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MEDIA PLANET

November 2012

STEM EDUCATION

3 FACTS

FOSTERING LEARNING, CURIOSITY AND INNOVATION

Inspiring our youth — Entrepreneur and inventor Ben Gulak encourages students nationwide to pursue a higher education in STEM

PHOTO: BEN GULAK

CHALLENGES

PHOTO : LET'S TALK SCIENCE

In order for Canada to remain competitive in the 21 century, we need a steady pool of competent, quality employees — meaning the average performance of our young people in areas of **science, technology, engineering and math needs to improve**.

Bringing up our future

When a child's interest in science is sparked, it can ignite a passion for exploration and discovery that lasts a lifetime. A fascination with a caterpillar's transformation can develop into a lifelong love of the biological sciences. A child's determination to construct a tower of unparalleled height can transform from a playground project to a feat in engineering. In a child's eyes, there are no limits.

As Minister of State for Science and Technology (S&T), I believe we need to nurture that passion and curiosity. These young explorers will be our next generation of Canadian innovators, entrepreneurs and problem solvers. For Canada to be a global leader and to stay competitive and productive, we need to encourage our young people to consider careers in science and engineering.

Why? Our Prime Minister has put it best: because science powers commerce.

Last month, the Council of Canadian Academies released a report evaluating the state of Canadian science and technology between 2005 and 2010. The CCA concluded that Canada's S&T enterprise is healthy, growing, internationally competitive and very well respected among the world's leading scientists. More than 5,000 international researchers ranked the quality of Canada's scientific enterprise fourth highest in the world. I am proud of that ranking, but know that we are capable of being number one.

That will be achieved with greater collaboration throughout the entire science, research and innovation ecosystem: sharing ideas and innovation, from the K-12 classrooms to manufacturing shop floors. It will be driven by special print sections like this one.

Support of S&T has been a fundamental priority for this government since 2006, as shown by the introduction of our S&T strategy in 2007.

The S&T strategy is guided by the principle that innovation is driven by collaboration.

Collaborations such as the one between the National Research Council (NRC) and the Sanofi BioGENEius Challenge Canada which engages students in the emerging science of biotechnology and its applications in health care, agriculture and the environment. High school students are paired with mentors who guide them in their research and help them conduct their experiments in world-class facilities, including laboratories at the NRC.

These are the partnerships that will help turn promising ideas into the groundbreaking products, and applications that create jobs and lead to economic growth.

Gary Goodyear Minister of State for Science and Technology, Federal Economic Development Agency of Southern Ontatio

TIPS

Encourage curiosity in your child

Children thrive on positive reinforcement. Make a point to encourage your child to take an interest in exploring the unknown at a young age. The earlier children begin to think outside the box, the greater chance they will continue to challenge their minds.

It's important to maintain balance

The knowledge based economy is upon us and the rate of technological advancement is happening much faster than ever before. I would encourage everyone to move on to post-secondary education but more importantly, to get a broad education from the beginning.

Our government is doing its part by creating an economic environment that allows science and technology to flourish. New knowledge and technologies will help us meet many of the challenges of the 21st century — from increasing productivity to preserving the quality of the environment to enhancing our health, and from protecting our safety and security to managing our energy and natural resources.

We stand behind every young person who takes his or her first steps toward a science-based career. We recognize that curiosity, innovative thinking and the development of technological skills are vital to our economy.

Canada can be a world leader in research and innovation if we encourage risk taking, competitive spirit, creative thinking and bold new approaches to traditional challenges.

Canada's future success will depend on your children's curiosity and higher education. By investing in science and technology programming we are preparing our kids for the jobs of the future; creating a stronger economy, and improving the quality of life of Canadians for years to come. Your child may grow up to be Canada's next great innovator. Let's help pave the way.

GARY GOODYEAR

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WE RECOMMEND

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MEDIA PLANET

STEM EDUCATION
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Canada's declining youth STEM engagement — An urgent and important challenge

Canadian students are good at science, scoring near the top on international assessments of science achievement, but most don't choose senior science courses, eliminating the possibility of STEM-related higher education and careers, and contributing to Canada's low percentage of science and engineering graduates.

But the real challenge, according to a 2010 study, is that the proportion of Canadian youth interested in pursuing a scientific career declines significantly from age 13 to 18.

The study also found that effective teachers make a significant difference in student interest in science, as does student perception that science is fun, inspiring, and important.

So, there's reason for hope — if we can help teachers be more effective, show youth that STEM is serious fun, and engage students no later than middle school.

Children are natural-born scientists, full of wonder and questions. Good STEM education develops these traits and challenges students to develop increasingly sophisticated explanations and solutions, while building a base of knowledge.

Unfortunately, few elementary teachers have a STEM background and many find teaching these subjects intimidating. High school STEM teachers have a background in the subjects, but few have experience in research or engineering — actually doing science.

Youth Science Canada's Smarter Science initiative helps K-12 teachers move beyond the delivery of content by integrating inquiry activities into their lessons. Students are more engaged, better equipped to investigate questions and tackle problems, and they enjoy science.

Reni Barlow Executive Director, Youth Science Canada

Most adults underestimate kids' capabilities. Given the opportunity, support, and recognition, Canadian youth do some remarkable science and engineering, as seen at 103 regional science fairs across the country and the annual Canada-Wide Science Fair.

Forget baking soda and vinegar volcanoes. Think instead of a hockey helmet that prevents concussions, soil bacteria that break down plastics in landfills, or a technique to target and kill cancer cells that avoids the side effects of today's anticancer drugs. All were winning projects by grade 7-12 students in recent fairs.

We assume that students make career choices in high school, but a 2011 study found that most chose whether or not to pursue STEM by the end of grade eight.

With little knowledge of what STEM offers, middle school students are "opting out" when opportunities in the field have never been greater.

A dynamic campaign — featuring young scientists, engineers and entrepreneurs — promoting STEM opportunities to middle school students should be a top priority. Canada's innovation and entrepreneurial future depends on it.

RENI BARLOW

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NEWS

Q&A
EDUCATION REFORM

Marcello Pavan
Experimental Nuclear Physicist; Outreach Coordinator, Triumf; Physics Professor, UBC

Q: What are some important things to consider when looking at the numbers of students dropping out of sciences at early ages?

A: It's no fun. I am convinced all kids are born scientists at some level, but all that innate wonder and curiosity is soon beaten out of them by a boring, stifling pedagogy which turns STEM into drudgery rather than the wondrous adventure it really is. We scientists somehow managed to keep some childish wonder against the odds. We must make STEM fun when we teach. No kid is attracted to anything — music, art, sport — if it isn't fun. It takes great teachers; it takes money, but mostly a whole new attitude.

Q: How can we leverage hands on learning programs to increase Canada's STEM Education level?

A: Part of making STEM fun is getting kids to see and interact with really interesting scientific phenomena that ignites their curiosity. See the effects of their causes, see how math can be used to understand it. The world is a weird and wonderful place and kids need to be reminded of that daily to retain the childish wonder which is basically under attack from the demands of modern urban culture. Every place where science is done should invite as many kids as possible to come inside and play.

Q: What is your vision for increasing interest or investment in sciences among young students? What can teachers and parents do to help bridge the gap?

A: Institutionally every STEM teacher at every level ought to have a STEM background, yet the sad fact is most have none. The most important STEM teachers are in elementary school, and the training and compensation ought to reflect that. Start by reforming the primary grades, and work our way up with the cohorts. In the meantime parents and teachers should introduce their students to as much cool real-world science as physically possible to keep the wonder alive.

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PHOTO: ACTUA

Making science more exciting

Question: How does science education fit into the future where individual careers and Canada's economy as a whole are concerned?

Answer: : Government forecasts indicate that employment growth and Canada's economy are linked to jobs in STEM: Science, Technology, Engineering and Mathematics. Future job projections point to growth in STEM-related careers: health, natural and applied sciences, technology and skilled trades.

In addition, Canada's overall global competitiveness is tied to improving our standing in areas of innovation. Against this background is cause for concern when we view the low rate of Canadian students who pursue science and related courses beyond the mandatory Grade 10 level. Canada's young people too often view these subjects as unexciting, difficult and offering limited career options. But that is changing as educators, employers and parents are ramping up efforts to excite kids and turn them on to what one calls "the joy of science."

Jennifer Martin, CEO of Calgary's new science centre, TELUS Spark, says society has a "limited view of what science is and what scientists do." In fact, she adds, science is everything from understanding how the food we eat is grown to predicting where the next big storm will happen. "I think we need to help kids get joy back into science. It's not just about facts," she says, "it's about sparking curiosity, learning to ask questions and taking risks that lead to discovery."

This is indeed the nucleus of innovation, an area in which Canada is losing ground. According to a Conference Board of Canada analysis, Canada gets a "D" grade for innovation ranking 14th out of 17 countries.

Bonnie Schmidt
President,
Let's Talk Science

Currently employers report difficulty in filling the growing number of positions in technical areas. A large labour survey found that three out of four of the top shortages occur in STEM areas: technicians, skilled trades and engineers. "We need to change the conversation about science," says Dr. Bonnie Schmidt, President of Let's Talk Science, a non-profit organization offering diverse STEM learning programs for students and educators across Canada. "Science is a word we throw around and sometimes understand only as academics in white coats doing research in laboratories."

Expanding horizons

Schmidt's organization has teamed up with a leading biotechnology company, Amgen Canada, to study where we are now with regard to science education, and where we need to be for future growth. Their report, Spotlight on Science Learning: A benchmark of Canadian talent, points to the need to go beyond simply demonstrating career options for youth to creating what is called "science for everyone."

"Science shouldn't be in a silo where learning is concerned," says Dr. Schmidt. "It should be integrated in our formal and informal education." That means parents, communities, governments and industry all need to contribute to expanding opportunities for young people in STEM areas.

Corporate support

As a corporate partner in fostering science education, Amgen's Director of Regulatory Affairs, Dr. Karen Burke, says it's "not just about a scientist doing laboratory research. If you look around, you'll see people with STEM education working in government, in the arts, and in business." She points to her own background as a PhD in chemistry who is now a business executive with a leading biotechnology company.

Another part of Amgen's tangible commitment is its annual Amgen Award for Science Teaching Excellence.

Calgary teacher Amy Park who received the award last year, says "kids drop out of science in high school because of lack of engagement. Relevancy and authenticity are essential for today's students to be successful.

"Finding ways to connect with experts outside of school is an excellent way to bring science to life in the classroom."

DIANA MCLAREN

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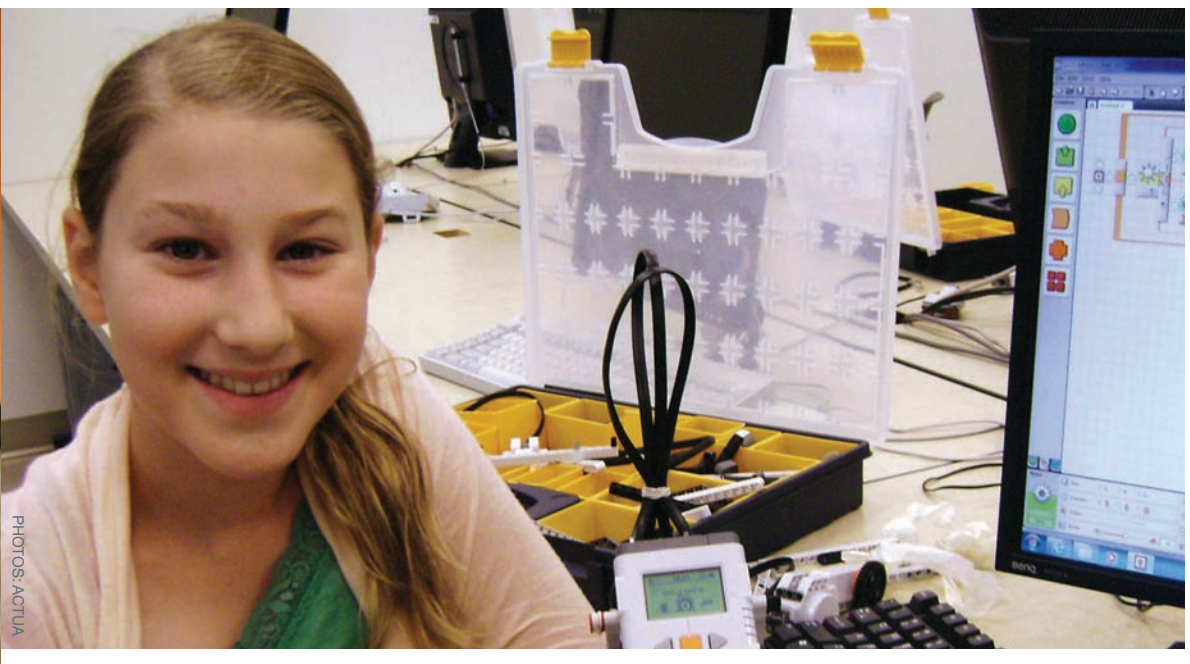
FACTS

- By the end of high school the majority of Canadian students take no science at all
- Of 15 highest-demand careers, almost all require STEM education
- The greatest demand is for healthcare professionals and managers, engineering science and technical occupations
- Job growth is also predicted in skilled trades requiring STEM education
- Government projections are 75 percent of new jobs over next 10 years will be high-skill
- The Conference Board of Canada ranking puts Canada near the bottom in innovation compared to other developed countries (14th out of 17)

SHOWCASE



PHOTOS: ACTUA

PHOTOS: ACTUA

Connecting STEM to innovation and economic prosperity

A girl at an Actua camp in Edson Alberta is designing a crash car that will safely carry a water balloon in a simulated high impact collision. She already spent the morning learning about the forces involved in collisions and thinking critically about the safety features cars should have to protect passengers. Now she explores ways to improve the design and presents her ideas to her team. She thinks about the end user of her product. Will it meet their needs? Her car may be safe, but will it be comfortable? Will it be affordable? How will she market the car?

She gets excited about her future and how she will apply her new skills in a career. She begins to appreciate that she will make a difference in her community and her country.

This young camper is experiencing science, technology, engineering and math (STEM) education at its best. She may only be 12 years old, but today, she is a mechanical engineer and an entrepreneur.

In just a few years, leading companies will recruit her enthusiasm to innovate. These top businesses know that building our capacity for innovation is critical to ensuring future competitiveness and prosperity.

For this to happen, we need a skilled and diverse workforce; all hands on deck contributing to the development of Canada's knowledge economy. The challenge: far too many barriers remain that prevent youth from entering STEM fields. There continues to be a strong lack of representation among many important segments of our population — including Aboriginal youth, girls and youth facing various socio-economic challenges.

To what do we attribute this underrepresentation of youth in STEM? A key barrier is quite simply the lack of awareness of opportunities in STEM. Arguably this lack of awareness is closely tied to existing misconceptions about STEM and its value to society. Ask most people what they think a scientist is and they'll describe an Einstein-esque old man in a labcoat, far away and detached from the rest of the world. This is further exasperated by the lack STEM role models to which youth can relate. The result is a generation of youth disconnected from science and lacking confidence in their ability to engage in STEM.

Actua, a national charitable organization, is changing all of this.

Each year, Actua's network of members, at universities and colleges across Canada, inspires 225,000 youth across every province and territory in Canada. Through innovative content, their programs take youth beyond traditional science activities to offer real-world experiences where those precursors to innovation develop.

Actua's hands-on, learner-centred approach to STEM programming coupled with direct interaction with dynamic role models who engage youth in real-life examples of the importance and relevance of STEM results in a fundamental shift in youth's perceptions about STEM.

Actua's key approach is reaching youth early and often. By high school, many young Canadians reach a fork in the road. They must decide on continuing their science and math education. And for too many youth, they battle the decision to actually stay in school. STEM education experiences, if delivered effectively over childhood, offers secondary school students a stronger sense of the role they play in their school and their community. It empowers them to take each step in their studies with confidence.

> "...we need a skilled and diverse workforce; all hands on deck contributing to the development of Canada's knowledge economy."

The take-home message is there is no one-size-fits-all solution to Canada's innovation challenge. A multi-sectoral approach is needed. Communities need to be engaged. It should start early, enabling children to see how science and engineering contribute to a better world. These children will become part of that diverse and skilled workforce that will then drive innovation and economic prosperity in Canada.

JENNIFER FLANAGAN
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INSIGHT

Successful students need teachers who inspire them

The hallmarks of excellence in STEM teaching (science, technology, engineering and mathematics) are engaging students, and fostering a climate of curiosity and excitement about learning.

Science teacher Racquel Carlow embodies these qualities. She exudes excitement for her subject and for her students at St. Martin Catholic Secondary School in Mississauga.

"It's not difficult to engage students in science," says Carlow. "We have all the tools around us." By its very nature, she says, science offers students opportunities to become problem-solvers, innovators, logical thinkers and technologically literate.

There is a high dropout rate after mandatory science courses end in high school, Carlow says. "We have to start changing this because participation in STEM programs has been shown to have direct economic impact."

Teachers key to success

Research shows that the single most important variable in boosting student achievement is a good classroom teacher, she adds.

This is where teacher training comes in. At the University of Calgary's Faculty of Education, student teachers at all levels can chose a subject specialist option in science or mathematics as part of their degree.

"At the elementary school level, we find most teachers have a humanities background," says Dr. Krista Francis-Poscente. "Specialists will be able to teach for understanding and get students excited about science."

Dr. Francis-Poscente is the new Director of IOSTEM (Imperial Oil STEM), a partnership between the University of Calgary Faculty of Education and Imperial Oil Foundation.

Faculty of Education Dean Dr. Dennis Sumara said the industry/university collaboration demonstrates "a joint commitment to develop and implement high-impact educational experiences for young people who will become the scientists and engineers of the future."

Dr. Krista Francis-Poscente
Director, IOSTEM
Faculty of Education, University of Calgary

Crossing boundaries

IOSTEM will engage in science education research projects and programming for K to 12 schools. It will offer a hands-on summer learning academy involving students, researchers, teachers and engineers. It's the kind of multi-partner, multi-disciplinary approach that STEM experts say is needed.

High school teacher Carlow serves as the current president of the Science Teachers Association of Ontario. In this role she sees the big picture and where shifts need to happen beyond just those in the classroom. "Society doesn't pay much attention to science," she says, outside of media stories about climate catastrophes or major oil spills. Emphasis is put on numeracy and literacy, but not science.

Carlow acknowledges that science is a challenging area of study, one that requires considerable effort. However with today's interactive technology, there are many ways to capture students' imaginations — everything from writing a blog to producing a multi-media video.

"In fact science incorporates all of the disciplines and a broad range of skills," Carlow says. "We need to have a more holistic view. We also need to help kids and parents understand how many jobs require a STEM education from chef to mechanic."

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The DTV all-terrain Shredder is one of the coolest ATV's on the market!
PHOTO: BEN GULAK

Question: Have you ever dreamed about inventing something, but thought it was completely unrealistic?
Answer: STOP and think again! Take a page out of Ben Gulak's book — he became an entrepreneur at age 17 and has never looked back.

Young innovator believes in the power of science

If by the age of 23 you'd appeared on the hit show Dragon's Den, raised millions of dollars of investment capital, had one of your inventions grace the cover of Popular Science magazine, and partied with the Hollywood glitterati, then the last thing you'd probably want to do is go back to school. But that's exactly what Ben Gulak intends to. "I worked really hard to get into MIT [Massachusetts Institute of Technology], and I left after first year to focus on my business," says Gulak, "But there's much more to learn and I want to finish my engineering degree."

Gulak has long had an inquisitive spirit. In grade 9 he had to choose a project for a science fair, but many of the suggested ideas presented to the class didn't interest him. Like finding out how many germs there were on a computer keyboard. Instead, he had an interest in Maglev (magnetic levitation) trains, and so he set to work designing and building a model one.

He then attended the Intel International Science and Engineering Fair, where he saw other kids building cool projects and met two engineers who built Shanghai's Maglev train. This inspired him even more. His grade 12 science project was the Uno, an electric powered vehicle that resembles a motorized unicycle. That school project launched Gulak's profile as one of North America's leading young innovators. The acclaimed Popular Science magazine recognized the Uno as the number one invention in 2008, and the tough as nails investors on the Dragon's Den committed more than a million dollars to further develop the vehicle. But Gulak realized that he wouldn't be able to bring the UNO to market, because of the prohibitive costs that it would take to get past the regulatory and safety hurdles.

"Like a lot of young people, it was hard to understand the practical application of my science and math classes," says Gulak, but I later learned that they are part of the tool set and building blocks to develop new technology." That interest in math and science fuelled his innovative drive, and with lessons learned from the Uno, Gulak designed and developed the Shredder, an off-road device with segway-like handle bars, a skateboard deck, and tank threads, which make it easy getting through snow, mud and uneven terrain. Gulak has preorders for 6,000 Shredders and is working on establishing 900 dealerships worldwide.

"We live in a society where sports stars and celebrities make a lot of money and get a lot of attention, but it is science and innovation that will solve the world's problems."

Ben Gulak
CEO & Chairman, BPG Werks

"That I've been able to make science and engineering cool for young kids is very gratifying," he says. "We live in a society where sports stars and celebrities make a lot of money and get a lot of attention, but it is science and innovation that will solve the world's problems."

KEN DONOHUE
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Q&A
EDUCATION REFORM

Andre Prefontaine
Executive Director, Royal Canadian Geographical Society

Q: Why is STEM education important in Canada?

A: In order to understand Canada and for success on both the individual and societal levels, students need a firm grounding in STEM and that includes geography. Geography is a capacious subject that is clearly aligned with science and technology, encompassing topics from geology, energy and earth sciences to information sciences (GIS), oceanography, environmental science and meteorology. The geographical dimension of these topics is related to their location, extent and interaction with humans.

Q: How can we ensure that the next generation is prepared for the competitive workforce?

A: Geographic literacy is a prerequisite for success in the global society and economy of today and tomorrow. Increasingly students entering the workforce will be joining a global economy, one in which an understanding of Canada, of the richness of its natural resources and of its place in the world is fundamental. This geographic literacy is predicated on a sound knowledge and awareness of geography which, in turn, assumes a sustained and explicit emphasis in the curriculum from kindergarten through high school in all territories and provinces. In short, the answer is more geography in the classroom.

Q: What is the most rewarding part about your career in STEM?

A: I am encouraged by the students and teachers who participate in our contests and who use our resources in the classroom. I am heartened by our partners in the public and private sectors, like Shell Canada, who appreciate the value of geographic and energy literacy and in ensuring the best possible materials reach our schools. I am proud of Canadian Geographic Education and the tireless efforts of the volunteer executive members whose dedication to fostering geographic engagement is unmatched.

Q: What are some things teachers can do to increase student engagement in STEM subjects?

A: Canadian Geographic Education offers teachers unique opportunities to engage their students in STEM activities including national contests such as the Classroom Energy Diet Challenge (CEDC) (www.energydiet.canadiangeographic.ca). A joint program with Shell Canada, the CEDC is an innovative way to teach students about STEM subjects. By engaging in activities that are science-based, students in the CEDC are increasing their energy literacy while at the same time engaging in a national competition. Shell Canada's partnership in the CEDC demonstrates a commitment to today's students and their knowledge and awareness of STEM subjects.

Classroom Energy Diet CHALLENGE

FEBRUARY 4 TO APRIL 25

The Classroom Energy Diet Challenge is back with bigger prizes and better challenges! Classrooms, school clubs and teacher-lead student groups from coast to coast are all eligible to compete for Canada's title in energy-saving supremacy.

This year, the curriculum-based challenges have three levels of engagement, so students can 'Think', 'Create' and 'Do' based on the difficulty level of their choice. A set of iPads and lots more great prizes are up for grabs.

EARLY BIRD REGISTRATION

Register your class before December 7 and you will be entered to win a $100 VISA gift card.

Already signed up for the challenge? Spread the word! For every teacher you refer, you get an entry in the draw to win 1 of 10 $100 gift cards to TenTree.org

REGISTER your class today!

REGISTRATION CLOSES JANUARY 20, 2013

energydiet.canadiangeographic.ca