

BRINGING QUANTUM SCIENCE AND TECHNOLOGY TO THE PUBLIC AND YOUTH ACROSS CANADA

SUMMARY: Building trust among the public and opportunities for youth from diverse backgrounds in quantum science and technology requires a multi-faceted approach. In this article, we review a selection of outreach efforts taking place across Canada to build a quantum-aware public and quantum-curious next generation.



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Quantum science is often qualified to be hard to understand, counter-intuitive, and even spooky or weird [1]. It is often seen in pop culture as very technical and reserved for an elite group of scientists. With quantum science taking more and more space in technology development and public investment, how can we build trust with the public and ask them to care about quantum? How do we get teenagers and young adults from a range of backgrounds to consider this field of studies? Providing positive contact with quantum science through thoughtful and inclusive outreach can go a long way towards engaging students of all levels [2]. Many centres dedicated to studying quantum science and technology in Canada are engaged in this essential outreach work.

ACTIVITIES FOR PRE-UNIVERSITY STUDENTS

Introducing quantum science and technology to different groups does not have a one-size-fits-all strategy. Just as some practitioners are more drawn to the philosophical aspects of quantum and others to the technological potential, pre-university students can be engaged with a variety of approaches, including lectures, hands-on experiments, puzzles, virtual games, exhibits, and more. Many groups across Canada have developed novel ways to approach students and other interested learners on a level that works for them, whether in a classroom, museum, library, or online.



Figure 1. Participants in the 2025 [Avantage quantique](#) program at the Institut Quantique de l'Université de Sherbrooke in Sherbrooke, QC attempt a quantum escape game, where they must solve quantum-themed puzzles to release padlocks on the backpack.

[The Quantum Enigmas](#), a series of videos produced by Institut quantique de l'Université de Sherbrooke (IQ), introduces the viewer to quantum programming key concepts via funny paradoxes. It is accompanied by two levels of online exercises to help the viewer understand. To introduce people to the series, IQ also developed the *2-Qubit Dance*, a game inspired by classic arcade dance games. In addition to getting participants on their feet and active, the [2-Qubit Dance](#) introduces them to fundamental ideas in quantum computers like logic gates and the Bloch sphere. By gamifying the theory, we can achieve a positive and fun first contact with the subject.

IQ also partnered with Freemick Aventure, a company that designs escape games, to build an activity for high school students inspired by escape games and involving quantum physics. The escape game component of the activity attracts a lot of attention from the teachers but also from other groups of people as well. For example, without really knowing they are playing with quantum concepts, players must solve an equation by finding numbers made from polarized filters. A science mediator explains those concepts at the end of the game to make sure students understand what they did and link the activity with the science curriculum. Quantum science in the game is seen as a bonus to their experience. Outreach activities with Let's Talk Science / Parlons Sciences, exhibitions like [QUANTUM:](#)

The Exhibition from the Institute for Quantum Computing (IQC), video series like *Quantum 101* from the Perimeter Institute for Theoretical Physics (PI), and online games like those featured *The Quantum Arcade* from UBC Geering Up Engineering Outreach (Geering Up) have also demonstrated a positive impact on participants. Bringing people into a research environment can also improve how people see the value of and opportunities in quantum science. In the nation-wide Quantum Canada Open Doors event in 2025, people had the chance to see labs across Canada: the people, the machines, the effort. Taking people where they can't usually go and taking the time to show them how quantum science is done creates this positive feeling of being part of something special and (ironically for quantum physics) bigger than us! This feeling is empowering and creates that sparkle that makes you want to know more about quantum after the visit. It also inspires the younger generation to be interested in science and to look for other ways to get involved and pursue this path for their future.



Figure 2. Students in Moncton, NB play Quantum 2048, a game on Geering Up's Quantum Arcade introducing quantum concepts like tunnelling to a familiar desktop game.

EFFECTIVELY ENGAGING YOUNG LEARNERS

If you have ever tried to give a child vegetables or medication to a sick pet, there is one simple rule: It cannot taste like vegetables or medicine. The broccoli must be utterly undetectable. The pill must be deceptively enveloped in cheddar. Learning, particularly after-school learning, should be a cleverly

made, captivating game wrapped around a core rich with foundational knowledge. Geering Up thinks of this as the Spinach Smoothie approach.

The question then becomes: what's the recipe to make learning feel like playing?

- 1 heaping scoop of cool science facts
- A healthy pour of inquiry-based approach
- 2-3 spoonfuls of wow-factor
- Two handfuls of supported STEM Identity
- And little to no barrier to entry

A few fruit snacks never hurt either.

What does this look like in practice? At Geering Up, programs are delivered in many formats to accommodate a wide variety of learners. Through in-school workshops, summer camps, weekend events, after-school clubs, online courses, and presentations, we are focused on ensuring that learners feel safe, supported, and importantly — that they're having fun. At the University of Victoria's [HighTechU](#), students spend three weeks in the summer deep diving into quantum through either electrical or software engineering. At the IQC's [Quantum School for Young Students \(QSYS\)](#), students from across the globe learn the fundamentals from experts, conduct labs with real quantum systems, and build a network of like-minded quantum champions [3].

A big part of this is explicitly championing groups that have been systemically excluded from STEM spaces. All Girls* (inclusive of cis and trans girls, genderqueer or non-binary people, and those who identify as other gender minorities), Indigenous STEM, Black Youth, and subsidized programming are all crucial for a diverse future. The University of Toronto's *Girls in STEM* programming, for example, provides this opportunity. Quantum mechanics carries a mystique and sci-fi connotation that can be intimidating, and pop-culture references have only added to this. Contrarily, quantum mechanics is as core to our existence as breathing, eating, or the water cycle. So why can we easily show one to a young learner and not the other? The answer is in the Spinach Smoothie approach- it's up to educators to make quantum mechanics a positive, approachable topic. As an example: superposition is a fundamental mechanic of the natural world but is often presented in complex math. Geering Up succeeded in engaging classes of grade 6/7s by developing a game of quantum battleship, where players solve for the probability of hitting their opponents' ships. When learning is gamified, students will wholeheartedly dive into complex topics and keep learning.

QUANTUM SCIENCE FOR TEACHERS

To reach students across Canada at scale, outreach efforts through even large educational and research institutions will struggle. One possible way to introduce more students to the excitement and opportunities of quantum science is by providing teachers with tools for their classrooms. While quantum science is part of the high-school curriculum in many provinces, usually in the final-year physics class, this is not the case nation-wide. When quantum science is present in the curriculum, it is often with a historical perspective focused on phenomena like wave-particle duality and the photoelectric effect [4] but not features like entanglement and coherence considered key for current

quantum communication and quantum computing, as well as technologies that have been making an impact for decades like atomic clocks and MRI. In addition to developing the theory in a way that connects to the curriculum, a variety of options for hands-on lab activities are presented, many of which require little to no budget. These include using diffraction from a human hair to demonstrate interference, using dice with removable faces to explain trade-offs in the uncertainty principle, and coins and boxes to role-play the quantum key distribution protocol.

After the workshops, most participants felt knowledgeable about (40/41) and confident teaching (37/41) these concepts. Other opportunities for teachers in Canada include the [EinsteinPlus](#) workshop and various others by PI and *Classe quantique* by IQ. There is certainly an appetite for quantum support among educators, with QEd participants over the years consistently ranking videos and hands-on lab activities as the most in-demand resources.

CONCLUSION

Our understanding of quantum science has impacted lives across the globe for the past 100 years. It is no longer considered niche or radical by scientists, but still is considered as especially abstract and difficult by most of the public. Breaking that perception and empowering the next generation to seriously consider studying quantum science necessitates a variety of approaches and working closely with students, teachers, and our community more broadly. With quantum research happening from coast-to-coast and multiple internationally recognized initiatives to engage students and the public, it is possible to make quantum ideas and opportunities accessible to all Canadians.

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