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# Among Women of Science


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Interview by Anne-Marie Paquette, Editor-in-chief

**Driven by a desire to explore complex realities, *Pédagogie collégiale* engaged in a captivating discussion with women from the fields of science, technology, engineering and mathematics (STEM). Farah Alibay, Leslie Moranta and Sarah Mtibaa embody three generations of scientists working in distinct spheres: the professional world, the university environment and the college network. Here, they share their personal reflections on teaching and learning science, offering a diversity of perspectives on the place of women in STEM.**

***Pedagogie collégiale* – Thank you to each of you for generously responding to our invitation to participate in this dialogue among women in science. The under-representation of women in STEM programs is getting a lot of attention in the teaching community. But you're bucking the trend: although boys are twice as likely as girls to enter STEM fields (Randstad Canada, 2023), all three of you have opted for the sciences. Where did this interest come from, and how has it been sustained over the years?**

**Farah Alibay –** Hollywood cinema in the 1980s and 1990s certainly shaped my vision of science. Science-fiction films made me dream when I was young—*Star Wars* and *Apollo 13* come to mind. It wasn't just entertainment for me, it was a revelation: careers in aerospace were real! But you can imagine that, at the time, I felt rather unrepresented in these films: the young immigrant woman of colour from Joliette didn't fit in. Despite the lack of representation and of female role models on the screen, these films nonetheless sparked my passion for science.

**Leslie Moranta –** Like Farah, it was a work of fiction that triggered my interest: *Georges*, the series of children's novels by Stephen Hawking and his daughter Lucy. My little brother had received them for Christmas. One day, I went to steal them from his bookshelf, and that's when it all started. For as long as I can remember, my interest in science has been linked to astrophysics and astronomy. Looking at the sky at night has always been part of my life. When the Curiosity robot landed on Mars in 2012, it had a profound effect on me. My love of science developed quite naturally through these small, significant moments.

**Sarah Mtibaa –** Science has always been a passion. I was home-schooled when I was younger, so I discovered science in a practical rather than theoretical way. Experiments, inspiring encounters, visits to exhibitions all over Quebec and Ontario—it was all very hands-on. Then, once at school, it was another form of learning, different but interesting all the same.

Personally, I was lucky to be surrounded by people who shared my love of science. My mother always encouraged me on this path. In fact, the only dilemma I ever faced with respect to science was: doctor or engineer? Apart from that, there was no doubt in my mind or in the minds of the people around me that I was a science girl.

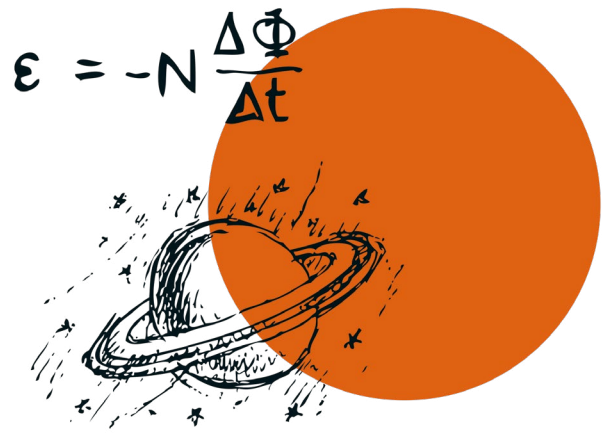
**LM –** Same here. It's no surprise to anyone that I ended up in this line of work! Both my parents come from scientific backgrounds, particularly biology. In fact, I think they were a bit taken with my choice of physics. It's true that the choice is often between pure science and health science, but for me it was clear. In Secondary 4, we had the chance to do a one-day internship in science, and I did it at the Exoplanet Research Institute where I currently work. Even then, my attachment to astrophysics was obvious.

**FA –** My father is an engineer, so I've had this model before my eyes for as long as I can remember. In my immediate family, my parents always told me that I could follow my aspirations, so my choice of STEM was no surprise to them. In my wider, more immigration-based community, I was asked a lot: "Why choose engineering? It's not a profession that's compatible with family life. Shouldn't you consider being a doctor or a dentist?" In this community, medicine and dentistry were socially acceptable career choices for women, but not so much engineering. That said, whatever the culture, the choice of science for girls remains fairly marginal.

At the age when young people here go to CEGEP, I was in England at an all-girls school. I was the only one in my cohort to opt for engineering. Only one other girl out of the 120 in my cohort chose mathematics, and a few—which I can count on the fingers of one hand—opted for health sciences with the aim of going into medicine. In other words, there were very few of us pursuing any kind of science.

**SM –** You know, I'm currently in CEGEP, and there's still this persistent prejudice that it's easier for women to go into the medical field. It's very much in line with what you said, Farah: even today, engineering is still perceived and portrayed as a male environment, with a reputation for being more difficult to break into, and imposing schedules that are less compatible with family life.

***Pedagogie collégiale* – Student success in science is a challenge in Quebec, as it is elsewhere in the world, for both girls and boys. The Education Endowment Foundation, a UK charity dedicated to improving educational attainment in disadvantaged areas, has issued a series of recommendations for improving science and technology teaching. Avenues for intervention include the use of models to support conceptual understanding, practical activities within structured teaching sequences, self-regulation of learning, effective feedback... What do you think of the way science is taught at school?**




**FA** – In the 1990s, the presence of science and, above all, the representation of science were quite limited. Imagine, the Internet wasn't even widely accessible yet! Today, it's easier for schools to integrate context elements and concrete applied examples. The children in grade 4 or 5 that I meet on elementary school visits have a clear idea of what a robot on Mars is, for example. Of course, they don't understand everything about how the robot works, but the aim is to show them exciting things in this field to motivate them to learn the basic language of science, a crucial step for going further later and eventually understanding complex concepts.

**LM** – I'd also say that science education doesn't happen early enough in the school career. I have very few memories of scientific activities in elementary school, which is surprising, because children's curiosity is tireless then. That's when it should be stimulated, in both boys and girls.

**SM** – That's so true! When I went back to school after homeschooling, I realized how little science there was in comparison. It was quite unsettling for me. In my 5th grade class, the most complex science project we did was to build a cardboard airplane and launch it. It was quite rudimentary.

**FA** – At least it has the merit of being concrete [laughs]! In my case, the problem at school was that we always started with theoretical science. As an engineer at heart, I kept asking myself: "What's the point of all this?" I had this sense of lack and I thought, "How do I use this in my everyday life?" In high school, for example, I loved chemistry because we did experiments. When you see the results of a mixture in concrete terms, it's immediately clearer. It took me a long time to understand that theory and practice were linked, and I think that's the case for most young scientists, which is why it's so important to let them explore their environment.

**LM** – When I think back to high school science courses, I really have in mind the focus on academic results, rather than on experimentation. We were learning for the exams, trying above all to follow precisely the path laid out by the teacher. I really struggled with this approach. Even if I had sound reasoning and the right answer, if the different steps didn't correspond to the ones taught, my results suffered. As a science enthusiast, this rigidity in scientific reasoning bothered me deeply. I imagine it must vary from school to school, even from teacher to teacher.

**SM** – If it makes you feel any better, I've had some excellent science teaching in the Middle Years Program (MYP) in high school. Because science is taught and learned in authentic contexts and with a sensitivity to international reality, it helps enormously to make science concrete and to think a little outside the box. Looking back, however, I realize that the links between the subjects—chemistry, physics, mathematics—were very thin. Life isn't divided into subjects! I have the feeling that these disciplines were never really linked until I went to college, which is a pity, because then the sciences seem disconnected from each other, whereas in the real world, it's quite the opposite.

***Pedagogie collégiale* – Sarah, you've taken us into important territory to explore, that of a more inclusive, cross-disciplinary science education. You mention the silos in science teaching, which are also present in other fields of study. In school laboratories, methods are still highly standardized, leaving little room for scientific creativity, whereas there is more and more talk of solving complex, so-called wicked, problems requiring varied expertise and interdisciplinary collaboration. Do you think that approaches to teaching and learning science prepare students well for the realities of today's scientific world?**

**LM** – Some people excel in the application of clear-cut recipes, often valued by the school system. However, in the real world of science, whether as a researcher or engineer, this rigidity is not the norm. In my opinion, there is a serious lack of laboratories where students create their own protocols, an essential competency to develop before university. This kind of approach could be introduced at CEGEP,[1] or even as early as high school. In a recent conversation with a PhD student, she confided that she found the transition to the scientific workplace very difficult. Independent and creative thinking is not always valued at school, and this can make adapting to a professional environment that encourages this freedom of thought somewhat destabilizing.

**FA** – It goes back a long way in my case, but I remember it the same way. Most of the time, the method for practical assignments was prescribed, and I sometimes felt like I was just going through the motions, completing the task without any real commitment—a feeling I didn't appreciate. The teachers who allowed me to take more creative approaches, outside the curriculum, really helped me. In physics, chemistry or mathematics, there are always several ways of getting the same answer. It seems crucial to me to explore a variety of approaches, because in research, some may be more effective or have a different level of error.

**LM** – It's true that rigid protocols have the disadvantage of putting the brain on autopilot. Some students get bad grades by not following the perfect method, while others follow the recipe without really understanding the logic behind it. In either case, we're no further ahead.

**SM** – By putting everyone in the same basket, with the same ways of learning, at the same pace, we inevitably lose players at both ends of the spectrum: those who encounter difficulties and those who are more advanced. So, I like the idea of teaching science in a more open, collaborative, and creative way. Currently, in my college chemistry courses, teachers are experimenting with a specifications grading approach.[2] Basically, you're either learning or you're competent according to predefined criteria. And it's possible to make mistakes and get back on track, just as it's possible to be competent while making a few mistakes or doing things differently. The important thing is not just to have the right answer, but rather to follow a relevant approach that can be understood by others. It's an approach I like because it makes you feel competent and confident in your abilities.

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[1] Editor's note: Readers interested in this subject can consult the article "Open Labs for Well-Educated Minds" on p. 14 of this issue of *Pédagogie collégiale*.

[2] Editor's note: Specifications grading is an evaluation method proposed by Linda B. Nilson (2014) that focuses on evaluating student competencies according to specific, predefined criteria (learning expectations) rather than assigning an overall grade. Each specification is evaluated as being either in *learning*, recognizing the right to error and offering an opportunity for retakes, or *mastered*, indicating the attainment of a previously defined threshold.

## Shaping a change of culture

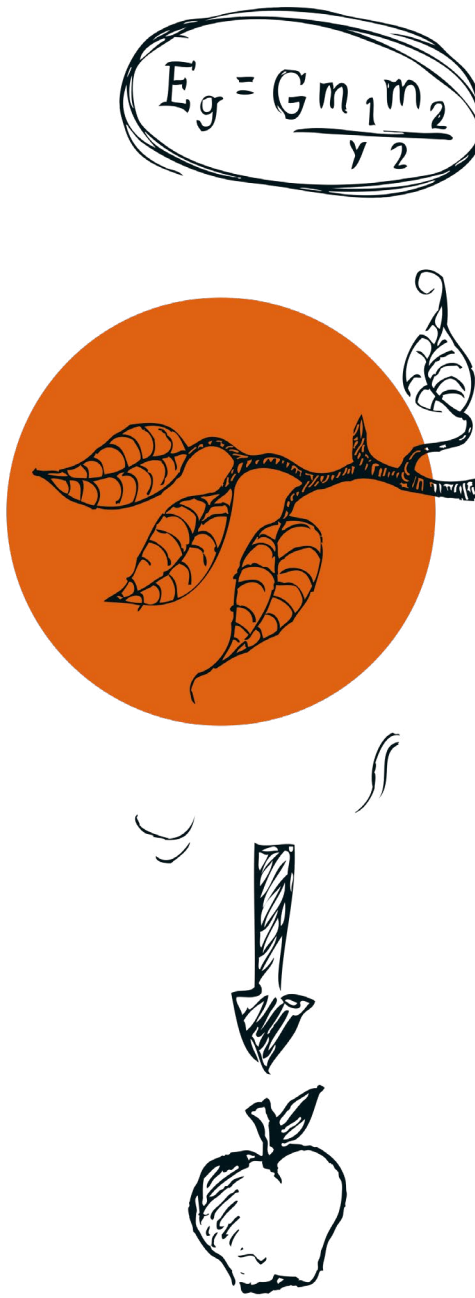
***Pedagogie collégiale* – Research indicates that students' perceptions of science careers are influenced by cultural beliefs rather than innate or gender differences. A recent study entitled "Overcoming the barriers to STEM" found that only 22% of young women cite technology as their favourite subject in school. When asked how good they would be in a STEM job, fewer women think they would be good in this role compared to men (IT: women -23.8%, men -43.1%; science: women -29.6%, men -40.1%; engineering: women -21%, men -38.9%) (Randstad Canada, 2023). These figures speak for themselves. What do you think accounts for women's perception of their abilities in science?**

**LM** – In my opinion, we're dealing with stereotypes. The importance of having a role model is crucial, of being able to say to yourself, "There's another woman—another person like me—who's done it, so I can do it too." Highlighting their stories and successes as scientists makes it easier for girls to imagine themselves successfully following a similar path. However, one of the challenges lies in the fact that we are already few and far between in our respective fields. Adding to this the burden of being the standard-bearer or doing outreach to show the presence of women in science can be overwhelming. It's a delicate balance to maintain.

**FA** – I couldn't agree with you more, Leslie [laughs]. Also, I think that beyond the visibility of female scientists, we need to create opportunities for girls to encounter science, period. What I observe during the school visits I take part in are differences in behaviour between girls and boys. Some may say that I'm generalizing, but these are observations made in the field. In fact, boys tend to be more daring, ready to try things without any guarantee of success; failure in science seems to be less of a concern for them. That's perfect: in science, we learn by trial and error, and sometimes by breaking equipment! It's a different story for girls. The ones I observe often tend to question their choice after making a mistake or encountering a challenge and say to themselves: "Maybe this isn't for me, maybe I should do something else?"

There's a program in Montreal called *Les Scientifines*, whose mission is to promote STEM among young girls from disadvantaged backgrounds, enabling them to develop various transversal competencies among girls. I think this kind of initiative is really important. It gives girls the opportunity to play an active role in science, to experiment and to thrive just as much as boys. What really helped me in high school was going to an all-girls school. That's extreme, you may say—and let's be clear, I don't recommend it for everyone, and I know there are many myths about single-sex schools—but what I'm saying is that, personally, looking back, I know it helped me to be in an all-girls learning environment because I had the space to develop my science skills, without fear of any judgment whatsoever.

**SM** – It's true that social pressure on girls to perform well at school persists, despite changing mentalities. Girls are conditioned from an early age to *do well* and *succeed*, while boys are less inclined



to worry about the image they project, except perhaps among friends, but that's another story! What seems contradictory to me in science education is that we can't aspire to break social constructs by trying to follow a precise mold, shaped up to now for a majority of men. We need to reflect on this, first and foremost, if we want women to engage in and pursue science studies.

**FA** – I do believe that there is still too little recognition of women's minority status in science in the school system, especially at university. It's unfortunate to say, but the system still limits the place of women and minorities in STEM today. The figures are there to prove it: these people publish less, are paid less for research and don't progress as far in their careers as men. Just take the example of university scholarships: out of 10 scholarships, only 2 or 3 will go to women. Leslie, I see you nodding, and I know that at the PhD level it's particularly difficult. Not only does academia leave few places for women in science, but it's also designed in such a way that women compete for the few places available. Perhaps it's a legacy of patriarchy, this perpetual power struggle? I don't know…

**LM** – What strikes me most about academia is the image of the overachieving female professor. It seems necessary to outdo everyone else and to put in exceptional effort. It's not enough to simply be excellent like your male colleagues; you have to go the extra mile. Watching these female role models, I sometimes wonder, "Can we just take a breath?" That said, I'd be inclined to believe that there's more collaboration than in your day, Farah. Where I study, the atmosphere is rather friendly. There's a strong sense of belonging among the female students who did their internships together and are continuing on to master's or doctoral studies.

**FA** – I also hope to reassure you by saying that, on the job market, things have changed considerably in recent years. Mutual support and team diversity are gaining ground. In engineering, as in many other fields, creativity and diversity are the keys to solving complex problems, hence the need to include more women and minorities. Faced with the challenges of the coming decades—and we know they are colossal—a homogeneous team educated within similar academic models will not suffice, in my opinion. It therefore seems fundamental to me to encourage not only the participation, but also the perseverance of women and minorities in science.

**LM** – Personally, what really motivated me to persevere were my mentors, those few key people who guided me through my school career. In my case, they were mostly men, and it doesn't necessarily have to be a woman or a gender minority. I have in mind a high school teacher who pushed me to participate in math competitions and who didn't slap me on the wrist because my way of thinking about science was a bit different. There was also a CEGEP teacher who landed us great opportunities to go into businesses to make mathematics more concrete. He even took us to the Google offices for a workshop on artificial intelligence. He was invested in understanding the learning process of individuals, interested not only in our academic success, but also in our fulfillment outside of school.

**SM** – My source of inspiration and motivation was also a teacher, a physics teacher in Secondary 5. She was genuinely passionate and took the liberty of breaking away from the curriculum, making science accessible. She would tell scientific anecdotes, tell us about particle laboratories and introduce us to so many new things! In fact, she suggested I attend a talk she thought I'd love: a conference by Farah Alibay [laughs]. This conference had a profound effect on me. This scientist's journey was not without its obstacles, but it was so inspiring, and, as a young girl, I could identify with it. And to think that today I'm having a conversation with her, among women of science!

***Pedagogie collégiale* – There are many inspiring examples of women in science, some of whom are still little-known. Their respective stories and the accounts of their educational paths certainly pave the way for interventions to make science education more engaging and diverse. By exploring themes such as the importance of female role models and the obstacles to women's representation in science, a space for exchange and reflection is created. To break down stereotypes and encourage a more inclusive and creative approach to science education, we have every interest in exploring the future of science teaching from the perspective of women and minorities. ▬**

## References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Source: Krystel V. Morin


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**Leslie Moranta** is a doctoral student in Astrophysics at the Université de Montréal; her dissertation focuses on the detection and characterization of stellar associations, environments conducive to the discovery of exoplanets. Passionate about astrophysics from an early age, she has been working at the Trottier Institute for Exoplanet Research and the Montreal Planetarium since 2020. She also holds a bachelor's degree in Physics and Computer Science from the Université de Montréal, obtained in winter 2022.

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**Sarah Mtibaa is** a Science student in the International Baccalaureate program at Cégep André-Laurendeau. Ever since she was a little girl, she's been involved in a wide range of projects, discovering new passions and exploring different fields to learn more about a multitude of subjects.

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