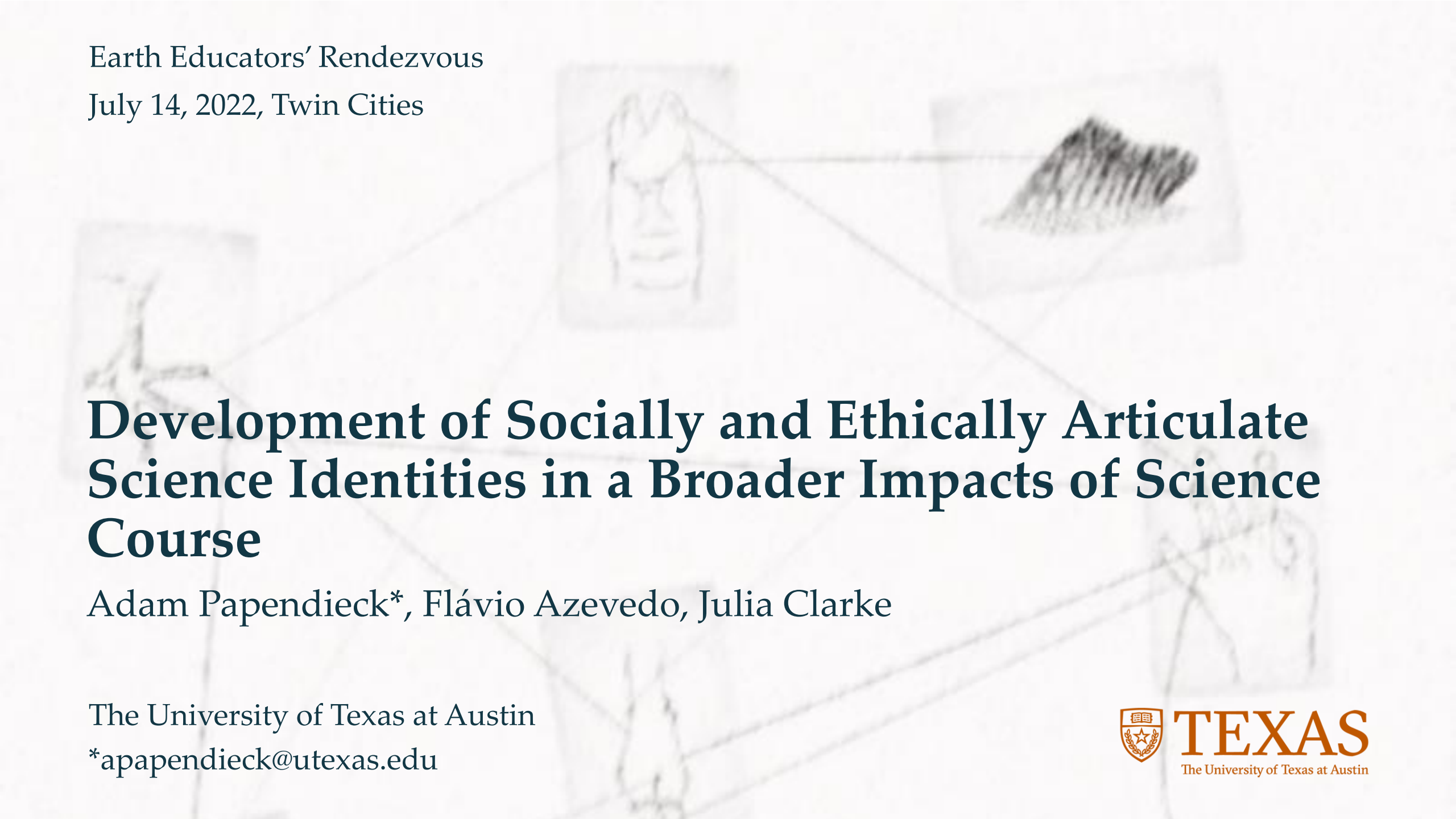
Earth Educators' Rendezvous

July 14, 2022, Twin Cities



Development of Socially and Ethically Articulate Science Identities in a Broader Impacts of Science Course

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TEXAS

The University of Texas at Austin

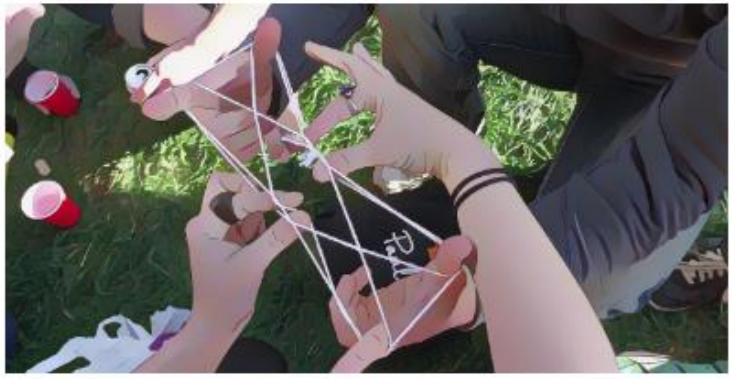
Learning Science CoLab

Designing and Researching for Better Science Learning and Engagement

Situated at The University of Texas at Austin's Jackson School of Geosciences, the Learning Science CoLab brings researchers from the social sciences and geosciences together with communities to investigate educational, social, and ethical issues of science learning, teaching, communication and public engagement.

www.lscolab.org

About



Collaborators

Meet

Collaborators

Adam Papendieck

Jackson School of Geosciences

Flávio Azevedo

College of Education

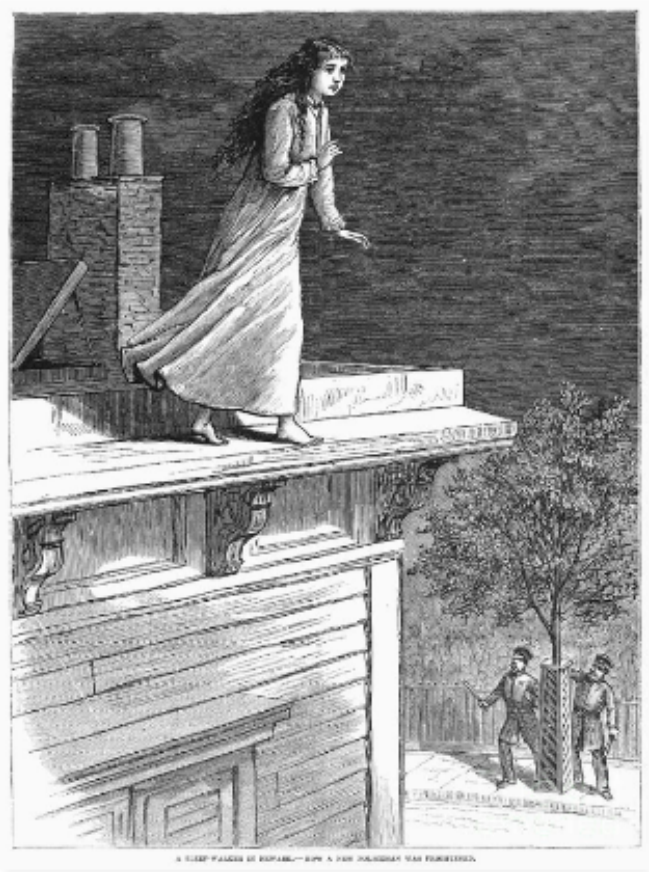
Julia Clarke

Jackson School of Geosciences

Broader Impacts: Designing and Communicating for Consequential Science (Sp 22)

Asking a creative scientist to be effectively concerned by the consequences of his work would be the equivalent of waking the sleepwalker, making him aware that the world is far from obeying his categories. He would doubt and fall, that is, be lost for science.

- Elisabeth Stengers, Another Science is Possible



Welcome! This course is designed to give you the opportunity to think critically and systematically about your science and your day-to-day scientific practice in broader social and ethical contexts. Drawing on case studies and readings from the History and Philosophy of Science (HPS) and Science and Technology Studies (STS), you will be challenged to think, talk and write about what counts as good science, and who counts as a scientist. We will examine common criteria and frameworks by which scientific researchers and their research are evaluated (e.g., NSF Merit Review Criteria), and will develop a more sophisticated understanding of notions of broader impacts, intellectual merit, equity, diversity, inclusion, engagement, education and mentorship. You will design and carry out an independent inquiry into an ethical issue of science in society, ultimately producing a short research-based commentary-style article suitable for a journal or media outlet with a broad audience. You will also design a broader impacts activity and develop components of your professional portfolio. The goal is to help you get a clearer sense of who you can be as a scientist, and help you plan for how you can use and change your science for better futures.

Weekly Modules

Zoom Meetings

Working Resource Index and Extended Bibliography

Office Hours

Design-based Research (Barab and Squire, 2004)

High-level Design Conjecture (Sandoval, 2014):

By challenging commonly-held assumptions about what counts as "good" science and who counts as a scientist, students would be prompted to rethink and renegotiate their relationship to their STEM fields and develop more complex socially- and ethically-articulate science identities.

Broader Impacts: Designing and Communicating for Consequential Science

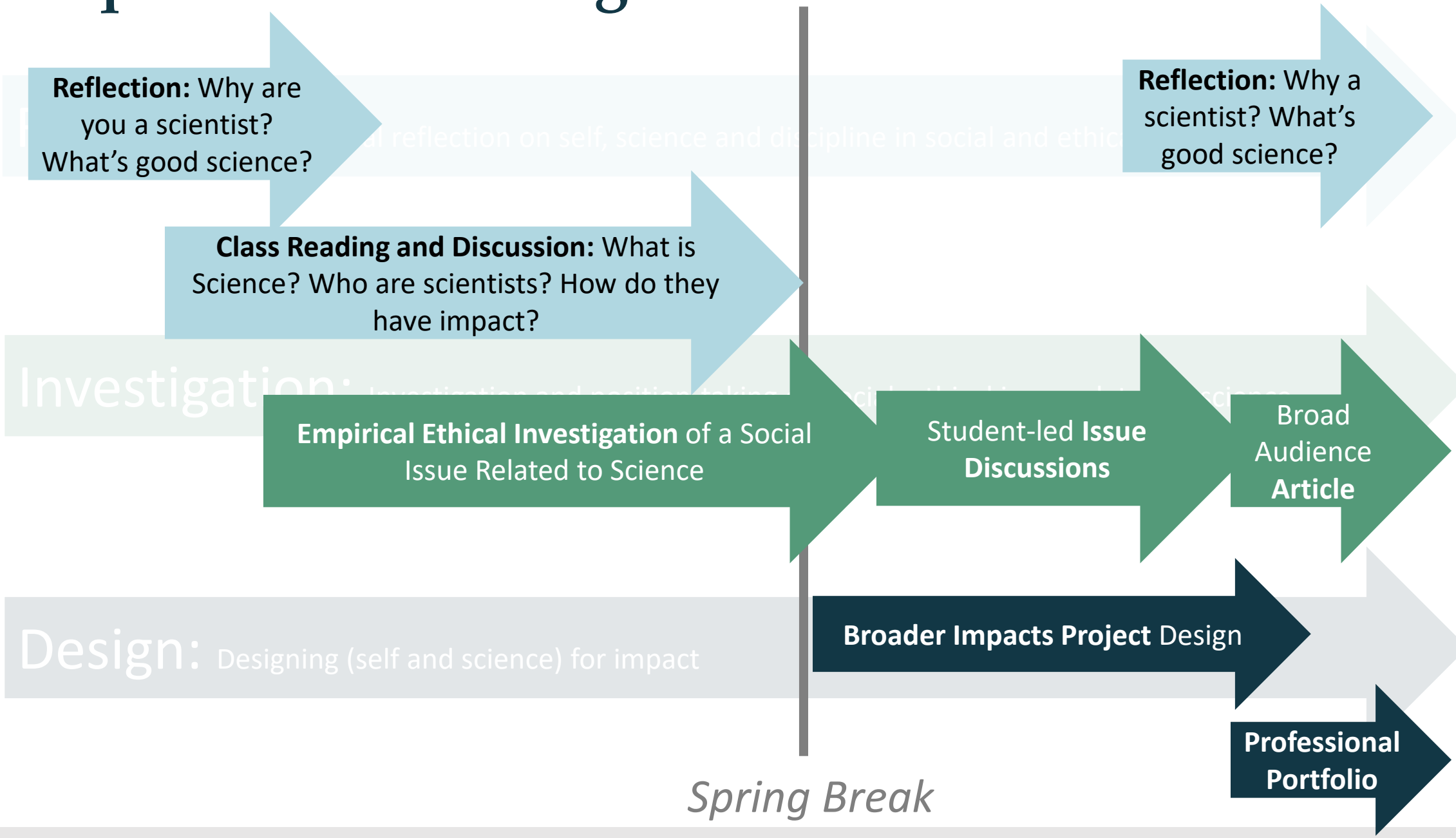
Model: Curiosity to Question (Papendieck, Clarke & Ellins, 2021)

- Mix disciplines, grads and undergrads, demographics
- Use writing and iterative feedback to drive interest-driven inquiry and reflection
- Build shared classroom fluencies and culture through collaborative work

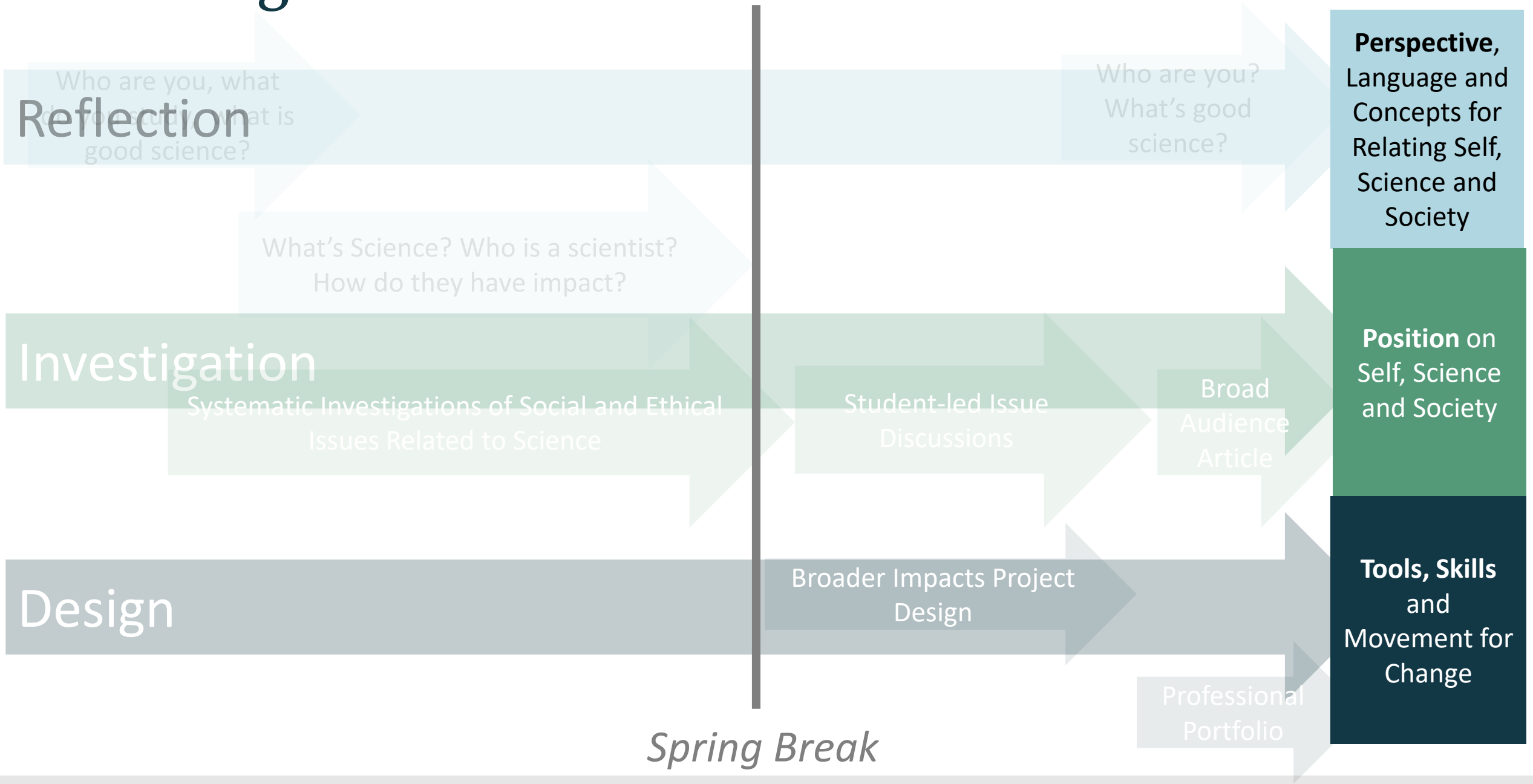
Curricular Emphasis: Writing, Ethics, Independent Inquiry

Semester Activity Streams

Sequence of Learning Activities



Learning Outcomes



Population and Data Corpus

Population: 31 students (Sp 2020-22)

Data Corpus

- 72 online forum discussions
- > 80 hours of recorded audio and video
- Student writing (3 drafts)
- Readings and resources assembled by students
- End of course survey: student reaction and perceived learning gains via modified URSSA (Weston and Laurson, 2015).

What did students do?

- **Reflected on:** science role models, importance of science communication, their own educational experiences, their own goals and ethical obligations
- **Wrote about:** AI, climate change, energy, cryptocurrency, de-extinction, JEDI in STEM, truth in the media, science and politics, science and religion, indigenous epistemologies
- **Designed:** educational modules, mentorship curricula, diversity interventions, outreach programs

Can International Climate Treaties Actually Stop Climate Change?

[redacted]

14 14

By [redacted], *Senior in Government and Geological Sciences*

Anthropogenic climate change is perhaps the largest threat to life on Earth. The ongoing mass extinction, severe weather, and famine are among some of the horrors climate scientists warn are in store for the world if humanity cannot significantly reduce our emissions of greenhouse gases (GHGs). Small

Reaching Rural: How Do We Spread Geosciences?

[redacted]

13 13

Reaching Rural: How Do We Spread Geosciences?

By [redacted], *Geosciences. Former GeoFORCE participant and rural high school graduate.*

Many communities, like my own, have limited to no exposure to the geoscience field. This limits students that may be interested in

(Artifacts: student-led issue discussion guides)

Students reported they…

…felt like scientists

- 79% a fair amount or great deal, n = 19

…felt like part of a scientific community

- 70% a fair amount or great deal, n = 20

…gained comfort discussing science concepts and impacts with others

- 80% good or great gains, n = 20

(Source: post-course survey)

Students said the course was novel and valuable.

*"This is **one of the only classes that has had such an emphasis on how we can use our science for good in society**."*

(Source: post-course survey (eCIS))

Students felt their perspective shifted.

- *"Directly applying what I had learned into an issue investigation […] changed the way I thought about my work and other things. I could tell I was* ***writing more critically****, geared to a broader audience in comparison to my writings before the class."*

- *"****My perspective on scientists definitely has changed****. Before this course I never really thought of scientists needing to be good communicators.*

- *"I think this class has given me more insight into* ***the impact politics, society, and personal gain have on science****."*

(Source: student reflections)

Students said they learned to design for change.

- *"The **project design experience will probably be the most helpful going into my career**. Being able to breakdown what impacts we wanted to make and how we will do it **using a model of change** seems like it will have a variety of useful applications, even outside of BI work."*

- *"The most important thing that I learned in this course was **how to implement a broader impacts [activity]** into the scientific work that I will be doing in the future."*

(Source: post-course survey)

Emergent Question about Learning:

How do apparent shifts in perspective on self, science and society come about?

Critical Sociocultural Theoretical Frame

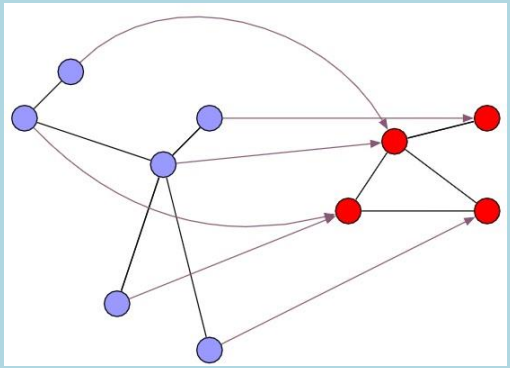
Technical Concepts:

- *Positioning* (Bell, van Horne, & Cheng, 2017)
- *Identity* (Azevedo & Mann, 2021; Gee, 2001)

Refined Question:

> How do STEM students *reason as if the other* to form socially and ethically articulate disciplinary identities?

Positioning Self and Science by *Reasoning as if the Other*



Sympathizing
"I probably believe in 'good' or 'bad' science to some extent but it's kind of like believing in 'good' or 'bad' people."

Empathizing:
"why would those other groups [abused by science] now start to simply accept scientific discoveries at face value?"

Anthropomorphizing
"I … like having a deeper intangible connection with the world around us, and I know that not a lot of scientists are really strong on the intangible, but, I think it's pretty great. [But] a human and a river are so different. That's not to say that I don't think a river shouldn't have rights... it's just… Maybe we got to work it out a little bit, you know?"

Zoomorphizing
"The cacti, usually so stalwart, seem naive and pliable, their spines still too fresh to ward off hungry snails. They remember the freeze on some molecular level, and they are navigating its aftermath. They are in a somewhat messy transition state; so am I, so are a lot of us"

Images: Alan Levine (cactus); Bd person (river)

Conceptual Directions

- Strategies involved remote, distal, imagined, idealized and non-human others

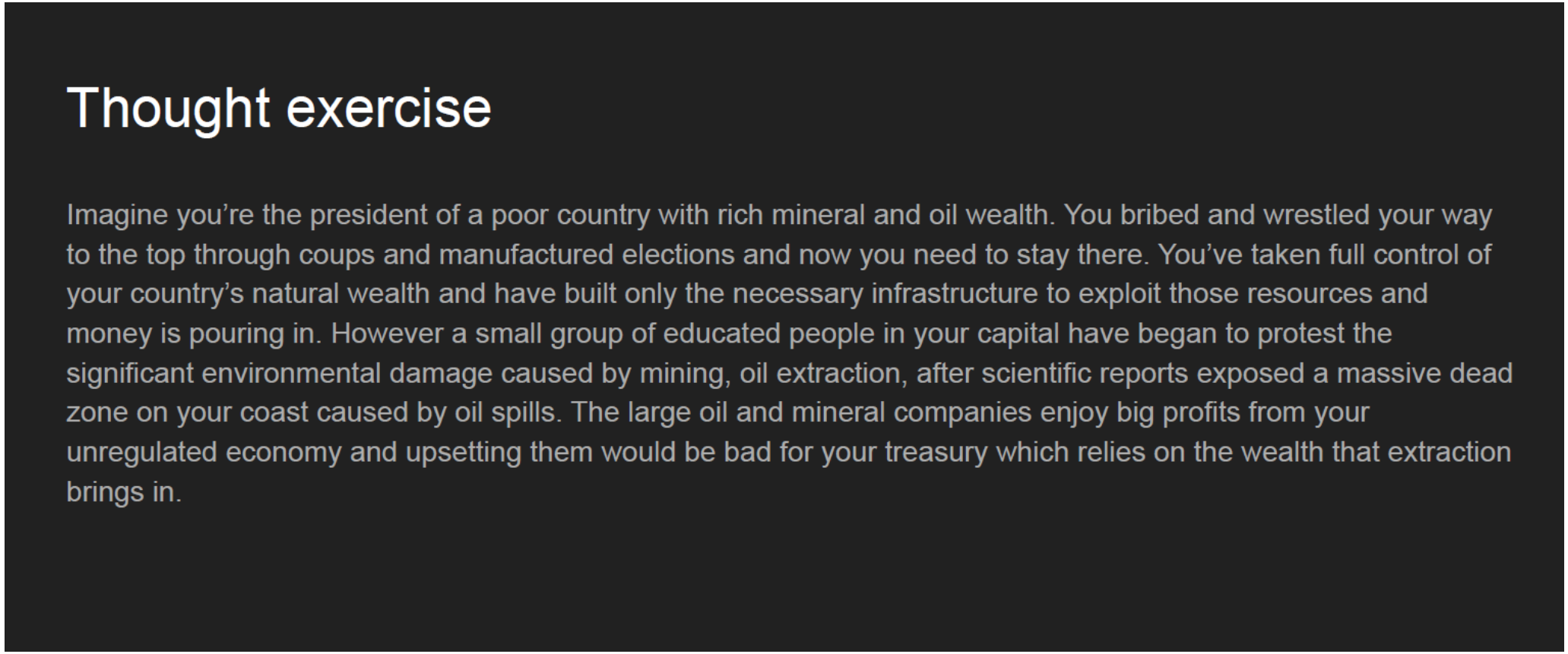
- Strategies helped students "pivot" into different, imagined "worlds" (Vygotsky, 1967)

- Strategies offered *conceptual* and *affective* affordances for *knowing* and *valuing* worlds

(Papendieck & Azevedo, 2022)

Design Directions

Playful moments for “pivoting” into imagined worlds:



(Course artifact: Issue discussion guide by Andy, GEO undergrad)

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Course Goals

- Understand science and scientific scholarship as complex, contentious and changeable
- Consider the variety of goals, values and ethics that pattern the work of scientists
- Explore roles (e.g researcher, communicator, educator) scientists can take in pursuit of goals like equity, justice, diversity, inclusion
- Learn to use frameworks and tools for design, implementation and measurement of interventions.