

# FOUR DECADES OF HIGH SCHOOL PHYSICS OLYMPICS COMPETITIONS AT THE UNIVERSITY OF BRITISH COLUMBIA

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University of British Columbia (UBC) Physics Olympics is a high school physics competition held annually at UBC in Vancouver. This annual outreach event attracts over 450 high school students, competing in teams, and over 55 teachers/coaches from across the province. This competition, organized by the Department of Physics and Astronomy and the Department of Curriculum and Pedagogy at UBC, is one of the largest and oldest high school physics competitions of its kind in North America.

The competition consists of six hands-on events (heats), of which two are pre-built by the students in the months before the competition. In recent years, it also included professional development workshops and networking opportunities for physics teachers/coaches who accompany the teams to the competition.

## PARTICIPATION

Each school may enter one student team, which participates in all 6 events. A team may have a maximum of 15 registered students, of which at most 5 can participate in a given event. Events are designed so undersized teams are not penalized. Each event is run and judged by a UBC faculty member assisted by 5-10 undergraduate and graduate students, in 6 one-hour heats.

### SUMMARY

**More than 450 BC students participate annually in UBC Physics Olympics - one of the largest and oldest high school physics competitions in North America.**

**Key words: hands-on science, high school physics, physics competition, pre-built activities, Science Technology Engineering and Mathematics (STEM), STEM outreach.**



Fig. 1 Student volunteers from the 2016 UBC Physics Olympics.

We receive about 60 registrations annually from all across BC, as far as Terrace [1], Mackenzie [2], and Invermere [2], [3] (1360 km, 970 km and 840 km driving distance from UBC respectively).

## PROGRAM DEVELOPMENT

Over 60 UBC students and 10 faculty members (Fig. 1) volunteer for the event annually. The heats are designed, prototyped and tested beginning in autumn, with some of the ideas originating from the undergraduate and graduate student volunteers. The program's success in attracting excellent students to UBC is reflected in its volunteer composition: about 50% of our volunteers for the event participated in Physics Olympics while they were in high school. The focus of the activities is on the understanding and utilization of physics principles, and not the ability to engineer devices or quickly solve standard physics problems.

## UBC PHYSICS OLYMPICS EVENTS

For the past decade, the Competition has consisted of six heats: two pre-builts, two lab-based and two



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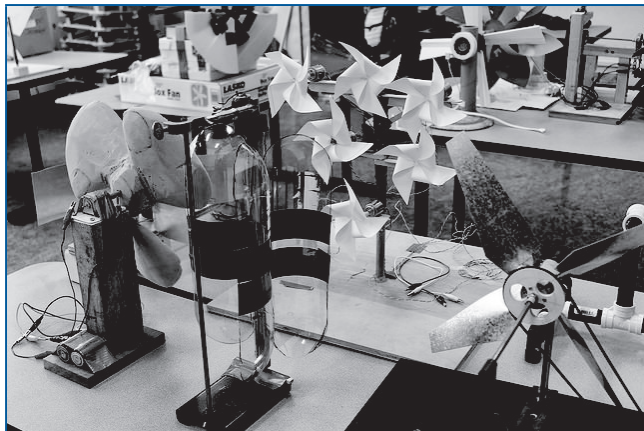


Fig. 2 Examples of students' pre-built projects.

knowledge-based events. Rules and the Rule Books from the past 24 years may be found on the Physics Olympics website <http://physoly.phas.ubc.ca/> [4].

**Pre-Build Events:** Two events require structures pre-built by the students in the month preceding the competition. Students design and construct an apparatus to perform a very specific task, satisfying rules on materials and construction (Fig. 2). For example, past pre-build events include design & construction of a device that:

- displaces the maximum amount of water when dropped in a filled bucket.
- elevates a golf ball by 50 cm in the minimum amount of time, using only the energy stored in a standard mousetrap.
- sustains circular orbital motion of a weight on a string for the longest possible time, using only gravitational potential energy from the descent of weights.

**Laboratory-Based Events:** Two lab-based events involve hands-on work with apparatus. Students are informed of the two general topics in advance, and receive details on the day. Past laboratory events included manipulating a 7-segment display using given circuit elements; building a pendulum with specific properties; determining the volume of irregular shapes using buoyancy concepts; figuring out the drag forces on a marble falling inside a container with viscous fluid; matching given position-time and velocity-time graphs using motion detectors, etc.

**Knowledge-Based Events:** One event consists of Fermi Questions, and the other is “Quizzics”, physics questions in a game-show format in which teams work together to solve and answer physics/astronomy questions and problems. The highlight event of the day brings all student competitors together for the exciting Quizzics championship, in which top teams compete in a gameshow tournament just before the award ceremony (Fig. 3).



Fig. 3 Final Quizzics at the end of Physics Olympics.

## PROFESSIONAL DEVELOPMENT FOR HIGH SCHOOL TEACHERS

In recent years, a faculty member in the Faculty of Education has organized professional development workshops for the benefit of the teachers/coaches who volunteer their time helping students prepare for the Physics Olympics, and accompany them on the trip to UBC.

## AWARDS

Gold, Silver and Bronze medals are awarded to the members of the top 3 teams in each of the 6 events. Each of the top 6 schools in the overall competition receives an engraved plaque to keep in their school; the top team overall gets possession of the grand traveling trophy for the year.

## CONCLUSION

In 2018, UBC Physics Olympics will celebrate its 40th anniversary. It has become one of the best known outreach events run by UBC Departments of Physics & Astronomy and Curriculum and Pedagogy. The positive feedback from the teachers, students and parents underscores the impact of the event on the community. In the words of one of the teachers (Mrs. Shirley Frykberg, used with permission):

*Events such as Physics Olympics provides our students with many opportunities [...] working in a team, across grades outside of the classroom, exposure to competition in a university setting, meeting like-minded students from other schools and towns, extending their math and physics skills beyond the curriculum, honing their critical thinking skills [...] It actually is fantastic what a one day event can provide to boost a student's interest and confidence in physics...*

*For teachers this is a great opportunity to network beyond our busy schedules and to discuss and share ideas with each other. Having the common room for teachers to meet as well as the professional development opportunity is an excellent idea.*

*[...] I also enjoyed hanging out with our students for the day, getting to know them and sharing the joy in their success.*

Events such as UBC Physics Olympics emphasize the value of collaboration between the Faculties of Science and Education in order to engage students in meaningful and creative physics activities.

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