Illustration: Fahmida Azim

Let's facilitate nuanced classroom conversations about ethics, science, and society

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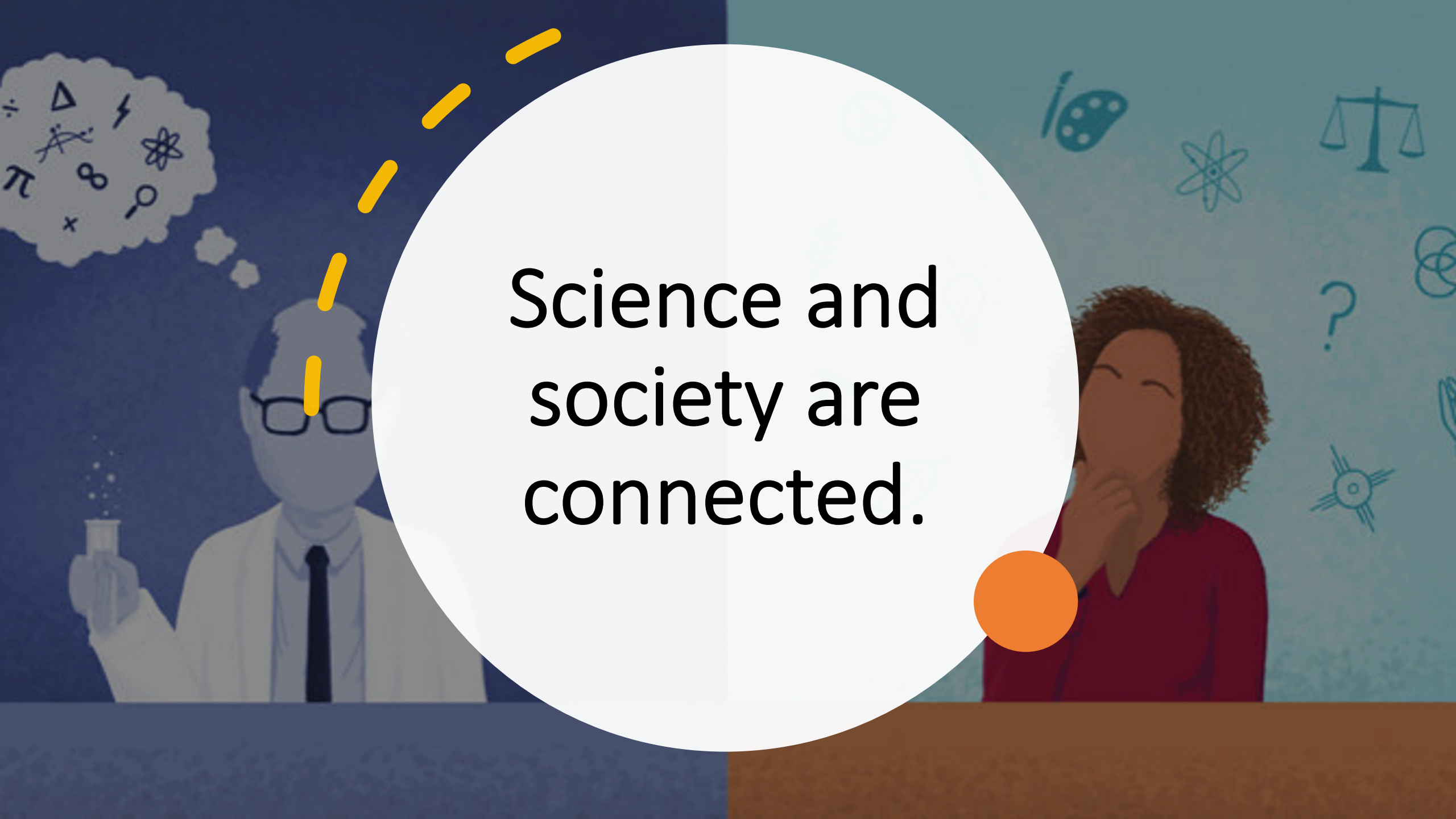

Science and society are connected.

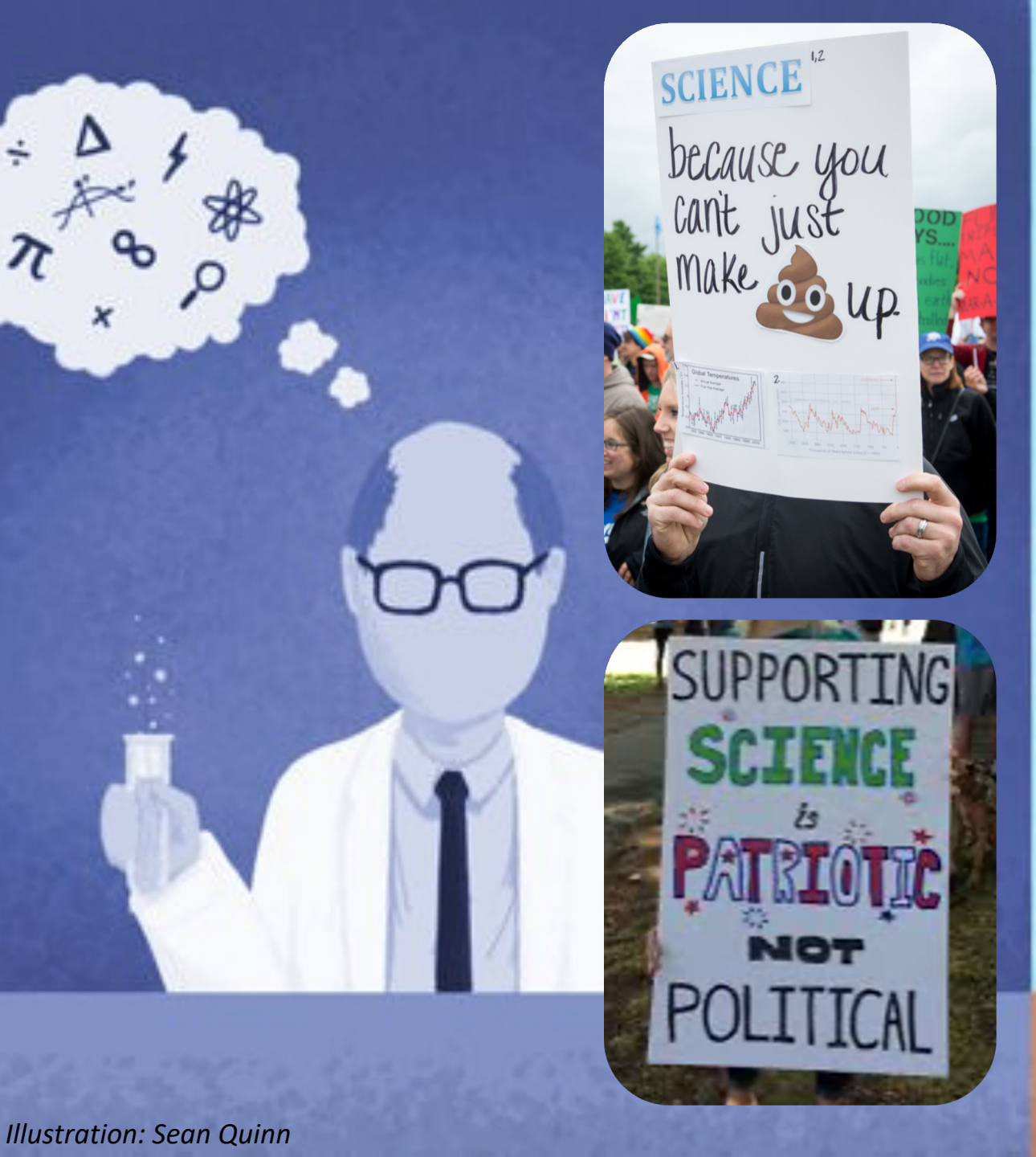


Illustration: Sean Quinn

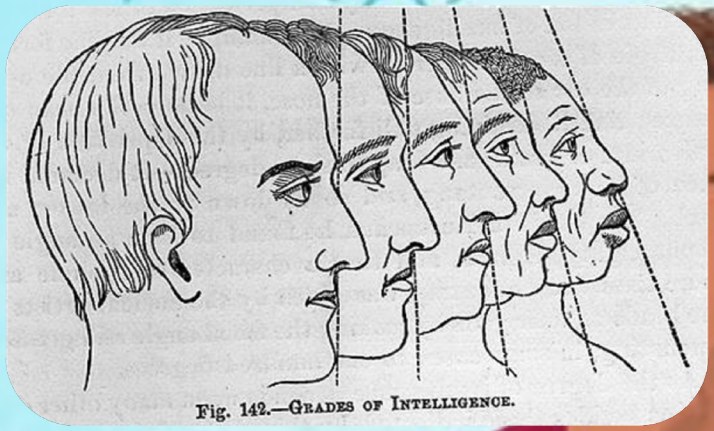
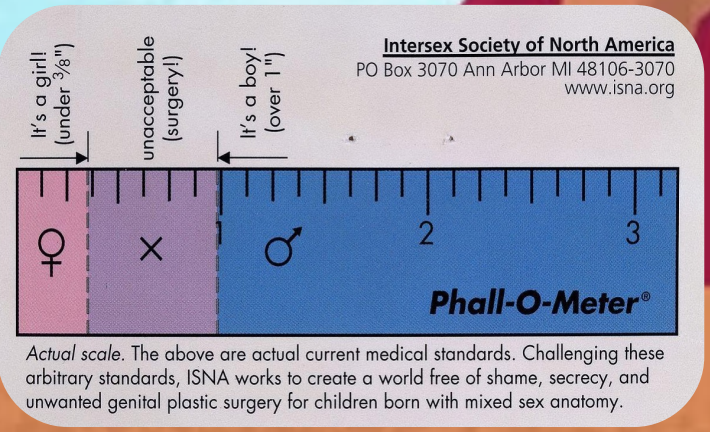


Fig. 142.—Grades of Intelligence.

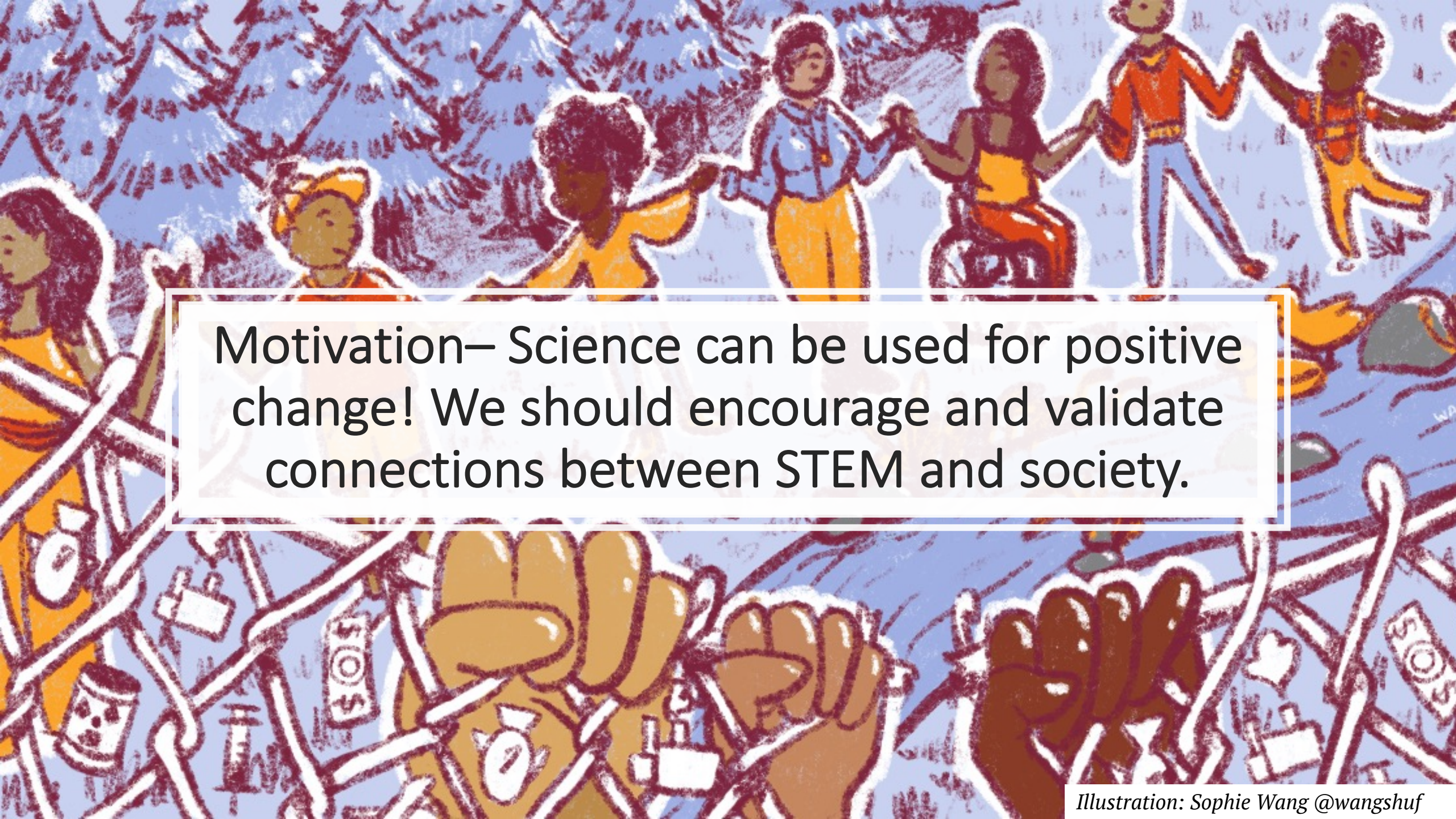


Actual scale. The above are actual current medical standards. Challenging these arbitrary standards, ISNA works to create a world free of shame, secrecy, and unwanted genital plastic surgery for children born with mixed sex anatomy.

“Objective” view of science encourages a disconnect from social responsibility.

Students’ sense of social responsibility declines over engineering degree, encouraged by the ideologies of meritocracy and depoliticization in STEM. (Cech 2013 & 2014)

Students with a commitment to social change can be pushed out of STEM. They are more often women and students of color. (McGee & Bentley 2017; Garibay 2015)


Motivation– Science can be used for positive change! We should encourage and validate connections between STEM and society.
SOS
SOS
Illustration: Sophie Wang @wangshuf

“Let’s talk about ethics!”

Developing motivation and skills to engage in ethical discussions about societal impacts of STEM

requires:

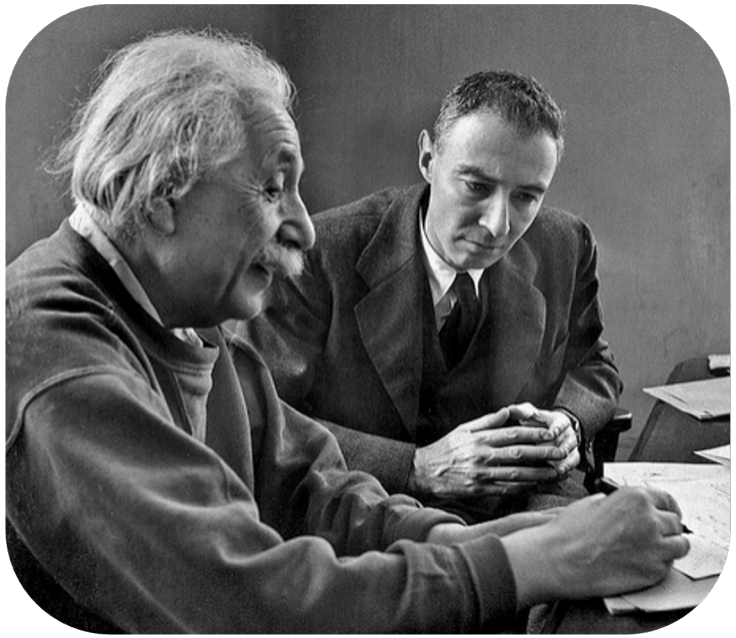
- practicing informed perspective taking
- experiencing validation that ethical reasoning is relevant to STEM

Ethics unit features and data collection (Conjecture mapping: Sandoval 2013)

Classroom & Curricular Features → **Interactions** → **Outcomes**

- Embedded within relevant physics units
- First-hand accounts from multiple stakeholders
- Scaffolded perspective taking
- Incorporated ethical frameworks
- Small group discussions

Science Ethics at Texas State University



Nuclear Physics
(Modern Physics)

A. Olmstead, E. Ochoa-Madrid, B. Gutmann

The Thirty Meter Telescope on Mauna Kea
(Observational Astrophysics)

A. Olmstead, B. Gutmann, A. Vasquez, D. Barringer

Multi-disciplinary STEM Ethics
(HON Ethics, Science, & Society)

A. Olmstead, B. Gutmann

Thirty Meter Telescope Construction




A. Olmstead, B. Gutmann, A. Vasquez, D. Barringer

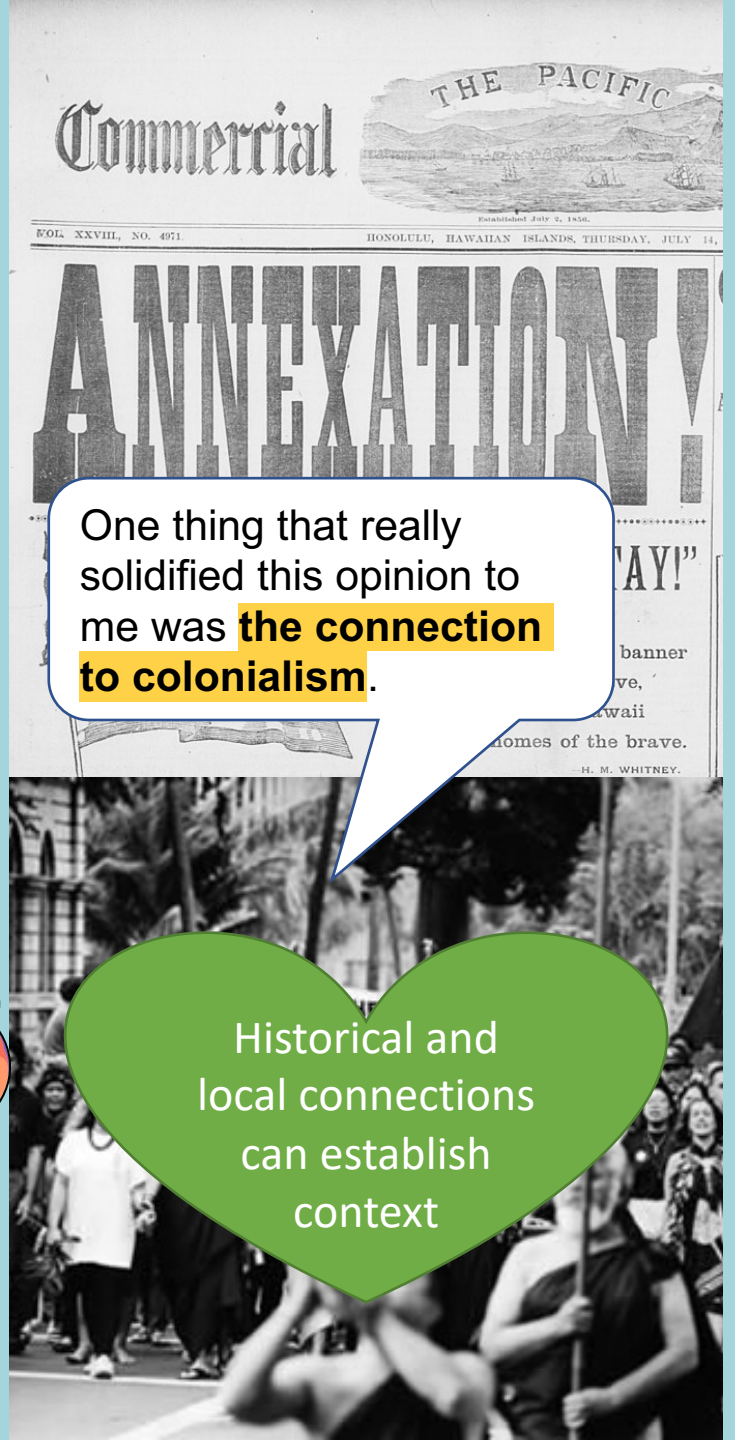
Observational Astrophysics

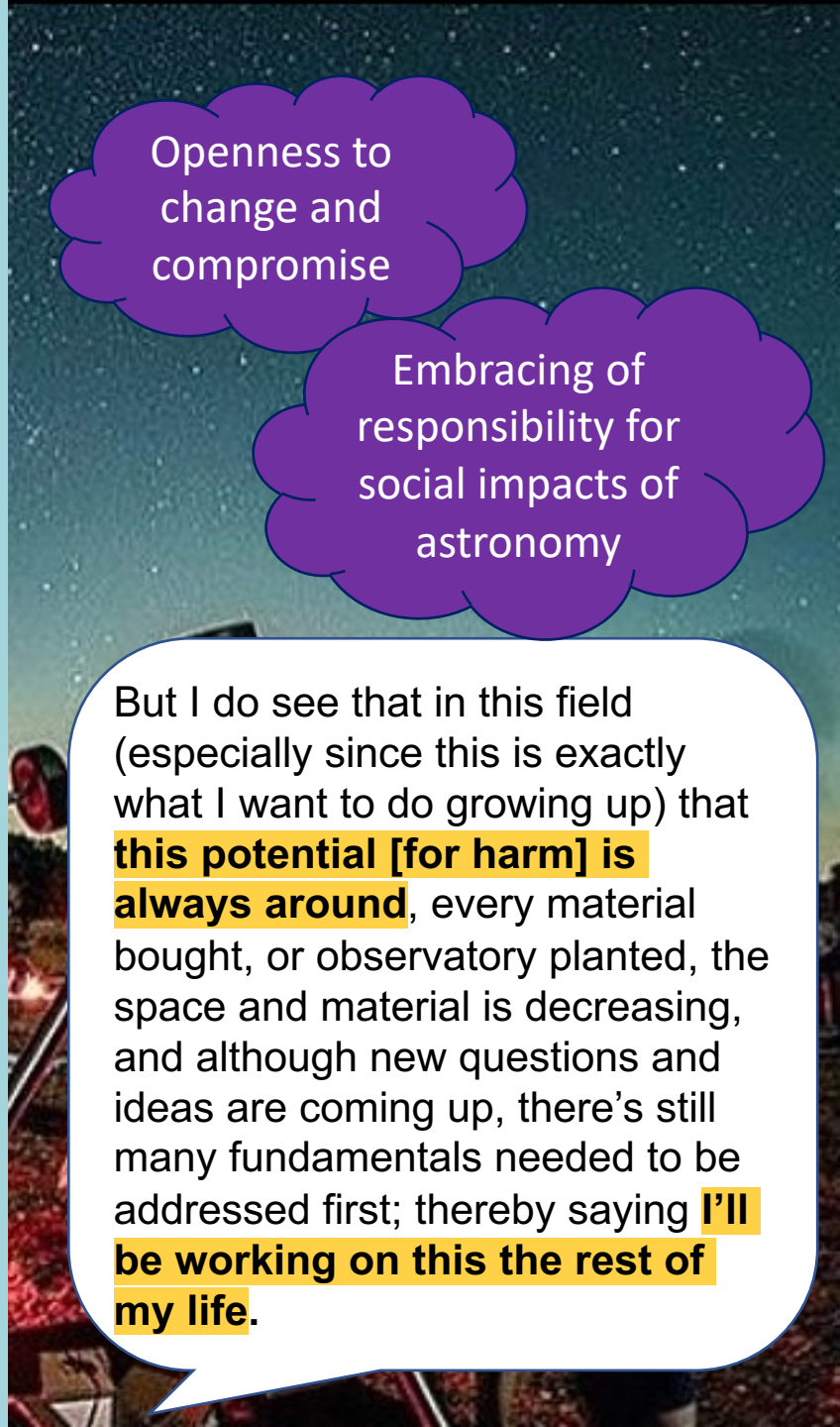
≈20 students

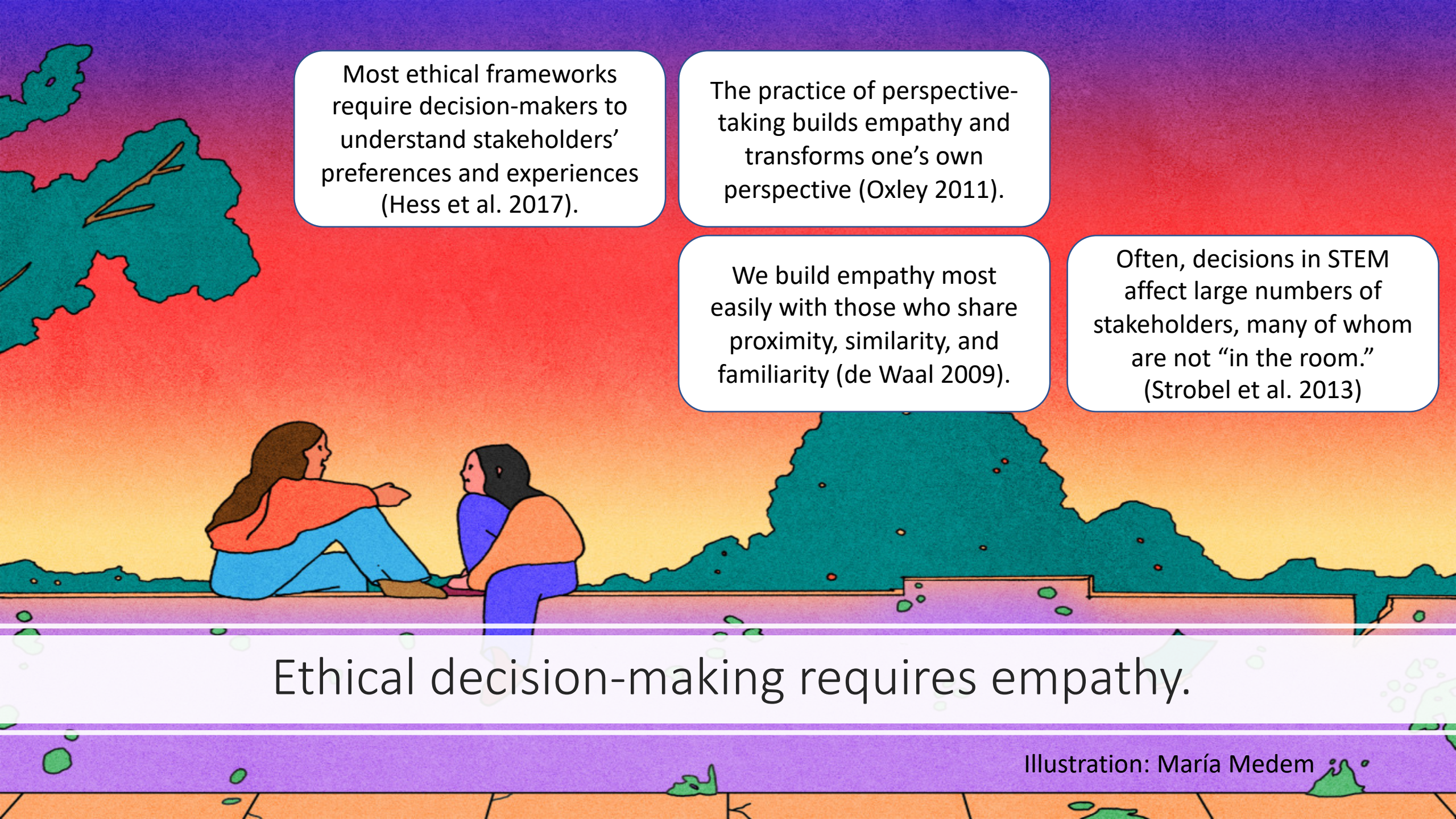
(upper division physics elective)

- Norm Setting & Introduction to Controversy
- Local Perspective: Gentrification around TXST
- Hawaiian History
- Primary Source Readings & Discussion
- Connect to Ethical Frameworks


REPORT OF THE HUI HOʻOLOHE
MARCH, 2018
The Hawaiians hold an incredibly special connection with Mauna Kea, **we could not possibly understand until we experience or hear their testimonies ourselves**.
First-hand stakeholder accounts can build empathy
HE M AA, HE W HE MOKU
ENVISION MAUNAKEA


Commercial
THE PACIFIC
HONOLULU, HAWAIIAN ISLANDS, THURSDAY, JULY
ANNEXATION!
AY!"
banner
ve,
awaii
omes of the brave.
H. M. WHITNEY.
One thing that really solidified this opinion to me was **the connection to colonialism**.
Historical and local connections can establish context


Openness to change and compromise
Embracing of responsibility for social impacts of astronomy
But I do see that in this field (especially since this is exactly what I want to do growing up) that **this potential [for harm] is always around**, every material bought, or observatory planted, the space and material is decreasing, and although new questions and ideas are coming up, there's still many fundamentals needed to be addressed first; thereby saying **I'll be working on this the rest of my life**.



Ethical decision-making requires empathy.

Illustration: María Medem

Illustration: María Medem

How do we build empathy with those who are not “there”?

Ideally, we want partnership and genuine conversation with as many different stakeholders as possible.

Imagined (and informed) perspective-taking is valuable for building empathy across distance (Davis 1996; Hoffman 2000).

It’s cognitively hard to do this for a group of people (Hess et al. 2017).

Potential construction of the Thirty Meter Telescope on Mauna Kea

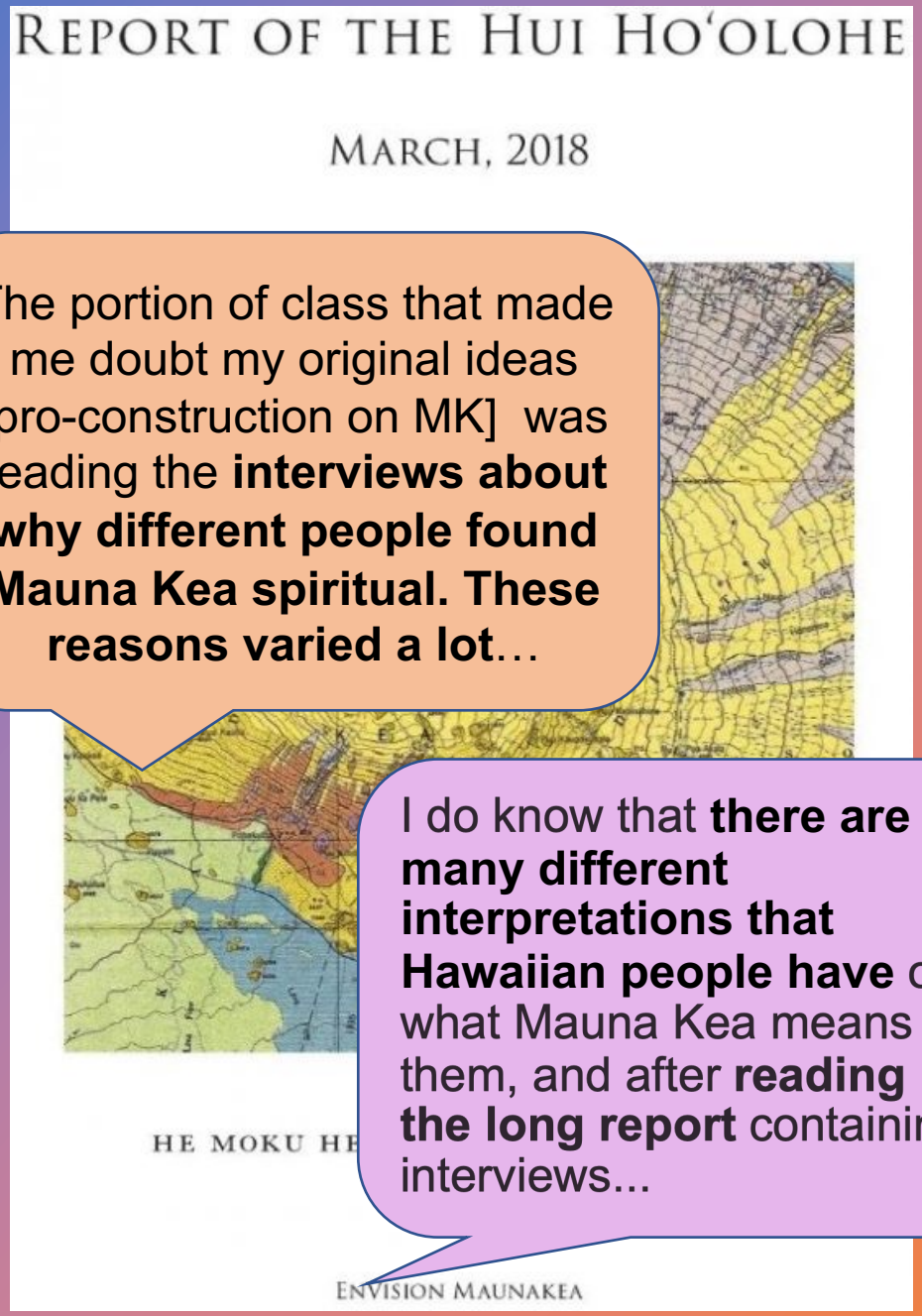
"Scientists" versus "Native Hawai'ians"

Native Hawai'ian scientists exist.

Neither Hawai'ians nor scientists are a monolith.

What can support students in articulating nuanced characterizations of stakeholder groups?

Highlighting multiple perspectives within a stakeholder group led to better articulation of variation within groups.



The portion of class that made me doubt my original ideas [pro-construction on MK] was reading the **interviews about why different people found Mauna Kea spiritual. These reasons varied a lot**…

I do know that **there are many different interpretations that Hawaiian people have** on what Mauna Kea means to them, and after **reading the long report** containing interviews...

I take these compromises with a grain of salt because the ones providing these compromises are from the side of construction. Had the compromises come from the indigenous people of Hawaii, I would give them a little more weight. **That begs the question –who, of the indigenous group, would we ask to compose these compromises?**

The scientific community is **surprisingly split** on whether to build or not, and likewise, a portion of native Hawaiians support the TMT.

Historical and local connections can establish context

First-hand stakeholder accounts can build empathy

Highlighting multiple perspectives within groups builds nuance in student reasoning.

The Manhattan Project



A. Olmstead, E. Ochoa-Madrid, B. Gutmann

Modern Physics

≈20 physics majors and minors
First upper-division course in physics
(required course)

- Norm Setting
- Scientific Principles of Nuclear Physics
- History/Timeline of Nuclear Weapons and WWII
- Ethical Framework (Beauchamp)
- Primary Source Readings & Discussion

What do you think about the decision Einstein made to advocate for the development of the atomic bomb? Would you have made the same decision? Why or why not?

expresses discomfort around unfamiliar task

Validation and support from the Learning Assistant

critiques scientists for claiming no competence on difficult social question

Validation from instructor

expresses desire to have no opinion, claims it is different because she's "not important"

Peer pushes her to see herself as a scientist

establishes firm stance against the dropping of the atomic bomb

"I understand why it's easy for me to say I'm against it because I wasn't at the time.

And obviously if I was at the time… I'm a woman, I wouldn't even have an opinion…

…and I'd probably be banned because I'm mixed, so... I wouldn't have rights."

reflects that her race and gender would have historically displaced her from this conversation

***more details in PERC 2020 Proceedings: Gutmann, Ochoa-Madrid, Olmstead

How do we bolster students' sense of agency for change in STEM?

Historical and local connections can establish context

First-hand stakeholder accounts can build empathy

Highlighting multiple perspectives within groups builds nuance in student reasoning

Peers, learning assistants, and instructors can validate students

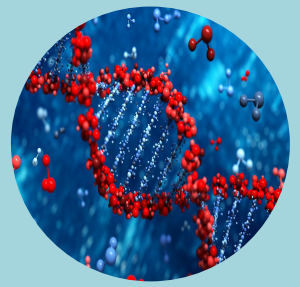
Students may experience discomfort around lack of practice

Students may position themselves as lacking agency historically and currently

Ethics, Science, and Society Course

Enrolled students include a variety of
STEM and non-STEM majors (N=10)



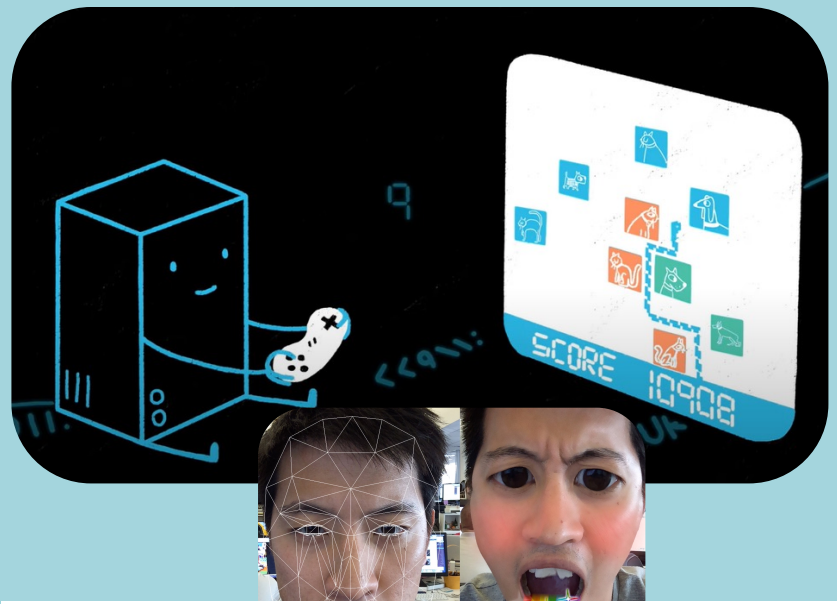


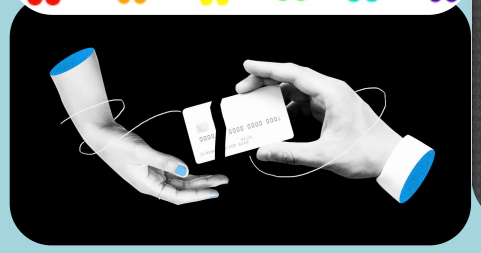
1: Objectivity in Science
2: Redistricting and the Politics of Math
3: Pharmaceutical Companies: Capitalism and Public Health
4: Space Exploration and Colonialism
5: Human-Centered Machine Learning Algorithms
6: Intelligence Tests

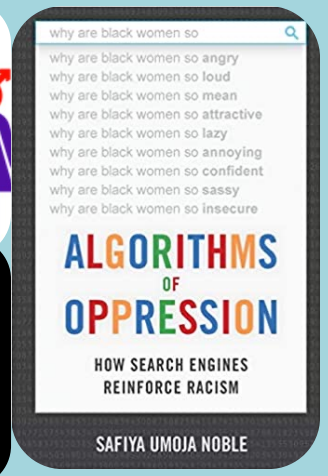

A. Olmstead, B. Gutmann

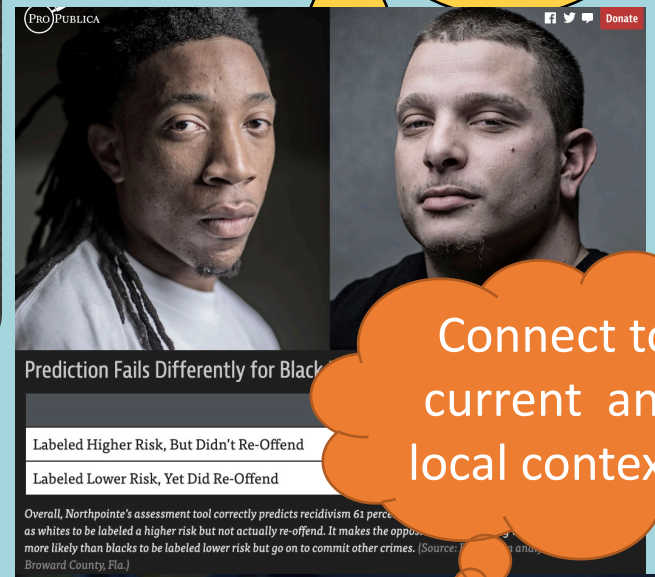
Bias in Human-Centered Machine Learning Algorithms

How do we bolster students' sense of agency for change in STEM?









Connect to current and local contexts

Mathematicians urge colleagues to boycott police work in wake

More than 1,400 researchers have signed a letter ca
working on predictive-policing algorithms and oth

A Case for Banning Fa
Recognition

A Google research scientist explains why she thinks the police shouldn't use facial recognition software.

Highlight efforts by STEM professionals

Student Discussions and Reflections

How do we bolster students' sense of agency for change in STEM?

Historical and local connections can establish context

First-hand stakeholder accounts can build empathy

Highlighting multiple perspectives within groups builds nuance in student reasoning

Peers, learning assistants, and instructors can validate students

Current and relevant issues can build motivation

Showcasing science activists can help students see paths to engage

1. It is important to validate and support junior and senior physicists in thinking about connections between science and society.

2. Facilitating and participating in these discussions is often challenging.

3. We can support each other in this process!

Thank you!

brianne.gutmann@sjsu.edu

publications by our team

Global Studies/Physics 280 at the University of Illinois

Nuclear Weapons and Arms Control for students in STEM, Social Sciences, and the Humanities

- Course Goals, History, Content Creation and Class Composition
- Course Content
- Course Organization (Lectures, Writing Laboratories, Office Hours)
- The role of ACDIS and the Student Security Group
- 280 as a Collaborative Writing Course
- Challenges

ILLINOIS

Matthias Grosse Perdekamp

Course Goals, History, Content Creation, and Class Composition

Goals:

(I) To provide a basic understanding of the nature of nuclear weapons, the threat they pose to humankind, and possible ways to reduce and eventually eliminate this threat.

(II) To improve collaborative technical writing skills as part of a broader effort to improve writing curriculum (support from the Center for Writing Studies + Technical Writer in Physics)

History/Content Creation:

Taught each Spring since 1982. Created jointly at the height of the cold war by faculty in Physics, Political Science, and Nuclear Engineering who already had been collaborating on security related research in the UIUC program for arms control, ACDIS.

Course Goals, History, Content Creation, and Class Composition

Class Composition – e.g. Spring 2021:

The class subject is multidisciplinary and so are the backgrounds of the students and teaching assistants in class.

Opportunity to practice, how to learn from each other and to collaborate across fields.

Physics	13
Political Science	8
Computer Science	7
Agr & Consumer Economics	6
Pre-Engineering	4
Mathematics	4
Computer Engineering	4
Molecular and Cellular Biology	3
Psychology	2
History	2
17 other majors	1-2

Course Goals, History, Content Creation, and Class Composition

Selection of TAs:

The course typically has 60-72 students in 7 writing labs with 5-6 TAs.

TA backgrounds: NPRE, Physics, Political Science, Global Studies

2-3 graduate TAs: Interview candidates from departments listed above.

3-2 undergraduate TAs: -> must have taken 280 in the past
-> active in ACDIS and/or SSG
-> exposed to technical writing through security related internships (ideally)

Center of Writing Studies offers pre-semester training for TAs.

Course Content

- Nuclear weapons
- Effects of nuclear explosions
- Terrorism and the possibility of nuclear terrorism
- Military systems for delivering nuclear weapons
- Arsenals of nuclear weapon states
- Missile defense
- History of nuclear arms control
- *5-10 minutes at the beginning of each session: Current events related to nuclear arms control (students may suggest topics)*

Course Organization

- **2 lectures:** Tuesdays and Thursdays, 80 minutes
  - Use TopHat quiz questions to engage students. Students are encouraged to discuss questions with co-students (with different background).
  - TAs attend lecture and contribute to discussion from their perspective. Follow content outside their own field of study, taught in the course.
- **1 writing lab:** Mondays,50 minutes.
  - TAs introduce writing assignments and explain response to writing
  - Writing exercises, discussion of readings and current events, peer review with small teams mixing students with different backgrounds.
- **Office hours:** Wednesdays noon to 6pm, each TA covers one hour. Students encouraged to work with TAs from different backgrounds.
  Includes 80 minute **TA-run Q&A sessions** for midterm and finals prep!
- **TA meeting:** Fridays, 120 minutes
  - Answer TA questions with regards to material
  - Coordinate writing response
  - Prepare for writing lab sessions
  - Identify extra credit opportunities (ACDIS!).

The Role of ACDIS and the SSG

ACDIS is the interdisciplinary UIUC program for Arms Control and Domestic and International Security. There is an associated Student Security Group (SSG):

- 280 is an elective course for the ACDIS security certificate
  ➔ recruiting students to 280.
- SSG helps forming pool of candidates for UG TAs for 280.
- SSG publishes Illini Journal of International Security (IJOIS)
  ➔ 280 student research papers can be published in IJOIS.
- ACDIS events ➔ credit opportunities for 280.
- ACDIS and SSG provide networking support for security related internships and scholarship opportunities.

280 as Collaborative Writing Course

(I) 4 Research Essays with revisions (8 assignments)

	Content	Format	Peer Review	Length	Writers Memo
RE1	Revocation of Robert Oppenheimer's security clearance	Scientific American	no	1.5-2 pages	to TA
RE2 v1,v2	Scientific Info on Nuclear Explosives for Congress during Manhattan project	CRS	yes	2 pages	to peer
RE3 v1,v2	Technical Info on Iran Nuclear Deal for staffers and members of Congress	CRS	yes	4 pages	to peer
RE4 v0,v1,v2	A: NCTC brief on terrorism B: Scientific American article on JCPOA	BLUF Scientific American	yes	2.5-3 pages	to peer

280 as Collaborative Writing Course

(II) Research Paper Project with revisions (4 assignments)

	Content	Format	Peer Review	Length	Writers Memo
RPP	Choose global security related topic state research question, thesis and references	280-assume expert role	yes	1.5-2 pages + references	to peer
RPCR	collegial response from collaborating expert/co-student	280-assume expert role	no	2 pages	to peer
RPv1	Merges research paper proposal and collegial response to first draft	IJOIS	yes	5-6 pages + figures	to peer
RPv2	Final research paper	IJOIS	no	5-6 pages + figures	to peer

Challenges

- Engaging students in substantial conversations with each other
- Recruitment of effective TAs
- Diversity of student population in class
- Identifying instructor
  - ➔ Technical experts from NPRE often had security clearance and don't want to speak publicly to avoid legal risks.
  - ➔ Non-STEM departments unwilling to provide instructor for financial reasons
- Content requires frequent updating

For more information and specifics about the course, visit:

https://courses.physics.illinois.edu/PHYS280/sp2023/index.html