INCREASING THE NUMBER OF WOMEN IN SCIENCE, TECHNOLOGY, ENGINEERING AND MATH (STEM)

REPORT OF THE CANADA-UNITED STATES COUNCIL FOR ADVANCEMENT OF WOMEN ENTREPRENEURS AND BUSINESS LEADERS
A CALL TO ACTION

The U.S. and Canadian economies need more entrepreneurs and more leaders to create businesses based on exciting advances in technology. To leverage the widest possible range of ideas and creativity, we must tap into the entire population in all its diversity.

An education in science, technology, engineering or math, collectively known as STEM, is one of the most effective tools for launching new businesses. It is from this foundation that new products and services evolve, and innovative enterprises are born.

To achieve this economic imperative, we need to encourage more young people to pursue a STEM education. This is particularly true for women, who make up an ever-growing percentage of STEM programs, but are not yet at parity with their male counterparts in many fields.

There are great success stories out there. The University of Toronto, one of the most respected universities in the world, boasts 42% women in its 2017-18 freshman engineering class. In the U.S., Harvey Mudd College graduated more women than men with computer science degrees for the first time in 2016, and 55% of its undergraduate computer science majors are women, far above the national average of 16%.

Despite these notable advances, a STEM gender gap in both the U.S. and Canada remains. More must be done. What lessons can we learn from these achievements? How can we build on the impressive momentum of these leaders to once and for all close the gender gap in STEM?

Women have broken through many glass ceilings since the mid-20th century. In some occupations once virtually closed to them — doctors, lawyers, bankers and opticians, to name a few — women now are a significant percentage, in some cases the majority, of the practitioners.

Notwithstanding these successes, broad progress has not materialized across all STEM fields. To unlock society’s full potential, we need more women — and a diverse workforce in all its forms — not only participating in STEM, but participating at the highest levels.

Women make up roughly half the population of the U.S. and Canada, and the proportion of them who go to college is even higher. Yet only about one-quarter of workers in STEM-related occupations are women, and in some fields, that figure is much lower.

In the U.S., women filled 47% of all jobs in 2015, yet held only 24% of STEM jobs, according to a U.S. Department of Commerce study published in November 2017. Only 18% of U.S. software developers, 15% of architects and 11% of aerospace engineers were women in 2015, according to the U.S. Bureau of Labor Statistics. This gap is even wider for women of color. According to a 2015 report by the National Sciences Foundation, fewer than 10% of working scientists and engineers in the U.S. identified as Asian, Black or Hispanic women. The pattern is similar in Canada, where women make up only about one in every eight civil, mechanical, electrical, and chemical engineers.

This imbalance is compounded by the fact that too many women who graduate with STEM degrees end up working in unrelated fields. Even those who start their careers in STEM jobs often move elsewhere. This is not inherently a concern. Applying the STEM skills of critical thinking and problem solving to meet new challenges and find great opportunities in fields outside of STEM is a powerful tool. Many industries target STEM graduates for exactly this reason.
However, some women leave their STEM careers for less innocuous reasons. The National Center for Women & Information Technology has found that more than half of mid-level women in technology jobs move on to work in other industries. A study sponsored by the center cited workplace conditions, a lack of access to key creative roles, and a sense of feeling stalled in one’s career as some of the key factors contributing to female attrition from the tech field.

The under-representation of women is most acute at the top of the corporate ladder and worse in technology fields, according to a 2015 Women in the Workplace survey of large U.S. companies by Lean In and McKinsey & Co. (exhibit 1).

### Exhibit 1  
**Women’s representation across the corporate STEM pipeline shows even lower levels than average**

<table>
<thead>
<tr>
<th>Position</th>
<th>All industries</th>
<th>Technology industry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entry Level</td>
<td>100%</td>
<td>47%</td>
</tr>
<tr>
<td>Manager</td>
<td>100%</td>
<td>36%</td>
</tr>
<tr>
<td>Sr. Manager/</td>
<td>100%</td>
<td>37%</td>
</tr>
<tr>
<td>Director</td>
<td>100%</td>
<td>30%</td>
</tr>
<tr>
<td>VP</td>
<td>100%</td>
<td>29%</td>
</tr>
<tr>
<td>SVP</td>
<td>100%</td>
<td>25%</td>
</tr>
<tr>
<td>C-suite</td>
<td>100%</td>
<td>21%</td>
</tr>
</tbody>
</table>

Source: Lean In and McKinsey & Co., Women in the Workplace

The study shows near parity at the entry level and reasonably high representation at the manager and senior manager levels, but with less impressive results in the most senior positions. Besides limiting women’s participation in top management, the diminishing number of senior female employees in technical roles means that women are unable to contribute fully to their companies’ key discoveries and designs.

Job turnover among women in STEM-related fields is also quite high. Nearly two in five women who earn engineering degrees quit the profession or never enter the field, research by the American Psychological
Association has found. What’s more, as numerous studies have documented, women’s pay typically remains lower than that of their male counterparts. The American Association of University Women found in a 2015 study that women in engineering and architectural fields are paid 82% of their male counterparts, and in computer and mathematical occupations 87%. This is easy to fix and an important message to women in these fields that their work is equally valued.

A continuing imbalance between men and women in STEM disadvantages us all.
The potential opportunities for women in STEM are boundless. STEM disciplines are at the cutting edge of today’s knowledge-based economy. Some of the most promising businesses of the future — in other words, those likely to offer the most exciting job opportunities and the highest wages — rely heavily on STEM skills. Tech-intensive employment has grown much faster than that of most other industries over the past decade. From 2008 to 2018, tech job creation is expected to surge by 17%, compared to 9.8% for other sectors, according to a U.S. Department of Commerce study. What’s more, the department found that women in STEM jobs earned 35% more than their counterparts in non-STEM employment in 2015 — and even 40% more than non-STEM men.

If half the population is not playing its full role in ground-breaking fields such as artificial intelligence, self-driving vehicles, advanced materials and 3D printing, we face a grave risk of debilitating labor shortages and, as a result, slower growth for the entire economy.

This gender gap has its origins in deep-rooted practices and cultural norms. They start in childhood and continue through school and university. In the workplace, they play themselves out in the form of conscious and unconscious bias. As a result, some women face difficult workplaces and widespread inequality in pay and promotion. These limitations preclude not just gender diversity, but diversity in race, nationality and other important perspectives.

Our action plan seeks to close these gaps — for the benefit not only of women, but of our entire society — and to build on the great momentum we have seen in many areas. But carrying out our proposals will take determination, imagination and an eye on the long game. We are encouraged, as this report shows, that a growing number of businesses, educational institutions and non-profits are up for the challenge.

ABOUT THE COUNCIL AND THIS REPORT
The Canada-U.S. Council for Advancement of Women Entrepreneurs and Business Leaders was established by the U.S. and Canadian governments in February 2017. The Council aspires to expand women’s participation in the economy and the number of women business leaders, and to contribute to the growth, stronger integration, and greater competitiveness of both the U.S. and Canadian economies.

The Council’s mandate is to recommend to the Canadian prime minister and U.S. president measures that can lower the barriers that limit women’s participation in business; support women’s professional advancement; and help women to start and grow their own businesses.

The Council is taking a targeted approach, focusing on five “pillars” of advancement (exhibit 2).
Exhibit 2  **The Council’s five pillars**

The task for each pillar is to identify success stories of what is working in each area, seek out barriers faced by women, and propose a few bold ideas that can “move the needle” in both countries. Our efforts involve a combination of research and stakeholder engagement with entrepreneurs, government, the private sector and community groups. We are engaging men as well as women, in the belief that we all must work together to drive real change.

This paper — which focuses on expanding the role of women in STEM — is based on:

- Numerous research papers and media reports (see a list of sources on page 23).
- An online discussion involving about 20 STEM experts organized by YPO, the global network of young business leaders.
- A policy-focused consultation in Washington, D.C., co-hosted by the Congressional Caucus for Women’s Issues and led by caucus vice-chair U.S. Representative Brenda Lawrence (D-MI-14), and the Women’s High Tech Coalition.
- A roundtable discussion in Toronto hosted by the Lieutenant-Governor of Ontario, Elizabeth Dowdeswell, and attended by about 20 senior representatives of business, academia and the non-profit sector with an interest in promoting women’s role in STEM.
- Panel discussions at the Canada 2067 National Leadership Conference, held in Toronto.
We also acknowledge ground-breaking work by the National Center for Women and Information Technology, Catalyst, Girls Who Code, Canada Learning Code, Accenture, McKinsey & Co., WISE Campaign (U.K.), and many others.

**ENCOURAGING PROGRESS**

The good news is that women’s representation in most STEM fields has improved markedly over the past 25 years. And the future looks promising. Evidence suggests that young women today are far more inclined to enroll in a STEM degree program than their mothers, aunts or grandmothers were. Canadian women aged 25 to 34 held 39% of STEM degrees in 2011, far above the 23% held by 55-to-64 olds, according to Statistics Canada (exhibit 3).

**Exhibit 3**  
**Percentage of women in university-level scientific occupations, 1991-2011 (Canada)**

We are optimistic that the choices made by girls now entering school and university will go a long way towards correcting the gender imbalance in STEM. A study by Accenture and Girls Who Code estimates that, with the right corrective measures, the number of women in computing could triple between 2016 and 2025 (exhibit 4).

### Exhibit 4 Women in computing could more than triple by 2025

<table>
<thead>
<tr>
<th>Actions taken during junior high, high school &amp; college</th>
<th>Result in 3.9M women working in computing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actions taken during college &amp; high school</td>
<td>2.8M</td>
</tr>
<tr>
<td>Actions taken during college</td>
<td>1.9M</td>
</tr>
<tr>
<td>Continue with today’s approach</td>
<td>1.7M</td>
</tr>
<tr>
<td>Number of women working in computing today</td>
<td>1.2M</td>
</tr>
</tbody>
</table>


Our optimism is buttressed by significant — even exciting — actions on various fronts to bolster girls’ enthusiasm for STEM at an early age, and to retain that interest throughout their careers. Here are a few examples of such pioneering initiatives:

- A growing number of businesses, many owned by women, are producing imaginative toys, books, apps, videos, animation and merchandise aimed at helping girls acquire an interest in STEM from a very young age. As California-based GoldieBlox notes, its products are “disrupting the pink aisle in toy stores globally and challenging gender stereotypes with the world’s first girl engineer character.” GoldieBlox has had more than a million app downloads and has sold over a million toys through 6,000 retailers around the world.

- **Spongelab Interactive**, based in Toronto, has devised games to promote STEM in school classrooms. One of its products, Ostevera, is a free science education game based on an imaginary abandoned planet. It was designed in partnership with Let’s Talk Science and funded by the Ontario’s Ministry of Education.

- Universities and colleges throughout North America are putting a growing emphasis on their female STEM cohorts.
More than half the computer science graduates at Harvey Mudd College in Claremont, CA, are now women, compared to only about 10% a decade ago. And more than 40% of the computer science faculty is female and, importantly, highly engaged in ensuring diversity is achieved. Harvey Mudd’s approach — which has been adopted by more than a dozen other colleges across the U.S. — is to make computer science instruction more engaging and designed to build confidence in students while maintaining its rigor. Among the college’s other strategies:

- Creating targeted recruitment programs with a personal touch. For example, the college’s president Maria Klawe wrote handwritten cards to each female student for the first four years after she took office.

- Creating a culture that emphasizes openness, inclusivity and support, rather than competitiveness.

- Reflecting diversity wherever possible, including in marketing materials and the college magazine.

- Defining diversity broadly, beyond gender to race, sexual orientation etc, recognizing that “we are all better when we celebrate differences.”

As the Los Angeles Times put it in January 2017: “Programming is so popular now in this science and engineering corner of the Claremont Colleges that its professors are campus celebrities and incoming freshmen are excited for classes before ever setting foot on campus…. For example, instead of having computer science students write arcane code, professors started giving them fun group puzzles and 3-D graphics to create their own games. After freshman year, students were offered research opportunities. They used algorithms to solve evolution questions and analyze DNA sequences.”

In Canada, the University of Toronto hosts networking sessions and provides mentorship opportunities for its staff with representatives from technology and engineering companies, enabling them to share experiences and discuss career paths. The results are impressive: women made up 42% of enrollment in the 2017 engineering class, up from 41% the previous year. The trend is gathering pace, and the work these students do will have a lasting impact. The current dean of the university’s faculty of applied science and engineering happens to be a woman. Among the school’s innovations:

- Outreach to high schools, students, teachers and parents from grade 9 and up. For example, parents are invited to spend a day at one-week summer camps for engineering students.

- Targeted follow-up of interested female students provides a personal touch that resonates with potential students.

- A qualitative assessment of performance, in addition to marks, as the basis for the entry offer. This includes evaluation of applicants’ success in a challenging environment, and their problem-solving skills.

- Female faculty has grown from 9% of the total to 22% over the past decade, providing important role models for female students.

- Making wider recruitment of female students part of a broader diversity agenda.
Elsewhere, a woman has headed the University of Waterloo’s engineering school since 2012. The computer science faculty at Dalhousie University in Halifax, Nova Scotia, has launched a We Are All CS campaign, which sets a target of doubling the number of female students in undergraduate programs for the 2018-19 academic year.

Employers are increasingly taking the initiative to expand their female STEM workforces, sometimes setting specific targets. General Electric, one of North America’s biggest industrial conglomerates, unveiled a commitment in February 2017 to have 20,000 women in STEM roles by 2020, and to reach 50:50 representation for all technical entry-level programs across its U.S. and Canadian operations. The program, GE said, “will significantly increase the representation of women in engineering, manufacturing, IT and product management roles – a strategy necessary to inject urgency into addressing ongoing gender imbalance in technical fields and fully transform into a digital industrial company.”

On a smaller scale, Canada Drives, a Vancouver-based financial technology company, is helping female employees in administrative jobs train as junior software engineers with the aim of broadening their career horizons.

In Los Angeles, local chapters of YPO, formerly the Young Presidents’ Organization, organize visits by 14-18 year-old school children to local tech companies. Senior female executives at the companies are asked to join the visitors as often as possible.

Non-profits and international organizations are also making valuable contributions. The UN Foundation’s Girl Up program, in collaboration with the U.S. State Department and chipmaker Intel, launched the WiSci Girls STEAM Camp (short for science, technology, engineering, arts and design, and mathematics) in 2015. The 16-day residential summer camp is open teenagers from around the world. Intel and other companies provide hands-on STEAM education and Girl Up organizes leadership and self-esteem workshops. Women leaders in the STEAM fields, State Department officials and Girl Up staff also mentor the campers.

BARRIERS REMAIN
We are encouraged by the growing awareness of women’s role in STEM. And we are heartened by the many concrete initiatives being taken to correct the gender imbalance in STEM. Even so, some obstacles remain that hold women back from achieving the targeted levels of parity. These issues need to be urgently addressed.

The hurdles start appearing in childhood, continue through school and university and remain a fact of life throughout most women’s careers. They are a limiting factor even in the upper echelons of the corporate and academic worlds.

We highlight below some of the specific barriers that girls and women face as they make — or, in far too many cases, do not make — their STEM journey.

1. The problem starts in childhood
The bias against a STEM education and a STEM career begins at a young age. Male stereotypes surround science and technology, and cloud some parents’ and teachers’ expectations of young girls. The result is that peer pressure discourages many girls from taking an interest in STEM.
Girls who do take an interest in STEM-related subjects may find themselves outnumbered by boys in the classroom although, as noted, this is changing. If there are only a handful of girls in a STEM class, they are unlikely to encounter female role models cheering them on throughout their studies. Reshma Saujani, founder and CEO of Girls Who Code, has made the point that girls all too often cannot picture themselves growing up to be programmers, engineers or tech entrepreneurs. In Ms. Saujani’s oft-quoted words: “You cannot be what you cannot see.”

This is where role models are so important. Highlighting role models is a powerful way for young women to visualize their own future STEM success. More often than not, children of STEM grads, both male and female, become STEM grads themselves. This is encouraging for the longer term given the rising numbers of female STEM students and grads in recent years. Likewise, teachers who disavow gender stereotypes by encouraging girls to pursue and enjoy STEM give the female talent pipeline a strong start. As we see it, excitement around and a passion for creativity, innovation – STEM – should be instilled in girls as early in life as possible.

3M’S VISITING WIZARDS:
INSTILLING A STEM CULTURE

Companies can play a crucial role in building kids’ interest in STEM. 3M has a great program called Visiting Wizards where company representatives visit schools to do experiments and talk about how products that students see or use every day are made and developed. Kids are electrified by the demonstrations, and a future scientist is born. The target audience is children in grades 1-6.

Greater involvement by parents and teachers can show girls at an early age that science and computing can be cool, fun and a means to realize their aspirations. If we want more women in technical positions, we need to encourage them to be involved in “technical play” starting even before kindergarten. The high school years are a time of especially high risk, when girls often lose interest in STEM subjects, never to return (exhibits 5 and 6). Opportunities for STEM education and girls’ access to them are crucially important. Research by Accenture and Girls Who Code has found that 81% of high school girls who studied computing during their summer vacations became interested in studying it in college, compared to 52% whose studies were confined to school.
By the time girls are in high school, computing and engineering have already lost appeal

Exhibit 6

Factors influencing girls’ interest in computing at each stage of their education


Interest in professions by girls ages 14-17, % of girls

- Arts or social sciences: 61%
- Entertainment / communications: 60%
- Medicine: 56%
- Physical / Life sciences: 46%
- Education: 42%
- Business / Finances: 39%
- Law: 38%
- Community / Social services: 38%
- Stay-at-home mom: 31%
- Architecture: 26%
- Engineering: 24%
- Computing or math: 23%
- Armed forces: 12%
- Manufacturing / construction: 11%

Computing, math, and engineering professions are among the least interesting to high-school girls

Source: Girl Scouts, Generation STEM: What Girls Say About STEM.
2. Too few women enroll in STEM degrees
The “leaky pipeline” in secondary school tends to widen the gender gap in specific STEM areas. Some, such as medicine and life sciences, already have strong female representation. Female enrollment in engineering, computing, and math is on the rise, but is still at only about half the level we would like to see. In 2013-14, women in the U.S. earned well over half of all degrees including PhDs in biological and biomedical science, but only slightly more than 20% of doctorates and 18% of bachelor degrees in computer sciences (exhibit 7). The trend is similar in Canada. There are encouraging signs of progress, but more movement is needed.

Exhibit 7  
Percentage of degrees earned by women in U.S. post-secondary institutions

<table>
<thead>
<tr>
<th>Field</th>
<th>Bachelor’s</th>
<th>Master’s</th>
<th>PhD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biological and biomedical sciences</td>
<td>58.5</td>
<td>56.5</td>
<td>53.2</td>
</tr>
<tr>
<td>Math and statistics</td>
<td>43.0</td>
<td>41.5</td>
<td>28.9</td>
</tr>
<tr>
<td>Engineering</td>
<td>18.4</td>
<td>24.4</td>
<td>22.7</td>
</tr>
<tr>
<td>Computer and information sciences</td>
<td>18.0</td>
<td>28.7</td>
<td>21.0</td>
</tr>
</tbody>
</table>

Source: Catalyst, Women In Science, Technology, Engineering and Mathematics.

3. Too many STEM graduates quit STEM
Once in the workforce, women remain under-represented in STEM fields, especially at senior levels. One reason is that they are more likely than men to leave the engineering profession. Another is the simple math that comes from years of male engineering grads dominating the workforce and senior positions. If we continue to encourage women to pursue STEM and retain that passion throughout their education and professional careers, over time we will narrow the gap.

Apart from the women who grow disillusioned in their STEM jobs, between 54,000 and 216,000 technical women in the U.S. are on career breaks at any one time, according to a task force set up by the Society of Women Engineers and iRelaunch.

The reasons for this high turnover are not hard to find. Women face direct and indirect barriers in both technical and business-oriented roles. They are more likely than men to start lower on the corporate ladder, often lack female role models and, indeed, may be the only female among their everyday work colleagues. Sometimes, women can face bias in the workplace and have difficulty making their voices heard.

The vast majority of businesses are not deliberately setting out to discourage women or make them feel unwelcome. “Although science, technology, engineering, and mathematics value objectivity as a fundamental principle, a growing body of evidence shows that unconscious gender bias disadvantages women and their work in STEM fields,” a 2015 study by researchers at Harvard University’s Kennedy School noted.
THE HIGH COST OF UNCONSCIOUS BIAS

A study cited by the American Association of University Women asked science faculty to evaluate resumés that were identical except for the candidates’ names. The researchers found that scientists were more likely to choose a male candidate over an identical female one for a hypothetical job opening at a lab. Both female and male scientists also offered a higher salary to the male candidate and were more willing to offer him mentoring opportunities.

In another study, potential employers systematically underestimated the mathematical performance of women compared with men, resulting in the hiring of lower-performing men over higher-performing women for mathematical work.

Training in unconscious bias can help alleviate the problem. It should become second nature to human resource departments to write a job description in a way that appeals to both women and men. Employers should set goals to include, say, two or three qualified women out of five candidates in short lists for open positions. Further, internal succession planning and development programs should focus on ensuring proper the levels of representation of women for future openings.

Additionally, women in STEM face the same challenges presented for women in other sectors, such as having to juggle work and family responsibilities, and the difficulties of returning to work after raising children.

The good news is that a growing number of employers are putting comprehensive programs in place to encourage more women to join their technical operations, and stay there.

ENBRIDGE: FEMINEN AND WOMEN@ENBRIDGE

FEMINEN, short for FEMAles IN Engineering, is a group for women engineers at Calgary-based Enbridge, one of North America’s biggest pipeline operators. The group gives women a forum to seek advice and have candid conversations about the barriers they face in the workplace. FEMINEN has created and maintains a mentorship program between Enbridge’s female engineers and aboriginal girls from high schools in Edmonton, Alberta, who show an interest in STEM.

Women@Enbridge is another employee resource group designed to promote inclusivity, leadership, career development, diversity and community. It works mostly through local chapters. For example, in 2015, the Edmonton chapter surveyed women in the region for their thoughts on diversity and inclusion. More than 370 women provided insights into their career challenges. Senior Women@Enbridge members then hosted focus groups at which over 100 women discussed ideas for improvement.

Initiatives like FEMINEN and Women@Enbridge help Enbridge build and shape an effective workplace. “We encourage diversity and inclusion in our workforce,” says Lori Campbell, senior manager of enterprise diversity and inclusiveness, “because we understand that different backgrounds, abilities, and perspectives help keep us innovative and dynamic, and contribute to our success.”
OUR ACTION PLAN

We are excited by the hundreds of programs, tools and great ideas that are already attracting more women to STEM. By scaling up these initiatives and creating new ones, we are confident that we can dramatically narrow, and even eliminate, the STEM gender gap.

The research mentioned above by Accenture and Girls Who Code suggests that a fresh approach could triple the number of women in U.S. computing jobs to 3.9 million by 2025, expanding their share of technology jobs from 24% today to 39%. It notes that “the greatest impact will come if we act now, starting with girls in junior high school and sustaining their interest throughout their education.”

What’s more, young girls will not be the only beneficiaries of breaking down gender stereotypes and promoting more STEM opportunities. Our entire society will benefit. Proactive measures encouraging children to fall in love with STEM and pursue STEM careers means that the next generation of STEM talent will inevitably be more diverse – in gender, race, nationality, and more.

Based on our experience and discussions with a wide variety of stakeholders, we believe that U.S. and Canadian businesses can take a number of practical steps to encourage more women to take an interest in STEM, and retain that interest throughout their working lives.

Our proposals fall into four main categories:
1. Communicate and educate
2. Identify and share tools
3. Identify and promote programs
4. Mentor and empower

One key, over-arching recommendation is relevant to all four categories:

- **Set up a comprehensive online STEM portal.**
  
  We recommend that the U.S. and Canadian governments each establish a public-private partnership to create an online, mobile friendly “one-stop shopping” STEM portal for teachers, students, parents and businesses.

  This website would map out career pathways in STEM areas of study, and be a guide to the kind of work that STEM graduates can get involved in. It would also indicate the current level of demand for STEM graduates and their earnings potential; provide access to publicly available tools, programs and job postings; and highlight success stories and role models who can inspire other young women. The main targets would be middle and secondary school-aged children, with a view to encouraging girls not to drop math and science when they choose their future coursework and to identify the opportunities that await them when they graduate.

  - Students could start their search by identifying a goal they have (e.g., ensure clean drinking water is accessible to all populations). From there, they could click to a list of jobs that would help them realize that goal (e.g., environmental water scientist), and the education needed for that job (e.g., undergraduate chemistry degree).

  - Students could also start their search from a program they already like (e.g., biology), and then drill down into available jobs in that area (e.g., marine biologist), the types of work involved (e.g., develop a plan to save endangered humpback whales), demand for relevant jobs (e.g., 600 postings today), and the earnings potential for each one.
One widely acclaimed model for such a portal is the U.K.’s STEM Learning (www.stem.org).

STEM Learning claims to be the U.K.’s largest provider of education and career support in science, technology, engineering and mathematics. Backed by a partnership of government, charitable trusts and businesses, its goal is to raise young people’s engagement and achievement in STEM subjects and careers. It works with schools, colleges and other groups to help teachers, parents, technicians and others instill a love for STEM in young people.

STEM Learning also offers continuing professional development courses, ranging from intensive residential courses to custom coaching programs for individual schools or networks.

Below are our recommendations for each of the four main categories of proposals. We have also highlighted some of the many companies, non-profits, government agencies and academic institutions that are successfully putting these ideas into action.

1. Communicate and educate
   - **STEM-centered organizations should set specific goals for under-represented minority participation in their activities and measure progress.** Broad diversity goals beyond gender alone are ideal to ensure maximum inclusion. Even non-gender-oriented groups should strive to expand their impact in a way proportional to the general public, also known as “gender mainstreaming.” Companies can encourage this type of accessibility by asking organizations they support to report on the make-up of participants. While we do not think funding decisions should necessarily be tied to such data, understanding an organization’s impact on closing the STEM gender gap can be one measure of effectiveness.

   - **Government STEM portals should include access to career planning tools centred on both outcomes and areas of interest as detailed above.** Being able to visualize an end-game that features STEM to achieve a personal goal or satisfy a passion is a critical element in deciding to pursue a STEM education.
Middle and secondary schools should expand their curriculums to increase STEM opportunities for students, including in areas such as computer science. In particular, greater emphasis should be placed on coding skills. Politicians and school boards should advocate for the funding needed to support such programs.

STEM curriculums at both secondary and post secondary level should be adjusted to strengthen their appeal to women, as well as men. They should be rigorous but also engaging and build confidence.

Post secondary STEM programs should:

- Hire more women to teach STEM courses. Colleges and universities could borrow a page from the business world by setting goals to specifically include women in their short lists for open positions. This would likely boost the number of female STEM professors and teachers.

- Establish targeted, personalized outreach programs for recruiting women to the programs.

- Include both qualitative and quantitative factors in assessing candidates for STEM offers.

Companies should commit to outreach programs to middle- and high-school girls that educate them about career opportunities. While every initiative is commendable, we urge companies, academic institutions and non-profits to pool their efforts wherever possible. Such partnerships have the advantage of maximum efficiency and the broadest possible reach, with minimum duplication of effort.

Employers should consider partnering with universities and colleges to set up STEM scholarship programs for women, especially under-represented minorities. The programs could offer a combination of financial support for tuition, summer internships and a job upon graduation.

Companies, governments and educational institutions at all levels should strengthen training to address unconscious bias in the workplace to ensure a more open, inclusive, supportive environment is created.
2. Identify and share tools
   - Companies should be encouraged to measure the results of their STEM gender equality efforts. (See also first recommendation under category 1 above.)
   - Government STEM portals should include information and links to tools designed to attract young women to STEM.
   - Companies and organizations should develop and share their own STEM tools or, in cases where they do not have the resources to do so, should support and share existing tools. These resources can be promoted through local schools to reach the maximum number of participants.

PUTTING IT INTO ACTION

Code.org is a non-profit dedicated to expanding access to computer science among women and underrepresented minorities. Its aim is to give every student in every school the opportunity to learn computer science, just as they learn biology, chemistry or algebra. Code.org organizes an annual Hour of Code campaign which has engaged millions of students around the world. It also provides the leading curriculum for K-12 computer science in the largest U.S. school districts.

(More examples can be found at the end of this paper.)

3. Identify and promote programs
   - Government STEM portals should include information and links to programs designed to attract young women to STEM.
   - Parents and their daughters should actively seek out programs that are designed to attract young women to STEM. The website proposed above offers a great opportunity to access this type of information.
   - Businesses should actively support these programs through endorsements, financial support, and by sending employees to serve as program volunteers and mentors. As previously mentioned, businesses should also consider asking the organizations that they support to report on their program’s target audience and reach. While not every program can or should focus solely on women, understanding how corporate dollars impact the gender divide in STEM can help companies assess the effectiveness of their giving.
   - Companies should develop women’s STEM retention programs to encourage female STEM employees to stay with them, and with STEM.
PUTTING IT INTO ACTION

Interest is growing in North America for programs based on the U.K’s Athena SWAN (Scientific Women’s Academic Network), which grades universities on gender equality in science. Already adopted by 140 British institutions, Athena SWAN asks universities to supply self-assessments to a non-profit group that judges them based on their inclusiveness and equality in hiring, promoting and retaining female staff in STEM-related fields. A U.S. pilot program, called SEA Change (STEM Equity Achievement Change) began in October 2017 under the auspices of the American Association for the Advancement of Science. Canada’s Natural Science and Engineering Research Council has also expressed interest in bringing SEA Change north of the border.

(More examples can be found at the end of this paper.)

4. Mentor and empower

- **Companies should develop women’s STEM mentorship programs**, using both male and female mentors for high-potential female STEM employees.

- **Companies should develop women’s STEM role model programs** that enable successful STEM employees at all levels to interact with youth in their communities. The goal is to provide role models who match young people’s aspirations.

- **Government STEM portals should include a section devoted to successful role models and case studies.** The websites should highlight “celebrity” scientists whom girls seek to emulate because they are doing amazing work.

- **Companies should devise training programs to counter unconscious bias in the workplace.**
PUTTING IT INTO ACTION

Amanda Dowd and Beth Zotter’s 2014 Kickstarter project **See It Be It: Profiles of Women Who Love Math and Science** helped young girls visualize careers in STEM. It introduced them to other young women doing “cool work in science and tech” via a 12-month calendar, featuring real female scientists and creators as models. “When girls are too old to play with their GoldieBlox and start reaching for Seventeen magazine, we want to grab their attention with these portraits,” said Zotter, herself a technologist. The calendar uses great images of hip, modern women to grab girls’ interest. Each role model’s profile details her field of expertise and answers questions like: What is the bravest thing you’ve ever done?

**DAPHNE LAROSE**

**works in COMPUTER SCIENCE**

**WHAT DO YOU LOVE ABOUT SCIENCE AND/OR MATH?**

In computer science, almost every problem can be reduced to a logic puzzle. The hardest part is making sure you have all of the pieces, but once you do, the task of rearranging the pieces to solve the puzzle becomes much simpler.

**WHAT EXCITES YOU ABOUT YOUR FIELD OF STUDY?**

Finding art in a field not usually perceived as creative. To me, writing a computer program is very creative – I approach it like I’m writing a story.

**WHAT’S THE BRAVEST THING YOU’VE DONE?**

The bravest thing I’ve ever done was making the leap into this field. I declared Computer Science as a major without having taken any classes in it, or programming anything more than basic CSS and HTML. Despite changing from an entirely different career path (fashion journalist), I knew this was the right choice for me. And I’ve been proud of that decision ever since.

**HAVE YOU EXPERIENCED BEING THE ONLY WOMAN WORKING ON A TEAM? DID YOU EVEN NOTICE?**

I’ve spent most of my career being the only woman or one of a tiny handful of women on developer teams. In my last job, I was the only woman on my team. In my current job, I am the only woman of color on my team. In my current job, I am the only woman of color engineer in the company. I don’t let it affect my work, but I always take note of the demographics of my environment as it gives me the leverage to change it. I started a website called Black Female Coders to support other women facing the same challenges.

**WHAT MAKES YOU FEEL BEAUTIFUL AND CONFIDENT?**

Surrounding myself with beautiful, confident, passionate and inclined people.

(More examples can be found at the end of this paper.)
WE CAN — AND MUST — STEP UP THE PACE!
The U.S. and Canada have made great strides over the past 30 years in drawing more women to STEM. Now is the time to accelerate those initiatives, build on the momentum, and then enjoy the economic benefits of tapping into a much larger talent pool.

The proposals above are rooted in our belief that girls should be given every opportunity to pursue an interest in STEM from an early age, and to strengthen that interest as they move through school and college. We also want to be sure that the path to a STEM career remains open throughout a woman’s working life.

Let’s keep building on our successes, using our achievements to break down the barriers that still remain.

LEADING THE WAY — MORE SUCCESS STORIES
The sections above outline a few of the exciting initiatives that are encouraging girls and women to take a greater interest in STEM. Below are other examples that participants have brought to our attention.

Needless to say, the list is by no means exhaustive. We look forward to sharing many more success stories in the months and years ahead.

1. Communicate and educate
The U.S. government has recognized the need for a larger STEM component in schools. Citing “the importance of expanding access to high-quality STEM and computer science education…particularly among historically underserved groups,” the White House directed the Secretary of Education in September 2017 to allocate at least $200 million a year in grants towards high-quality STEM education, with a focus on computer science. It has also asked the Department of Education to explore administrative measures that will sharpen the focus on computer science in existing K-12 and post-secondary programs.

At least 11 states have created special projects to integrate computer science into their school curriculums. Arkansas has seen a near-fivefold surge in enrollment for computer coding classes since it passed a law in 2015 requiring all public high schools to offer these courses.

Linamar, a global auto parts maker based in Guelph, Ontario, has set up a partnership with Western University in London, Ontario. Linamar offers STEM-related scholarships to 10 female students each year to fund half their tuition fees. It also provides summer co-op positions for these students after their third and fourth years, plus an offer of full-time employment upon graduation. The combination of funding and job opportunities is a powerful tool to attract students.

FIRST (For Inspiration and Recognition of Science and Technology) has sought to inspire an appreciation of science and technology in young people since 1989. FIRST designs accessible, innovative programs to build self-confidence, knowledge, and life skills while motivating young people to pursue opportunities in science, technology and engineering. The non-profit, based in Manchester, NH, has garnered support from over 200 of the Fortune 500 companies and more than $50 million in college scholarships. It hosts the FIRST Robotics Competition for students in Grades 9-12; FIRST Tech Challenge for Grades 7-12; FIRST LEGO League for Grades 4-8; and FIRST LEGO League Jr. for Grades K-4.
Men Advocating Real Change (MARC) is an online community for men to engage in candid conversations about the role of gender in the workplace. The MARC website — www.onthemarc.org/home — showcases member-generated advice, insights and best practices to inspire men eager to expand gender diversity within their organizations. Hate speech is not tolerated, but freedom of expression is encouraged. Recent blog posts have included such topical issues as:

- Should men come clean on past sexual harassment?
- What worries men about traveling on business with a woman?
- Our most popular gender equity resources for men from 2017.

MARC is an initiative of Catalyst, an international non-profit that seeks to accelerate the progress of women in the workplace.

2. Identify and share tools

Digital Promise is an independent, bipartisan non-profit which works with education leaders, researchers, entrepreneurs and developers to improve learning with the power of technology. Its League of Innovative Schools is a U.S. national network of K-12 school district superintendents who work together to solve challenges facing schools. Similarly, its Verizon Innovative Learning Schools is a network of 74 low-income middle schools that provide mobile devices, connectivity on and off campus, and professional development to help prepare students for college and the jobs of the future.

In Canada, Actua is a national charity that prepares youth to be innovators and leaders by engaging them in STEM experiences to build critical skills and confidence. For example, Codemakers is a national program delivered by Actua in partnership with Google.org to transform the way youth engage with computer science.

Canada’s Let’s Talk Science Outreach program is a national, community-based program connecting educators and youth with volunteers to deliver a wide variety of STEM activities for children as young as three and youth up to Grade 12. Let’s Talk Science Outreach volunteers act as role models and are typically post-secondary graduate students, studying a wide variety of STEM-related subjects. They deliver hands-on outreach to students from kindergarten to Grade 12 in classrooms and community settings across Canada.

Howtoons kits provide everything a child needs for a complete science experiment or engineering project in a box. In the words of the San Francisco-based company, the kits “seek to inspire the highest heights of imagination with fabulous adventures that give kids lifelong skills in science, crafts, creativity, using tools, and engineering.”

3. Identify and promote programs

Girls Who Code and Black Girls Code are among the many groups that aim to close the gender gap in technology. Girls Who Code anticipated reaching 40,000 girls in all 50 U.S. states by the end of 2017. Its clubs stretch from rural Oklahoma, to homeless shelters in Massachusetts, and to the country’s most prestigious private schools. More than 60 companies have offered internship and job opportunities with Girls Who Code alumni. Black Girls Code counts about a dozen prominent companies among its partners and sponsors.
General Motors’ Take 2 internship program helps experienced technical professionals — mainly women — who are eager to relaunch their careers after being out of the workforce for more than two years. The 12-week program, launched in 2016, has become an effective and popular program for helping parents, caregivers and trailing spouses return to the workforce. Participants receive technical training, professional development and personalized mentoring with GM leaders that prepare them for opportunities in engineering, information technology, finance, customer care and other critical functions in GM’s global workforce. Take 2 has proven enormously popular. Since the initiative was launched in 2016, more than 60 individuals have taken part. For the most recent cohort, Take 2 received more than 3,600 applications for 60 positions in seven departments around the world.

The University of Maryland’s Office of Diversity and Inclusion is working to make diversity training an integral part of campus life. A key part of that strategy is UMD’s University 100 course, which is mandatory for all new students. The course aims to connect students to the resources they need to excel, and to make their transition to college as smooth as possible. The recommended curriculum includes a component on the importance of diversity, and course instructors often ask the Office of D&I to conduct formal diversity training for students. Requests for formal training have doubled since 2016, and nearly all University 100 courses now have a formal diversity training component.

Go ENG Girl, spearheaded by the Ontario Network of Women in Engineering, brings together all the province’s schools and faculties of engineering. It offers an opportunity for girls in grades 7-10 across Ontario — and more recently, other provinces too — as well as one parent or guardian to visit their local university campus and learn about the world of engineering from women professionals, academics and students. While the girls enjoy fun hands-on activities and student exhibits, their parents are treated to an informative session about careers in engineering. The network notes that it has an inclusive view of the word “girl,” and welcomes trans, gender queer and non-binary folks interested in attending an event.

4. Mentor and empower
In the U.S., the Public Leadership Education Network brings 300 college women from around the country to Washington D.C. for a series of 3-5 day educational seminars that match them with mentors and help give them the skills, networks and confidence they need to be successful leaders. Current seminars include women in STEM policy.

Australia’s Male Champions of Change Institute has brought together 130 influential male leaders from across the private sector and government to help them drive actions that encourage gender equality in the workplace.

HeForShe, an offshoot of UN Women, has similar goals. Canada’s prime minister Justin Trudeau became the organization’s first head-of-government champion in September 2016. The University of Waterloo also takes part in HeForShe’s IMPACT 10x10x10 framework – an effort to engage governments, leading universities and global businesses to make gender equality an institutional priority and develop bold commitments to achieve gender equality for all. UofW has committed to increasing the number of girls and women in STEM outreach activities to 33% by 2020. Notably, it has already exceeded that goal, reaching 35% in 2017.
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