools



# Scientists & Innovators in the Schools

SCIENCE WORLD at  
TELUS WORLD  
of SCIENCE


[TICKETS](#)
[DONATE](#)

Today we are  
**CLOSED**

[VIEW OUR COMPLETE HOURS](#)


**VISIT**  
Plan A Trip

**LEARN**  
Resources & Field Trips

**OUTREACH**  
Online & Across BC

**JOIN**  
Support & Membership

**FOLLOW**  
Email & Social Media

## Scientists in Schools



### Across BC

At Your Event  
At Your School  
After-School Science  
Big Science For Little Hands  
Community Science Celebration  
KEVA Kits  
Pro-D For K-12 Educators

Scientists In Schools

Volunteer With SIS

Teen Career Networking  
Teen Leadership Workshop

79  
SHARES

### Inspiring students with free, in-school presentations by real scientists

*Scientists and Innovators in the Schools (SIS)* is a volunteer-based program that helps address British Columbia's need for more scientists, engineers, technologists and technicians to promote students' interest in these areas. Our goal is to inspire students with exciting, in-school presentations by real scientists. The program is offered to Grades K-12 everywhere in BC.

In 2016/17, 240 SIS volunteers visited 420 schools in 128 communities across British Columbia, delivering free presentations to over 35,000 students.

### Get started with SIS

[REQUEST A SCIENTIST](#)
[VOLUNTEER WITH SIS](#)

### Join our Educators' mailing list

Sign up for our educators email newsletter to stay up-to-date with exclusive Science World events, activities and programs for teachers.

**SIGN UP**

### SIS Blog





# Scientists and Innovators in the Schools

SCIENCE WORLD

OPEN TODAY 10AM-5PM Buy Tickets Shop [Donate](#) Search

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← ALL EVENTS

## COMMUNITY SCIENCE CELEBRATION - PORT ALBERNI

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[I understand](#)

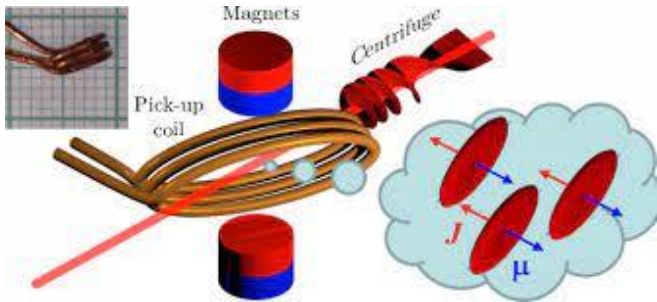
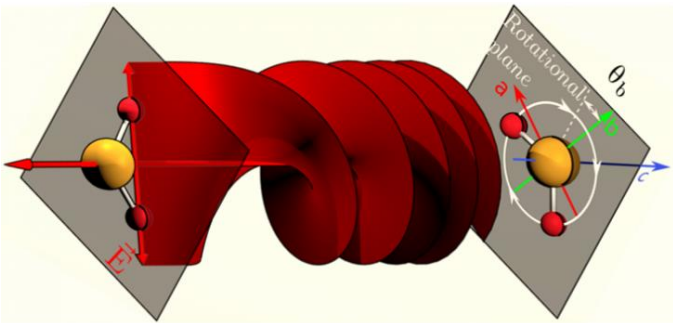
Details

Come join us at the Port Alberni [Community Science Celebration](#) on Saturday, May 18 to explore the Science in YOUR community!

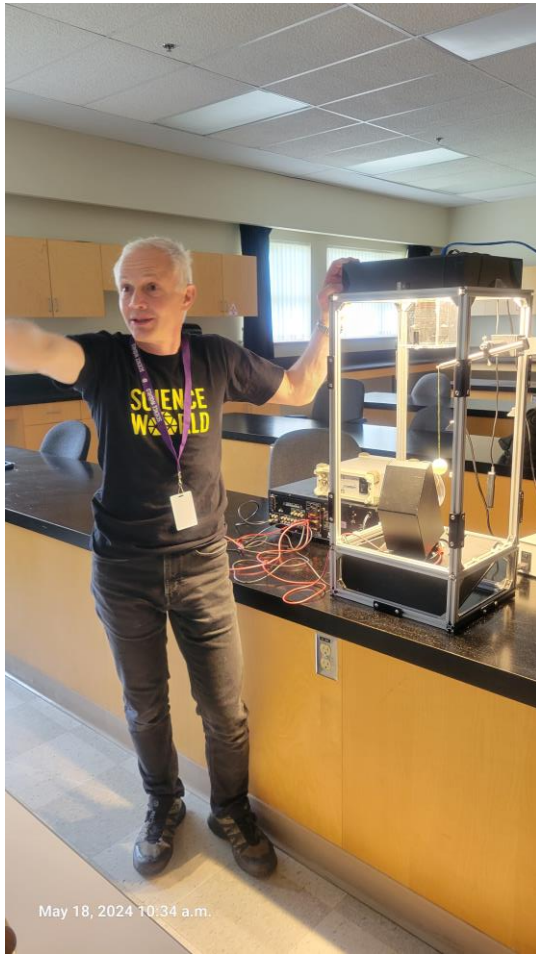
## Visiting remote communities

# 4

# Scientists in Schools

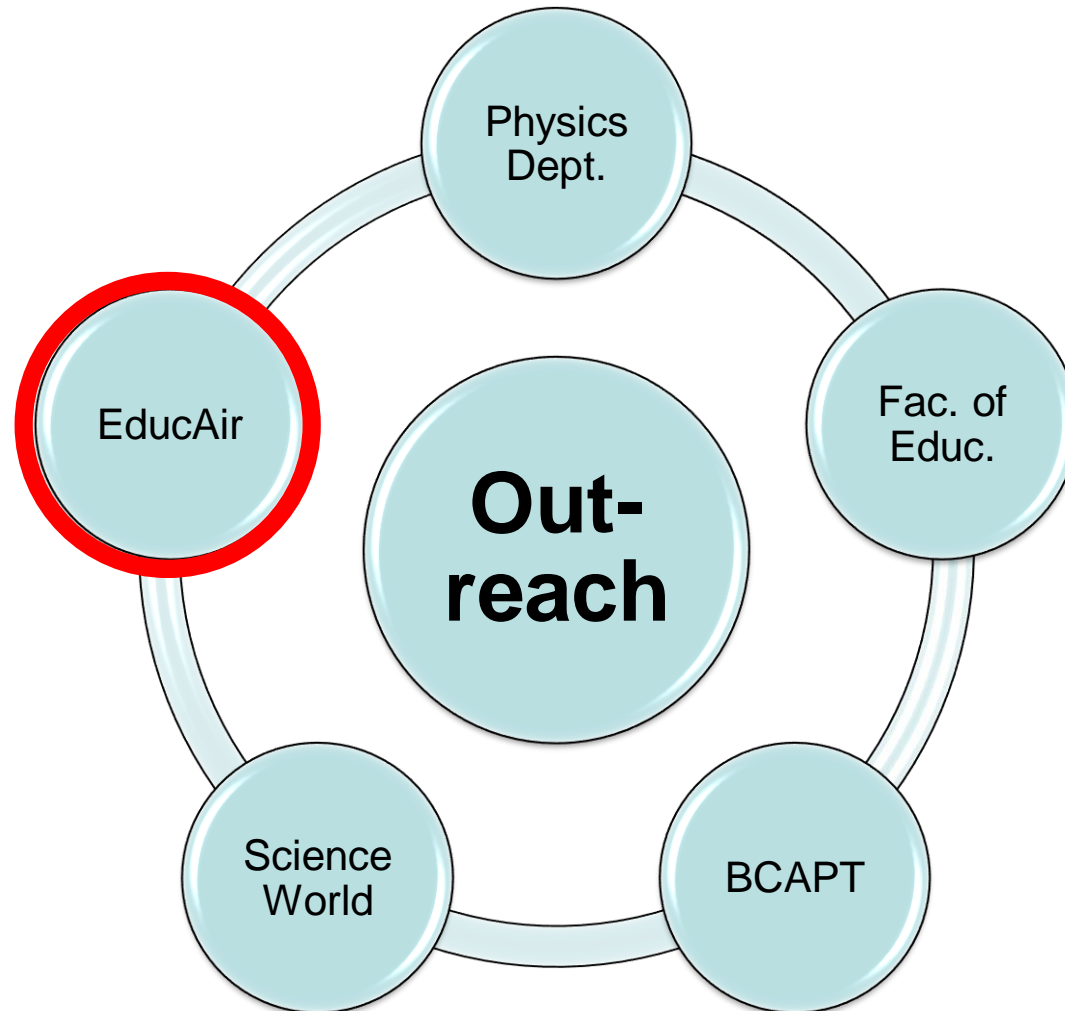


Sharing authentic research



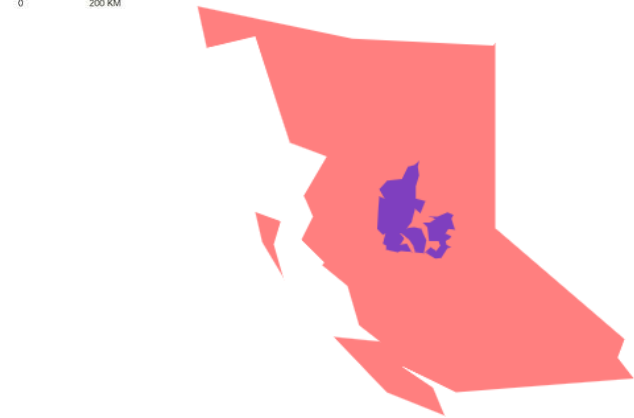
Exploring resonance with a wine glass and a fast-speed camera

# 5. EducAir: Flying for STEM



# 5

# EducAir



Area of BC is ~ 22 times bigger than of Denmark with similar population, and many islands (not all are named). Unlike Denmark, BC has mountains.



Garibaldi Provincial Park in British Columbia





## Flying high for STEM

Science outreach with aviation

Contact us

Recent Trips

<https://educair.ca/>

# 5

# EducAir



## EducAir

[Home](#) [About](#) [STEM Visits](#) [Blog](#) [Gallery](#)



### EducAir STEM Trip # 5: Chatelech Secondary School, Sechelt, BC

Our fifth trip was to a secondary school on Sunshine

23 MAY, 24

[Read More >](#)



### EducAir STEM Trip # 4: Community Science Day, Port Alberni, BC

On Saturday, May 18, 2024, our friends from Scientists and

20 MAY, 24

[Read More >](#)



### EducAir STEM Trip # 3: Carihi Secondary School, Campbell River, BC

This is our second visit to Carihi Secondary School in

20 MAY, 24

[Read More >](#)



### EducAir STEM Trip #2: LV Rogers, Nelson, BC

23 MAY, 23

[Read More >](#)



### EducAir takes off - STEM Trip #1: Carihi Secondary School, Campbell River, BC

<https://educair.ca/>

# Physics Outreach in Canada

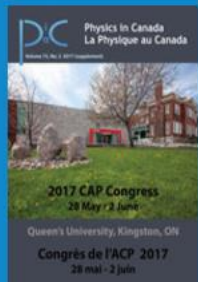
Physics in Canada, Editor Bela Joos

Special Issue on Physics Outreach:

Editors M. Milner-Bolotin, Sarah Johnson

Coming out this October – 2017, Volume 73, number 3

## PiC Archives (1955 - 2017)



Vol 73, No. 2a, 2017



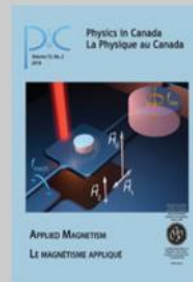
Vol 72, No. 4, 2016



Vol 72, No. 3, 2016



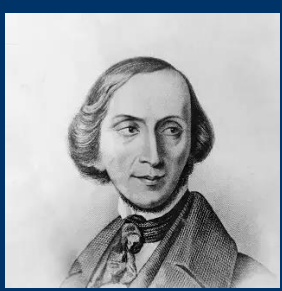
Vol 72, No. 2a, 2016



Vol 72, No. 2, 2016



Vol 72, No. 1, 2016



# Keiserens Nye Klæder

**Science outreach helps us prevent “the Emperor’s new clothes” problem in science by:**

1. Promoting science literacy while **learning from students’ questions**
2. Fostering open dialogue about science **while improving science communication**
3. **Combating pseudoscience** while **understanding people’s concerns**
4. **Building trust in scientific method** while **encouraging scientists to bring science evidence for their claims**



The Emperor’s New Clothes by Hans Christian Andersen (1805-1875)

# Questions & Answers



Rocky Mountains in Canada 37