# #TURNINGTABLESINSTEM

**A PHOTO-RESEARCH EXHIBIT FEATURING GIRLS & WOMEN IN SCIENCE AT THE TABLE.**

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# #TurningTablesinSTEM

## A photo-research exhibit featuring girls and women in science at the table

Who is at the table in science?

This photo-research exhibit celebrates success in science, technology, engineering, and math (STEM) among girls and women spanning nine decades of experiences. Featured scientists represent fields like physics, biology, zoology, chemistry, and engineering.

The images are linked with research from social psychology, education, sociology, and organizational psychology and related to each scientist and their science. Scientists are all photographed at the same table – representing that each person has unique skills and perspectives to contribute to the scientific conversation.

Together, these scientists bring decades of scientific experience to the table. They bring the perspectives of those not historically welcomed at the table. They call to action for greater inclusion to occur at the table.They are the turning tables in science where women have been traditionally excluded.

The table itself is a work surface. It is a physical place, but also a place where academic, economic, political, and cultural decisions are made. As a metaphor for inclusion in science, this series presents girls and women in science at the table.

When engaging with the images, we ask you to think about the various tables in your life. Who is included at each table? How does each table serve those who sit there? How can tables change, rearrange and be part of exchanges? What does it mean to turn tables in science?

*Eden Hennessey, PhD*
*Researcher and Exhibit Creator*

Thanks to Hilary Gauld, Photographer, The Laurier Centre for Women in Science (WinS), and the Laurier Students' Union.

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WOMEN IN SCIENCE

# The Future of Science at the Table

## Gracyn Hepplewhite

## Aspiring Paleontologist


In day-to-day life, cultural stereotypes suggest that girls and women are not suited for science; for example, children's products whose messages undermine efforts to encourage science careers for girls. “Barbie” books entitled, “I Can Be a Computer Engineer” (Romano, 2014), portray Barbie as unable to code without assistance from her male friends, and it isn't hard to find girl’s clothing featuring statements like “Too pretty to do math” (Amazon.com).

Real-world examples of similar stereotypes even appear in comments by high-profile academics like former Harvard President Larry Summers who stated that women may be under-represented in science for biological reasons (Dobbs, 2005). Nobel laureate Tim Hunt stated that women are distracting in the lab due to their attractiveness and emotionality (Waxman, 2015), and a recent former Google engineer penned a memo that overstated the role of biological sex differences to explain the underrepresentation of women in technology (Horton, 2017).

Such messages may eventually get to girls like Gracyn, who wants to be a Paleontologist, a field in which women remain underrepresented (Stigall, 2013). In fact, to find a dinosaur sweater she liked, she purchased the one she’s wearing from the “Boys” section at H & M, a clothing brand that inspired two women to create the Just Kids Campaign (justkidscampaign.com) that promotes clothing free of gender labels. In a world where gender identity is more than binary, it will be necessary to challenge restrictive gender messaging so that all children can see themselves as scientists.

# 3D Modelling at the Table

## Denisa Dica

## 3D Printing Specialist/ Machine Technician/Customer Success, InkSmith Ltd.


“You don’t look like a scientist” is something women in science often hear – imagine going to work every day and being asked to prove who you are and what you do. Imagine having your qualifications questioned regularly just because of your appearance or demographic characteristics. This is something that women in science and engineering hear – giving rise to social media campaigns like #ILookLikeAnEngineer (Zamon, 2015).

Denisa Dica hears similar comments in her role as a technician at the educational technology company InkSmith Ltd. This experience may be because some people think that Denisa does not ‘look like’ a stereotypical scientist (e.g., an older man in a white lab coat). Recent research (Banchefsky, Westfall, Park, & Judd, 2016) asked people to look at images of research scientists and to rate them on attractiveness, competence, and the likelihood of being a scientist or an educator. All participants said that those who were more attractive were less likely to be scientists.

Not surprisingly, women in science have reported limiting the degree to which they express femininity to avoid drawing attention to their gender and the fear that appearing to be more feminine will also signal they are not suited for science (Hewlett et al. 2008; Pronin et al. 2004). Importantly, the perceptions that scientists are socially awkward, nerdy, and anti-social has negative consequences for retaining women in science; among undergraduate women, stronger endorsement of the typical nerd stereotype was negatively related to science identity and motivation to pursue a career in science (Starr, 2018). Given the pervasiveness of the ‘scientists as nerds’ stereotype, it will be essential for all people in science to challenge such stereotypes as a means of attracting and retaining more girls and women.

# Global Change at the Table


## Jennifer Baltzer

### Associate Professor at Wilfrid Laurier University

### Canada Research Chair in Forests and Global Change



Some of the biggest marches in recent years have been led by students and scientists promoting the need for action in the face of rapid climate change.  Although the need for climate action is increasingly a focus of international headlines, the science of releasing carbon into the atmosphere has been around for more than a century. In 1856, Eunice Foote hypothesized that changes in carbon dioxide in the atmosphere would affect the Earth's temperature (Wilkinson, 2019) in her paper titled "Circumstances Affecting the Heat of Sun's Rays."

Today, women are still leading climate change science – from youth activists Autumn Peltier and Greta Thunberg to scientists like Laurier's Jennifer Baltzer, who holds a Canada Research Chair in Forests and Global Change. Jenn's research often takes her into the field, or in her case, the forest, to collect samples of soil and plants in Northwestern North America that tell her how rapid changing climate is affecting boreal forests and their ability to support us in the future. To best prepare for imminent global challenges affecting everything from weather to food and water security, scientists like Jenn will need all qualified minds at the table. Indeed, research shows that diverse groups can generate creative solutions to problems (Gurin, Dey, Hurtado, & Gurin, 2002).

Interestingly, some evidence shows that women and men can possess different amounts of climate-related knowledge and concern (McCright, 2010). Moreover, gender is relevant to climate science because women are disproportionately affected by climate change around the world (Government of Canada, 2019; United Nations Framework Convention on Climate Change, 2019). Given the urgency of climate change, we need all scientists working together at the table to give us the best chance at understanding and mitigating the effects of climate change through inclusive climate science.

# Re-Writing Stories at the Table

## Komal Singh
## Engineering Program Manager at Google
## Author of Ara the Star Engineer


When something needs to be done, sometimes you must do it yourself.

This was true for Komal Singh, a computer engineer at Google. Given her career in science, it was a surprise when her daughter remarked that ‘engineers are boys.’ Komal took action to counteract this stereotype and penned the book ‘Ara the Star Engineer’ – a children’s book that follows a curious girl Ara on her quest to count all the stars in the galaxy. Books like this one provide children with information that counteracts the stereotype that only men can be scientists (Nosek et al., 2009).

Books like ‘Ara’ also address the lack of gender and racial diversity in children’s books; an analysis of the most popular illustrated children’s books found that the majority did not feature women or people of color in lead roles or as authors (Ferguson, 2019). Komal’s work encourages children to see themselves as scientists by featuring real-life engineering trailblazers of diverse backgrounds. Notably, efforts to include girls and women in science are working slowly toward balance – a recent study found that when asked to draw a scientist, children are drawing more women in science than ever before (especially girls; Miller, Nolla, Eagly, & Uttal, 2018).

As we work to change stereotypes about who is in science with books like Komal’s, we can also improve digital literacy among girls and women worldwide, ultimately contributing to economic growth and social equity (Plan International, 2018).

# Engineering Inclusion at the Table

## Vanessa Raponi
## Founder of EngiQueers Canada/Engineer at Spin Master


Women in science are often discussed as though they are a homogeneous group, when in reality, women in STEM have multiple identities that affect their experiences (e.g., race, ethnicity, sexual orientation, religion). The notion that holding multiple different identities can intersect to amplify oppression is called intersectionality (Crenshaw, 1989). The underrepresentation of African American women and Latinas in college science programs has been well-documented (Augustine, 2005; National Science Board (NSB), 2008; NSF, 2009). In fact, scholars have referred to the challenges of multiple identities in science in work describing the ‘double bind’ for women of colour in science who face the interactive effects of sexism and racism (Ong, 2011).

Other research documents that many STEM workplaces are not perceived as welcoming by LGBTQ2S+ scientists (Barres, Montague-Hellen, & Yoder, 2017; Yoder & Mattheis, 2016). Similarly, while women comprise the majority of some science undergraduate programs like Biology, the number of women decrease as one moves up through academic stages to advanced positions (e.g., Dean’s; Sheltzer & Smith, 2014). As the context in science becomes one in whichpeople are encouraged to disclose different aspects of their identities, it will be imperative to ensure that scientists feel supported to learn and work as their full selves. Vanessa Raponi was a master’s student when she saw a gap in her Engineering program; that is, there was no support for students who identified as a part of the LGBTQ2S+ community.

So, as an innovator, Vanessa founded EngiQueers Canada, a nation-wide organization that supports inclusion in engineering that through more than 30 chapters. By providing inclusive spaces for all people in science, we canincrease the numbers of qualified scientists entering schools and the workforce.

# Trailblazing at the Table

## Anne Innis Dagg
## Adjunct Professor, University of Waterloo
## Zoologist/Giraffe Researcher & Author


As much as efforts have been slow to impact the numbers of women in science, there has been progress. Anne Innis Dagg is a Canadian zoologist, biologist, feminist author, and living reminder of how far gender equity in science has come. During the mid-1950s, Anne travelled to South Africa to study giraffes. After her return, she published extensively on the biology of giraffes (Dagg, 1962) and eventually her scientific travels (e.g., Dagg, 2006).

Anne was unlike anyone at the table in the 1950's; that is, in general, women were very underrepresented in scientific and academic roles. Similarly, giraffes are unlike any other animal - even their closest relatives share few common characteristics (look up the Okapi). Despite her expertise, Anne was denied academic opportunities because she of her uniqueness as a woman. After decades of part-time lecturing and continued work engaging students, interest in Anne's story was renewed by people making a documentary about her incredible career and life. The documentary film 'The Woman who Loves Giraffes' was launched in 2018 and has since reached international success.

At the same time as the film has reached new heights, two sub-species of giraffe were added to the critically endangered list according to the International Union for Conservation of Nature (Diskin, 2018). This new documentary and research like Anne's, are effective ways to raise awareness of the threats to giraffe populations so that this wondrous species can continue to live in its natural habitat. Given that women in science may often have non-linear career paths (Vasseur & Vanvolkenburg, 2018), scientific workplaces and institutions must consider how to create inclusive spaces for all students of science so that talent is retained.

# Head of the Table

## Deb MacLatchy
## President and Vice Chancellor
## Professor, Biology, Wilfrid Laurier University


There is evidence that many people associate science with men and women with arts (Nosek et al., 2009), however, a more-established literature exists on perceptions of women in leadership. According to the role incongruity model, when people occupy unexpected roles (e.g., women in leadership), they may face negative evaluations by others (Eagly & Karau, 2002) because of a perceived mismatch between the female gender role (e.g., as communal and kind) and leadership roles (e.g., as agentic and decisive; Eagly, 2007; Eagly & Carli, 2007). Similarly, the lack of fit model (Heilman, 1983) proposes that people associate leadership qualities with men versus women, therefore when women do occupy leadership roles, they might be perceived as a 'bad fit' (Heilman & Eagly, 2008).

Defying multiple stereotypes, women in science and in leadership roles like Laurier President Deb MacLatchy are important for scientific innovation and for the retention of future scientists. According to the stereotype inoculation model, exposure to successful women in STEM benefits female student's STEM self-concept and increases intentions to pursue science (Stout, Dasgupta, Hunsinger, & McManus, 2011).

By demonstrating leadership in and beyond the lab, President MacLatchy contributes to the scientific community while also inoculating' students from negative societal stereotypes suggesting that women do not belong in science or at the head of the academic or boardroom table.

# Breaking Down Barriers at the Table

**Emily Agard**
**Immunologist**
**Director of SciXchange, Ryerson University**


Who is at the table in science?

That is, when making decisions in scientific research or policy, who is making those decisions? Who is affected by such decisions, but not at the table during negotiations? What barriers surround the table in science? Researchers from social psychology and sociology have long-documented how systemic barriers like sexism and racism have contributed to underrepresentation in science (Ong, Wright, Espinosa, & Orfield, 2011). According to recent reports by the National Academy of the Sciences (2018), sexual harassment in academia occurs at a rate higher than other fields, second only to the military.

Emily Agard breaks down such systemic barriers – creating space at the table for all to engage in scientific dialogue. Emily and her team at SciXchange Ryerson work with partners like Let's Talk Science to deliver free hands-on science engagement opportunities for schools and the community.

By creating a culture of inclusivity in science (Sukhai & Mohler, 2016), we can grow the largest pool of qualified potential participants and increase the overall excellence of research (NSERC, 2019). By increasing access to science for everyone, we enhance overall science literacy in the general public.

# Seeking Clarity at the Table

## Lisa Cole

### Education Officer, System Planning, Research and Innovation Division, Innovation Design & Implementation Team, seconded from Durham District School Board
### Physics & Mathematics Educator


As students in science, we often start at the drawing table. That is, we start without much expertise and are instead driven by passion and curiosity. At different stages of the scientific journey, it can be difficult to see where a career in science can take you. This is where science educators like Lisa Cole play a pivotal role in creating a clear vision for the future of science education.

Lisa is an award-winning physics educator, known for her enthusiastic instruction and ability to inspire students and educators. Her vision for the future of STEM education is one that emphasizes creating opportunities to explore different interests, and one that includes all students actively shaping their journey towards scientific self-discovery.

Research shows that implementing programs to promote inclusive learning environments benefit student learning, and instructors' attitudes in science (Kirch, Bargerhuff, Turner, & Wheatly, 2005). Given girls as young as 6 years old are less likely than boys to believe members of their gender group are brilliant (Bian, Leslie, & Cimpian, 2017), it is clear that we must establish inclusion early in the classroom context as a way to attract, diversify and retain the most scientific talent.

# STEAM Team at the Table


## Mayar Tharowat Mohamed & Hiba Miari

### Graduate student in Physics, Wilfrid Laurier University
### Graduate student in Biology, Wilfrid Laurier University
### Scholars, Daughters for Life



STEM and STEAM – you might have recently encountered these acronyms that are often used to describe science, technology, engineering, arts, and math. Interestingly, adding the 'a' to STEM could change how people think about science as a stereotypically masculine profession. Indeed, according to Nosek et al., (2009), people tend to implicitly associate science with men and arts with women. What are the consequences of holding such associations? It is possible that such associations could affect behavior; research shows that some female scientists avoid overtly feminine practices or gender displays (e.g., make-up, high heels) to avoid being seen as ‘less scientific’ (Ong, 2005; Rhoton, 2011). Furthermore, the extent to which science is perceived as 'creative' affects men's and women's choices differently; for women (but not men) the more science and creativity are associated, the more women are interested in scientific careers (Valenti, Masnick, Cox, & Osman, 2016).

Mayar is a talented physicist, who is also an artist. Hiba is a knowledgeable biologist, who is also a dancer. By combining passions for science and the arts, it is possible that Hiba and Mayar will experience greater success; research suggests that integrating arts into sciences can unleash potential to foster creativity and STEM innovation (Robelen, 2011). Moreover, their friendship models how women can support other women in their scientific journeys - in fact, a shared social identity as women in science may increase their likelihood of pursuing science careers (Stout, Dasgupta, Hunsinger, & McManus, 2011). It is increasingly important that scientists communicate their work; integration of the arts is one potential avenue for doing so while also promoting public engagement with scientific and social issues.

# Conditionally at the Table


## Sara Mazrouei

### Planetary Scientist
### Space Matters Lead, Centre for Planetary Science and Exploration, Western University



Many of us can recall a time when we were on the outside looking in. For many scientists around the world, nationality is a factor that impacts where they can study and conduct scientific work. For example, one study assessed mobility of scholars using a database of 14 million papers published between 2008 and 2015 from almost 16 million scientists. Results showed that while only 4% of scholars were mobile (i.e., more than one country of affiliation), these scholars were cited significantly more often (40% higher; Sugimoto, Robinson-Garcia, Murray, Yegros-Yegros, Costas & Larivière, 2017). This suggests that by restricting scientists' movements, we are stunting scientific growth and collaboration.

The recent travel bans enacted by the United States Government have impacted thousands of scientists, resulting in canceled talks, deferred hires, and compromised research projects (Cobey & Karr, 2017). Previous research notes that the degree to which scientists are mobile is influenced by a multitude of factors, including the context, existing networks, and opportunities for training and collaboration (Appelt, van Beuzekom, Galindo-Rueda, & de Pinho, 2015).

Sara Mazrouei is a planetary scientist and science communicator who is affected by certain security clearance conditions because she was born in Iran. Given the importance of having multiple perspectives at the scientific table, we must be aware of and challenge unjust restrictions limiting how scientists move and collaborate so that all voices are represented in scientific decision-making and dialogue.

# Interweaving Sciences at the Table


## Emily Cyr
### PhD Candidate, University of Waterloo
### Social psychology
### Researcher with Engendering Success in STEM Consortium



In Canada, while women comprise 70% of university graduates, only 30% of STEM graduates are female (Hango, 2013). Women's under-representation in STEM is likely multi-determined; however, there is little compelling evidence that it is due to lack of capacity or self-selection. In fact, girls outperform boys in math before they enter university (Voyer & Voyer, 2014). Instead, a major barrier to women's retention in STEM is gender bias, experienced across a range of ages and contexts: in early childhood (Buck, Plano Clark, Leslie-Pelecky, Lu, & Cerda-Lizarraga, 2008), in university (Knobloch-Westerwick, Glynn, & Huge, 2013), and at work (Blickenstaff, 2005; Hewlett et al., 2008).

Many studies about gender bias in science are conducted by social scientists, however, this information is not always communicated to those who could benefit from it most (i.e., those studying and working in science).

Emily Cyr is a social scientist weaving together research and data, consolidating findings into accessible formats to share with those in and beyond the scientific community. By communicating social science data, Emily can leverage evidence from prior research so that all scientists benefit from shared knowledge. With interdisciplinary groups working together at the same table, we can approach scientific and social challenges from multiple points of view.

# Uncertainty at the Table


## Kristine Boone

### PhD Candidate, Institute for Quantum Computing
### University of Waterloo
### Researcher, Quantum Benchmark





Imagine that you have just finished years of training in your scientific field. What's next? For many people in science, the path after finishing school is uncertain. On the one hand, you can choose to pursue a career as an academic scientist, and spend most of your time writing grant applications, supervising students, and publishing papers. On the other hand, you can choose to pursue a career in industry or government, where you spend much of your time applying the skills gained in graduate school to a real-world context. For some, the choice between academia and industry is easy, whereas for others, it is a difficult one. Some scholars have produced recommendations to help students decide what path is right for them (Searls, 2009). There is some evidence that most people do not pursue an academic career after graduate school - just 1 in 5 PhDs in Canada will become a professor, whereas most pursue careers in industry, business, and government (Edge, 2015).

For Kristine Boone, who studies quantum computing, the choice between a career in academia and industry was not easy. According to the principle of quantum uncertainty, you can never simultaneously know the exact position and the exact speed of an object because everything in the universe acts like a particle and a wave at the same time. For scientists, it is challenging to decide if you will be more satisfied with a career in academia or in industry, especially because they both have some benefits and also some drawbacks. Kristine has chosen to pursue a career in industry wherein she will certainly continue to succeed in quantum science.

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