Decolonizing Secondary Physics Curricula

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Who we are

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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

Gloria Ladson-Billings
Culturally Relevant Pedagogy
Asking a Different Question

Geneva Gay
Culturally Responsive Teaching
Theory, Research, and Practice

James A. Banks
An Introduction to Multicultural Education
One More Framework

**Equity in STEM instruction**

**Systems to interrogate**

- The math and science “canon”
  (eg, physics starts with Newton)
- Structures of privilege
  (eg, math professors are mostly white men)
- Personal bias and identities
  (eg, a belief that girls don’t like STEM)
- STEM teaching methods
  (eg, students must “do” in order to learn)

**Classroom actions to take**

- Explicitly study STEM history
- Discuss modern-day STEM inequity
- Build students’ STEM identities
- Teach responsively; use STEM for good

Elissa D. Levy, January 2021

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

https://medium.com/educate-pub/how-i-approach-equity-when-teaching-stem-597b9c735822
# Examples Across the Physics Curriculum

<table>
<thead>
<tr>
<th>Component</th>
<th>Examples</th>
</tr>
</thead>
</table>
| 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

<table>
<thead>
<tr>
<th>Problematic aspect of teaching Newton’s Laws</th>
<th>Possible approaches to address these components</th>
</tr>
</thead>
<tbody>
<tr>
<td>The “what”: Enlightenment physics was developed in service of imperialism, colonialism, and warfare</td>
<td>Adapt curriculum (where possible) to acknowledge but spend less time on physics in service of colonization.</td>
</tr>
<tr>
<td>The “how”: Few students find joy in learning Newton’s Laws</td>
<td>Make the content fun and engaging, with multiple modalities and entrance points.</td>
</tr>
<tr>
<td>The “why”: Few students find Newton’s Laws relevant to their lives</td>
<td>Focus examples on what’s meaningful to students’ lives, realistic / genuine applications.</td>
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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


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

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

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


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

Student-facing slide
# Electrostatics (my turn in the “hot seat”)

<table>
<thead>
<tr>
<th>Step 1: I shared lessons</th>
<th>Step 2: I got feedback</th>
<th>Step 3: I made changes</th>
</tr>
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</table>
| Self assessment: my unit had hands-on engagement and relevant examples but was missing a global/justice context. | 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](#) | 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? |

Initial lessons linked here:  
- [Static electricity](#)  
- [Coulomb's Law](#)  
- [Electric fields](#)  
- [Electric potential](#)  
- Quiz 1 and 2
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
- Discuss theory / philosophy
- Hone internally until polished
- Decolonize CONTENT
- Focus on our own learning first
- Start with single lessons
- Make our work implementable
- Invite public comments early
- Decolonize PRACTICES
- 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