

K–12 Methods: Sciences

This module focuses on content areas related to the sciences, including natural sciences, ecology, chemistry, physics, and biology. We explore ways to expand lessons to include 2SLGBTQ+ content, and to challenge ideas about who should study science. The principles may be adapted to any science course taught at the primary or secondary level.

What does it mean to queer Science courses?

Queering science courses means challenging assumptions about who is best suited to study science, questioning how science works to produce knowledge, what is considered “valid” and “objective” knowledge—particularly when it comes to heteronormative and cisgender-normative understandings of the world.

Because science is often seen as a discipline for men, women and trans and nonbinary people are underrepresented in scientific professions and their work is not regarded with the same respect as male colleagues. Similarly, women, girls, and trans and nonbinary people may be subtly and overtly discouraged from studying science (e.g., as we see in women in STEM/Science Technology, Engineering, Medicine movements).

Queering science also means highlighting and questioning scientific discourses and interpretations rooted in heteronormativity and binary understandings of sex and gender, including those that impose heteronormative assumptions about procreation, a static binary of gender, or a “natural order” regarding gender and sexuality. Assuming an exclusively scientific-rationalist approach to science (e.g., one based on classifications, taxonomies, objectivity) can work to discount other forms of knowledge about what comprises science, including those of Indigenous peoples and Indigenous ways of knowing. As well, queering science courses may also be important for questioning the presumed apolitical, neutral, “objective” nature of science disciplines, whereas history is rife with examples that science has been used to serve political and social agendas, from colonization to climate change. (See also [Health module](#) for discussion of scientific-medicalized discourse regarding health, sex education, etc.)

Why do we need to do this?

Women, nonbinary, and 2SLGBTQ+ people’s underrepresentation in STEM fields (science, technology, engineering and mathematics) is perpetuated because girls and trans/nonbinary children are not encouraged to study sciences—in fact, they may be actively or passively discouraged by teachers and peers who mistakenly believe the trope that girls and women are not suited to these fields.

The notion that sciences are “male” disciplines may be rooted in the myths that sciences are highly rational and completely objective, and that men are more capable of rational thought than women (Fox Keller, 1985, p. 48). This mythology needs to change so that all children, regardless of sexual orientation or gender identity (or Indigeneity, racialization, class/socioeconomic status, etc.) all have the same chance to excel in the sciences. Innovations are not sexed or gendered. By gatekeeping who can become a scientist, we limit

the possibilities for scientific endeavour. This is not new, and Fox Keller and others have been making this argument for decades.

How do we do it?

- *Queering science starts with replacing the established interpretation of sex as a binary.* The notion that every biological element of nature—including humans, other animals, and plants—are either male or female is simply not correct, as scientists have been pointing out since the mid-1960s (Fausto-Sterling, 2012, p. 23), and yet this fallacy underwrites much scientific understanding and teaching. Recent work continues to question the notion of chromosomal determinism when it comes to sex, recognizing that there is a larger spectrum than just binary male and female (e.g., Ainsworth, 2018).
- *Encourage teacher candidates to identify women, trans/nonbinary, and 2SLGBTQ+ scientists behind the famous theories they will be teaching.* A few examples are Mileva Marić, Albert Einstein’s first wife, whose uncredited contributions to his early work are a source of ongoing discussion (Esterson & Cassidy, 2019); Black women involved in the development of computing theory as documented in the 2016 film *Hidden Figures*; and two-time Nobel Prize-winning scientist Marie Curie, who discovered radium and polonium.
- Challenge the core misconception of binary sex as a law of nature in order to facilitate the process of opening up the study of science to all students, because the justification for excluding girls, trans/nonbinary, and other 2SLGBTQ+ students from the study of science is eroded if we understand that sex and gender are not binaries or exhaustive categories (but invented ones), and that traits we associate with these binaries are social constructions.
- *Challenge the idea that heterosexuality is the norm by shifting the focus away from the myth of sex and gender binaries and focusing on the actual diversity of human genders, sexes, and sexualities* (Lehr, 2007, 35). In this way, science lessons trouble a binary worldview and encourage students to think about people and perspectives beyond textbooks.
- *Scientific discourse operates as a system of social power that positions knowledge as objective and rational, despite being embedded in social and disciplinary discourses that structure knowledge—including what is considered “knowable,” what valid knowledge involves, and how knowledge is developed.* Queering science involves discussions that highlight the hidden assumptions of scientific discourse and working to identify the ways that knowledge is constructed through social and disciplinary practices. Historically, these scientific discourses have excluded, pathologized, and marginalized 2SLGBTQ+ identities through portrayals of homosexuality as being unnatural or aberrant, trans people as being disordered, and confining gender to binary categories based on procreative potential (e.g., Foucault, 1978; Gunckel, 2009; Lett, 1995). *As with any discipline, science is subject to the disciplinary norms, social settings, and discourses that give rise to its particular nature/character—what we think of when we think about*

“doing” science—and these often reflect the societal, professional, and political conventions of the people working in the discipline (e.g., Foucault, 1978; Latour & Woolgar, 1986). Science contributes to the formation of knowledge and its presumed objectivity often obfuscates the power that it has to structure what we know and what we consider to be “valid” knowledge. For example, in biology, the impulse to classify gender into binary categories presumed procreation was the exclusive evolutionary purpose of sex/companionship, that homosexual behaviour did not exist in the natural world, and that there were only two biological sexes—all of which have been roundly discredited (e.g., Snyder & Broadway, 2004). In the case of sex and gender, and similarly with racialization and disability, science has imposed human social understandings on the natural world. Seen as objective and innately true, these understandings have been used to justify discrimination and marginalization. As the social world began to change, people began to question the degree to which scientific conventions, still taken for granted by many, were shaped by social, political, and religious beliefs.

- *Explore concepts from Indigenous knowledge systems that understand gender and sexuality as naturally diverse.* A useful way to unsettle sex and gender binaries with students is to study the millennia-long history of Two-Spirit people, whose existence points to an understanding of sex and gender that has long been more expansive than contemporary beliefs. Importantly, this is also an opportunity to discuss the impact colonization has had on scientific understanding, highlighting that Western knowledge is privileged, while Indigenous knowledge is routinely dismissed in school settings. To start changing that, science teachers can incorporate land-based learning and study Indigenous people’s centuries of contributions to scientific understanding (Snively and Corsiglia, 2001).
- In classes about sex and biology, teach students about trans people, intersex people, and the range of sexes that occur in all animals, including humans. Anne Fausto-Sterling’s (2012) *Sex/gender: Biology in a social world* is a good teaching tool for these themes.
- Teachers may encounter resistance when teaching age-appropriate lessons about sex and gender to children. It should be noted that our culture overtly teaches and reinforces heterosexuality and the gender binary to children in myriad ways. It is our responsibility as educators—given the frequency of sexuality- and gender-based bullying and startling rates of suicidality among 2SLGBTQ+ youth (e.g., Peter et al., 2016; Taylor & Peter, 2011)—to teach the whole biological spectrum, age-appropriately and in context, so that no student feels that their body is unfit for the classroom or the world around them. (See the [section on resistance](#) for more information.)
- Question the language and metaphors of science by looking at (and changing) how (negative) gender assumptions are coded into the way we understand and teach scientific concepts (Martin, 2001, p. 35). Teaching science in a way that challenges rather than reinforces assumptions about gender is an important way that teachers can queer science education.

- Change the way we teach, assess, and evaluate sciences—including contextualized assessment for a diversity of learners and learning styles. Feature land-based assignments in addition to labs and exams to show students that there are different ways of learning about science, just as there are different kinds of learners in the class, and all are valued.

Resources

[Locke \(2014\), *What your science teacher told you about sex chromosomes is wrong*](#)

[Scientific American \(2017\), *The new science of sex and gender*](#)

Science Lesson plans by grade level from [SOGI 123](#)

4/5 Physical and Health Education – Gender Identity, Media and Stereotypes (EN/FR)
<https://bc.sogieducation.org/gender-identity-elementary-2>

8/9/10 Physical and Health Education & 10/11/12 Social Studies – Language and Terminology (EN/FR)
<https://bc.sogieducation.org/language-and-terminology>

10/11/12 Social Studies / BC First Peoples / Indigenous Studies – First People’s Perspectives on Gender (EN/FR)
<https://bc.sogieducation.org/indigenous-perspectives>

10/11/12 Science, Life Sciences, Biology & Anatomy and Physiology - Intersex Biology
<https://bc.sogieducation.org/intersex-biology-lesson>

References & Suggested Readings

Ainsworth, C. (2018, October 22). *Sex redefined: The idea of 2 sexes is overly simplistic*. Scientific American. <https://www.scientificamerican.com/article/sex-redefined-the-idea-of-2-sexes-is-overly-simplistic1/>

Bagemihl, B. (1999). *Biological exuberance: Animal homosexuality and natural diversity*. Macmillan.

Esterson, A., & Cassidy, D. C. (2019). *Einstein's Wife: The Real Story of Mileva Einstein-Maric*. MIT Press.

Fausto-Sterling, A. (2012). *Sex/gender: Biology in a social world*. Routledge.

- Fifield, S., & Letts, W. (2014). [Re] considering queer theories and science education. *Cultural Studies of Science Education*, (9)2, 393–407.
- Fifield, S., & Swain, H. L. (2002). Heteronormativity and common sense in science (teacher) education. In R. Kissen (Ed.), *Getting ready for Benjamin: Preparing teachers for sexual diversity in the classroom* (pp. 177–189). Rowman & Littlefield.
- Foucault, M. (1978). *The history of sexuality: An introduction. Volume 1*. Vintage.
- Fox Keller, E. (1985). *Reflections on Gender and Science*. Yale.
- Gunckel, K. L. (2009). Queering science for all: Probing queer theory in science education. *Journal of Curriculum Theorizing*, 25(2), 62–75.
- Latour, B., & Woolgar, S. (1986). *Laboratory life: The construction of scientific facts*. Princeton University Press.
- Lehr, J. L. (2007). Beyond nature: Critically engaging science to queer straight teachers. In N. M. Rodriguez & W. F. Pinar (Eds.), *Queering straight teachers: Discourse and identity in education* (pp. 33–64). Peter Lang.
- Letts, W., & Fifield, S. (2019). *STEM of desire: Queer theories and science education*. Brill Sense.
- Letts, W. (1995, September). *Queering science: Using sexuality theory and research to critique the natural sciences* [Conference presentation]. Lavender Scholars Lecture Series, University of Delaware, Newark, DE.
- Liboiron, M. (2021). *Pollution is colonialism*. Duke University Press.
- Lundin, M. (2014). Inviting queer ideas into the science classroom: Studying sexuality education from a queer perspective. *Cultural studies of science education*, 9(2), 377–391.
- Martin, E. (2001). *The woman in the body: A cultural analysis of reproduction*. Beacon Press.
- Peter, T., Taylor, C., & Campbell, C. (2016). You can't break... when you're already broken": The importance of school climate to suicidality among LGBTQ youth. *Journal of Gay & Lesbian Mental Health*, 20(3), 195–213.
<https://doi.org/10.1080/19359705.2016.1171188>
- Reiss, M. J. (2019). Thinking like a fox: Queering the science classroom when teaching about sex and sexuality. In W. Letts & S. Fifield (Eds.), *STEM of desire: Queer theories and science education* (pp. 255–267). Brill.

- Rooke, A. (2010). Trans youth, science and art: Creating (trans) gendered space. *Gender, Place & Culture*, 17(5), 655–672.
- Ryan, C. L., Patraw, J. M., & Bednar, M. (2013). Discussing princess boys and pregnant men: Teaching about gender diversity and transgender experiences within an elementary school curriculum. *Journal of LGBT Youth*, 10(1–2), 83–105. <https://www.doi.org/10.1080/19361653.2012.718540>
- Snively, G., & Corsiglia, J. (2001). Discovering Indigenous science: Implications for science education. *Science education*, 85(1), 6–34.
- Snyder, V. L., & Broadway, F. S. (2004). Queering high school biology textbooks. *Journal of research in science teaching*, 41(6), 617–636. <https://doi.org/10.1002/tea.20014>
- Sutherland, D., & Swayze, N. (2012). Including Indigenous knowledges and pedagogies in science-based environmental education programs. *Canadian Journal of Environmental Education (CJEE)*, 17, 80–96.
- TallBear, K. (2019). Feminist, queer, and Indigenous thinking as an antidote to masculinist objectivity and binary thinking in biological anthropology. *American Anthropologist*, 121(2), 494–496. <https://doi.org/10.1111/aman.13229>
- Williams, D. H., & Shipley, G. P. (2018). Cultural taboos as a factor in the participation rate of Native Americans in STEM. *International Journal of STEM Education*, 5(1), 1–8.