August 2014

# Report in Focus

## SCIENCE CULTURE: WHERE CANADA STANDS

From the creation of insulin by Banting and Best, to Chris Hadfield's extraordinary ability to showcase the experience of living in space, science touches the lives of Canadians in many ways. Medical discoveries, such as the existence of stem cells by McCulloch and Till at the Ontario Cancer Institute, can result in new treatments for disease, helping millions. As a driving force of the economy, science is a catalyst for innovation and the creation of new goods and services. Science has also changed how Canadians interact with one another through new technologies. In addition, it can spur, inform, and intensify public debate on a range of issues, from climate change to genetically modified organisms. Understanding society's complex and evolving relationship with science is important to ensuring that science continues to improve and enrich the lives of all Canadians.

### CHARGE TO THE EXPERT PANEL

In recognition of the important role science plays in the daily lives of Canadians, the Canada Science and Technology Museums Corporation, Industry Canada, and Natural Resources Canada asked the Council of Canadian Academies (the Council) to conduct an in-depth, independent assessment to answer the following question:

**What is the state of Canada's science culture?**

The Council assembled a 14-member expert panel (the Panel) of Canadian and international experts to complete a comprehensive examination of Canada's science culture and science culture support system. With members from academia, government, and the private sector, the Panel drew on experience and expertise in science communication, public policy, science centres and museums, and science education to complete the assessment.

*Figure 1*
**Yukon Beringia Interpretive Centre in Whitehorse**

### The Panel's Approach

To determine the state of Canada's science culture, the Panel's analysis focused on four key dimensions:

- public attitudes towards science and technology (S&T);
- public engagement in science;
- public science knowledge; and
- science and technology skills.

**Defining Science Culture:** Although frequently used to convey the degree to which society and the public are broadly engaged in science, the term *science culture* is rarely defined with precision. As understood by the Panel, a society has a strong science culture when it embraces discovery and supports the use of scientific knowledge and methodology. Such a culture encourages the education and training of a highly skilled workforce and the development of an innovative knowledge-based economy.

***"Canadians perform well across a range of science culture indicators. However, it is important that we continue to strive for a society that looks to science to help inform our decisions and broaden our world view."***

– Dr. Arthur Carty, O.C., FRSC, FCAE, Expert Panel Chair

These four dimensions were assessed through established indicators from surveys and other data sources, including a new public survey of over 2,000 Canadians commissioned by the Panel. The Panel also assessed the system of social and institutional support for science culture in Canada, reviewing the network of organizations, programs, and initiatives that provide opportunities for science learning and engagement outside of the classroom. This collection of data helps to paint the clearest picture of Canada's science culture and science culture support system in 25 years.

# Key Findings

## THE STATE OF CANADA'S SCIENCE CULTURE

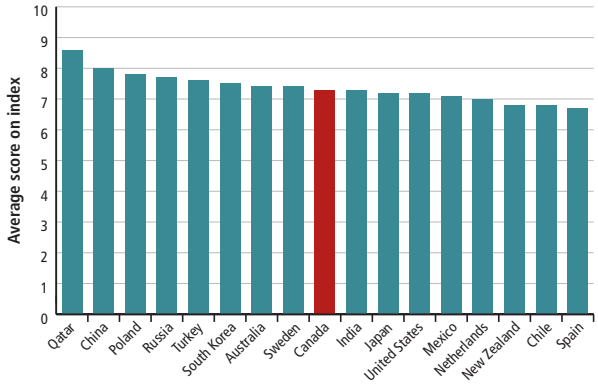
### Public Attitudes Towards Science and Technology

*Canadians have positive attitudes towards S&T and low levels of reservations about science compared with citizens of other countries.*

Like citizens of most industrialized countries, Canadians have predominately positive attitudes towards science. Canada ranks 9th out of 17 countries on an index based on standard survey questions about the promise of science. Approximately three-quarters of Canadians agree with statements such as "the world is better off because of science and technology" and "science and technology are making our lives healthier, easier and more comfortable." Most Canadians believe that science will continue to create more opportunities for the next generation.

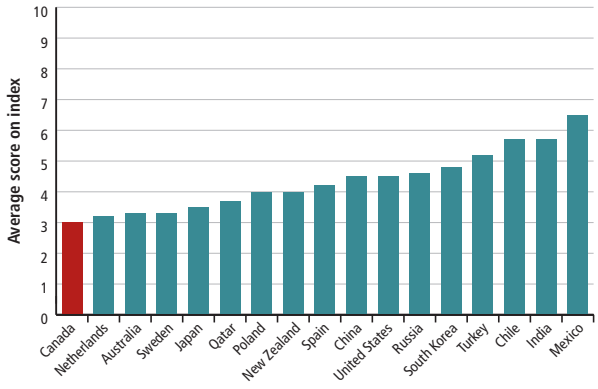
Canadians also have some of the lowest levels of reservation towards science, ranking 1st out of 17 industrialized countries on an index based on standard survey questions assessing reservations about science. The Panel found that few Canadians express beliefs such as "it is not important for me to know about science in my daily life" or "we depend too much on science and not enough on faith." In addition, public apprehension about science has declined on average in Canada since 1989.

However, some trends reveal a more nuanced picture. Since 2004 Canadians have become slightly more skeptical about




Data Source: Panel survey data and WVSA (2013)

***Figure 2***
**Public Attitudes Towards the Promise of Science by Country, 2011–2013**
Attitudes towards the promise of science can be appraised using an index that combines responses on the level of agreement with three statements. The analysis excludes respondents who show no variation in responses across the attitudes questions and respondents who offer neutral and non-responses. Standard errors for all countries are between 0.03 and 0.07.




Data Source: Panel survey data and WVSA (2013)

***Figure 3***
**Public Reservations Towards Science by Country, 2011–2013**
Reservations about science can be appraised using an index that combines responses on the level of agreement with three statements. The analysis excludes respondents who show no variation in responses across the attitudes questions and respondents who offer neutral and non-responses. Standard errors for all countries are between 0.04 and 0.08.

the ability of S&T to achieve a range of social, environmental, and economic objectives, despite the fact that Canadians' perception of the relevance of science to their daily lives has increased.

### Public Engagement in Science

*Canadians exhibit a high level of engagement with S&T relative to citizens of other countries.*

Most Canadians engage with science through formal schooling, and many participate in science-related activities throughout their lives. These activities can include attending a science centre or museum, participating in a hobby related to S&T, attending public meetings or debates on science, joining demonstrations on science-related issues, or donating money to a research campaign.

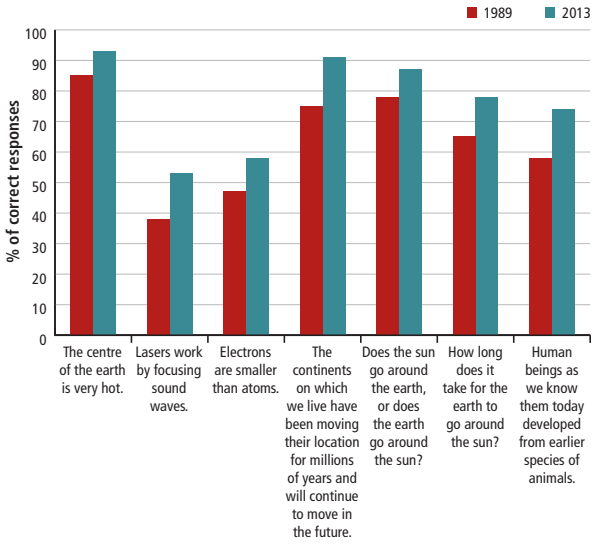
Based on the Panel's survey data, 93% of Canadians report being moderately or very interested in new scientific discoveries and technological developments, ranking 1st out of 33 countries on this measure. Within Canada, interest in science varies by demographic group. Interest levels tend to be higher among younger respondents, more educated respondents, and higher income respondents. The greatest difference, however, is between men and women, with 60% of men, but only 40% of women, saying they are "very interested" in new scientific discoveries.

Canadians are also more likely to visit a science and technology museum than citizens of any other country except Sweden. Nearly one-third of Canadians report having visited such an institution at least once in the past year, and this share has increased over the past two decades.

### Public Science Knowledge

*Canadians' level of science knowledge is on a par with or above citizens of other countries for which data are available.*

Based on data from the Panel's survey, Canadians have a relatively high level of understanding of scientific concepts and methods. Forty-two per cent of Canadians exhibit a sufficient level of knowledge to grasp basic concepts and understand general media coverage of scientific issues, and the level of Canadians' science knowledge has increased since 1989. Canada ranks first on a science literacy index among countries with available data. However, this ranking should be interpreted carefully as Canadian data are more recent and science literacy has been improving over time in most countries.




Data Source: Panel survey data and Einsiedel (1990)

***Figure 4***
**Canadian Science Knowledge Over Time, 1989 and 2013**
Canadian science knowledge in the adult population has improved since 1989 across a range of factual knowledge questions. Results from the Panel's 2013 survey aggregate "definitely true" and "probably true" responses and aggregate "definitely false" and "probably false" responses. Results are accurate to ± 2.2% 19 times out of 20.

These survey data are consistent with findings from student assessments such as PISA (Programme for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study), which show that on average Canadian students excel in achievements in science and mathematics compared with students in most other developed nations.

Despite the relatively high level of public science knowledge in Canada, there remains room for improvement. Many Canadians still struggle to explain key scientific concepts. For example, 51% of respondents had a general understanding of the term *DNA*, 46% could articulate the features of a *scientific study*, and only 28% could accurately explain the term *molecule*. Canada has also seen a decline in its PISA scores in science and mathematics since 2006, raising concerns that Canada is losing ground among its international peers when it comes to science and math education.

### Science and Technology Skills

*Canada's performance on indicators of S&T skills development is variable compared with other OECD countries.*

Though Canada shows higher levels of science knowledge than other industrialized countries, its performance in terms

of S&T skills development varies. Canada ranks first among OECD countries in overall post-secondary educational attainment, but only 20% of first university degrees in Canada are in the sciences and engineering — well behind leaders such as Korea and Germany. However, the sciences' share of first degrees in Canada has been relatively stable over the past decade while declining in the majority of developed economies. In addition, the level of PhD graduates in science and engineering in Canada per capita is slightly above the OECD average.

The Panel also made a number of important observations when assessing the data:

- Fifty-one per cent of individuals holding science, technology, engineering, and mathematics degrees in Canada are immigrants.
- Though 49% of university degrees in the natural sciences are awarded to women, they receive only 23% of degrees in engineering, and an even smaller share in computing.[1]
- Approximately 30% of Canadian employees are engaged in work relating to science or technology, compared to countries such as the United States, Finland, Germany, Australia, and the Netherlands where this share is over 35%.


***Figure 5***
**FIRST Lego League competitions provide students with a forum to compete in building small robots capable of solving defined challenges.**

***Figure 6***
**Canada has a number of established science festivals such as the Eureka! Festival in Montréal which attracted over 68,000 attendees in 2012.**

## Institutional and Social Support for Science Culture in Canada

Many organizations contribute to the development of science culture in Canada. These include both formal science education providers and informal science learning institutions like museums and science centres, science media programs, and a growing array of digital and online resources. Canada's formal and informal science learning environments are linked, and Canada's primary and secondary education systems strongly contribute to Canadians' relatively high level of scientific knowledge and engagement compared to other countries. Having access to a diverse set of informal science learning and engagement opportunities, such as visits to a science centre, or searching for information on a science website, however, is also critical to sustaining interest and engagement in science throughout an individual's lifetime.

The system of organizations supporting science culture in any country is dynamic. Organizations, programs, and initiatives are continually created and discontinued. A 2011 inventory of science culture and communication initiatives in Canada identified more than 700 such programs or organizations, including over 400 initiatives related to museums, science centres, zoos, or aquariums; 64 NGOs or associations; 49 education initiatives; 60 government policies and programs, and 27 media programs. Canada can also boast several

1. See the Council's 2012 report, *Strengthening Canada's Research Capacity: The Gender Dimension*.

long-standing, iconic television and radio science programs such as *The Nature of Things*, *Quirks and Quarks*, and *Découverte*, though general science coverage is limited in the English-language Canadian press (a function of the decline of print media in general).

### Cultivating a Strong Science Culture

The Panel's review of evidence and research identified many promising strategies and practices for cultivating a strong science culture, which can be organized under five broad themes:

*Supporting Lifelong Science Learning:* Though exposure to science in the classroom is a critical determinant of the level of science knowledge for many, most individuals spend a small portion of their lives in formal school settings. Adults encounter new needs for scientific knowledge throughout their lifetime. Therefore, it is important to recognize the value of formal educational settings in creating a foundation of knowledge and skills, while at the same time ensuring a variety of informal science learning channels are available for adults throughout their lives.

*Making Science Inclusive:* Science learning and engagement opportunities can be tailored to social and cultural contexts of groups traditionally underrepresented in the sciences. For example, evidence suggests that young women are more likely to develop an interest in science and pursue education and career opportunities when social relevance is made clear, or when mentorship opportunities are provided. In Aboriginal communities, incorporating aspects of traditional knowledge can be important in helping students make connections between science and their cultural backgrounds.

*Adapting to New Technologies:* Science culture in Canada and other countries is evolving in a rapidly changing technological environment. Individuals are increasingly turning to online sources for information, and scientists and the media are adapting to new and evolving channels of communication such as social media. This transition is challenging many of the traditional models of operation used by science centres, museums, and science media providers. Despite this, technology presents opportunities for science culture organizations. For example, internet-based resources may allow individuals to tailor learning to their own style, and the use of social media can enhance a variety of science outreach and offer new modes of public engagement.

*Enhancing Science Communication and Engagement:* Scientists who are encouraged to communicate with the public and equipped with the tools to engage successfully can build support, knowledge, and interest across the population. Engaging the public in certain areas of science decision-making can also make science more relevant to society and increase science knowledge. Other approaches to facilitating public engagement in science include acknowledging debates and linking science with other aspects of culture such as the arts.

*Providing National or Regional Leadership:* Governments at every level can play a role in supporting science culture in different ways. Many already support various initiatives through funding and knowledge translation programs, but governments can also show leadership by articulating a vision for science culture that provides a framework for action and a foundation for coordination.

## CONCLUSION

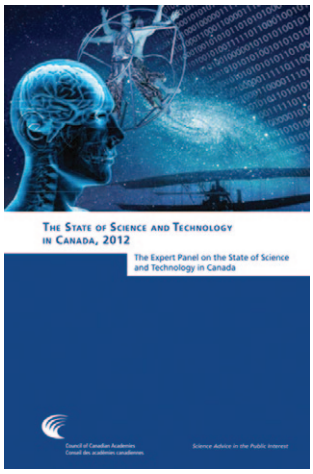
Much of the evidence reviewed by the Panel speaks to the strength of Canada's science culture. Canada performs well against its peers on a range of indicators, exhibiting high levels of science knowledge and engagement, and low levels of reservation about science. Canada also boasts a diverse range of programs and initiatives designed to strengthen science understanding and engagement, and Canadians are fortunate to have access to such opportunities. However, there is room for improvement. As science and society continue to evolve, Canadians' level of science understanding and engagement may need to deepen as new discoveries and developments present themselves. Strengthening Canada's science culture therefore remains a work in progress and should continue to be an important goal for governments, businesses, and civil society.

Einsiedel, E. F. (1990). *Scientific Literacy: A Survey of Adult Canadians. Report to the Social Sciences and Humanities Research Council and Industry, Science and Technology Canada.* Calgary (AB): University of Calgary.

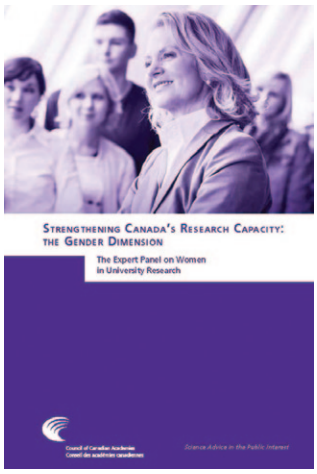
WVSA (World Values Survey Association). (2013). *World Values Survey 2011-2013 Data Set.*

## OTHER COUNCIL REPORTS THAT MAY BE OF INTEREST:

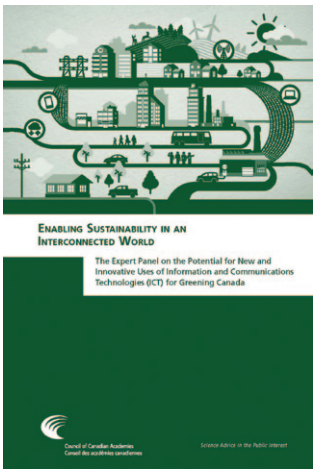
**The State of Science and Technology in Canada, 2012**




**Strengthening Canada's Research Capacity: The Gender Dimension**




**Enabling Susatainability in an Interconnected World**

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The Council also recognizes the important contribution to this assessment of **Ian Hacking, C.C., FRSC,** University Professor Emeritus in Philosophy at the University of Toronto.

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This *Report in Focus* was prepared by the Council based on the Report of the Expert Panel on the State of Canada's Science Culture.