Decolonizing Secondary Physics Curricula

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CSAAPT Fall Meeting • October 21, 2023

Who we are

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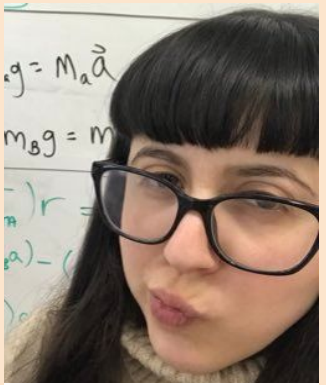


Rachel Wax
High School, NY

Our Origin Story

At the February 2021 URC Unconference, a group of us talked about what it would mean to “decolonize” physics, not just as a conversation for a special day but as an everyday practice. Our professional learning community has been meeting monthly on Zoom ever since. We have no specific leader and we rotate host / organizer.

Problem of practice: how can we work towards a world where physics is “decolonized”?

Turn-and-talk

What does it mean to “colonize” something?

What does it mean to “decolonize” something?

How I Define It (and it changes all the time)

"Decolonizing" physics = decentering the whiteness, maleness, and Western-ness in physics.

We need to acknowledge…

That the physics content we were taught (and were taught to teach) grew out of colonialism and does not universally represent the values or aspirations of our communities and of the world.

We need to reconsider…

- What we teach (content)
- How we teach (pedagogy)
- How we assess (grading)
- How we situate our course in broader school, local, and global systems

Why We Do It

To *decolonise* and not just diversify curriculums is to recognise that knowledge is inevitably marked by power relations. … A *decolonised* curriculum would bring questions of class, caste, race, gender, ability and sexuality into dialogue with each other, instead of pretending that there is some kind of generic identity we all share.

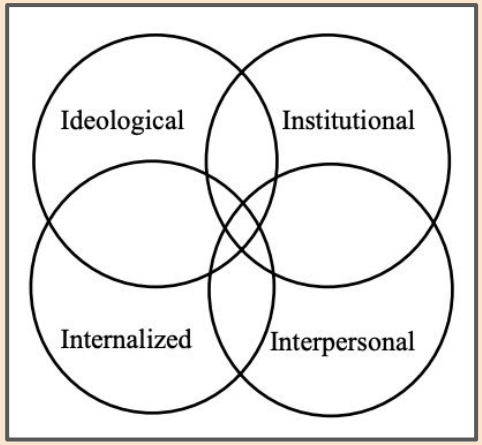
Priyamvada Gopal, Professor of Postcolonial Studies, University of Cambridge

Why We Do It

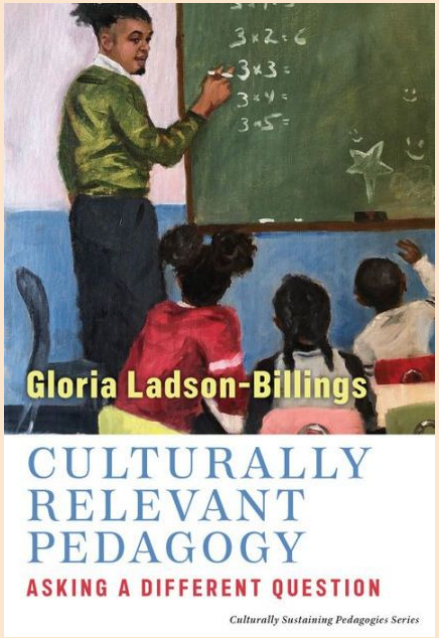
"*Decolonizing* science will also involve encouraging Western institutions … to reflect more on the violent political contexts of war and colonization …"

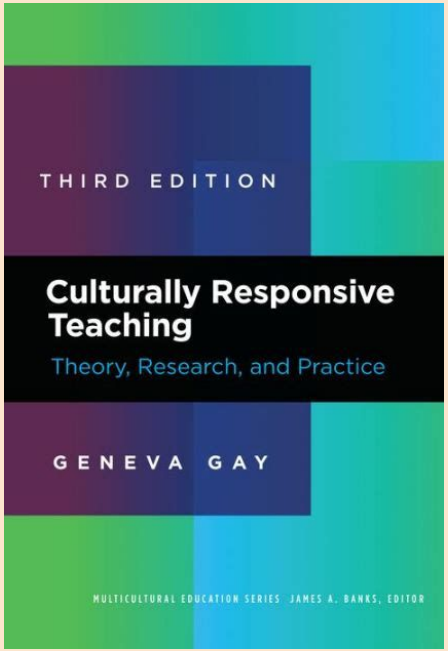
Rohan Deb Roy, Associate Professor in South Asian History, University of Reading

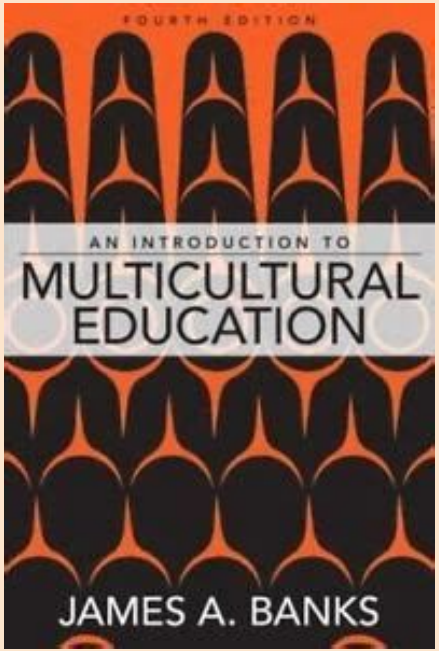
Many frameworks guide our work



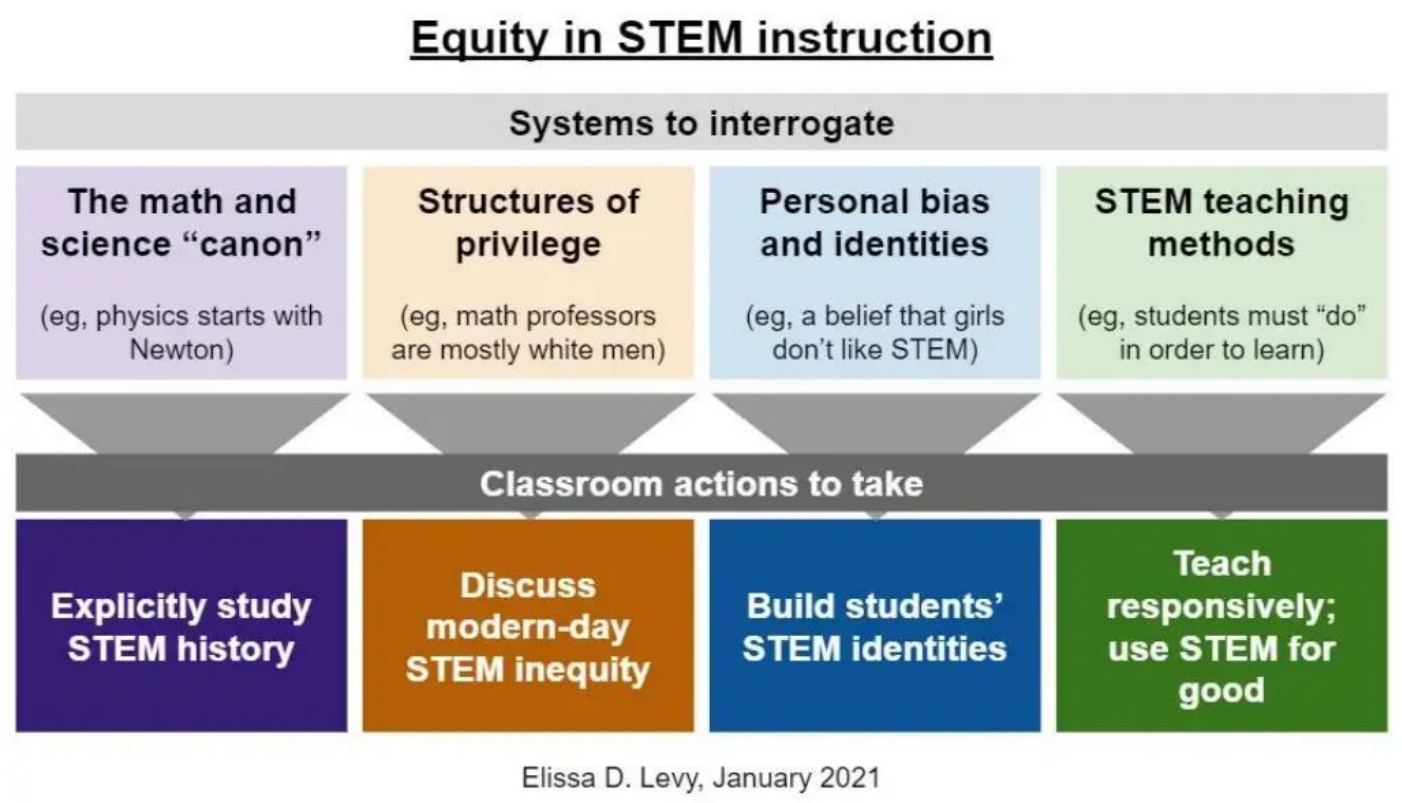
[The Four I's of Oppression]







One More Framework



https://medium.com/educate-pub/how-i-approach-equity-when-teaching-stem-597b9c735822

Tell your partner about one of these things you do currently in your teaching practice.

Examples Across the Physics Curriculum

Component	Examples
Fix historical attribution	• Discuss Ibn Sahl's discovery of what we call Snell's Law. • Discuss history of inertia from as early as ancient China.
Discuss equity in STEM	• Use resources such as the URC and STEP UP to explicitly discuss equity and justice issues that transcend a particular unit of study.
Build students' STEM identities	• Investigate local issues (e.g., using heat maps). • Support students' choice and interests in meaningful ways. • Connect classes with diverse physicists (e.g., Skype-A-Scientist).
Teach responsively; use STEM for good	• Stop teaching projectile motion (it was developed for warfare). • Use climate change as an anchor phenomenon for energy. • Address issues like seizing foreign land for battery production materials; design conflict-free batteries.

A Case Study: Newton's Laws

Problematic aspect of teaching Newton's Laws	Possible approaches to address these components
The **"who"**: Newton's Laws actually came from a multi-century global exchange of ideas	Have students read historiography around Newton's Laws. Consider the power of naming/owning knowledge.
The **"what"**: Enlightenment physics was developed in service of imperialism, colonialism, and warfare	Adapt curriculum (where possible) to acknowledge but spend less time on physics in service of colonization.
The **"how"**: Few students find joy in learning Newton's Laws	Make the content fun and engaging, with multiple modalities and entrance points.
The **"why"**: Few students find Newton's Laws relevant to their lives	Focus examples on what's meaningful to students' lives, realistic / genuine applications.

https://medium.com/educate-pub/why-i-teach-history-in-my-physics-class-dd718633476f

Making the Global History Explicit

Two places where our group's work directly affected my teaching practice in 2023:

1. Universal Gravitation and Kepler's Laws

2. Electrostatics

Universal gravitation has a global history

Student-facing slide

Greece (Aristotle): Posited that downward motion of heavy bodies is related to their nature (gravity)
https://en.wikipedia.org/wiki/History_of_gravitational_theory

India (Brahmagupta): "...all people on the earth stand upright, and all heavy things fall down to the earth by a law of nature, for it is the nature of the earth to attract and to keep things..."
https://en.wikipedia.org/wiki/Brahmagupta#Early_concept_of_Gravity

Denmark (Brahe): Described the solar system, made precise celestial measurements
https://mathshistory.st-andrews.ac.uk/Biographies/Brahe

United Kingdom (Newton): Developed law of universal gravitation
https://scholar.harvard.edu/kleelerner/publications/newtons-law-universal-gravitation

Americas: Predicted celestial events
https://mexikaresistance.files.wordpress.com/2013/09/american-indian-contributions-to-the-world.pdf

China: Showed the stars move but are not physically connected to anything
https://en.wikipedia.org/wiki/Chinese_astronomy

India (Bhāskara II): "Objects fall on the earth due to a force of attraction by the earth. Therefore, the earth, planets,... moon, and sun are held in orbit due to this attraction"
http://www.mysteryofindia.com/2015/02/law-gravity-discovered-indian.html

Germany (Kepler): Developed laws of planetary motion
https://www.britannica.com/biography/Johannes-Kepler

USA (LIGO): Detected gravitational waves
https://news.mit.edu/2016/ligo-first-detection-gravitational-waves-0211

Electrostatics (my turn in the “hot seat”)

Step 1: I shared lessons

Self assessment: my unit had hands-on engagement and relevant examples but was missing a global/justice context.

Initial lessons linked here:

- Static electricity
- Coulomb's Law
- Electric fields
- Electric potential
- Quiz 1 and 2

Step 2: I got feedback

Collaborators pushed me to do research and ask why; tell the global story.

- Storing electrical potential in the Baghdad battery
- Amber as a colonial extraction
- Coulomb as a colonizer
- Exploitation in extraction of materials for batteries
- Social costs of e-waste

Step 3: I made changes

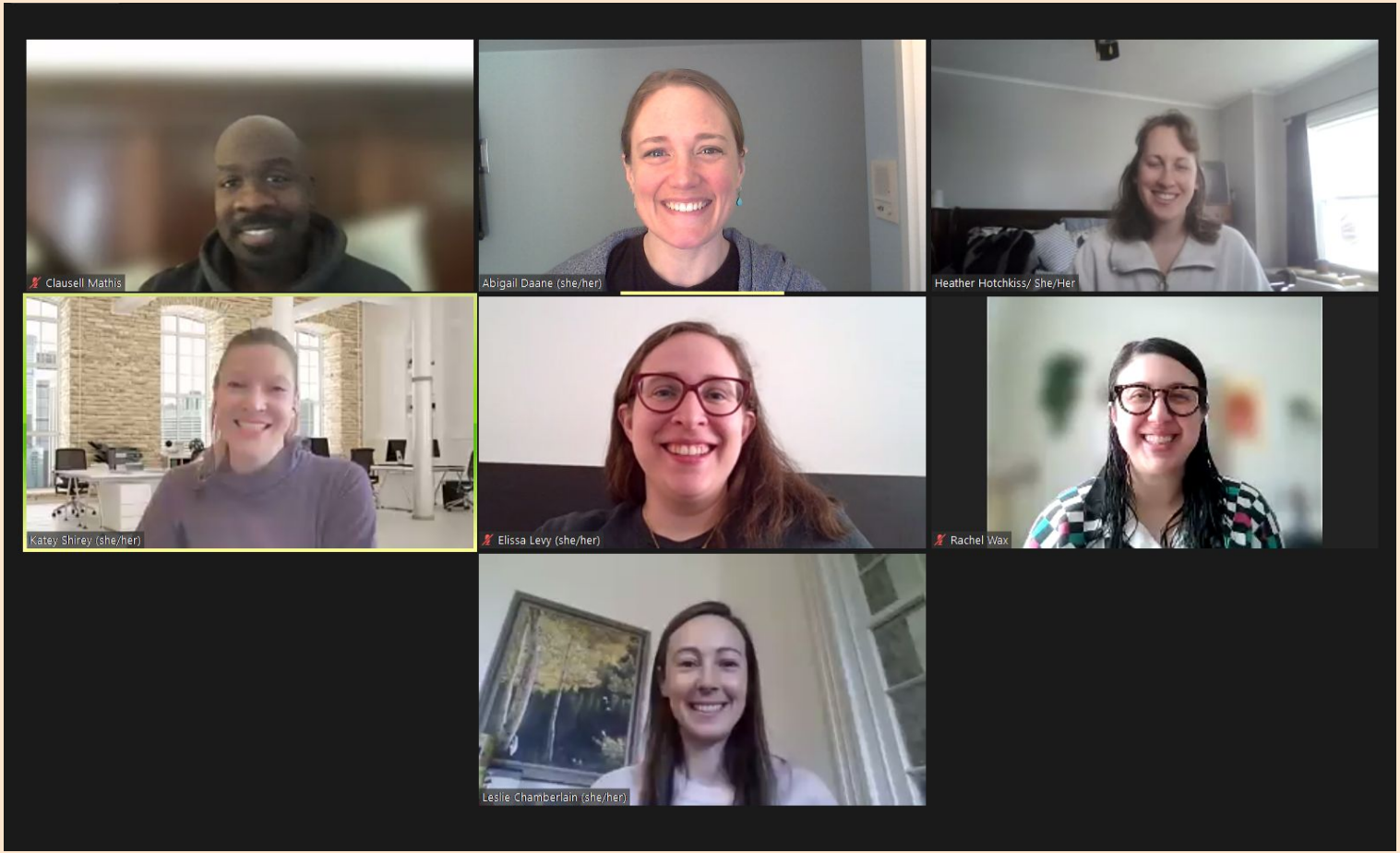
I added global context questions to my lessons (and now use these questions in every unit).

- Why do humans study electricity?
- How is electricity social, cultural, and political?
- Who benefits and who is harmed when we further develop our understanding of electricity?

Questions to ask students during any unit

- Why do humans study _____?
- How is _____ social, cultural, and political?
- Who benefits and who is harmed when we further develop our understanding of _____?

Selfie from Electrostatics Day



The Tensions We Feel

Write top-down curricula	Start with single lessons
Discuss theory / philosophy	Make our work implementable
Hone internally until polished	Invite public comments early
Decolonize CONTENT	Decolonize PRACTICES
Focus on our own learning first	Make classroom materials now

What's Next?

- Continue developing physics lessons and units that frame learning through:
  - Meaningful personal context
  - Global historical context
  - Current societal context
- Determine when and how to disseminate our work, collect feedback, and keep iterating
- Find a way to actually meet in person one day!

Decolonizing Physics

Books we're reading

- Horizons: Global Origins of Modern Science
- People's History of Science
- Blackfoot Physics
- Disordered Cosmos
- House of Wisdom
- Unconscious Bias in Schools

Relevant articles

- Decolonization is not a metaphor
- Decolonizing the mind
- Speaking up without tearing down
- Relocating modern science
- Three Ways to Decolonise Science
- Amalgamating Western Science and African Indigenous Knowledge Systems
- The Social and Economic Roots of Newton's *Principia*

Stay In Touch

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