Westcoast Women in Engineering, Science & Technology

NSERC CRSNG
Chairs for Women in Science and Engineering
Chaires pour les femmes en sciences et en génie

Why STEM?
for Parents & Guardians

Science, technology, engineering, and mathematics (STEM) fields often are associated with the stereotype of being "hard," "boring," or "not for me."

Contrary to these stereotypes, careers in STEM fields involve teamwork, creativity, and communication.[1] They often go beyond the laboratory to address current issues our society faces. STEM teams require a variety of people with different skills in order to be successful.

For example, engineering is a creative, engaging, rewarding profession where people solve problems, design solutions, and help local, and global communities. It also requires students to take science and math courses in high school before starting a post-secondary program.

While the young people in your life are starting to make decisions about their future, encourage them to keep STEM options open. Finding role models that help demonstrate what STEM careers involve, and going to events that allow them to try out STEM activities (camps, workshops, open houses) challenge the dominant stereotypes, and are crucial to helping youth make informed career decisions.

3 Reasons to Consider Careers in STEM

The variety of career paths

environmental protection policies | development | advanced composite biomedical device design | textile human-robot interaction | water food supply improvements | buildings | lean manufacturing | construction management | video game materials | process improvements design | transportation networks and sanitation | workplace safety technology development | green special effects | primary resource

STEM qualifications are in demand

from technicians to Ph.D.s

STEM organizations need new workers:

95,000+ engineering jobs available by 2020 due to retiring employees.[2]

100,000+ environmental sector job vacancies in the next decade.[3]

Contribute to solving today's challenges[4]

- Clean water access
- Health Informatics
- Affordable renewable energy
- Cyber security
- Restoring & improving infrastructure
- Improving medicine

Why should your child keep STEM options open?

70% of top jobs require STEM education[3]

70%

But less than 50% of Canadian high school graduates complete Gr. 11 & 12 math and science[5]

Graduates with STEM degrees:

- ✓ Earn 26% more on average[3]
- ✓ Have better job security[3]
- ✓ Earn more than non-STEM graduates, regardless of career[3]

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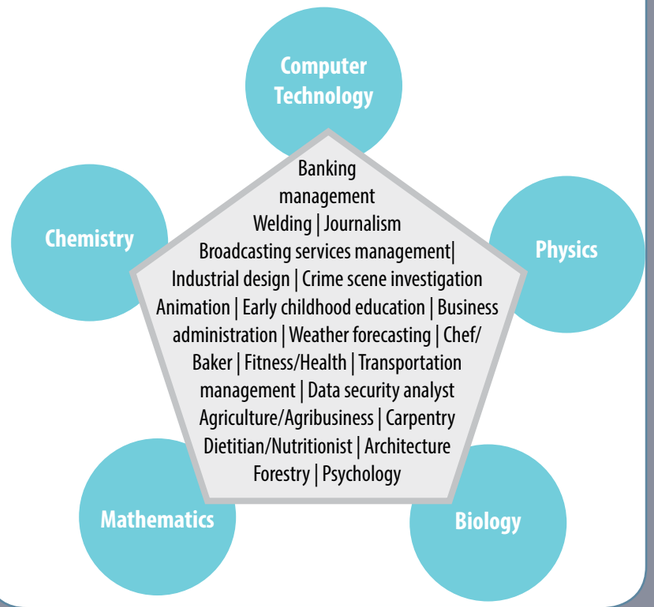
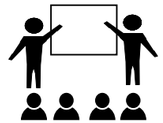
Unexpected Careers that have STEM prerequisites[3]



You are Influential[6]

76% of students say their **parents** have the greatest influence on their educational direction.[7]



(teachers are second at 24%)[7]

Pressure to succeed → Supporting a narrow range of careers

Restricts your child's ability to explore alternative careers.[8]

only **28%** of parents talk to their children about the value of optional STEM courses.[9]

STEM Self-Efficacy

Self-Efficacy
a person's belief in their ability to perform a task[10]

strongly predicts[11-13]

- academic interest*
- persistence *
- performance*

*in STEM disciplines[12-18]

4 Factors Affect Self-Efficacy[10,19,20]

Social Persuasion	Feedback, support and judgment from others (especially influential figures - parents, teachers).
Mastery Experiences	Has done the task before. Had a chance to learn & practice strategies to do task effectively.
Physiological Factors	How a person interprets their emotional/physiological state. E.g. "butterflies", nerves.
Vicarious Experiences	Learning by observing others doing the task. Role models are important for this.

Self-efficacy influences **the choices we make** in terms of:[21]

- what **goals** we choose
- how much **effort** we put into pursuing them
- our **persistence** when difficulties arise.

The most **influential source** of **STEM self-efficacy**:[22]

- Boys → **Mastery Experiences**
- Girls → **Social Persuasion**, **Vicarious Experiences**

Middle school girls' science self-efficacy is **lower than boys'**, & they are **more anxious** about science performance despite achieving higher grades overall.[23]

Perceptions of STEM Professions

Middle school students were asked to **draw** an **engineer...**

... most drew men in "workers'" clothes, seeing engineers as builders or car makers.[24,25]

Students were asked to **draw** a **scientist...**

... most drew men in lab coats.[26,27]

4th year student teachers' drawings of scientists were **more stereotypical** than **Gr. 5 students'.**[27]

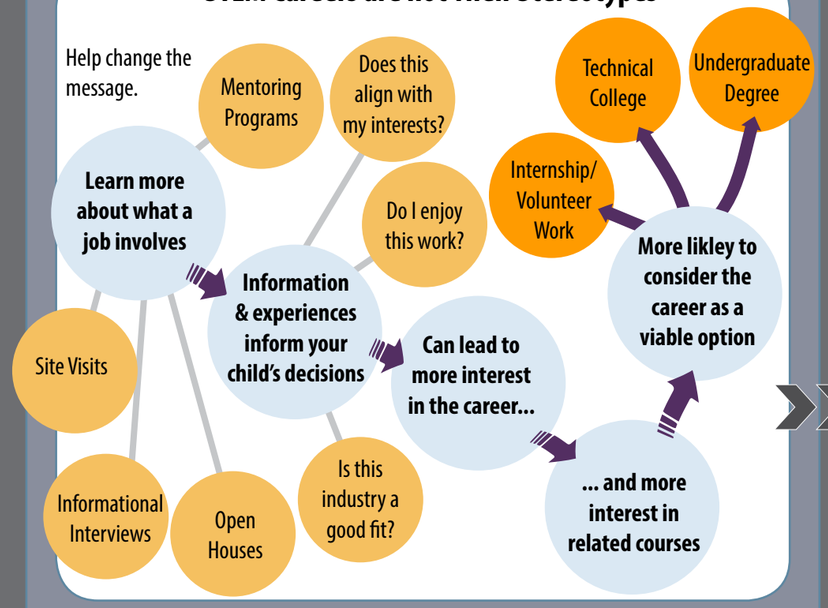
only **4%** of Grs. 7 and 9 students think engineering is a profession that can make the world a **better place**.[28]

IN REALITY

Top 10 Employability Skills
for UK STEM Companies:[29]

- Communication & interpersonal skills
- Problem solving skills
- Initiative & self motivation
- Working under pressure & to deadlines
- Organizational skills
- Teamwork
- Ability to learn & adapt
- Numeracy
- Valuing diversity & difference
- Negotiation skills

STEM Careers are not Their Stereotypes



What Can We Do?

Encourage your child to pursue a broad range of activities and interests.

Help your child build self-efficacy, not just self-confidence. Give them opportunities outside of class to try new things, and work on mastery.

Be a role model to your child. Try new things. Talk about STEM at home. Consider family outings to STEM destinations, pursuing hands-on activities and do-it-yourself projects at home, and discussing STEM topics on TV or the news.

Expose your child to STEM careers through role models, mentors, workplace visits, the media, summer camps, and career days.

When you see stereotypes in person or in the media, challenge them. Discuss stereotypes with your child. Emphasize that each of us is unique, and have different strengths. Stereotypes do not define us.

If your child appears to be opting out of STEM, encourage them to keep their options open. People with STEM backgrounds are very successful in other fields, but it can be hard to move into STEM if you have opted out of math and science in school.

Overall, take the time to learn about what real STEM careers involve, and provide opportunities for your child to try them out.

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WWEST
c/o UBC Mechanical Engineering
2054-6250 Applied Science Lane
Vancouver, BC V6T 1Z4
604-827-4090 | wwest@mech.ubc.ca

References

1. National Academy of Engineering: Committee on Public Understanding of Engineering Messages. (2008). *Changing the conversation: Methods for improving public understanding of engineering.* Washington, D.C., National Academies Press.
2. Engineers Canada. (2012). *The engineering labour market in Canada: Projections to 2020*. Retrieved from: http://www.engineerscanada.ca/labour-market-report
3. Let's Talk Science and Amgen Canada. (2013). *Spotlight on science learning: The high cost of dropping science and math*. Retrieved from: http://www.letstalkscience.ca/research-publications/publications-by-year.html
4. National Academy of Engineering (2008). *Grand challenges for engineering.* Retrieved from: http://www.engineeringchallenges.org
5. Let's Talk Science and Amgen Canada. (2012). *Spotlight on science learning: A benchmark of Canadian talent.* Retrieved from: http://www.letstalkscience.ca/research-publications/publications-by-year.html
6. Bardick, A.D., Bernes, K.B., Magnusson, K.D. (2004). Junior high career planning: What students want. *Canadian Journal of Counselling, 38*(2), 104-117.
7. Let's Talk Science and Amgen Canada. (2014). *Spotlight on science learning: Shaping tomorrow's workforce - what do Canada's teens think about their future?* Retrieved from: http://www.letstalkscience.ca/research-publications/publications-by-year.html
8. Middleton, E.B., & Loughead, T.A. (1993). Parental influence on career development: An integrative framework for adolescent career counselling. *Journal of Career Development, 19*(3), 161-173.
9. Let's Talk Science and Amgen Canada. (2015). *Spotlight on science learning: Exploring parental influence.* Retrieved from: http://www.letstalkscience.ca/research-publications/publications-by-year.html
10. Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioural change. *Psychological Review, 84*(2), 191-215.
11. Lent, R.W., Brown, S.D., & Hackett, G. (2000). Contextual supports and barriers to career choice: A social cognitive analysis. *Journal of Counseling Psychology, 47*, 36-49.
12. Lent, R.W., Brown, S.D., & Larkin, K.C. (1984). Relation of self-efficacy expectations to academic achievement and persistence. *Journal of Counseling Psychology, 31*, 356-362.
13. Lent, R.W., Sheu, H-B., Singly, D., Schimdt, J.A., Schmidt, L.C., & Gloster, C.S. (2008). Longitudinal relations of self-efficacy to outcome expectations, interests, and major choice goals in engineering students. *Journal of Vocational Behaviour, 73*, 328-335.
14. Betz, N.E., & Hackett., G. (1983). The relationship of mathematics self-efficacy expectations to the selection of science-based college majors. *Journal of Vocational Behaviour, 23*, 329-345.
15. Fouad, N.A., & Smith, P.L. (1996). A test of social cognitive model for middle school students: Math and science. *Journal of Counselling Psychology, 43,* 338-346.
16. Lapan, R.T., Boggs, K.R., & Morrill, W.J. (1996). Efficacy expectations and vocational interests as mediators between sex and choice of math/science college majors: A longitudinal study. *Journal of Vocational Behaviour, 49,* 277-291.
17. Luzzo, D.A., Hasper, P., Albert, K.A., Bibby, M.A., & Martinelli, E.A. (1999). Effects of self-efficacy-enhancing interventions on the math/science self-efficacy and career interests, goals, and actions of career undecided college students. *Journal of Counseling Psychology, 46*, 233-243.
18. Schaefers, K.G., Epperson, D.L., & Natura, M.M. (1997). Women's career development: Can theoretically derived variables predict persistence in engineering majors? *Journal of Counselling Psychology, 49,* 173-183.
19. Gist, M. E., & Mitchell, T. R. (1992). Self-efficacy: A theoretical analysis of its determinants and malleability. *Academy of Management Review, 17*, 183–211.
20. Pajares, F. (2005). Gender differences in mathematics self-efficacy beliefs. In A. M. Gallagher & J. C. Kaufman (Eds.), *Gender differences in mathematics: An integrative psychological approach* (pp. 294–315). New York: Cambridge University Press.
21. Bandura, A. (1997). *Self-efficacy: The exercise of control.* New York: W. H. Freeman and Company.
22. Zeldin, A. L., & Pajares, F. (2000). Against the odds: Self-efficacy beliefs of women in mathematical, scientific, and technological careers. *American Educational Research Journal, 37*, 215–246.
23. Britner, S. L., & Pajares, F. (2006). Sources of science self-efficacy beliefs of middle school students. *Journal of Research in Science Teaching, 43*, 485–499.
24. Fralick, B., Kearn, J., Thompson, S., & Lyons, J. (2009). How middle schoolers draw engineers and scientists. *Journal of Science Education Technology, 18*, 60-73.
25. Karatas, F.O., Micklos, A., & Bodner, G.M. (2011). Sixth-grade students' views of the nature of engineering and images of engineers. *Journal of Science Education Technology, 20,* 123-125.
26. Ruiz-Mallén, I., & Escalas, M.T. (2012). Scientists seen by children: A case study in Catalonia, Spain. *Science Communication, 34*(4), 520-545.
27. Unver, A.O. (2010). Perceptions of scientists: A comparative study of fifth graders and fourth year student teachers. *Necatibey Faculty of Education Electronic Journal of Science and Mathematics Education, 4*(1), 11-28.
28. Franz-Odendaal, T., Blotnicky, K., French, F., & Joy, P. (2014). *Career choices and influencers in science, technology, engineering and math: An analysis of the maritime proinces.* Retrieved from: http://www.wiseatlantic.ca/Researchteam.asp
29. STEMNET (n.d). *Top 10 employability skills. R*etrieved from http://www.exeter.ac.uk/ambassadors/HESTEM/resources/General/STEMNET%20Employability%20skills%20guide.pdf

Recommended Readings

1. Subject choice in STEM: Factors influencing young people in education. http://www.wellcome.ac.uk/stellent/groups/corporatesite/@msh_publishing_group/documents/web_document/wtx063082.pdf
2. http://www.wherestemcantakeyou.co.uk/docs/Why_STEM_Careers.pdf

About WWEST

Westcoast Women in Engineering, Science & Technology 2010-2015 (WWEST) is the operating name for the NSERC Chair for Women in Science and Engineering (CWSE), BC and Yukon Region. Our mission is to advance engineering and science as welcoming careers that serve our world through holistic understanding and creative, appropriate and sustainable solutions. WWEST works locally and, in conjunction with the other CWSE Chairs, nationally on policy, research, advocacy, facilitation, and pilot programs that support women in science and engineering.

About the Chairholder

The 2010-2015 Chair was held by Dr. Elizabeth Croft, P.Eng., FEC, FASME. Dr. Croft is the Associate Dean, Education and Professional Development in the Faculty of Applied Science, and a Professor of Mechanical Engineering at the University of British Columbia. She is also the Director of the Collaborative Advanced Robotics and Intelligent Systems (CARIS) Laboratory. Her research investigates how robotic systems can behave, and be perceived to behave, in a safe, predictable, and helpful manner. She is the lead investigator of "Engendering Engineering Success," a 3-year interdisciplinary research project that aims to take an evidence-based approach to increasing the retention of women in engineering by understanding and changing aspects of workplace culture that place women at a disadvantage.

Thank you to our sponsors

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