

# Eighteen Tips

## *A Guide for Including Everybody in Science, Technology, Engineering, and Mathematics*

by Susan Wismer

*Le Women Inventor's Project a entrepris une étude pour faciliter l'accessibilité des filles et des jeunes femmes aux sci-*

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*ences, aux technologies de pointe, à l'ingénierie ou aux mathématiques et donne dans cet article, un résumé de 18 de leurs bons conseils.*

*I didn't know that there were women [in science, technologies, engineering, and math] because we never talk about them. (Adolescent participant, WIP workshop)*

In Canada, about 70 per cent of all jobs require varying levels of expertise in sciences, technologies, engineering, or mathematics (STEM). Among jobs which pay well, have good future prospects and have desirable working conditions, the proportion is even higher, and is rising rapidly. Currently, however, fewer than one in five workers in STEM jobs are women. Although major gains in women's participation in higher education in areas such as law, medicine, and accountancy have been made in the past 20 years, women still represent only 18 per cent of university students in engineering and applied sciences and 28 per cent of those in sciences and mathematics. At the same time, women represent over half of all students in higher education programs in Canada (Statistics Canada 1995).

Gender equality is more than a human rights issue. It makes good economic and environmental sense as well. Women's disproportionately low representation in higher education in STEM areas means not only that women are barred from access to an increasing proportion of the most desirable jobs in the labour market, but also that key areas of the economy do not have adequate access to the skills and abilities

of over half of the post-secondary population. Finding ways to encourage girls to participate in STEM education is critical, not only to their futures, but also to the future of Canada. In a world in which environmental problems are looming larger and larger, everyone needs a strong science background. We all need the skills and knowledge which science offers us: critical thinking, strategies for making informed decisions, ways of exploring and understanding the complexities of natural and human systems and how they can impact on one another. Solving environmental problems is a task for us all, but right now the potential contribution of any people is less than it could be, simply because those people are girls and women who are "missing" from science, technology, engineering, and mathematics.

As one effort to remedy this situation, Women Inventors Project (WIP) worked in partnership with Youth Science and Engineering (YES) Camps during 1995 and 1996 to develop and pilot a workshop format and accompanying materials on teaching styles and gender-inclusive activities. YES camps are summer day-camp programs located on 21 university campuses across Canada which are designed to introduce young people to

the potential of science, mathematics, and engineering. Although the proportions of girls registered as participants vary across camp locations, in the YES camp system as a whole, girls are significantly under represented.

One outcome of the partnership was a list of Eighteen Tips. The list was developed based on WIP's experience running workshops with girls and women all over Canada and, as well, on individual surveys and focus group discussions carried out with participants and potential participants in YES camps and in WIP workshops with other youth-oriented organizations such as the Girl Guides and the YWCA. The "tips," summarized below, are meant to be a guide to inclusivity of girls and young women in the recruitment, design, and implementation of STEM programming in a variety of formal and informal educational settings, including classrooms, camps, and programs sponsored by non-profit groups.<sup>1</sup>

### **Tips for recruitment**

#### ***1) Use gender-sensitive language.***

Simply being neutral in the use of language is not enough. Boys and girls do experience life differently, and for girls in our society, that often means feeling less confident about STEM than most boys do. When most people read phrases like "rocket scientist," "chemical engineer," "mathematician," or "computer scientist," male images come to mind. Reminding people that a cook is a chemist and that someone who knits or sews is a mathematician will help to correct these stereotypes.

#### ***2) Use gender-inclusive images.***

Of course, it is important to include girls as well as boys in photographs and graphics in more or less equal numbers. Even more important is what the people in your images are

doing. Analyses of mathematics and science texts find that, even now, girls are often shown as passive observers, standing on the sidelines or in supporting roles (Vickers). Girls need to be shown as active leaders, at the centre of attention, engaged in activities which they themselves have identified as being “fun.”

**3) Demystify science and technology.** STEM is about history, adventure, discovery, communication, politics and social values, and relationships. Many people have not considered that music and mathematics draw on the same set of abilities and interests, that physics is all about philosophy, that we won’t ever figure out how to save the earth without science, that the design of everything from jewelry to clothing to housing requires engineering knowledge, that both art and journalism require significant technological expertise....

**4) Use a personal touch.** For many girls and young women in our society, the best decision is the one that their friends and role models like and think is a good choice. WIP has found that it is important to talk with girls and women in groups about STEM, emphasizing that they can have fun together learning about STEM and introducing them to people who they can identify with or who they will admire who have pursued STEM education or employment opportunities.

*We have already put some of your suggestions to good use in designing our brochure. We included pictures and copy that reflected girls’ interest in the environment and in practical applications. We stressed the hands-on activities and tried to stay away from loaded language. I hope that the overall tone of the brochure says that science and technology are ... not a mystery, but rather an adventure to be discovered. (Participant, WIP workshop, January 1996)*

### Tips for program design

**5) Take time for reflection.** Activities which allow time for discus-

sion, thinking, and planning work best for everyone. Many girls are most comfortable with collaborative approaches to learning, in which they discuss the activity first, then try it out. Boys often like to go directly to hands-on activity, see how it goes and discuss, if necessary, afterwards. Either approach—“discuss first, do later” or “do first, discuss later” is fine, as long as both discussing and doing are given equal importance.

**6) Emphasize process and product, aesthetics and usefulness.** Activities need to demonstrate that the process and the product both have value. It is also important to give value to aesthetics as well as usefulness and to discuss in advance the relative importance of these values for any particular project. Evaluation of activities should include an assessment of the skills and knowledge used in the process, as well as looking at the quality of the final product.

**7) Include some same-sex activities.** Girls will often feel more comfortable leading and will participate more in such groups. Some teenage girls, for example, are reluctant to do anything in mixed groups which might be interpreted as “unfeminine”—like being loud (enthusiastic) or bossy (assertive, showing leadership skills) or pushy (active and involved). The opinion of their female peers is equally important. No one wants to be laughed at (willing to make mistakes, make creative suggestions), or ostracized from the group (independent thinker). The process behaviours that activity leaders would like to encourage in girls may be seen by many girls to be fraught with social risks. Offering a variety of same-sex and mixed activities may help to keep the feelings of risk within manageable limits.

**8) Use female role models.** When asked to write down the names of famous women and men, most school children have difficulty identifying women. In general, they identify at least twice as many men as women. In STEM, we have very few well-known Canadian role models who are women. STEM materials in schools are

still written predominantly by men. Bringing in women who are guest speakers, putting up posters of women in STEM, bringing in videos, and making a special effort to identify and talk about the stories of individual women who have found fulfillment and success in STEM activities and employment helps to fill that gap.

Question: Identify ten Canadian women who have achieved success in STEM pursuits. Answer: Rosalie Bertell, Ursula Franklin, Roberta Bondar ... and every woman who manages a household, since household management requires a knowledge of mathematics, engineering, science, and technologies....

**9) Emphasize practical applications and hands-on learning.** Experiential, hands-on learning is important for everyone—we all like to learn by trying things out for ourselves. For girls in STEM, the opportunity for direct experience is particularly important, because their previous exposure to some traditional STEM activities and much commonly-used equipment (e.g. computers) will often be less than that of most of the boys (British Columbia Ministry of Education). One study found that, given the task of building a brick wall, girls in a mathematics class had much more difficulty than boys in determining how the bricks would need to fit together. However, in a subsequent class in which the task was embroidery, boys had much more difficulty than girls in sorting out how to match thread with patterns (Willis in Gaskell and Willinsky).

**10) Take a multidisciplinary approach.** Linking design and technology, science and society, literature and mathematics will help to engage the interest of both girls and boys. Girls may care more about the effects, impact, and context of STEM as they relate to other parts of society, than about isolated facts of achievements. They are interested in environmental, social, and political issues related to STEM.

**11) Allow adequate time for activities.** This is particularly important in testing situations. In scholas-

tic aptitude tests, removing time limits results in the disappearance of gender-based differences in achievement in mathematics (Fennema and Meyer in Secada). In general, allowing extra time for activities will allow girls, who may have had less previous exposure to STEM activities and equipment, the time they need for trial and error and figuring things out.

**12) Design for cooperation and mutual support.** Research shows that both boys and girls improve their academic achievement levels in situations where activities are structured to require communication and collaboration for completion. The same studies suggest that, in order to counteract the tendency of boys to dominate in mixed-sex groupings, activities should be structured so that girls take leadership positions and positions of active participation at least as often as boys (Streitmatter). There is considerable controversy over whether boys and girls have different learning styles, but it is clear that school science is often taught only in an intellectual and abstract way which is foreign to the learning styles of many young people. A number of studies suggest that girls achieve more highly in STEM when activities are structured as cooperative ventures (Gilligan *et al.*; Streitmatter; Grossman and Grossman).

### Tips for implementing activities

Hundreds of skillful, well-intentioned professionals inadvertently teach boys better than girls.... (Sadker and Sadker 3)

As Myra and David Sadker have pointed out:

- boys call out eight times more often than girls in classrooms;
- girls receive less time from teachers, less help, and fewer challenges;
- girls who know the answer wait to be called upon, boys shout it out;
- girls' correct answers are attributed to luck or the assistance they have received, boys' answers to ability and perseverance; girls' incorrect answers are attributed to lack of abil-

ity, while boys who get the wrong answer are encouraged to try harder;

•sexual harassment is a way of life in America's schools....

**13) Give positive feedback often.** Even girls who have been identified as gifted and/or who are getting excellent marks in STEM subjects in school doubt their abilities (McLaren and Gaskell in Gaskell and Willinsky). Direct and clearly worded praise or recognition of a job well-done is invaluable to everyone, and especially to those who lack self-confidence.

**14) Encourage competent conversation.** Talking about activities in precise and credible terms is particularly important for girls, since it helps to build their self-esteem, to make their achievements "real," to practice using unfamiliar language and to develop further the understanding which many girls feel they need before they are ready to "do" an activity.

**15) Debrief after activities or testing.** Many girls have a tendency to personalize and internalize failure, attributing their difficulties to lack of ability. Watch for self-deprecating behaviour and comment on it, making it clear that there are other, more positive viewpoints. Seating people in a circle and giving each person in turn an opportunity to speak is often helpful.

**16) Don't overlap.** Empowering girls means that they learn to do things themselves. Girls often have less experience with "tinkering" or "hacking" than boys do, especially if they are using tools or mechanical or computer equipment. Unfortunately other people (male peers, teachers, group leaders ...) often respond to this apparent helplessness by doing things for the girls.

**17) No put-downs allowed.** It is important to intervene directly and strongly in situations where boys tease or put down girls for being female, where girls tease each other about personal characteristics, or where anyone makes fun of someone else for being who they are. Be aware that, in any group of ten or more young people, chances are very high that at least

one person will be homosexual, lesbian, or bisexual. Homophobic and other forms of discriminatory comment should also be responded to directly and with firmness. Some people will be members of visible minorities, in particular those coming from diverse ethnic and cultural backgrounds. Many people also live with various forms of physical or emotional disability, which are not necessarily visible. Monitor computer games for violent or sexist content and make it clear that pornographic and violent content and images are out of bounds for Internet and World Wide Web users. In a number of studies, girls have reported that they expect to be harassed by the boys in their mathematics and physical science classes (British Columbia Ministry of Education). Research in the areas of violence prevention and anti-racism suggests that appreciation of diverse viewpoints, empathy, and cooperative approaches to conflict resolution are skills which can be taught as part of curricula in all subject areas (Pignatelli and Pflaum).

**18) Involve parents and other teachers.** Involving girls and young women in STEM is an ongoing process. Girls who feel supported and encouraged from parents, teachers, and other important adults in their lives will be more likely to develop their interest in STEM and to believe in their own ability to pursue that interest and achieve success for themselves, however they may wish to define it.

*Now I understand that normal people can be inventors....*

(Adolescent participant, WIP workshop)

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<sup>1</sup>An expanded version of the "tips,"

in manual format, is currently being prepared for publication by the Women Inventors Project, 107 Holm Crescent, Thornhill, Ontario, L3T 5J4. Tel: (905) 731-0328. Fax: (905) 731-9691.

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## SHEREE-LEE OLSON

### Bone

I know the voice, she's called here before  
though the place is wrong, New Orleans  
not New York ("He threw me out")  
I tell her she'd need a helicopter  
to reach my sister, who is cooking  
somewhere in the bush—  
hasn't been here since last summer

when she came for the birth of my son  
"Oh," breathes Angela from New Orleans  
"a son!" Yes, I tell her, yes  
he is wonderful, he is almost a year  
Almost a year since my sister watched  
them sew me back together, layer after layer  
so they would do it right

the way she once watched  
them sew up Angela's daughter  
after someone beat her nearly dead and  
shoved his flesh into her teenage self  
But all the Queens doctors and all the Queens men  
couldn't put Lisa together again—  
"Almost a year!" shouts Angela from New Orleans

Afterwards I wonder if she still keeps  
the box my sister told me about  
whether right now somewhere in New Orleans  
she is lifting from its wrapping of silk  
her daughter's wrist bone  
to lay against her cheek as she weeps  
the way I am weeping now, into my son's hair

*Sheree-Lee Olson's poetry appears earlier in this volume.*