Communicating Science: The Complex and the Conflicted

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Introduction

Yes, and…

Mirroring

With the exception of the video links at the end (which are spectacular!) this document was modified to be self contained - because it is based on a workshop this outline is not easy to follow so please contact the authors for more details or to schedule a workshop
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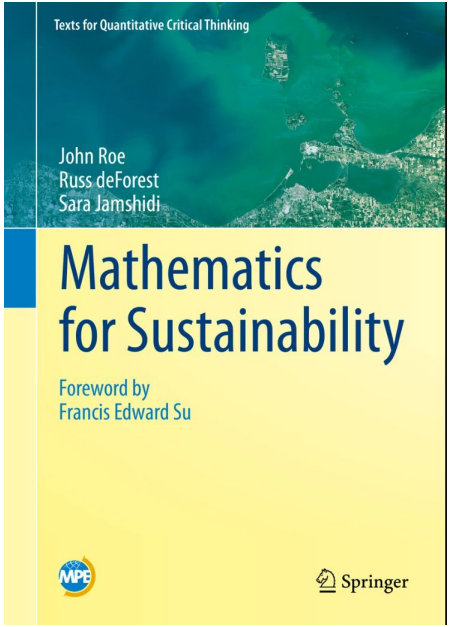
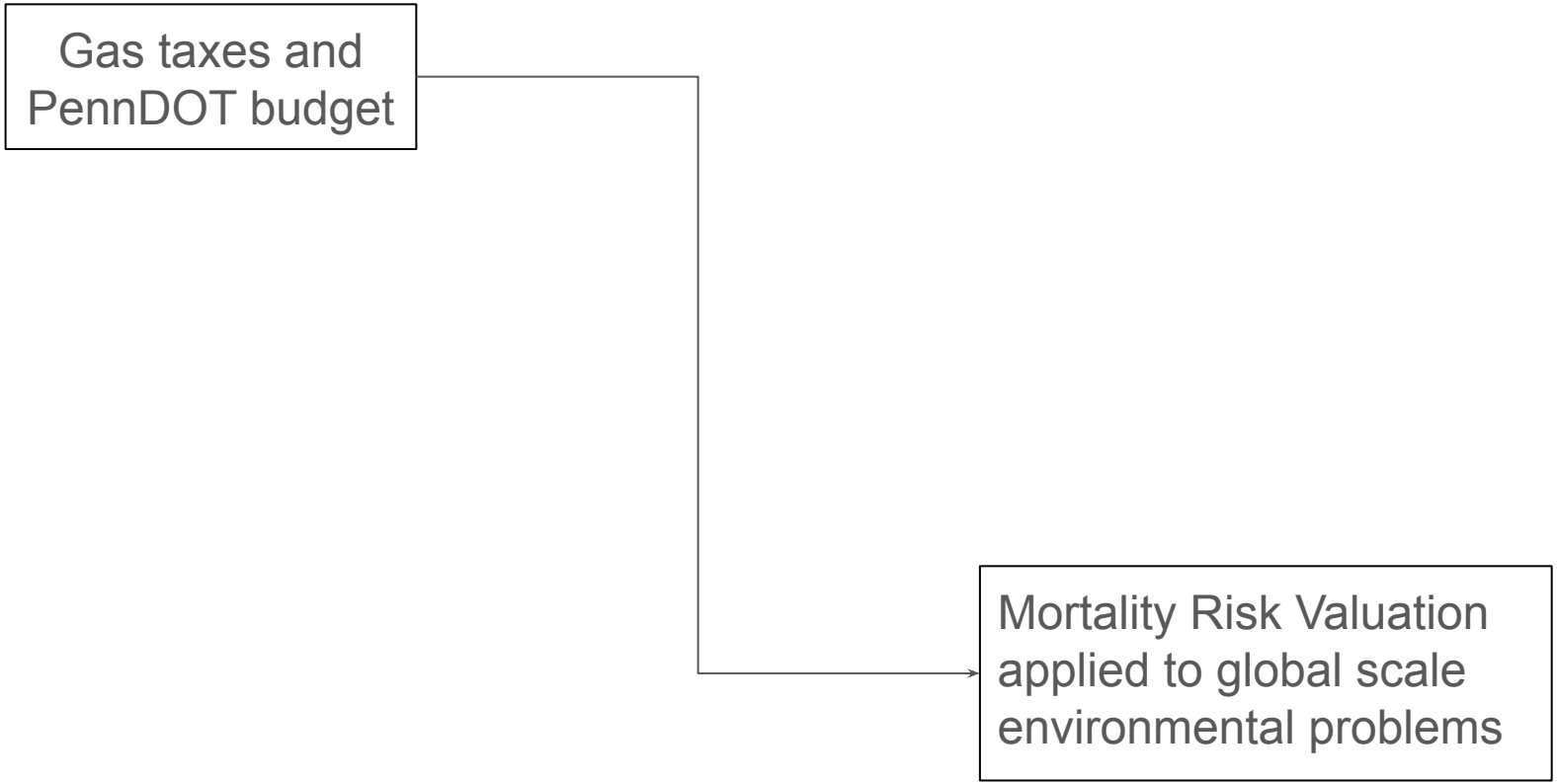
Math for Sustainability

Quantitative and Ethical Reasoning in General Education Mathematics

- Foster curiosity and facilitate students in asking their own questions, foster and following their interests.
- Build student skill in understanding and engaging with arguments supported by quantitative evidence.
- Build student skill in creating and communicating arguments supported by quantitative evidence.



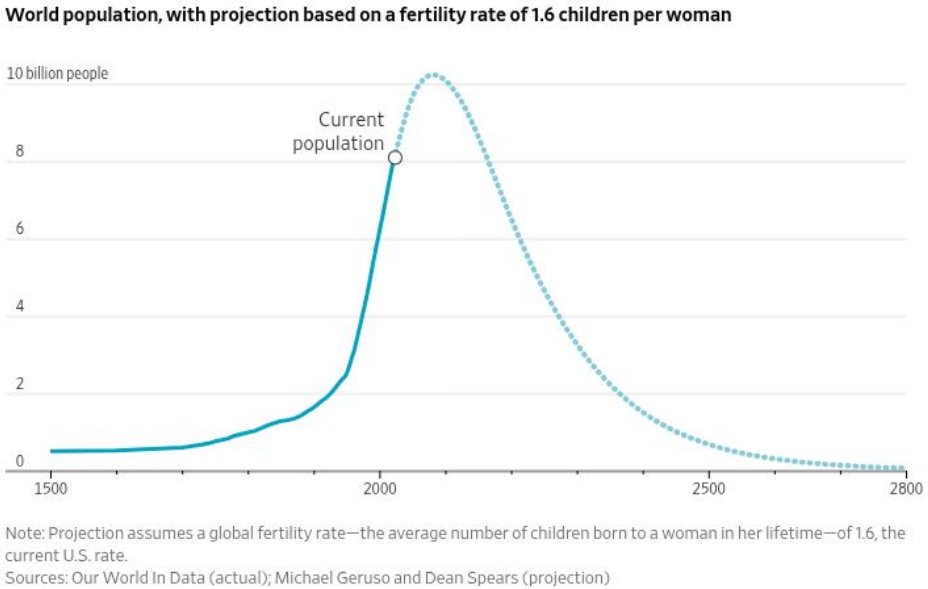
Climate Change in Math for Sustainability



The (De)population Bomb?

Potentially Competing Claims:

- Global population may exceed Earth's capacity to support it.
- Likely long term outcome is depopulation due to low birth-rates (through individual choice).



Greg Ip, The Depopulation Bomb, WSJ, July, 2025

Exercise: Leading a discussion

- Decide on an audience (example: First semester Calculus class discussion/project)
- What is the timeline? (single in-class discussion/activity, assignment or project over multiple class sessions, seminar talk)
- Where would you like the audience to end up? (Learning Objectives)
  - Example Learning Objective: Students will gain skill in recognizing and clearly stating assumptions used in a mathematical model.
  - Example Goal: Students will gain confidence in their ability to raise questions about a topic of interest and to follow up on developing answers to those questions.
- Develop some questions related to the topic - can you turn these questions into a prompt or an outline for a longer activity?
- Make note of concerns, ethical questions, or other issues that come up.

Questions/prompts

- Data by country/ region - sources of data
- Population model that captures graph
- calc prereq -
- why is the graph the way it is (no claims stated at first)

What concerns come up in this process?

Exercise: Write a Press Release

Write a press release for a recent scientific article.

Example: SEE ARTICLE PROCESSED MEAT
Compare to CNN coverage in article
NO SAFE MEAT

Story Cubes

Closing

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Communicating Science: the complex and the conflicted (in 80 minutes)

Eric Marland (Appalachian State), Russ deForest (Penn State)

Workshop

0. Introduction (5 minutes) (Eric)

What are we going to do?

- Ideas to improve your communication skills
- Ideas to improve the communication skills of your students
- Ideas for implementing in the classroom (i.e. introduction interviews)

Why are we doing it?

- Why these skills are important
- Lateral skills and knowledge transfer

1a. Yes, and ... (10 minutes) (Russ)

A classic improv game (might just explain or show an example)

1. Form a circle or multiple circles
2. A story or conversation moves around the group
3. Each person must positively build on the previous person's statement by saying "Yes, and ..."
4. The phrase "Yes, and ..." is less important than the spirit.

What do we learn?

- Active listening and valuing the previous opinion/statement
- Respecting the person, even if not the views
- We need to have this approach for the whole session

1b. Mirroring (15 minutes) (Eric)

Another classic

1. Mirroring - with a partner, mirror their movements as if looking in a mirror.
2. Switch which partner is leading and which is following.
3. Guided mirroring - what can you do to make it easier to follow you?
   Try building on a specific theme and being predictable.
4. See if you can mirror with no one leading
   That is, micro-switch on an ongoing basis.
5. Mirrored talking ... try it out. How is it different?

What do we learn?

We learn to watch for audience reception and reaction
We learn to micro-adapt and change based on the audience
We learn to make it easier for the person to receive our message

2. Learning without Being Wrong (25 minutes) (Russ)

1. Climate Change in Math for Sustainability.
2. The (De)population bomb?
3. Resource/Exercise: Write a press release.

What do we learn?

How do we offer tools and knowledge without telling people what to think?
How do we let people learn without telling them they are wrong?
How can we adapt our presentations to the audience?
How do we evaluate and balance resources?

3. Story Cubes and storytelling (25 minutes) (Eric)

Storytelling with props

1. Roll the dice and line them up without looking
2. Tell a story based on the cubes ... no preparation, just go!

(Alt.)

1. Name origins - pick a location on a map and tell a story of how it got its name.
2. A second person starts with “Yes, but this is really how it happened, and ...”

Lateral Learning

1. Discuss how the cubes are similar to powerpoint slides

Demo

1. Have Russ run though demo slides to show similarity

Discuss how this relates to the classroom and to research presentations

Slide purpose
Slide design

What do we learn?

We learn to tell a cohesive story with little preparation
We learn to adapt, link, and segue
We learn how slides support us rather than control us

4. Closing: Into the Classroom (10 minutes) (Both)

What did we do?

insight into the method

examples of ideas

How do you continue?

what's next for you

your colleagues

your students

Additional resources and sharing

sign up to get more

Resources

Suggested Discussion Ideas

1. Trust Compression

What convinces people, learning without being wrong

2. Linguistic Chameleon (D. Conquergood, T. Noah) (20 minutes - discussion)

talking to people in their own language / terminology

3. Tips on giving talks (10 minutes - talk)

action movie: dynamic, opening, sign posts, closing

4. Into the classroom

Pedagogy, organization, interaction, progression with trust

Suggested Activities

1. Riffin' on Kipling

This is a take on Kipling's just-so stories, which are short stories about how things came to be. Make a long list of possible candidates to "things" needing an origin story. Practice on the same thing and see how different each person can make it.

2. Passing objects / passing stories / emotions

This classic improv exercise is about passing an invisible object around the room. Handle the object for long enough that the next person have an idea what it is before passing it. While you have it, you can transform it by compressing, baking, stretching, magic-ing, or whatever. But the object must be received in the manner it was given, but transforming.

That is, you have to pay attention to the person before you very carefully.

Try the same thing with a story so that the next person continues the story. Try one word at a time, one sentence at a time, or a few sentences. If these are too easy, try passing an emotion - either mimicking or responding.

When passing a story, try not to plan ahead. Many students will try to think of something clever to add when it is there turn ... which means they aren't listening to the actual story. Sometimes you are just a linking part of the story and don't get to make a dramatic change.

Try to make the story realistic, outlandish, boring, etc.

3. Interviewing Introductions

Instead of having everyone introduce themselves, have them interview their neighbor and ask questions that actually interest each other. This does take up class time, but the students learn a great deal about each other and may collaborate more through the semester because they are no longer generic strangers.

4. Collaborative Interviewing about research

Sometimes interviews are more like interrogations. This is not that. This is more like a radio station interviewing a musician to help them get people to their upcoming concerts (and to get more musicians to come be interviewed). The goal is to help them look good and to ask interesting questions.

So how do you help each other to make a good interview? Discuss these ideas first.

5. Human Statuary

In the classroom with partners, have one set of partners exit the room and come up with a concept, emotion, or state (sadness, regret, epiphany, awe, heroic, just broke up with partner who cheated, etc). Pose the partner student (caution about touching - suggest no touching rule to avoid issues. Instead, "move your leg three inches to the right ..."). Tour the statues and look at commonalities and differences. Have the statues try to guess the concept, emotion, or state. Exchange roles and repeat.

This exercise is both fun and a learning tool. We don't all express emotions in the same way. We don't all respond to crisis in the same way. Sometimes pain is invisible. The tour of the statues shows this in the raw. Discussing these differences is useful.

6. Leikert Scale of Emotion

Pass an emotion around the room with a very subtle uptick in scale (happiness as a 1, 2, 3, ...10). Comment on how the differences show in how people express themselves and discuss

how this relates to communicating with someone. How can you “read the room” when there is so much variation?

7. The Great Fortune Cookie Experiment

Each person gets one minute to prepare a one-minute “speech” about the fortune. The timer starts when the cookie is cracked. The term “speech” is held loosley - it can be a formal speech, a story, a tale, truth, fiction, anything ... but related to the fortune.

This helps students pull ideas and experiences from memory to craft a short story. This can relate to the question “What do you study”, or “What is your research about”, where you get caught off-guard but need to come up with something very quickly.

8. Write a press release for a recent scientific article - processed meat consumption example. SEE ARTICLE PROCESSED MEAT, associated press release SEE CNN NO SAFE MEAT

- Length
- Audience
- Accuracy and depth

Suggested Readings

0. Tom Murphy - do the math, energy in a finite world
1. Kenneth Burke - “Terministic Screens”

The terminology we use reveals our views on a topic

2. Trevor Noah - “Born a Crime”, Chapter 4 “Chameleon”

Using someone else’s language can help connect with them

3. Alan Alda - “If I understood you would I have this look on my face?”

How improv skills can help connect with people

4. Dwight Conquergood 1, 2

How to listen, value, and connect to an audience

5. 6. Katherine Hayhoe, “Saving Us”

Example of using commonalities to connect with different audiences

7. Michael Pollan

Examples of effective science writing

8. A reading for external validation, from the AAAS (American Association for the Advancement of Science), "SEE ARTICLE SCIENTISTS IN CIVIC LIFE".

Document of the AAAS about the importance of communication skills in science. Adds in a few ideas, but mostly motivational (advocating for ... not really that exciting).

9. Bruce Alberts "SEE ARTICLE TRIVIALIZING SCIENCE EDUCATION"

An essay on the purpose of science education and advocate for understanding over mem.

10. Will Wise ...

11. SEE ARTICLE DOWN A RABBIT HOLE

A discussion about how to evaluate information sources and the value of reading opposing views. A short guide to avoiding trust compression.

12. David Campt, "White Ally Toolkit"

Another scenario where people are willing to learning, but don't want to be wrong.

A book on how to engage in dialog on difficult topics

Leverages conflict management theory

Suggested Videos

1. Lara Boroditsky - https://www.youtube.com/watch?v=RKK7wGAYP6k&t=5s

On how our language and terminology shape the meaning of what we say.

2. Jacob Collier - https://www.youtube.com/watch?v=eRkgK4jfi6M&t=77s

"Harmony" explained five ways - showing how to use "Yes, and ..." and modifying your terminology to talk about the same topic with audiences with different backgrounds.

3. Neil deGrasse Tyson - https://www.youtube.com/watch?v=3PsQxXmOMJ4

About the intuitive terminology in physics and how that helps its comprehension.

4. Hans Rosling - https://www.youtube.com/watch?v=Z8t4k0Q8e8Y

Innovative explanation of population growth and health in thwe world over time.

https://www.youtube.com/watch?v=GwmKc5mxwmA

Purposefully antagonistic - watch the difference.

5. Maggie Koerth - https://abcnews.go.com/fivethirtyeight/video/state-law-defines-man-woman-gets-left-fivethirtyeight-99168370

Simply outstanding science journalism.

6. Steven Strogatz - TEDx talk on synchrony - https://www.youtube.com/watch?v=aSNrKS-sCE0

Example of effective science communication

7. Veratasium - https://www.youtube.com/@veritasium

8. Smarter every day - https://www.smartereveryday.com/