SPOTLIGHT ON SCIENCE LEARNING

Snapshot of a Decade

2012-2022

AMGEN®

let's talk science

Mission

Let's Talk Science is a national, charitable organization that motivates and empowers youth to fulfill their potential and prepare for their future careers and roles as citizens. Let's Talk Science supports learning and skill development through engagement in science, technology, engineering and mathematics (STEM).

Spotlight on Science Learning: Snapshot of a Decade is the latest research report from Let's Talk Science, made possible by Amgen Canada.

For more information about Let's Talk Science, please visit **letstalkscience.ca**.

Acknowledgements
Let's Talk Science and Amgen Canada would like to acknowledge the support and assistance provided by the following individuals: Karin Archer; Stuart Foxman; Roger Holstein; Kristen Odegaard; Bonnie Schmidt; Emily Krysten Spencer-Muller; Justine Sparling; Rana Van Tuyl

This publication is also available online at **letstalkscience.ca/spotlight**

Executive Summary

Ten years after Let's Talk Science produced the first Spotlight on Science Learning report, the environment has changed considerably. The evolution towards a sustainable economy – one that addresses the impact of climate change and the global pandemic – is reshaping expectations for work and citizenship. The rapid rise of misinformation further highlights the importance of scientific literacy, trust in science and STEM skills. In this report, we look at the past decade and what has changed, what hasn't changed and what needs to change.

Like most countries around the world, Canada faces new challenges: driving productivity and economic growth in responsible and sustainable ways, while transforming how work is done in an increasingly digital environment. Addressing these challenges will require creative solutions that demand deep and broad capabilities in STEM – science, technology, engineering and math. Are we positioned well to meet the moment?

"Strong interest and abilities in STEM are critical. We require them to fill and create rewarding jobs across all sectors. We also need those probing and problem-solving STEM traits to grow a thriving 21st-century economy, foster innovative processes and discoveries, and keep Canada competitive."[1]

That's what we wrote in 2012, in our first Spotlight on Science Learning (SOSL) report. It is even more true a decade later.

A scientifically literate and STEM-skilled population benefits us all. A strong foundation built on meaningful science and technology engagement prepares young people for STEM-related careers, or for any jobs that call on STEM skills like problem-solving and related characteristics such as resiliency. It also helps them to be informed and engaged citizens.

Ten years after our first SOSL report, what has changed, what hasn't changed, and what needs to change with respect to STEM learning and engagement?

Since we released our **Benchmark of Canadian Talent**[1] report 10 years ago, we have published four other Spotlight on Science Learning reports:

1. **The High Cost of Dropping Science and Math**[2];
2. **Shaping Tomorrow's Workforce: What do Canada's Teens Think About Their Futures?**[3];
3. **Exploring Parental Influence: Shaping Teen Decisions Regarding Science Education**[4]; and
4. **The Evolution of STEM Education: A Review of Recent International and Canadian Policy Recommendations**[5].

Our first report shared recommendations from an expert panel about what to track to help us monitor and evaluate the outcomes of STEM learning. Since then we have continued to monitor these recommendations, several of which highlight the choices made by students in Canada and the opportunities available to them.

The world is very different now than it was when the first SOSL report was completed. The passing of a decade offers an opportunity to reflect and see where we stand now.

The charts that populate this report offer some insight into academic patterns and performance, post-secondary education decisions, degrees and diplomas, job needs and gaps, and more. The data in this report has been gathered from a variety of public sources. We have also included examples of best practices from organizations striving to address the challenges.

What has changed

When assessing what has changed in the STEM landscape, there has been increased awareness and recognition of the importance of STEM overall.

Ten years ago, we needed to define the acronym. Now there are STEM academies, STEM magnet schools, STEM clubs, STEM toys and more. "STEM" has become a marketing brand, itself. Digital literacy has increased priority in schools, clubs and camps. Students, parents and the public at large are familiar with the STEM definition and acknowledge its importance. A poll we recently conducted found that 95% of adults support and recognize the value of youth STEM education.

The STEM outreach sector has grown significantly over the decade with many organizations offering programs that engage youth, educators and the public. The ecosystem includes organizations and networks like Let's Talk Science, along with science centres, museums, zoos, aquariums and many others. Industry and the research community are also increasingly engaged in STEM outreach and public awareness activities. While these collective efforts continue to be fragmented, they have played an essential role in strengthening the science culture in the country.

The outreach ecosystem benefits from investments made by governments at all levels. At the federal level, for example, the government has invested in initiatives like CanCode[6] to support digital literacy, resulting in opportunities for youth to gain skills and experience in coding, data analytics, digital content development and more. Other federal programs aim to promote science and engineering more broadly (NSERC PromoScience[7]), while others give access to science projects and experiments (Citizen Science Portal[8]).

What has changed

The federal government has also shown its commitment to close the digital divide and ensure there is high-speed broadband Internet access across Canada.[9] This technology infrastructure is recognized as a key enabler for equity and prosperity.

In elementary and secondary schools, we've seen some advances in STEM-based learning models, along with the adoption of concepts like 21st Century Skills and global competencies. These relate to the acquisition and development of a set of attitudes, skills, knowledge and values – things like critical thinking, collaboration, innovation, creativity, global citizenship and sustainability. These skills and attributes can be developed through meaningful STEM engagement.

At the post-secondary level, many universities and colleges are adding new programs and expanding the number of students accepted into STEM programs, as described later in this report.

Something else fundamental has changed. While acknowledgement of the importance of science literacy is on the rise, so are misinformation and distrust.

Consider the global COVID-19 pandemic, which has had a profound impact, for good and ill, on the perception of science and public trust in science.

The pandemic highlighted the value of scientific literacy to support citizens in understanding and following public health measures. For the first time, people around the world saw science happen in real time through daily briefings by public health officials and the development of vaccines. For a time, and for much of the population, trust in science rose. The Canadian results of a global **3M survey**[10] found that skepticism toward science dropped, and the percentage of Canadians more willing to advocate for science doubled.

Other STEM areas showed rapid change during the pandemic. While schools closed for in-person learning across Canada, technological advances enabled remote learning for students at all levels.

A national initiative called **#ScienceUpFirst** aims to stop the spread of misinformation relating to health such as COVID-19. This effort is managed by the Canadian Association of Science Centres (working with a collective of independent scientists, researchers, health care experts and science communicators), and is supported by the Public Health Agency of Canada.

Organizations accelerated digital adoption as well. A **McKinsey report**[11] indicated that COVID-19 pushed companies over the technology tipping point, speeding up digitization by several years, and transforming businesses forever.

At the same time, there was an epidemic of misinformation around STEM, largely propagated through social media. Misinformation has been prevalent throughout the pandemic, as evidenced by the rise of anti-vax conspiracy theories and challenges to evidence-based public health measures such as masking. For some, this has led to decreased trust in science. Part of the reaction might be explained by politics. However, an apparent lack of understanding about scientific processes also fostered distrust among many people. They wondered how vaccines could be developed so fast, or why public health recommendations changed as new evidence emerged about the virus.

Misinformation has also been rampant in the discourse around climate change, exacerbating what is already an existential threat.

It all showcases the importance of literacy and trust in science, and having an informed ability to think critically, ask meaningful questions and use evidence appropriately. It also highlights the dangers of wilful ignorance.

We need to gain an even greater understanding about - and ability to communicate - how science influences our lives and why people engage or disengage with it. With this understanding, we can also rebalance the demand and supply equation to address current and emerging needs.

What has changed

On the demand side, the needs are clear. Entire sectors, and all types of forecasted jobs, will call on STEM skills, attributes and knowledge. Figure 1 shows projected employment growth by industry through most of this decade, with significant gains forecast in STEM fields. Figure 2 shows how the transition to a green economy will lead to critical workforce shortages in 10 broad areas.

Figure 1: Employment Growth by Industry (2019-2028)

Industries Projected to Have the Strongest Employment Growth, Projection 2019-2028 (average annual growth, in percentage)

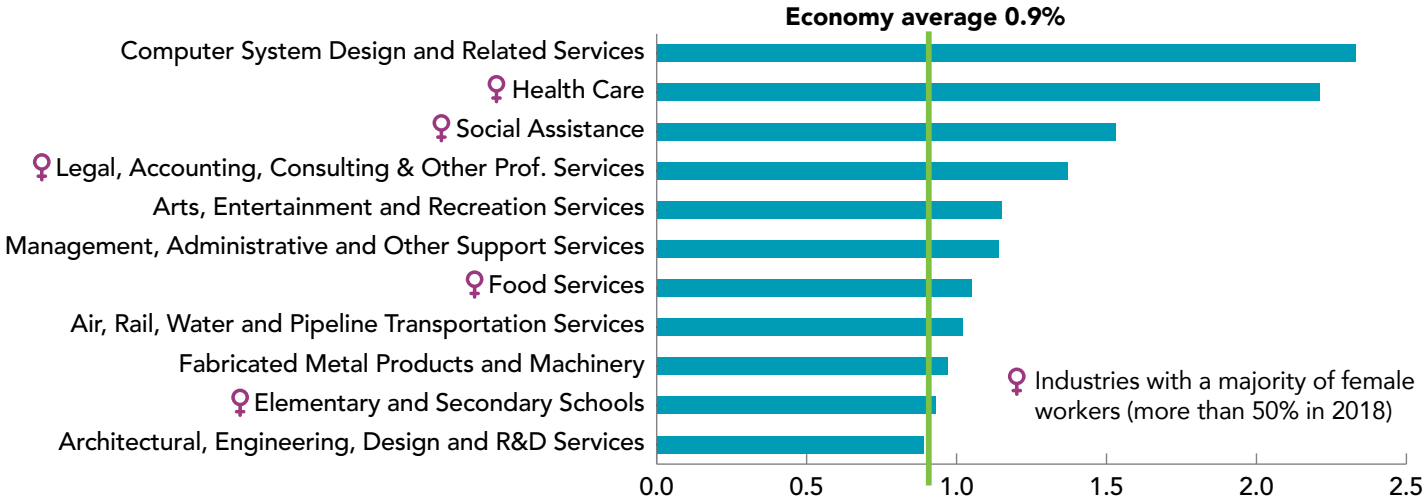


Figure 1: ESDC 2019 COPS industrial projections. https://occupations.esdc.gc.ca/sppc-cops/l.3bd.2t.1.3lshtml@-eng.jsp?fid=1&lid=22&preview=1

Figure 2: Shortages expected in environmental workers in Canada

The following occupations are projected to experience a critical shortage of environmental workers across Canada due to (1) wider supply/demand gaps, (2) post-secondary education pre-requisites, and (3) environmental-specific competency requirements:

- Legislators and senior management
- Engineering inspectors and regulatory officers & inspectors in public and environmental health and occupational health and safety; Non-destructive testers and inspection technicians
- Utilities equipment operators and controllers (incl. water and wastewater treatment plant operators)
- Physical and life sciences professionals
- Construction managers; Construction millwrights and industrial mechanics
- Electrical and electronics engineers; Aerospace engineers & other professional engineers
- Architects; Landscape architects; Urban and land use planners & land surveyors
- Forestry technologists and technicians & conservation and fishery officers; Agricultural and fish products inspectors
- Managers in manufacturing and utilities
- Contractors and supervisors, mining, oil and gas

Figure 2 https://info.eco.ca/acton/attachment/42902/f-e71451d5-61a8-4207-9712-b0c2641a7877/1/-/-/-/-/Outlook%20Report%20to%202025.pdf

What has changed

These employment shifts are outpacing changes in school curricula. While the goal of elementary and secondary education is not to train workers, a significant disconnect could be problematic. The growing focus on global competencies, at least in some jurisdictions, places a focus on the key skills and competencies required for work and citizenship demands. However, there is a clear need to evolve the curricula at elementary and secondary levels even more.

The Organisation for Economic Co-operation and Development (OECD) has recognized the need for change. The OECD, an intergovernmental organization that promotes policies to improve economic and social well-being, implements the Programme for International Student Assessment (PISA). PISA measures the ability of 15-year-olds to use their reading, mathematics and science knowledge and skills to meet real-life challenges. This international test is administered in over 80 countries and is considered a bellwether for curriculum change.

In early 2020, an international **panel of experts recommended**[12] that PISA evolve to assess student performance related to several new fields and dimensions. Among them: informatics and artificial intelligence; the development and misuse of scientific knowledge; socio-environmental systems and sustainability; using scientific knowledge for decision-making; understanding probabilities and risk; science ethics; and the capacity to critically use science for personal and social benefit.

This is quite different from past assessments and highlights the evolving relevance of STEM in our lives.

To succeed and live better in our world, the demands for STEM engagement and literacy are growing and changing. However the supply side of talent development is not keeping up, especially at high school graduation. We continue to graduate too few students with senior high school STEM courses. A mass of students are still abandoning STEM courses at first chance, which is usually after Grade 10.

It's not that we need more young people to specifically study biology, chemistry and physics. But we do need more students who are able to take on the challenges of today and tomorrow, which are increasingly shaped by STEM.

What hasn't changed

While much has changed over the past decade, other critical aspects have not changed enough. Growing attention on science learning has not translated into a significantly broader and more diverse pipeline of STEM talent among domestic students, despite an increase in overall post-secondary enrolment.

In Ontario, for example, the centralized application process shows that there has been an increase in the number of applications to post-secondary STEM programs over the past decade, outpacing applications for other disciplines (Figure 3). Overall in Canada, registrations to and graduations from post-secondary STEM programs have also increased by more than 10% over the last two decades (Figure 4). However, these findings can be deceiving when taking a closer look at domestic versus international students.

Figure 3: Applications (number and percentage) to post-secondary STEM programs in Ontario

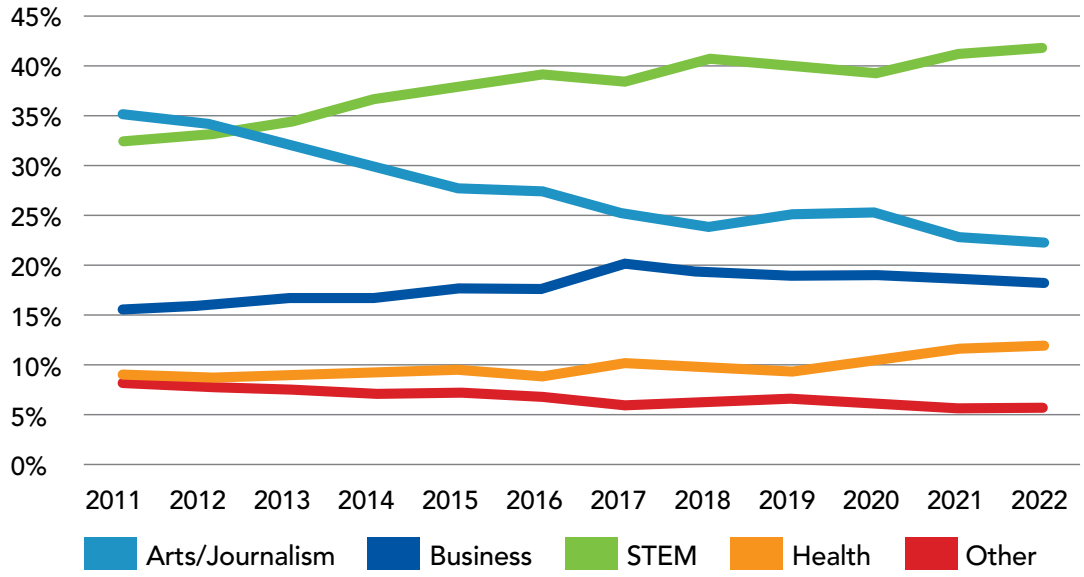


Figure 3 Percentage of total enrolments in STEM + Health, by post-secondary sector in Canada (retrieved from https://higheredstrategy.com/ontario-applications-data-2022/)

Figure 4: Registrations (by year) to and graduation (number and percentage) from post-secondary STEM programs at all levels (e.g. undergraduate degrees, graduate degrees, diplomas)

Percentage of total enrolments in STEM + Health, by post-secondary sector (university and college) in Canada. Over the past two decades, the proportion of students in these disciplines has increased by more than 10%.

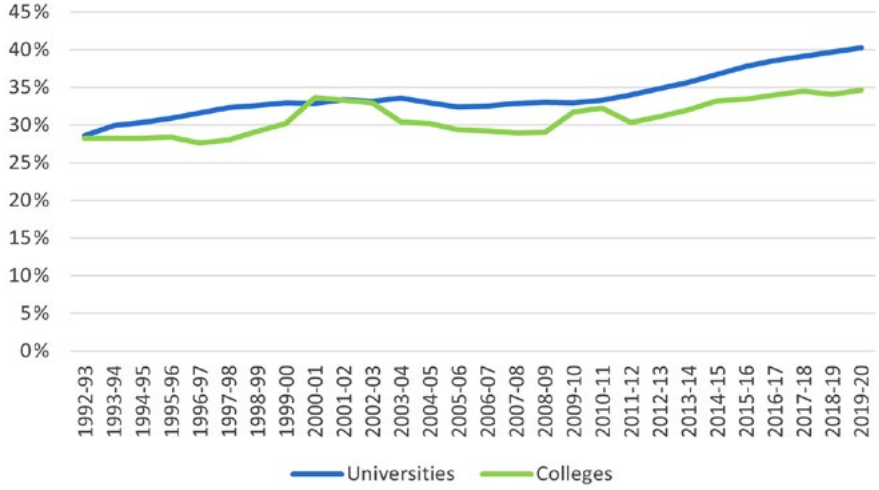


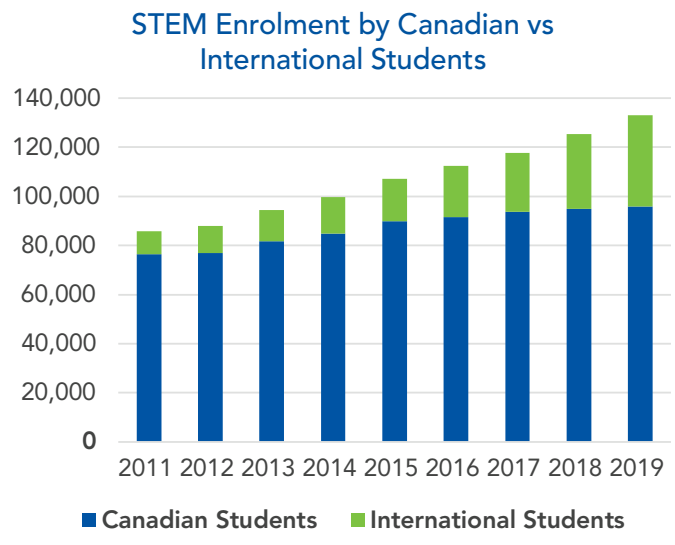
Figure 4 Percentage of total enrolments in STEM + Health, by post-secondary sector in Canada (retrieved from https://higheredstrategy.com/statscan-enrolment-day-2021/)

What hasn't changed

In 2019, 587,151 Canadian students were enrolled in post-secondary studies, up from 467,034 in 2011. However, the apparent growth in post-secondary participation could be misleading. The numbers are boosted by the year-over-year increases in international student registration in post-secondary STEM programs. So while the total number of students is increasing, domestic students actually represent a declining percentage of total STEM graduates, from 89% in 2011 to 72% now (Figure 5).

Figure 5: Proportion of university STEM enrolment of Canadian vs. International students (2020)

Graphs show the number and proportion of domestic and international students pursuing post-secondary STEM studies in Canada during 2011 – 2019. While their number has increased over the period, domestic students represent a declining percentage of total STEM students as international students grew to represent 28% of the total, pre-pandemic.



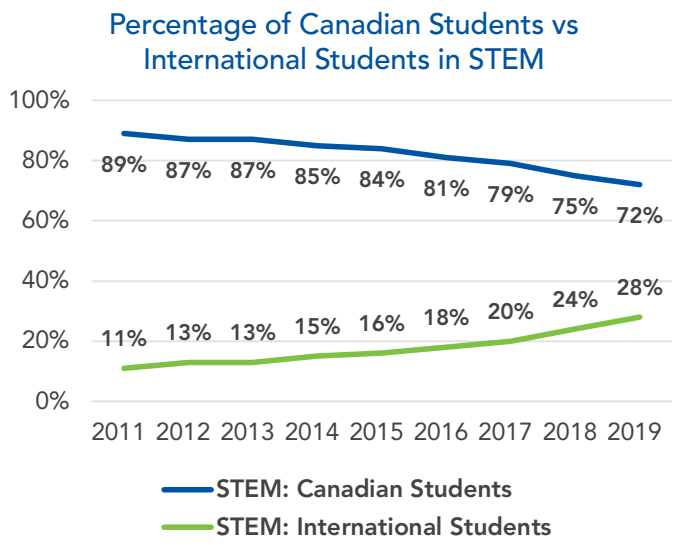


Figure 5 Statistics Canada. Table 37-10-0164-01 Post-secondary graduates, by International Standard Classification of Education, institution type, Classification of Instructional Programs, STEM and BHASE groupings, status of student in Canada, age group and gender. DOI: https://doi.org/10.25318/3710016401-eng

What hasn't changed

The performance of students on the math and science Pan-Canadian Assessment Program (PCAP) tests has remained status quo (Figure 6 and Figure 7).

Figure 6: PCAP achievement scores in Mathematics 2013 vs. 2019

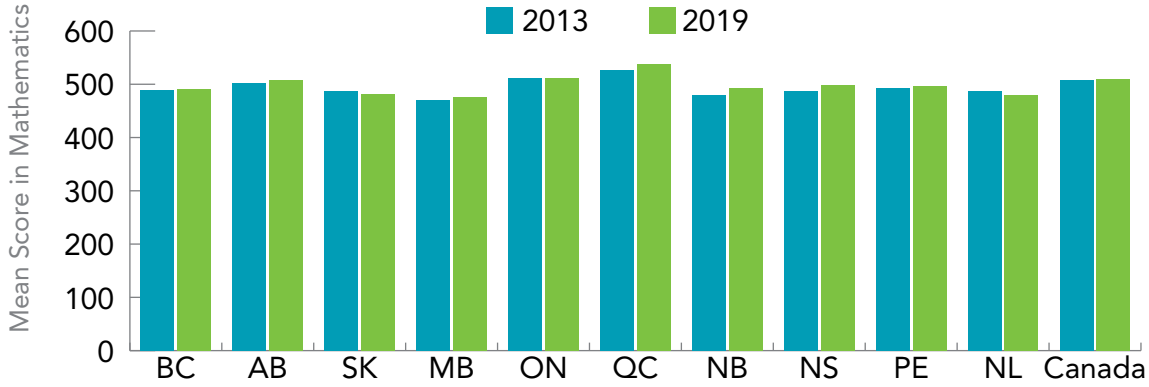


Figure 7: PCAP achievement scores in Science 2013 vs. 2019

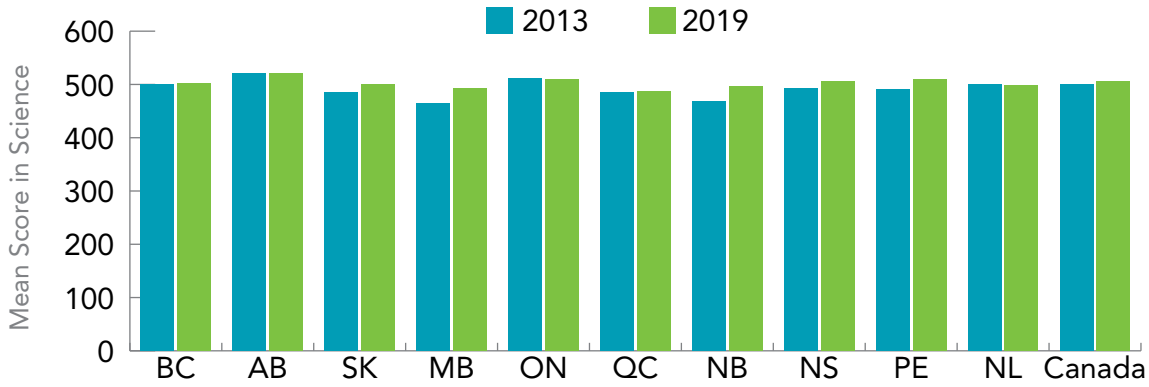
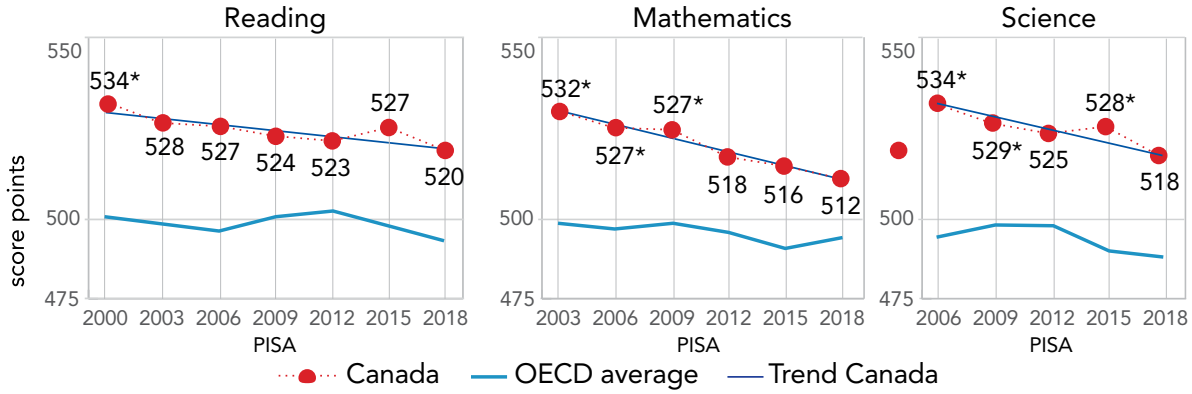


Figure 6 &7. Council of Minsters of Education, Canada (2021) PCAP 2019: Report on the Pan-Canadian Assessment of Mathematics, Reading, and Science. Retrieved from: https://www.cmec.ca/Publications/Lists/Publications/Attachments/426/PCAP2019-Public-Report-EN.pdf

What hasn't changed

Canada is still in the top tier internationally, above the OECD average. But year over year, our scores are actually slipping somewhat, more so in math and science than in reading (Figure 8). There are no easy conclusions, however, some Canadian jurisdictions have placed a greater emphasis on skills and competencies that may not be aligned with the current PISA tests.

Figure 8: Student performance on international science and math tests (PISA)



Note: *indicates mean-performance estimates that are statistically significantly above or below PISA 2018 estimates

Figure 8: OECD, PISA 2018 Database, Tables I. B1.10, I. B1.11 and I. B1.12. Retrieved from: https://www.oecd.org/pisa/publications/PISA2018_CN_CAN.pdf

Student participation in optional STEM courses at high school has also remained fairly flat. There have been slight increases at best in Grade 12 course selection (Figure 9). However, the majority of Canadian students do not take biology, chemistry, physics or computer science in Grade 12.

Figure 9: Average national participation rate in various Grade 12 courses (2008-2019)

Average national participation rate in various Grade 12 courses that are commonly accepted for admission to university STEM studies.

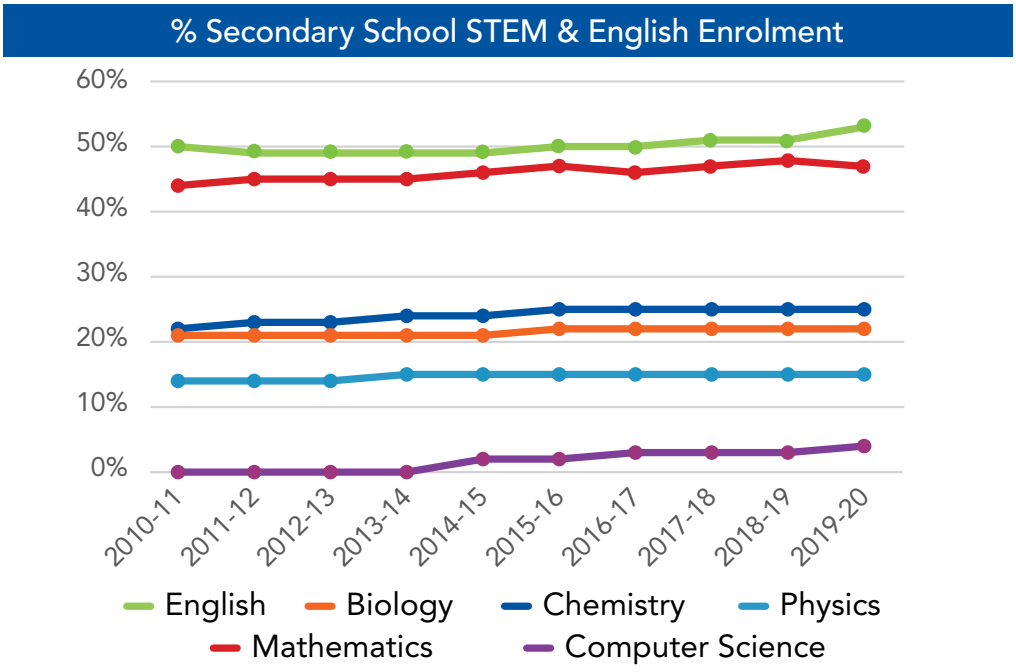


Figure 9. Average percentage enrolment of students in various Grade 12 courses in BC, ON, NL, SK AB, NB, PE where data was available (Collected from the Ministry of Education within each Jurisdiction).

What hasn't changed

Admission requirements for post-secondary science and engineering programs typically include a combination of Grade 12 biology, physics, chemistry and math credits. Based on aggregate student data obtained from Ministries/Departments of Education across Canada, the majority of students continue to graduate without completing those courses.

More than half of students still graduate high school without the senior level math and/or science credits needed for entry to university STEM studies. That closes many doors.

Grade 12 math has the highest national completion rate at 47%. Trailing behind are: chemistry – 25%; biology – 22%; physics – 15%; and computer science – 3%.

The required high school science credits needed to graduate haven't moved much as shown in Figure 10. Four jurisdictions require four credits, one requires three credits, seven jurisdictions require two credits, and one requires just a single credit. And only four jurisdictions require at least one of those credits to be from Grade 11 or 12.

Figure 10: Number of science credits required for graduation

Number of science credits required for secondary school graduation by jurisdiction. Graduation requirements vary by province and territory but all jurisdictions require at least one science credit for secondary school graduation – most require two science credits. In four jurisdictions, at least one science credit must be at the senior level.

Jurisdiction	Number of Science Credits Required for Graduation	Includes at least 1 credit at Grade 11 or 12
British Columbia	**4**	**YES**
Alberta	**2**	
Saskatchewan	**2**	**YES**
Manitoba	**2**	
Ontario	**2**	
Quebec	**4**	
New Brunswick	**1**	**YES**
Nova Scotia	**3**	
Prince Edward Island	**2**	
Newfoundland and Labrador	**4**	
Yukon	**4** (follow BC requirements)	**YES**
Northwest Territories	**2**	
Nunavut	**2**	

What hasn't changed

Admission requirements for university faculties of science are slow to evolve. However, with the expansion of new post-secondary programs, admission requirements appear to be broadening in approximately 60% of the universities reviewed as described in Figure 11. This trend should be encouraged.

Figure 11: Admission Requirements to Faculties of Science across Canada (2022)

	Earth & Space Science Accepted	Computer Science Accepted	Could Apply Without Pure Science	Admission Requirement to Science Faculty
Acadia University			**YES**	Pure sciences recommended for most science programs but not required
Brandon University				Biology 40S or Chemistry 40S, Physics 30S (Physics 40S preferred) required for most science programs.
Brock University	**YES**	**YES**	**YES**	2 of: SB14U (Biology), SC4U (Chemistry), SPH4U (Physics), MCV4U (Calculus and Vectors), MHF4U (Functions), SES4U (Earth and Space Science), ICS4U (Computer Studies)
Cape Breton University	**YES**	**YES**	**YES**	2 Science 12 level (did not specify which science courses are accepted)
Carleton University	**YES**		**YES**	2 of: Calculus & Vectors MCV4U, Biology SBI4U, Chemistry SCH4U, Physics SPH4U or Earth & Space Science SES4U
Concordia University		**YES**	**YES**	2 of: Mathematics 30-1 (Advanced Functions MHF4U), Mathematics 30-2, Mathematics 31 Calculus and Vectors (MCV4U), Biology 30, Chemistry 30, Computing Science Advanced, Physics 30, Science 30 (Science 12U)
Dalhousie University	**N/A**	**N/A**	**YES**	No science specific requirements
Lakehead University	**YES**		**YES**	2 of: Advanced Functions (MHF4U), Biology (SBI4U), Calculus & Vectors (MCV4U), Chemistry (SCH4U), Data Management (MDM4U), Earth & Space Science (SES4U), or Physics (SPH4U)
McGill University				2 of: Biology SBI4U, Chemistry SCH4U or Physics SPH4U
McMaster University	**YES**	**YES**	**YES**	2 of: Biology SBI4U, Chemistry SCH4U, Physics SPH4U, Earth & Space Science SES4U, Computer Science ICS4U, Computer Engineering Technology TEJ4M
Memorial University of Newfoundland	**YES**		**YES**	1 of: Biology 3201 Chemistry 3202 Physics 3204 Earth Systems 3209
Mount Allison University		**YES**	**YES**	1 grade 12 level science (will consider without science credit)
Mount Saint Vincent University	**YES**	**YES**	**YES**	Grade 12 academic science
Nipissing University				Most science programs require at least one of Biology, Chemistry or Physics
Ontario Tech University				2 of: Biology (SBI4U), Calculus and Vectors (MCV4U), Chemistry (SCH4U) or Physics (SPH4U)
Queen's University				2 of: Biology SBI4U, Chemistry SCH4U or Physics SPH4U
	27%	**32%**	**59%**	

What hasn't changed

	Earth & Space Science Accepted	Computer Science Accepted	Could Apply Without Pure Science	Admission Requirement to Science Faculty
Redeemer University				5 Grade 12 U or M level courses - Most science programs require one or more Biology, Chemistry or Physics
Simon Fraser University				2 of: Anatomy & Physiology (Biology 12), Calculus, Chemistry, Physics
St. Francis Xavier University				2 of: Biology 12, Chemistry 12, Physics 12
St. Mary's University		YES	YES	1 academic 12 science course (Biology, Chemistry, Physics or Computer Programming)
Thompson Rivers				Most programs require Life Sciences 11 or Anatomy and Physiology 12 and Physics 11 or Chemistry 11
Toronto Metropolitan University				2 of: Biology SBI4U, Chemistry SCH4U or Physics SPH4U
Trent University	N/A	N/A	YES	General science program with no science specific requirements. Students choose specialization in the 2nd year of study.
Trinity Western University	N/A	N/A	YES	No science specific requirements, however, grade 12 biology, chemistry and physics are strongly encouraged for entry into a science program.
University of Alberta		YES	YES	2 of: Computing Science ADV(CTS-5Cr), Physics 30, Biology 30, Calculus and Vectors (MCV4U), Chemistry 30
University of British Columbia				1 of: Grade 12 Biology, Chemistry, or Physics
University of Calgary		YES	YES	2 of: Biology SBI4U, Chemistry SCH4U or Physics SPH4U, Calculus and Vectors MCV4U, Computer Science ICS4U
University of Guelph				2 of: Biology SBI4U, Chemistry SCH4U, Physics SPH4U
University of Lethbridge	N/A	N/A	YES	Could apply to general science program with no science specific credits, however, specific courses are required for certain specialized streams.
University of Manitoba		YES	YES	1 of: Biology, Chemistry, Computer Science, or Physics 40S
University of New Brunswick			YES	1 of: Senior Physics, Senior Biology or Senior Geology, Senior Chemistry
University of Northern British Columbia			YES	Could apply to some science programs without science specific credits, however, most programs require Life Sciences 11 or Anatomy and Physiology 12; Physics 11 or Chemistry 11
University of Ottawa	YES			2 of: Biology SBI4U, Chemistry SCH4U, Physics SPH4U, Earth & Space Science SES4U
University of Prince Edward Island		YES	YES	2 of: Grade 12 Chemistry, Biology, Physics, Computer Science, Oceanography, Animal Science, Environmental Science
University of Regina				2 of: Biology 30, Chemistry 30, Math 31, or Physics 30
	27%	32%	59%	

What hasn't changed

	Earth & Space Science Accepted	Computer Science Accepted	Could Apply Without Pure Science	Admission Requirement to Science Faculty
University of Saskatchewan				2 or more: Biology SBI4U, Chemistry SCH4U or Physics SPH4U
University of the Fraser Valley		YES	YES	1 of: Anatomy and Physiology, Chemistry, Computer Science, Geography, Geology, Physics, or Statistics
University of Toronto				1 or more of: Biology SBI4U, Chemistry SCH4U or Physics SPH4U
University of Victoria	YES			2 of: Biology - SBI4U, Chemistry - SCH4U, Earth & Space Science - SES4U, Physics - SPH4U
University of Waterloo	YES		YES	2 of: Biology SBI4U, Chemistry SCH4U, Physics SPH4U, Earth & Space Science SES4U, Data Management (MDM4U)
University of Western Ontario	YES	YES	YES	2 of: Advanced Functions MHF4U, Data Management MDM4U, Biology SBI4U, Chemistry SCH4U, Physics SPH4U, Earth & Space Science SES4U or Computer Science ICS4U
University of Windsor				2 of: Biology SBI4U, Chemistry SCH4U or Physics SPH4U
University of Winnipeg			YES	Could apply to some science programs without science specific credits, however, Chemistry 40S required for most programs
Vancouver Island University	N/A	N/A	YES	Some science programs with no science specific requirements
Wilfrid Laurier University			YES	2 or more of: Advanced Functions MHF4U, Biology SBI4U, Chemistry SCH4U or Physics SPH4U, or Calculus & Vectors MCV4U
York University				1 or more of: Biology SBI4U, Chemistry SCH4U or Physics SPH4U
	27%	32%	59%	

Post-secondary admission requirements have a significant influence on the uptake of optional high school STEM courses. For example, if a college or university requires Grade 12 biology as opposed to another multi-disciplinary course, that will influence student choice. And if students consider the pure sciences "hard" and feel it will drop their overall marks, affecting their post-secondary prospects, they might not be too inclined to take those courses at all.

What does "hard" really mean? So much of this is related to relevancy and pedagogy. If students don't see why a science course (or any subject area) matters, it's often perceived to be harder. And students might not see the relevance because they don't appreciate (or haven't been exposed to) the diversity of career pathways that can follow.

The training of educators hasn't changed much either. While there does appear to be more focus on including global competencies in pre-service education, there appear to be no new requirements for teaching STEM, including no consideration for work experience outside the education sector.

Sourcing education statistics like post-secondary application rates is still difficult at the national level. That's because each jurisdiction uses a different application process. Only Ontario and British Columbia use a centralized post-secondary admissions process. Canada has no common data systems and inconsistent high school course codes. In this context, it can be hard to compare data appropriately, making it challenging to assess trends.

What needs to change

> What's clear is that we have to find ways to fill critical pathways and career pipelines, with major talent shortages expected in many STEM fields.

Among the industries projected to post the strongest growth in employment are computer systems design and related services, health care and engineering. In every industry, moreover, technology advances are creating new opportunities. And a large number of senior level engineers, technology professionals and scientists are preparing to retire.

Add it all up and STEM job openings will abound. However, in many cases the demand appears to be rising faster than our ability to fill them.

A 2021 KPMG survey[13] asked Canadian corporate leaders to name the biggest threats to business growth. Number one was a shortage of digital skills. Canadian businesses can't recruit digital technology specialists fast enough to keep up with new technology solutions. Canada needs those workers to take full advantage of existing technology and create future innovations.

Demand is outpacing supply in other fields too. Health care is one of the fastest-growing sectors. Yet research points to continued and future labour shortages across the field. That's especially true in biomanufacturing, which is also important in the food and chemical sectors.

The green economy is also expanding rapidly. A forecast from Environmental Careers Organization Canada[14] says that job growth and retirements will account for 173,000 net job openings in this broad sector by 2025. We expect to see labour shortages across a wide range of occupations, from physical and life science professionals, to environmental health inspectors, to mechanical engineers, to urban and land use planners. These shortages could stunt the ability of organizations across all industries to reach environmental goals.

A STEM education can be a golden ticket. Workers with STEM skills are growing in demand, with the average income of a STEM graduate more than $15,000 higher than graduates of non-STEM fields, according to Statistics Canada.[15]

Young graduates with degrees in engineering or computer and information science are very likely to bring their qualifications to where they're needed in the labour market. In contrast, young bachelor's degree holders in the arts, humanities and social and behavioural sciences are more likely than other young graduates to work in jobs that typically do not require extensive post-secondary education.[16] We need to find better ways to integrate science and humanities studies to ensure the best of both are available for learners.

And while fields like biotechnology, nanosystems engineering and clean energy are growing, we also need many more skilled tradespeople to contribute to infrastructure, technology and transportation solutions. The underpinning throughline, regardless of post-secondary pathway, is STEM skills.

Described on page 18, Let's Talk Careers offers a meaningful way to raise awareness about the breadth and diversity of careers available to those with a STEM background.

We can't keep drawing students into STEM programs and careers from a narrow pool. We need to broaden and diversify the pool itself.

Change can start right at the beginning. The federal government has shown its support for early learning with agreements made with every province and territory towards building a Canada-wide, community-based system of quality child care. We have a tremendous and unique opportunity to develop a generation of young people who are even better prepared for school entry. However, the early years workforce educating young people, isn't well versed in science and often lacks experience using STEM as an effective learning platform.

What needs to change

Young children have an innate love for and interest in science. They are curious about the world around them and have no end of questions. We need to nurture that curiosity and foster an inquiry mindset, continually developing it as they proceed through school. These traits can be developed when educators are comfortable and confident learning alongside their students, acting as facilitators and coaches. This requires new ways of preparing and supporting educators - and more resourcing for hands-on programming.

As students advance through the grades, there is a need to evolve the curriculum to make it more relevant, issues-based, student-centred and experiential. Leveraging STEM as a learning platform supports the development of all the global competencies.

A more multi-disciplinary approach would change the curriculum for the better. For instance, a climate course can include chemistry, biology, math, political science, language and more. Projects related to the United Nations' Sustainable Development Goals could do the same. Students want to focus on real-life issues and tie their learning to something that's meaningful to them.

New approaches that focus on solving problems also open the door to including more diverse ways of knowing, alongside traditional western science. This includes Indigenous knowledge that has been absent, ignored or misappropriated over time. Using different ways of approaching challenges, with broader inputs, will yield better solutions in the long run.

What needs to change

No one is saying we shouldn't teach traditional subjects or key foundational knowledge. However, we can do it in innovative and meaningful ways that engage and retain more young people. That's beginning to happen and is being encouraged by developments, such as the PISA international panel of experts recommendations. However, more could be done to drive change.

To succeed and be innovative, whether you're a company or a student, you also have to be comfortable with failure and be resilient. There's always more than one way to get to a destination, and sometimes the destination itself isn't completely clear. That's learning.

Yet PISA reports[17] that 15-year-olds in Canada have a strong fear of failure; 62% agreed that when they fail they worry about what others think of them. That's higher than the OECD average. PISA added that in Canada, and almost every other education system around the world, girls expressed greater fear of failure than boys, and that this gender gap was even wider among top-performing students. Part of spurring more innovation is focussing on the process, not on the end result.

Another way to broaden and diversify the pool is to remove the systemic barriers, including unconscious biases, that continue to exist for many racialized audiences. Benefits will be gained with more inclusive approaches to learning, diversity in curriculum and better access to resources, including information about careers and post-secondary pathways.

We can do much more to foster the science identity of all youth, helping to build confidence and self-efficacy so more see themselves succeeding in the world of STEM. There is better awareness of the barriers and inequities, but we're not seeing substantial improvements yet, possibly because of the time needed for real change to be seen at the macro-level.

We need to continue to narrow gender gaps too. While we see a continued increase in female post-secondary participation in general, it remains low in select STEM fields (e.g. computer science and engineering).

Looking at high-performing students in math or science, according to the PISA 2018[17] results, about one in three boys in Canada expect to work as an engineer or science professional at the age of 30, compared to one in seven girls. And some 7% of boys and 1% of girls in Canada expect to work in professions related to Information and Communication Technology (ICT).

In contrast, about two in five high-performing girls expect to work in health-related professions, compared to one in six high-performing boys. So the gender gap works both ways.

For all students, we need to build better awareness about career and post-secondary paths and offer more work-integrated learning opportunities. That has to happen early on and be sustained throughout school.

Educators need resources and support that help them showcase the value of certain skills vs. specific jobs. So many skills, including STEM skills, are transferable to a wide range of settings. But youth can't be interested in paths they don't even know exist.

Post-secondary entrance requirements, especially for university, could change. Beyond the traditional sciences, admission requirements could also recognize issues-based courses and/or critical skills instead of subject areas. That would have the power to expand the use of multi-disciplinary approaches at the secondary school level. In turn, that would appeal to more students and likely increase and broaden participation.

Keeping the traditional entry requirements means we will likely continue tapping into the existing applicant pool. So, even if a greater number are admitted at post-secondary, we could miss the opportunity to deepen and broaden the pool and improve the diversity of STEM students.

What needs to change

One of the recommendations in the original 2012 SOSL report was to achieve greater coordination across the science, technology and innovation (ST&I), STEM and education ecosystems. That hasn't happened to the extent needed for scaled, sustained impact. The organizations that are producing STEM knowledge have too few connections to education systems, something else that needs to change.

We have an opportunity now and in the years ahead to evolve how we teach STEM, to make it more inclusive, more multi-disciplinary, more issues-focused and more accessible and relevant to more young people. This is about getting people ready for jobs and responsible citizenship. Both are vital. See page 21 for information about I-STEM, an innovative education pilot offered by the Halton District School Board.

The importance of STEM education has been recognized. It must continue evolving if we are to reach ambitious diversity goals and fully leverage its potential.

In the next decade, a few areas of focus could have a transformative impact: embracing the importance of Indigenous ways of knowing, adopting multi-disciplinary approaches, advancing career education, and broadening post-secondary admission requirements.

A STEM background ultimately supports us in seizing opportunities, finding sustainable solutions, driving innovation responsibly, and thriving in a fast-changing world.

Let's Talk Careers

What can motivate youth to take optional STEM courses in high school? One way is to raise awareness of the breadth and diversity of careers in STEM and the skilled trades.

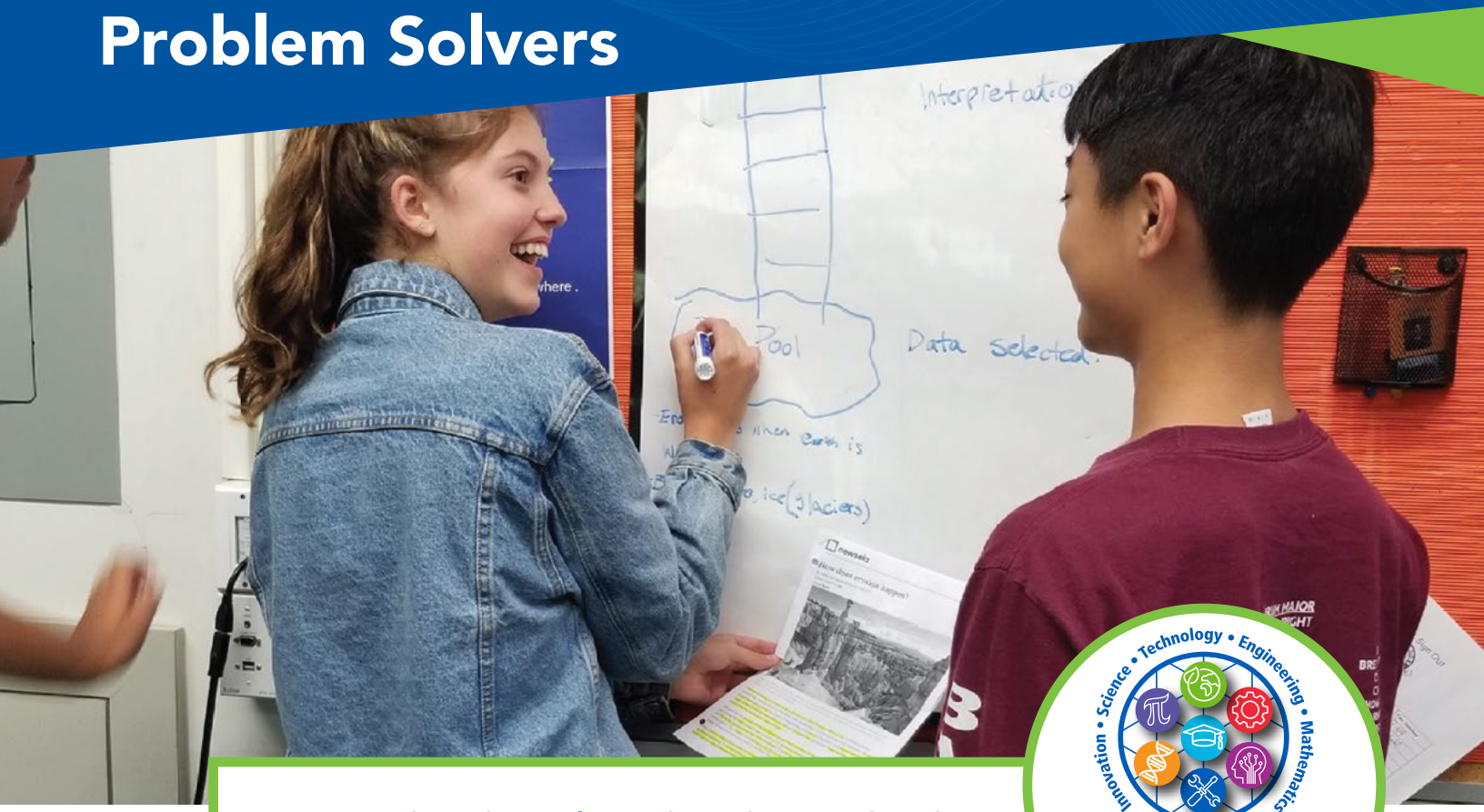
That is a goal of a partnership between Let's Talk Science, Skills/ Compétences Canada[18], ChatterHigh[19] and Engineers Canada[20] called Let's Talk Careers: Canada's Most Informed School and Students competition[19].

Through a fun and interactive competition, students earn points by researching and answering questions about careers, post-secondary pathways and the labour market.

Despite the impacts of disruptive technologies and the rapid change of the global economy, little has changed in the public perception of jobs in STEM and skilled trades fields. Too many students are unaware of the breadth of opportunities available. Let's Talk Careers gets students thinking differently and more broadly about potential careers and how to get there. That exposure to career information is critical - early and often.

The platform is free to educators and students. Every day, registered students receive questions with links to relevant post-secondary and career web pages. Artificial intelligence tools enable customization of 20% of the questions based on expressed student interest. In 2021-22, nearly 18,000 students from 581 schools explored almost 2 million career pages through the ChatterHigh platform. Students expressed greater interest in careers they had heard about previously, supporting the need to introduce youth to career information early.

Preparing Students to be Problem Solvers



Parents and teachers often ask students "What do you want to be when you grow up?" Perhaps a better question is: **"What problem do you want to solve?"**

That's one of the ideas driving I-STEM, a new program for students in Grade 9-12 that launched at the Halton District School Board in Ontario. Students in this new four-year program develop innovation skills related to engineering design and design thinking (Grade 9), entrepreneurial thinking skills (Grade 10) and global competencies (Grades 11-12).

The students learn to be prepared for technological change and disruption, globalization and shifting demographics. By the end of the program, they'll develop and implement solutions to real-life social, economic, or environmental global issues, culminating in a public exhibition of their work.

The program leaned on several key insights from Let's Talk Science's Canada 2067[21] initiative, especially the student recommendations around things like collaboration, technology in the classroom and experiential learning. Celebrating the sesqui-centennial, Canada 2067 was a national effort to develop a vision for science, technology, engineering and math learning, focusing on K-12.

The I-STEM Program is being offered at Aldershot High School in Burlington and Elsie MacGill Secondary School in Milton for the 2022-2023 school year. In the 2023-2024 school year, I-STEM will expand to T.A. Blakelock High School in Oakville. It's a prime example of reimagining the future of STEM education.

Citations

1. Let's Talk Science (2012). A Benchmark of Canadian Talent. *Spotlight on Science Learning.* https://letstalkscience.ca/research-publications

2. Let's Talk Science (2013). The high cost of dropping science and math. *Spotlight on Science Learning.* https://letstalkscience.ca/research-publications

3. Let's Talk Science (2014). Shaping tomorrow's workforce: What do Canada's teens think about their futures? *Spotlight on Science Learning.* https://letstalkscience.ca/research-publications

4. Let's Talk Science (2015). Exploring parental influence: Shaping teen decisions regarding science education. *Spotlight on Science Learning.* https://letstalkscience.ca/research-publications

5. Let's Talk Science (2017). The evolution of STEM education: A review of recent International and Canadian policy recommendations. *Spotlight on Science Learning.* https://letstalkscience.ca/research-publications

6. Government of Canada (n.d.). *Cancode.* Innovation, Science and Economic Development Canada. https://ised-isde.canada.ca/site/cancode/en

7. Government of Canada (n.d.). *Promoscience. Natural Sciences and Engineering Research Council of Canada.* https://www.nserc-crsng.gc.ca/Promoter-Promotion/PromoScience-PromoScience/Index_eng.asp

8. Government of Canada (n.d.). *Citizen science portal.* Science and innovation. https://science.gc.ca/site/science/en/citizen-science-portal

9. Government of Canada (n.d.). *Universal broadband fund.* Innovation, Science and Economic Development Canada. https://ised-isde.canada.ca/site/high-speed-internet-canada/en/universal-broadband-fund

10. 3M (2022). *State of science index.* Science centre. https://sciencecentre.3mcanada.ca/3m-state-of-science-index?intcid=brand-edu-sc_sosi_sustainable_future-july21

11. LaBerge, L., O'Toole, C., Schneider, J., & Smaje, K. (2020, October 5). How COVID-19 has pushed companies over the technology tipping point—and transformed business forever. *McKinsey & Company.* https://www.mckinsey.com/capabilities/strategy-and-corporate-finance/our-insights/how-covid-19-has-pushed-companies-over-the-technology-tipping-point-and-transformed-business-forever

12. Organisation for Economic Co-operation and Development (2020, March). PISA 2024 Strategic Vision and Direction for Science. *Programme for International Student Assessment.* https://www.oecd.org/pisa/publications/PISA-2024-Science-Strategic-Vision-Proposal.pdf

13. KPMG LLP (2021, August 31). *Canadian Businesses struggling to find skilled talent: KPMG Survey.* https://home.kpmg/ca/en/home/media/press-releases/2021/08/tech-skills-top-priority-for-businesses-kpmg.html

14. ECO Canada (2021). From recession to recovery: Environmental workforce needs, trends and challenges updated labour market outlook to 2025. *Labour Market Research Report.* https://eco.ca/new-reports/updated-environmental-labour-outlook-to-2025/

15. Statistics Canada. Table 37-10-0158-01 *Characteristics and median employment income of post-secondary graduates two years after graduation, by educational qualification and field of study (STEM and BHASE (non-STEM) groupings).* DOI: https://doi.org/10.25318/3710015601-eng

16. Statistics Canada. (2017, November 29). Are young bachelor's degree holders finding jobs that match their studies? *Census in Brief.* Retrieved from: https://www12.statcan.gc.ca/census-recensement/2016/as-sa/98-200-x/2016025/98-200-x2016025-eng.cfm

17. Organisation for Economic Co-operation and Development (2019). Programme for International student assessment results from PISA 2018. *Programme for International Student Assessment.* https://www.oecd.org/pisa/publications/PISA2018_CN_CAN.pdf

18. Skills/Compétences Canada (n.d.). *Skills Canada.* https://www.skillscompetencescanada.com/en/

19. Chatterhigh (n.d.). *Let's Talk Careers.* https://resources.chatterhigh.com/lets-talk-careers?utm_campaign=Let%27s%20Talk%20Careers&utm_source=Partner-referral&utm_medium=LTS

20. Engineers Canada (n.d.). *Engineers Canada.* https://engineerscanada.ca/

21. Let's Talk Science (n.d.). *Canada2067.* https://canada2067.letstalkscience.ca/en/

Past SOSL reports

Want to know more?

SCAN ME

Let's Talk Science
1-877-474-4081
letstalkscience.ca

Charitable registration number: 88540 0846 RR001

let's talk science | parlons sciences

@LetsTalkScience

@LetsTalkScience

LetsTalkScience

@letstalkscience_hq

Let's Talk Science