

# A WAKE-UP CALL ON SCIENCE LITERACY: CANADA'S FUTURE DEPENDS ON IT

Kenneth Knox and Bonnie Schmidt



Canada's future prosperity and quality of life are directly related to our ability to thrive and compete in a knowledge-based, global economy in which science and technology play a pivotal role. Other countries are racing us to the top in terms of developing science-literate societies that embrace, and will thrive in, such an economy. Canada is falling short of ensuring that our citizens, including our youth, are prepared with the science skills and knowledge that are needed to meet emerging and predicted demands. Kenneth Knox and Bonnie Schmidt see an opportunity now for the federal government to take a leadership role and set a bold course that will ensure Canada's success in the 21<sup>st</sup> century.

La prospérité et la qualité de vie du Canada sont directement liées à sa compétitivité dans une économie du savoir mondialisée où la science et les technologies jouent un rôle pivot. Or nous risquons d'être devancés par d'autres pays qui développent actuellement une culture scientifique qui les prépare à l'économie de demain. Car le Canada n'arrive plus à procurer à ses citoyens, y compris à sa jeunesse, les connaissances et les compétences qui sauront répondre aux demandes émergentes. Selon Kenneth Knox et Bonnie Schmidt, le gouvernement fédéral doit renverser la tendance en faisant preuve de leadership et en lançant un plan audacieux qui assurera notre réussite au XXI<sup>e</sup> siècle.

Canada's future prosperity and quality of life are directly related to our ability to thrive and compete in a knowledge-based, global economy in which science and technology play a pivotal role. The 21<sup>st</sup> century demands a highly skilled, well-educated workforce that welcomes change and creates new ideas to drive innovation. We simply cannot compete on the basis of size with countries such as China, India or the United States. Therefore, Canada must focus on fostering innovation and a commitment to the quality of output rather than cost containment as our measures of productivity.

Beyond the need to develop a new type of workforce, scientific issues are also at the core of significant political decisions that Canada faces. In our democratic society, it is crucial for people to have an understanding of science to be able to take an informed and active role in our country's future. Without it, how can we and our elected representatives make informed decisions about issues such as stem cell research, new sources of power generation or genetically modified organisms? How can we assess the validity of competing claims and voices on such issues? It is time to develop a culture of innovation that is founded on science literacy.

Canada needs, and we are getting, a wake-up call. Most people agree that the race to the top will be won by countries that invest in developing scientifically driven, knowledge-based economies. Even the OECD dedicated its 2005 Global Science Forum to examining student enrolment in science and technology studies. Little is actually happening, however, to invest in the development of a culture that will thrive in such a world — in Canada, that is. Over the past few years, other countries have adopted national programs, established national strategies, set common objectives, even adopted federal policies designed to improve science literacy. Canada has not.

What is science literacy? It encompasses knowledge of basic scientific concepts and processes. It also includes important skills such as information management and problem solving; as science knowledge continues to grow exponentially these science-based skills become increasingly critical. Science literacy enables us to understand and advance the links between science, technology, innovation, the economy and our society.

How are Canadians doing? Canadian youth generally score well on international assessments of science and

mathematics. In 2003 the results ranked Canadian students second in reading behind Finland, third in mathematics behind Hong Kong, China and Finland, and fifth in science. However, recent Canadian assessments found that overall approximately one-third of students are not performing at expected levels and that student performance fell in 2004 as compared to 1999. On a positive note, there is now very little difference in the performance of males and females so the increased focus over the past 15 years on raising science awareness among females, in particular, seems to be having a positive effect.

According to the OECD Scorecard from 2005, Canada ranks 20<sup>th</sup> in the proportion of science and engineering graduates, behind countries such as Korea, Sweden, Germany, Ireland and Mexico, and behind the averages for the EU and the OECD countries (figure 1). At the post-secondary level, data from Statistics Canada (2003) says that

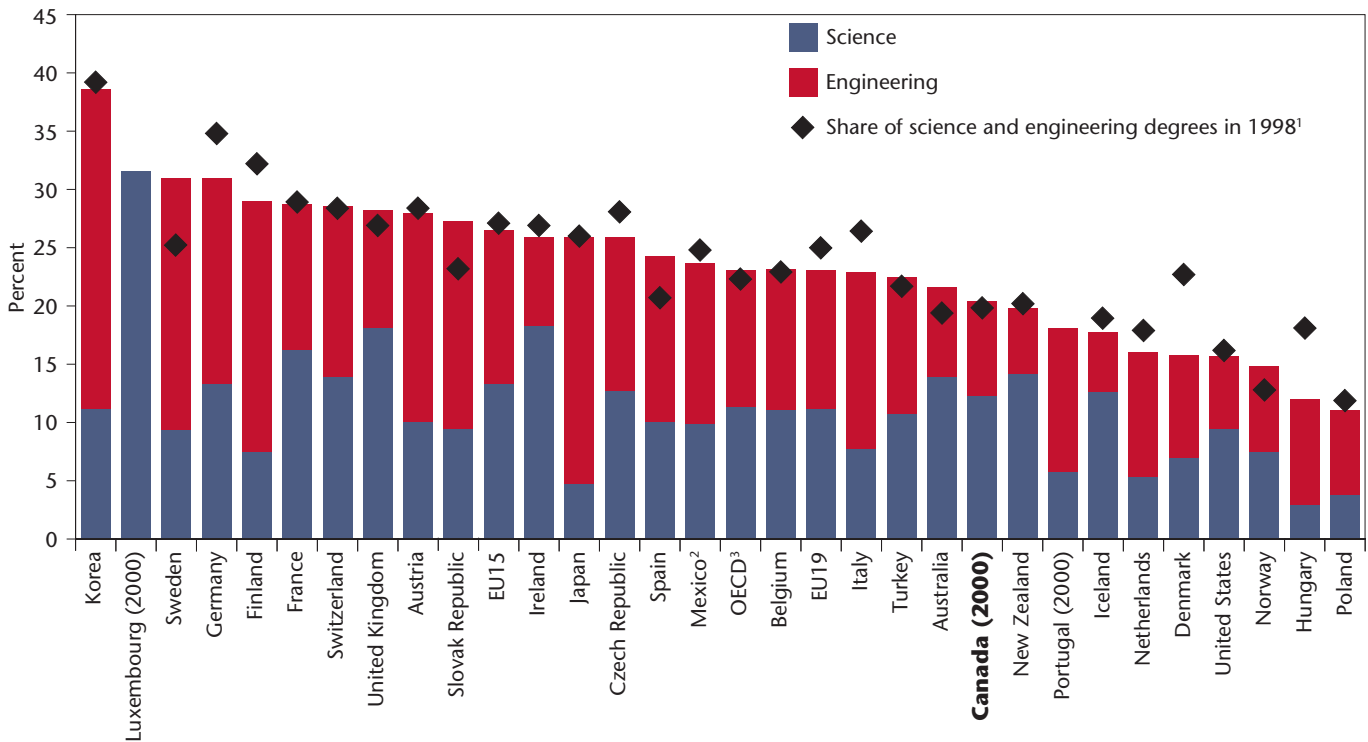
the proportion of science and engineering graduates is only 16.5 percent of total graduates (figure 2). Why are youth not pursuing studies in science despite the numerous reports that have been issued for years about the looming skills shortage in our knowledge-based society?

With respect to Canadian adults, we're simply not sure about their level of science literacy. A 2004 survey by Ekos Research Associates found positive attitudes toward science and research and the public funding of research, with 70 percent of Canadians supportive. There are, however, areas of public concern regarding ethical issues associated with new technologies, and regarding levels of trust, particularly of government and politicians as to the scientific information they provide. Nearly half of those surveyed do not think the federal government does a good job of taking advantage of new scientific discoveries or reflecting their (society's) values

when making decisions. Similar findings emerged from awareness studies in the US and the UK.

For Canada to prosper we need to train, nurture, attract and retain people with science skills and knowledge. While immigration will remain an important recruitment strategy, it must not be our primary one. To solve our impending human resource challenges, we must continue to learn, investigate and inquire — and we must foster these attributes in Canadian children and reinforce them throughout life. We know, and research supports, that experiential science learning accomplished through well-executed “hands-on, minds-on” programs builds science skills and positive attitudes toward science. It also builds problem-solving skills, communication skills and critical team skills along with fostering a creative approach to exploring and understanding the marvels of our world. All these skills are important not only for scientists and

FIGURE 1. SCIENCE AND ENGINEERING DEGREES AS A PERCENTAGE OF TOTAL NEW DEGREES, 2002



Source: OECD, Education database, April 2005.

<sup>1</sup> 1999 instead of 1998 for the Slovak Republic and Denmark.

<sup>2</sup> Excludes tertiary-type A second degree programs.

<sup>3</sup> Average of shares for countries available. Excludes Canada, Portugal and Luxembourg.

engineers but also for the development of “renaissance teams,” a term coined by Canadian Bill Buxton, chief researcher at Microsoft, who is interested in human aspects of technology. Buxton believes that mastering all that needs to be mastered to address most of the serious problems today is beyond the capacity of any individual — unlike the Renaissance man or woman of a former era. He concludes that innovation works best when people with different knowledge, skills and perspectives are brought together to tackle challenges — renaissance teams.

What is Canada doing to improve science literacy? Many organizations have become involved in science literacy initiatives, many of which focus on engaging youth. What once was the exclusive domain of science centres now includes national and regional outreach organizations, media, libraries, scientific societies, research institutes, universities and colleges. Collectively, science awareness efforts are reaching very young children, elementary and high school students, parents, teachers and educators, and, to a lesser degree, the general public with

innovative and engaging activities. This is moving us in the right direction but is it enough to reach the goal?

There has even been a culture shift among Canadian science and engineering professionals, including

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From coast to coast, Canada boasts an impressive collection of science centres and museums where youth and adults can explore exhibits and engage in programs. The National Museum of Science and Technology, TELUS World of Science — Edmonton and the Montreal Science Centre (iSCI) are just three examples of science centres that provide current information about science and technology to the public.

Outreach agencies have evolved to bring science out to communities, in particular children and youth. For example, Let’s Talk Science has developed Wings of Discovery, a comprehensive early science program now used in approximately 500 child care and early learning resource centres, 25 percent of which serve Aboriginal families. The organization also offers a world-class national volunteer program that connects young scientists, primarily graduate students, with youth in their own communities. Last year, over 1,200 volunteers were engaged through 22 university and college campuses. Actua is another national agency that supports its extensive team of undergraduate students through 31 university and college partners in the delivery of hands-on science and technology programs. The Youth Science Foundation is known for its excellent work with youth science fairs. Across Canada, there are many other examples of regionally based organizations involved in science awareness activities.

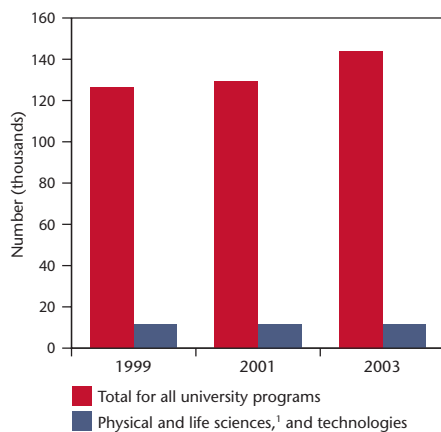
researchers. Whereas 15 years ago, few researchers were engaged in outreach, now an increasing number are prepared to be involved. A new trend has research granting councils occasionally tying public awareness activities to research grants, an activity that shows promise but has not yet been evaluated.

The federal government and some provincial governments are contributing sporadically. However, wide segments of the population are not benefiting from these efforts due to limited funding, a lack of coordination and a leadership void.

Is it working? Despite the growth in activity, we aren’t seeing the shift in our culture that might be expected. It’s not actually that surprising — it’s simply not happening fast enough, nor is it reaching everyone, and these are required to achieve long-term system-wide change. The collective effort may be a mile wide but is only an inch deep. The current approaches are fragmented; there is no national strategy, no common goals. There is no system in place to evaluate the various programs and measure the national return on investment. Indeed, the current lack of funding turns potential collaborators into competitors.

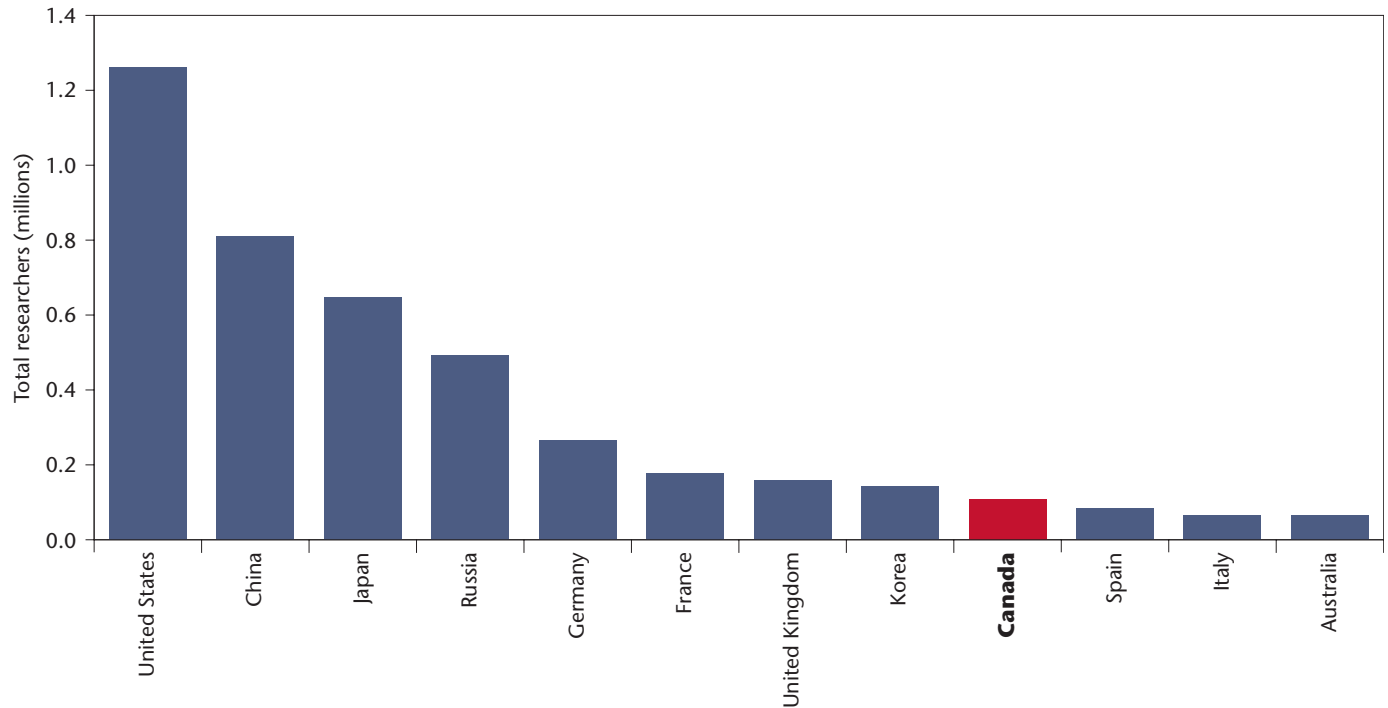
Recognizing the importance of the issue and the current challenges, and with a feeling of abandonment, the science awareness community has begun to self-organize. With the estab-

FIGURE 2. UNIVERSITY DEGREES, DIPLOMAS AND CERTIFICATES AWARDED



Source: Statistics Canada, CANSIM table 477-0014.  
 1 Physical and life sciences include physics, chemistry, biological sciences, earth and space sciences.

FIGURE 3. TOTAL RESEARCHERS, BY COUNTRY, 2002



Source: OECD Main Science and Technology Indicators, May 2004.

lishment of the Science & Technology Awareness Network, the Canadian Association of Science Centres and Science pour tous, it is demonstrating a desire to work together. However, the available funding is inadequate to launch programs that will effect long-term systemic change.

**H**ow do we compare internationally? The critical importance of developing a science culture has become a global issue and other countries are rising to the challenge much faster than Canada. Germany and Ireland have established national science literacy programs.

The United States has set national goals and objectives through the American Competitiveness Initiative, as announced in the 2006 State of the Union Address. It also established the National Science Board Commission on 21<sup>st</sup> Century Education in Science, Technology, Engineering and Mathematics. Additionally, the National Science Foundation, the major federal granting agency for natural science research in the US, allocates approximately 14 percent of its annual operating budget

to science education, amounting to \$800 million in 2006. By comparison, in Canada, the Natural Sciences and Engineering Research Council now spends approximately \$3.5 million annually or 0.4 percent of its \$865-million budget on science education and outreach.

India and China over the past four years have adopted federal policies related to science awareness, and by 2003, China had the second-largest number of researchers (862,000) behind only the US (figure 3). China has already developed a manufacturing capacity with which western economies cannot compete. It is now aggressively developing their education and technology capacity. This wise strategy is already resulting in China becoming even more attractive as a place to stay or return to for home-grown scientists and engineers.

Over the next few decades, we'll watch China's standard of living continue to improve. Wage disparities between Chinese-trained and Canadian-trained engineers will likely decrease, thereby levelling the playing field. However, unless we wake up and

begin investing more in Canadian youth and our own skill development, it will be too late.

Canada must do better. There is no second best in this. There really are no silver or bronze medals and there is no silver bullet.

Much needs to happen and many diverse stakeholders need to be engaged in this complex challenge. A required starting point is the establishment of a new federal, independently governed science literacy agency that focuses on leading and supporting the science awareness community. Such a bold move would shift the perception of science awareness away from one of passive "popularization" and foster recognition that such investments are critical for the 21<sup>st</sup> century and Canada's position in a changing global environment.

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