Egale

# Relearn and React Series

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## Math is for Everyone

*(Grades 9/10 Math)*

# About Egale Canada

Egale is Canada's national 2SLGBTQI organization. Egale works to improve the lives of 2SLGBTQI people in Canada and to enhance the global response to 2SLGBTQI issues. Egale achieves this by informing public policy, inspiring cultural change, and promoting human rights and inclusion through research, education, awareness, and legal advocacy. Our vision is a Canada, and ultimately a world, without homophobia, biphobia, transphobia and all other forms of oppression so that every person can achieve their full potential, free from hatred and bias.

# Contents

# The Egale Relearn and React Series

The Relearn and React Series is a collection of educational toolkits with video resources created to help and support grade 7-12 teachers who wish to diversify their curriculum. The series contains curriculum-friendly teaching resources and materials featuring topics supporting 2SLGBTQI representation and inclusion within the Ontario curriculum.

Each toolkit includes:

- An educational video dedicated to the subject
- A detailed teaching guide on how to tackle the topic and guide your students through their learning journey
- A list to help you connect this topic to the current teaching curriculum
- Tailorable pre-video questions and reflection prompts
- Resources to support productive and engaging post-video discussions
- Exercises on how to help students put their knowledge into practice
- Additional resources to enrich the class according to your needs

If you wish to know more about the project, visit
https://egale.ca/RelearnAndReactSeries/

# Learning Outcomes

With the following toolkit, your students will learn:

- How to situate 2SLGBTQI lives within the field of mathematics.
- To discern the dangers of queer erasure and straightwashing in the sciences.
- To understand how "objective" sciences are a product of non-objective societies.
- How queer erasure fosters forms of negative bias towards 2SLGBTQI folks in STEM (Science, Technology, Engineering, Math) and beyond.
- How queer advocacy and representation belong in all classrooms.

# Connect to Curriculum: Grade 9/10 Math

These are ways to connect this material in the grades 9/10 Mathematics curriculum. Other grades can adapt this content for use in a variety of subjects.

- Strand AA: Social-Emotional Learning (SEL) Skills in Mathematics
    - By exploring the life of queer voices in the field of math, this toolbox will help students explore social-emotional learning skills in mathematics. It will also help them reflect on bias in the world of mathematics and STEM as a whole.
- Strand A: Mathematical Thinking and Making Connections
    - By providing the biographies of mathematicians within different sub-fields, this toolbox will help you make connections between the math students are learning and their lived experiences, various knowledge systems, and real-life applications.
- Strand B: Number
    - By unveiling the culture in which many foundational discoveries in math have taken place, this toolbox will help students make connections among various number systems, the cultural development of number concepts, and real-life applications.

- Strand C: Algebra
    - By exploring the lives of scientists who made a difference in the field of algebra, students will continue to develop an understanding of the subject by making connections between algebra and real-life events.
- Strand D: Data
    - By revisiting the lives of scientists who made a difference in the field of data science, students will understand how new discoveries in the realm of mathematical modeling are bound to real-life situations.
- Strand E: Geometry and Measurement
    - By providing updated biographical information of scientists who made a difference in the field of geometry, this toolbox will help students understand the sociohistorical background that brought the discovery of the geometric properties they are studying.

# Teaching Guide

## Preparation: General Guidelines

Each *Relearn and React* Series' toolkit is centered around a topical three-minute educational video. As you prepare to deliver this activity with your students, we encourage you to review the toolkit video more than once.

*Prepare yourself scholarly and cognitively*. Take a look at the additional content and learn as much as you can about the topic from several sources. Explore perspectives beyond the heteronormative canon of past scholarship and encourage creativity.

*Know your students*. What topics might invite engagement from your students? What components of this learning experience may cause a reaction? Which topic might require a content warning before being introduced? Prepare proactively for the topic of the discussion. The values of our upbringing, including gender norms and biases, may mean some students are uncomfortable because they have been taught to be. Share how the topic can

be an invitation to explore one's own beliefs and think through them critically. Acknowledge discomfort, validate it, and find positive ways to help move past it without delegitimizing it.

*Establish a safe learning environment* before engaging with the class. These are important topics, and students may need to first build trust with each other and with you to fully engage with this content. As a teacher, you can support a safer learning environment in your classroom by avoiding judgment and bias, setting up ground rules for discussion, demonstrating comfort with the topics and issues, and showing care for every student's opinion.

More practical guidelines to help you establish a safer learning environment include:

- Examining your own assumptions about your students.
- Learning about your students and helping students learn about one another.
- Using inclusive language that can represent and be understood by all in the classroom.
- Assessing how diverse perspectives are represented in the curriculum.
- Enriching your classes by using examples and materials representing diverse backgrounds.
- Considering ways in which to encourage active participation and reflection that does not ask one learner to speak for others.
- Providing constructive and frequent feedback to students.
- Establishing clear guidelines for discussion and classroom behaviour.
- Conveying care for students.[1]

Attending to students' social-emotional learning and class environment will help create the conditions for productive conversation, nurture relationships across lines of difference, and facilitate models of inclusiveness. Commit to being a classroom that both respects differences of opinion as well as inclusion.

1 Holley L. C. & Steiner S. (2005). Safe space: student perspectives on classroom environment. *Journal of Social Work Education* 49–64.

### A note on the use of the word "queer"

Reclamation is powerful. What was once a pejorative term for anyone falling outside of societal canons is now being reclaimed by some members of the 2SLGBTQI community. While umbrella acronyms may sometimes tend to presume gender and sexual identities are binary in nature, the term "queer" is a unifying term that challenges the assumed binary of sexual and gender identity. "Queer" is about non-heteronormativity, creativity, and diversity far beyond homonormative culture. Today, the term can be used to describe a personal identity, an academic field of study, or 2SLGBTQI communities as a whole. It is in the latter sense that the term is used throughout this document. This said, outside of the queer community, this word can still harken the darkest days of legal and societal discrimination in Canada and elsewhere. Its usage, even in 2SLGBTQI spaces, may trigger hurt or negative emotions for some people. As such, it should be utilized with caution and not used in reference to any individual without their consent.

## Understanding the Value of Queering Contributions to Mathematics

Does a mathematician's life and gender identity matter in the eye of science? Can we truly appreciate their contribution to STEM if we detach them from their age, culture, and society? While using this toolkit, you will be tasked with a difficult but essential piece of your students' learning journey: challenging math and the realm of STEM as an objective, bias-free field.

To begin this journey, start by reflecting on a question: while scientific findings might have universal application, who is at the source of such findings?

More simply put: "Who does the math? Where (in what spaces) does math live? And who decides who gets to do the math?"

A quick scan of the many academic faculties in North America and the world reveals that - while we are indeed making strides regarding equity, diversity, and inclusion in the world of mathematics and STEM as a whole - many are still left out of the conversation. Therefore, agency in math and science cannot be understood outside of the realm of positionality and intersectionality.

## Useful definitions: positionality and intersectionality

Here's a quick guide to addressing these two very important concepts.

**Positionality:** A person's relative position within society based on how closely their various social identities align with societal norms and ideals. It impacts how they are generally perceived by others, their relative access to resources, social acceptance, respectability, representation and visibility, authority and control, and their overall experiences in the world.[2]

**Intersectionality:** refers to particular forms of intersecting oppressions, for example, intersections of race and gender, or of sexuality and nation. Intersectional paradigms remind us that oppression cannot be reduced to one fundamental type, and that oppressions work together in producing injustice.[3]

For more information on intersectionality and privilege, see:

The University of Edinburgh - Intersectionality and Privilege - https://www.ed.ac.uk/equality-diversity/students/intersectionality

Keep in mind that students are more successful in classes when the content is tied to their lives, even when it comes to math and STEM in general. Research shows that 62% of 2SLGBTQI students feel unsafe at school, and at least 42% of them have reported verbal harassment about their sexual orientation.[4] In addition, studies show that 2SLGBTQI students in schools with an inclusive curriculum were less likely to miss school in the last month due to feeling unsafe or uncomfortable and were less likely to say they might not graduate high school.[5] Moreover, 2SLGBTQI high school seniors were more likely to be interested in studying STEM in college if their relevant high school classes had included positive 2SLGBTQI content.[6]

Egale Canada's recent in-depth study on the state of 2SLGBTQI inclusion in Canadian classrooms shows how crucial it is for teachers and educators to

2 Misawa, M. (2010). Queer Race Pedagogy for Educators in Higher Education: Dealing with Power Dynamics and Positionality of LGBTQ Students of Color. *International Journal of Critical Pedagogy, 3*(1), 26-35.
3 Collins, P.H. (2001). *Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment*. Routledge
4 Peter, T., Campbell, C.P., & Taylor, C. (2021). *Still in every class in every school: Final report on the second climate survey on homophobia, biphobia, and transphobia in Canadian schools.* Toronto, ON: Egale Canada Human Rights Trust. https://egale.ca/awareness/still-in-every-class/
5 Kosciw, J. G., Clark, C. M., & Menard, L. (2022). *The 2021 National School Climate Survey: The experiences of LGBTQ+ youth in our nation's schools.* New York: GLSEN https://www.glsen.org/research/2021-national-school-climate-survey
6 Whipple, K. S. (n.d.). How Do We Make Math Class More Inclusive of Trans and Non-binary Identities. *GLSEN Website.* https://www.glsen.org/blog/how-do-we-make-math-class-more-inclusive-trans-and-non-binary-identities

ensure that there is 2SLGBTQ visibility in classrooms and demonstrate allyship through inclusive curricula and resources.[7] By celebrating queer contributions to math and giving space to 2SLGBTQI mathematicians' voices, you will help lessen these systemic binds and show that queer advocacy belongs to all classrooms. By doing so, you will introduce your students to the idea that it is okay for everyone to love math and contribute to the world of STEM as a whole.

## Countering Queer Erasure: Seven Queering Voices from the Realm of Mathematics

Within history, science has often indulged in intentional and unintentional acts of queer erasure. 2SLGBTQI community members have been systematically removed from the records or have been the object of intensive straightwashing. This process, that Rosenthal describes as the "displacement of queer peoples from public view,"[8] has deeply impacted the global worldview on queer contribution to the history of humanity. In order to counteract this centuries-long process, it is necessary to go back to our records, and write queer characters back into our history books.

### Useful definitions: queer erasure and straightwashing

**Queer erasure** (or 2SLGBTQI erasure) refers to the intentional or unintentional act of removing queer people from record, or to dismiss or downplay their significance in history, academic literature, etc.[9]

**Straightwashing** refers to the intentional or unintentional act of portraying 2SLGBTQI people, in fiction and historical recounts, as heterosexual (straight), making 2SLGBTQI people appear heterosexual, or altering information about historical figures to make their representation comply with heteronormativity.[10]

7 Campbell & Taylor, 2021
8 Rosenthal G. S. (2017). Make Roanoke Queer Again: Community History and Urban Change in a Southern City. *The Public Historian* 35–60.
9 Scot, J. (2014). A Revisionist History: How Archives are Used to Reverse the Erasure of Queer People in Contemporary History. *Qed: A Journal in GLGBTQ Worldmaking,* 205–209.
10 Smith, L. (April 20, 2018). What is straightwashing? When Hollywood erases gay characters from films. PinkNews Website. https://www.thepinknews.com/2018/04/20/what-is-straightwashing-gay-characters-hollywood-films/

The contributions of queer folks to the world of mathematics throughout the ages are many. To help you introduce your students to more queer voices in mathematics, we have chosen to bring forth seven scientists from across human history:

- Antiquity
  - Pythagoras (c.570-495 BCE)
  - Hypatia (c. 370-415 CE)
- Middle Ages and Early Modernity
  - Leonardo da Vinci (1452-1519)
  - Georg Joachim Rheticus (1514-1574)
- Modern Times
  - Alan Turing (1912-1954)
  - Shakuntala Devi (1929-2013)
  - James Stewart (1941-2014)

The reasons for this selection are manifold. Guided by the principle that everyone can (and should) contribute to the field of mathematics, we wanted to give voice to a wide and diverse crowd of mathematicians bridging four ages and three continents. That said, this grouping should be understood as merely an introduction to the topic and does not include all the instances of queer contributions to mathematics across the world.

Below you will find a list of valuable resources to further enrich your classes with more queer voices. Feel free to add more as you see fit.

**Spectra: The Association for LGBT Mathematicians. -** http://lgbtmath.org/

**500 Queer Scientists -** https://500queerscientists.com/

**LGBTQ+ STEM -** https://lgbtstem.wordpress.com/

**Pride in STEM -** https://prideinstem.org/

**National Association of Gay and Lesbian Scientists and Technical Professionals -** https://www.noglstp.org/outtoinnovate/

# Queering Voices in Mathematics: Antiquity

## Pythagoras of Samos (c. 570 – c. 495 BCE)

Figure 1: *Bronze bust of a philosopher from Villa of the Papyri, Herculaneum, possibly a fictional bust of Pythagoras. (Wikimedia Commons)*

Credited with an incredible amount of mathematical and scientific discoveries – including the sphericity of the Earth, the Pythagorean theorem, Pythagorean tuning, the Theory of Proportions, the five regular solids, and the identity of the morning and evening stars as the planet Venus – Pythagoras and his school left an incredible mark on the global advancement of mathematics, astronomy, geometry, and music.

Pythagoras was born on the Greek island of Samos, a few miles away from modern-day Turkey. According to the ancient Greek philosopher Aristotle, Pythagoras and his school believed that all things were made of numbers and that numbers were the essence of the divine.

Together with being one of the most influential mathematicians in history, Pythagoras was also the founder of a new way of life. As a scientific and spiritual guide, in fact, Pythagoras decided to live in an all-men mystical commune. The members of his school vowed devotion to Pythagoras and each other, sharing every part of their life. One of the most important Pythagorean sayings was "*koinà tà phílōn*" or "All things in common among loved ones." Love, mathematics, and communal living, therefore, informed Pythagoras' teachings in all aspects.

## Hypatia of Alexandria (c. 350 – 415 AD)

Hypatia was a philosopher, astronomer, and mathematician who lived in Alexandria, Egypt, during the late Roman Empire. Daughter of the mathematician Theon of Alexandria, she soon surpassed her father as a

scholar and educator. She is the first woman mathematician whose life is reasonably well recorded in historiographical sources, where she is depicted as a renowned teacher and political counselor. During her life, she wrote extensively on arithmetic, geometry, and astronomy. Although not much has remained of her original research, multiple sources of the time testify to her outstanding abilities as a mathematician and astronomer, as well as her craft in building complex astrolabes and hydrometers.[11] A pagan throughout her life, she taught and supported many Christian students regardless of their religious differences.

Figure 2: *Portrait of a young woman in red, 90--120 C.E. Credit: The Metropolitan Museum of Art, New York*

While little is known about Hypatia's private life, several ancient sources testify to Hypatia's refusal to marry or even tolerate male courtship. This position is further supported by the latest studies, which claim that, at the time of her death, Hypatia had no appointed successor, no spouse, and no offspring.[12] Despite the dangers of living in celibacy in a culture that provided little support to unmarried women, Hypatia stayed true to herself until the very end.

## Queering Voices in Mathematics: Middle Ages and Early Modernity

### Leonardo da Vinci (1452-1519)

Leonardo di ser Piero da Vinci was a Florentine polymath of the High Renaissance. He was active as a scientist, painter, engineer, theorist, sculptor, and architect. His iconographic masterpiece, the Mona Lisa, is often regarded as one the world's most famous paintings. While his fame initially rested on his

11 See Philostorgius and Hesychius of Alexandria in Waithe M.E. (1987), *Ancient Women Philosophers: 600 B.C.–500 A.D.*, vol. 1, Martinus Nijhoff Publishers, 173.
12 Watts, E.J. (2017), *Hypatia: The Life and Legend of an Ancient Philosopher*, Oxford University Press, 117. See also Booth C. (2017), *Hypatia: Mathematician, Philosopher, Myth*, Fonthill Media, 113-114.

achievements as a painter, he also made substantial discoveries in anatomy, civil engineering, geology, optics, hydrodynamics, and tribology. Admired for his artistic and technological creativity, he conceptualized flying machines, armored fighting vehicles, concentrated solar power, a ratio device to be used in rudimentary calculators, and the double hull.

Figure 3: *Francesco Melzi - Portrait of Leonardo (Wikimedia Commons)*


During his life, Leonardo tried to keep his private life secret. This is probably due to the fact that, already in 1476, the polymath had to face a charge of sodomy. Allegedly, only through the help of his powerful patrons, the Medici family in Florence, was he saved from the accusations. After the polymath's death, one of his pupils, Francesco Melzi, would describe Leonardo's relationship with some of his close apprentices as fond, caring, and passionate. The loving relationship between the two is further corroborated by the fact that, upon his death, Leonardo left all personal belongings, paintings, drawings, and notes to Melzi.

### Georg Joachim Rheticus (1514-1574)

Georg Joachim von Lauchen Rheticus was an Austrian mathematician, astronomer, cartographer, navigational-instrument maker, medical practitioner, and the only apprentice of Renaissance polymath Nicolaus Copernicus. Rheticus was instrumental in the publication of Copernicus' ground-breaking treatise on heliocentrism, On the Revolutions of the Celestial Spheres, which triggered the Copernican Revolution. He also contributed personally to the treatise itself, writing and curating the trigonometric sections of Copernicus' De revolutionibus in a separate publication, On the Sides and Angles of Triangles. Later in life, Rheticus published the first six-function trigonometric tables in known history. His posthumous work, Science of Triangles, finished by his own

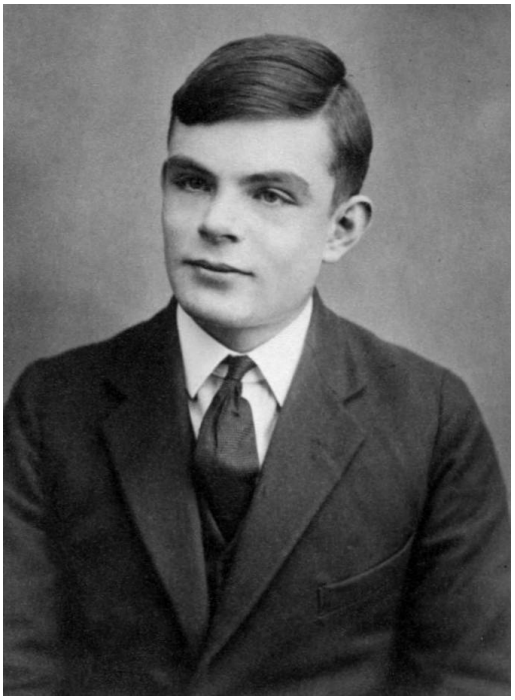
student, included trigonometric tables for all six trigonometry functions accurate enough for use into the early 20th century.

Rheticus' gender and love life had very adverse effects on his career. In 1551, Rheticus had to quit his job as a university professor of higher mathematics in Leipzig and flee the country because he was accused of sodomy. In 1552, Rheticus was found guilty and exiled from Leipzig for 101 years. The city had all his possessions impounded and made him a public criminal. As a result, Rheticus also lost most of his academic friendships and scholarly network.

## Queering Voices in Mathematics: Modern Times

### Alan Turing (1912-1954)

Figure 4: *Alan Turing at 16 - Wikimedia Commons*



Alan Mathison Turing was an English mathematician, computer scientist, cryptanalyst, logician, and biologist. During his life, he was incredibly influential in the development of theoretical computer science, providing a formalization of the concepts of algorithm and computation with the Turing machine, considered by many as an early model of a general-purpose computer. Today, he is widely regarded as the father of theoretical computer science and artificial intelligence, and the creator of the Turing test, which also led to the creation of CAPTCHA tests.

During the Second World War, Turing worked for the Government Code and Cypher School, Britain's codebreaking centre. He led Hut 8, the section responsible for German naval cryptanalysis for a time. Here, he developed several techniques for speeding the breaking of German ciphers, including improvements to the pre-war Polish bomba method, a machine able to find settings for the Enigma machine. Turing played a vital role in cracking intercepted coded messages that enabled the Allies to defeat the Axis powers

in many battles, including the crucial Battle of the Atlantic. After the war, Turing worked at England's National Physical Laboratory, where he designed the Automatic Computing Engine (ACE), one of the first designs for a stored-program computer. In 1948, Turing joined Max Newman's Computing Machine Laboratory, where he helped develop the famous Manchester computers.

Despite his many accomplishments in the field of STEM and his active service to the British Crown, later in life, Turing was the object of inhumane persecution by the state. In January 1952, after denouncing a burglary in his apartment, the mathematician was charged with the crime of "gross indecency." As a punishment for his "crimes," he was forced to undergo invasive hormonal therapies to reduce libido, known as "chemical castration." His conviction barred him from his cryptographic consultancy for the government and was the reason he was denied entry into the United States. Notwithstanding his tragic history, Turing is now celebrated as one of the brightest minds of the twentieth century.

**Shakuntala Devi (1929-2013)**

Shakuntala Devi was an Indian specialist in mental calculation and held the record for the fastest human calculator for forty years (1980-2020). Throughout her life, Shakuntala sought to create educational content to teach mental calculation to children, trailblazing a new generation of mental calculators before the foundation of the Mind Sports Olympiad and the Mental Calculation World Cup. She wrote several texts on mathematics, puzzles, and astrology.

Figure 5: *Shakuntala Devi – Wikimedia Commons*

Born from humble origins (her father was a professional circus performer), Shakuntala demonstrated exceptional calculation abilities since early childhood and without the help of any formal education. At age six, she was already exhibiting her incredible arithmetic abilities at the University of Mysore, India.

While her youth was spent traveling the world as a math prodigy, during her adult years, Shakuntala devoted herself to the empowerment of Indian women and the decriminalization of homosexuality in India. Her 1977 book, The World of Homosexuals, was the first published academic study of homosexuality in India and is still remarkable for its progressive approach to the subject compared with contemporary works. "Immorality" she writes, "does not consist in being different. It consists in not allowing others to be so."

**James Stewart (1941-2014)**

James Drewry Stewart was a Canadian mathematician, skillful violinist, and beloved university professor. He is best known for his world-renowned calculus textbooks used for high school, college, and university-level courses. He is also known for his commission of Toronto's celebrated Integral House, one of North America's most relevant architectural private houses.

Together with being a successful scholar and educator, Stewart was deeply involved in 2SLGBTQI activism. During the 1970s, Stewart was at the vanguard of the LGBT liberation movement and was involved in protests and demonstrations. A cause that he kept at heart throughout his life. During one of his last interviews, Stewart stated that the most important thing he has ever done in his entire life was probably his work in the gay rights movement in Hamilton.

## Queering Your Math Class, Topic by Topic

Whether you wish to use the content above only in relation to the educational video included in this toolkit or in separate classes, here are a few suggestions on integrating queer voices into your regular classes – no matter the grade.

- Pythagoras (c.570-495 BCE)
    - Pythagoras' theorem
    - The five regular solids
    - The sphericity of the Earth

- Hypatia (c. 370–415 CE)
  - Relative density of liquids
  - Triangulation
  - Conic sections
- Leonardo da Vinci (1452–1519)
  - Perspective
  - The golden ratio
  - Physics of flight
- Georg Joachim Rheticus (1514–1574)
  - Solar system
  - Trigonometry
  - Sine and cosine tables
- Alan Turing (1912–1954)
  - Turing test
  - Turing machine
  - Algorithms
  - Cryptanalysis
- Shakuntala Devi (1929–2013)
  - Mental calculation
- James Stewart (1941–2014)
  - Calculus in general
  - Integrals
  - Harmonic analysis
  - Functional analysis

**What could this look like in your classroom?**

Explicitly acknowledging the identities of the scientist(s) behind the concepts or models you are teaching provides much-needed representation for 2SLGBTQI students within the curriculum that can significantly impact scholastic and career outcomes. Further, it provides all students with a more well-rounded and realistic vision of human gender and sexual diversity across time.

Critiques of scientific objectivity and how researcher positionality affects humanity's collected knowledge are entire topics of their own. If these extend beyond the scope of your own classes, we encourage you to at least introduce the concepts to your students and to make visible 2SLGBTQI scientists to the extent that you are able.

No scientific domain exists in a vacuum. Thus, it is important for teachers, regardless of their subject area, to be familiar with not only the identities of the major contributors to their own field but also any related fields. Further, discussing with students how those scientists' worldviews may have impacted their scientific outputs role models critical skills and scientific literacy.

# Pre-Video Reflection and Discussion Guide

Before showing the video clip in class, consider dividing your students into small groups (roughly four people per group) and ask them to reflect on two or more of these questions:

- Does the person doing the math shape the way math is done?
- Historically, who has been encouraged to study math/STEM? And why?
- Do people from equity-deserving groups get the same opportunities to contribute to scientific research?
- What are the obstacles that 2SLGBTQI mathematicians could have faced in the past?

# Post-Video Reflection and Discussion Guide

These are some of the questions you might want to ask your students after watching the video clip:

- Did anything surprise you from the video? What was new for you?
- Were you familiar with any of the seven mathematicians included in the video? Why do you think some of them might have been excluded from school lessons in the past?
- Why do you think it's important to talk about these mathematicians as part of (or as allies of) the 2SLGBTQI community?
- What might encourage more 2SLGBTQI people to pursue careers in mathematics?

## Knowledge in Practice

In order for students to reflect on how bias impacts the world of math and sciences in general, consider the following content as a take-home exercise.

> Answer this short riddle and prepare a written response that explains your answer.
>
> A father and son go on a study trip in a very remote region of the world. At the end of the first month, the son is tasked with returning to Canada while the father stays onsite to collect more samples. Once landed in his hometown, the son is hurt and is rushed to the hospital; just as he's about to be operated on, the surgeon says, "I can't operate—that boy is my son!"
>
> How is it possible?

Here is some context to help you prepare your feedback on their answers.

In a recent research project conducted by Mikaela Wapman and Deborah Belle that asked a similar riddle, a vast majority of folks tended to overlook the possibility that the surgeon in the riddle was the mother. In the initial research, only a small minority of subjects—roughly 15%—came up with the mom's-the-surgeon answer. Curiously, life experiences that might suggest the mom

answer had no association with how one performed on the riddle. Even in groups where women outnumbered men two-to-one or groups with people whose mothers were doctors or health care professionals had a lot of difficulty with the puzzle. A small number of participants did propose a two-father household as a possible solution. But this solution, too, was far outnumbered by more complicated solutions (hallucinations, adoption, biological father versus priest "father," etc.), demonstrating the durability of both patriarchal and heteronormative schema biases.

This little riddle is a good way to demonstrate how biased our perception is toward the world of sciences and how, while we think science is objective, our vision of who should do science is not. Remember, research shows that children between seven and ten are already developing the same bias that adults show, so reflecting on this bias at an early stage can be instrumental in fighting workplace and academic bias.

See more here:


Barlow, R. (January 16, 2021). BU Research: A Riddle Reveals Depth of Gender Bias. *BU Today Website.* https://www.bu.edu/articles/2014/bu-research-riddle-reveals-the-depth-of-gender-bias/

Belle, D., Tartarilla, A. B., Wapman, M., Schlieber, M., & Mercurio, A. E. (2021). "I Can't Operate, that Boy Is my Son!": Gender Schemas and a Classic Riddle. *Sex Roles*, 85(3–4), 161–171. https://doi.org/10.1007/s11199-020-01211-4

Hobson, N. (May 18, 2022). This 50-Year-Old Riddle That Continues to Stump Us Explains Why We Still Have a Strong Gender Bias. *Inc. Magazine*. https://www.inc.com/nick-hobson/the-100-year-old-riddle-that-continues-to-stump-us-explains-why-we-still-have-a-strong-gender-bias.html

# Additional Content and Research

These resources can be used to further understand the rationale that went into creating this resource. Here you will also find all the aggregated resources shared throughout the document together with some additional links.

## Printed Resources


Collins, P.H. (2001). *Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment*. New York: Routledge.

Dubbs, C. (2016) A Queer Turn in Mathematics Education Research: Centering the Experience of Marginalized Queer Students. *North American Chapter of the International Group for the Psychology of Mathematics Education*. https://files.eric.ed.gov/fulltext/ED583735.pdf

Misawa, M. (2010). Queer Race Pedagogy for Educators in Higher Education: Dealing with Power Dynamics and Positionality of LGBTQ Students of Color. *International Journal of Critical Pedagogy, 3* (1), 26-35. Retrieved from http://libjournal.uncg.edu/ijcp/article/view/68.

Rands K. (2009). Mathematical Inqu[ee]ry: Beyond 'Add-Queers-and-Stir' elementary mathematics education. *Sex Education*. 9, 181-191. 10.1080/14681810902829646.

Rosenthal G. S. (2017). Make Roanoke Queer Again: Community History and Urban Change in a Southern City. *The Public Historian,* 35–60. https://doi.org/10.1525/tph.2017.39.1.35

Scot, J. (2014). A Revisionist History: How Archives are used to reverse the Erasure of Queer People in Contemporary History. *Qed: A Journal in GLBTQ Worldmaking,* 205–209.

Waid, B. E. (2020). Supporting LGBTQ+ Students in K–12 Mathematics. *Mathematics Teacher: Learning and Teaching PK-12.* 113 (11), 874-884. DOI: https://doi.org/10.5951/MTLT.2019.0403


## Online Resources

### 500 Queer Scientists

https://500queerscientists.com/

**A Guide to Virtual GSAs (Egale)**

https://egale.ca/awareness/a-guide-to-virtual-gsas/

**Affirming Adults: A Safe Return to Class (Egale)**

https://egale.ca/awareness/safe-return-to-class/

**Affirming and Inclusive Language (Egale)**

https://egale.ca/awareness/affirming-and-inclusive-language/

**Developing LGBTQ-Inclusive Classroom Resources. (GLSEN)**

https://www.glsen.org/activity/inclusive-curriculum-guide

**LGBTQ+ STEM**

https://lgbtstem.wordpress.com/

**LGBTQ-Inclusive Lessons and Resources**

https://www.teach.lgbt/subject/math/

**National Association of Gay and Lesbian Scientists and Technical Professionals**

https://www.noglstp.org/outtoinnovate/

**Pride in STEM**

https://prideinstem.org/

**Spectra: The Association for LGBT Mathematicians**

http://lgbtmath.org/

**Tackling Anti-2SLGBTQI Cyberbullying in Schools (Egale)**

https://egale.ca/awareness/tackling-anti-2slgbtqi-cyberbullying-in-schools/

**The Queer Mathematics Teacher: Educational Coaching to Re/humanize Mathematics**

https://www.thequeermathematicsteacher.com/resources/

# References


Barlow, R. (January 16, 2021). BU Research: A Riddle Reveals Depth of Gender Bias. *BU Today Website.* https://www.bu.edu/articles/2014/bu-research-riddle-reveals-the-depth-of-gender-bias/

Belle, D., Tartarilla, A. B., Wapman, M., Schlieber, M., & Mercurio, A. E. (2021). "I Can't Operate, that Boy Is my Son!": Gender Schemas and a Classic Riddle. *Sex Roles*, 85(3–4), 161–171. https://doi.org/10.1007/s11199-020-01211-4

Booth C. (2017). *Hypatia: Mathematician, Philosopher, Myth*, Fonthill Media, 113-114.

Collins, P.H. (2001). *Black Feminist Thought: Knowledge, Consciousness, and the Politics of Empowerment*. Routledge

Hobson, N. (May 18, 2022). This 50-Year-Old Riddle That Continues to Stump Us Explains Why We Still Have a Strong Gender Bias. *Inc. Magazine*. https://www.inc.com/nick-hobson/the-100-year-old-riddle-that-continues-to-stump-us-explains-why-we-still-have-a-strong-gender-bias.html

Holley L. C. & Steiner S. (2005). Safe Space: Student Perspectives on Classroom Environment. *Journal of Social Work Education* 49–64.

Kosciw, J. G., Clark, C. M., & Menard, L. (2022). *The 2021 National School Climate Survey: The experiences of LGBTQ+ youth in our nation's schools.* New York: GLSEN https://www.glsen.org/research/2021-national-school-climate-survey

Misawa, M. (2010). Queer Race Pedagogy for Educators in Higher Education: Dealing with Power Dynamics and Positionality of LGBTQ Students of Color. *International Journal of Critical Pedagogy, 3* (1), 26-35.

Peter, T., Campbell, C.P., & Taylor, C. (2021). *Still in every class in every school: Final report on the second climate survey on homophobia, biphobia, and transphobia in Canadian schools.* Toronto, ON: Egale Canada Human Rights Trust. https://egale.ca/awareness/still-in-every-class/

Rosenthal G. S. (2017). Make Roanoke Queer Again: Community History and Urban Change in a Southern City. *The Public Historian* 35–60.

Scot, J. (2014). A Revisionist History: How Archives are Used to Reverse the Erasure of Queer People in Contemporary History. *Qed: A Journal in GLGBTQ Worldmaking,* 205–209.

Smith, L. (April 20, 2018). What is straightwashing? When Hollywood erases gay characters from films. PinkNews Website. https://www.thepinknews.com/2018/04/20/what-is-straightwashing-gay-characters-hollywood-films/

University of Edinburgh. (Feb 8, 2021). Intersectionality and Privilege. https://www.ed.ac.uk/equality-diversity/students/intersectionality

Waithe M. E. (1987). Philostorgius and Hesychius of Alexandria. *Ancient Women Philosophers: 600 B.C.–500 A.D.*, vol. 1, Martinus Nijhoff Publishers, 173.

Watts, E. J. (2017). *Hypatia: The Life and Legend of an Ancient Philosopher*, Oxford University Press, 117.

Whipple, K. S. (n.d.). How Do We Make Math Class More Inclusive of Trans and Non-binary Identities. *GLSEN Website.* https://www.glsen.org/blog/how-do-we-make-math-class-more-inclusive-trans-and-non-binary-identities