Turning Misinformation into Educational Opportunities

Dr. Brad Hoge – Director of Teacher Support
National Center for Science Education
Turning Misinformation into Educational Opportunity

• Response to Heritage Foundation’s mailing to teachers
• Identifies 5 key misconceptions
• Builds Misconception-Based / Place-Based / Inquiry-Based lessons
  • John Cook (George Mason Center for Climate Change Communication)
  • Brad Hoge (Director of Teacher Support at NCSE)
  • Frank Niepold (NOAA / CLEAN)
  • Rebecca Anderson (ACE)

• NCSE Teacher Ambassador Program / Strategy
Synergy from Pedagogy of Misconception to Overcome Barriers to Learning

• Cognitive barriers (evolutionary psychology)
  • Probability
  • Proximity
  • Deep time
  • Familiarity

• Ideological barriers
  • Affiliation with groups (social / historical)
  • Affiliation with ratiocination (social / logical)

• Cultural and religious barriers
NCSE Ambassador Teachers

- David Amidon – Syracuse, NY
- Bonnie Bourgeois – Salt Lake City, UT
- Jennifer Broo – Cincinnati, OH
- Nina Corley – Galveston, TX
- Alexander Dorsch – New Castle, PA
- Kim Parfitt – Cheyenne, WY
- Kelly Pipes – Wilkesboro, NC
- Erin Stutzman – Boise, ID
5 Lessons for 5 Misconceptions

1. Scientists don’t agree
2. Models aren’t good science
3. It’s just a natural process, climate has always changed
4. Extreme weather happens, it’s not climate change
5. There’s nothing we can do about it
Misconception-based learning

Test scores

Mean score

Misconception based learning

Traditional learning

Pretest  Posttest  Delayed posttest

McCuin et al. 2014
5 CHARACTERISTICS OF SCIENCE DENIAL

F
Fake Experts

L
Logical Fallacies

I
Impossible Expectations

C
Cherry Picking

C
Conspiracy Theories

Magnified Minority

Red Herring

Misrepresentation

Jumping to Conclusions

False Dichotomy
Fact-myth-fallacy structure

**FACT**
Replace the myth with a factual alternative that meets all the causal requirements left by the myth.

**MYTH/MISCONCEPTION**
Warn people before mentioning the myth so they’re cognitively on guard.

**FALLACY**
Explain the technique used by the myth to distort the fact. This enables people to reconcile the fact with the myth.

- **F** Fake Experts
- **L** Logical Fallacies
- **I** Impossible Expectations
- **C** Cherry Picking
- **C** Conspiracy Theories
Pre and Post Tests

How much do you agree or disagree with the following statements?

9. The Earth’s climate has changed naturally in the past, therefore humans are not the cause of global warming.
   *Check one:*
   - ○ Strongly agree
   - ○ Somewhat agree
   - ○ Somewhat disagree
   - ○ Strongly disagree

10. Climate change is increasing risk from extreme weather.
    *Check one:*
    - ○ Strongly agree
    - ○ Somewhat agree
    - ○ Somewhat disagree
    - ○ Strongly disagree

11. Scientists’ computer models are too unreliable to predict the climate of the future.
    *Check one:*
    - ○ Strongly agree
    - ○ Somewhat agree
    - ○ Somewhat disagree
    - ○ Strongly disagree
Lesson 1 – Teaching Consensus

• This lesson is a bit different than the rest

• This lesson sets the table for the rest of the unit

• The learning objectives for this lesson focus on skills – particularly inoculation against misinformation

• Closing the lesson with FLICC provides an opportunity for assessment
Focus on Data

Upper atmospheric temperature

Lower atmospheric temperature
Possible questions to guide student inquiry:

• How can the sun impact Earth’s average global temperature?
• How can Greenhouse Gases impact Earth’s average global temperature?
• Why is the troposphere warmer than the stratosphere?
• Why does each layer cool at night?
• Why are summer days and nights warmer than winter days and nights?
• Do you think the stratosphere has seasonal variations too?
• What happens where the troposphere and stratosphere meet?
• Why are the layers so distinct?
Assess Using FLICC

FACT  Based on independent lines of evidence, a scientific consensus has formed that humans are causing global warming.

MYTH  31,000 dissenting scientists prove there’s no scientific consensus agreement on human-caused global warming.

FALLACY Fake experts: people who convey the impression of expertise but with no relevant expertise are often used to cast doubt on expert consensus.
Lesson 2: Climate models

FACT
Climate models have made many successful predictions of long-term warming and specific climate patterns. While there are parts of climate that are challenging to simulate, such as short-term predictions, models are continually being improved to introduce more detailed physical processes.

MYTH
Model predictions have failed in the past, therefore models can’t be trusted.

FALLACY
Impossible Expectations: No model is perfect but they are useful tools that can reproduce the past and provide insights into the future.
Lesson 2 - Modelling

• Two approaches
  • Predict a trend and build a model to help from the demands of the prediction
  • Identify components of the climate system and arrange them into a 2-dimensional model
Predicting the Future

Predict the trend shown to the year 2017
Compare to Actual Data

How accurate was your prediction?

Now predict the trend to the year 2030, 2050, and 2100.
Lesson 3: Past climate change

FACT  Modern climate change is abrupt and driven by human activity, distinguishing it from past climate change.

MYTH  Natural climate change in the past implies current climate change is also natural.

FALLACY  **Jumping to conclusions:** Just because climate change was caused by natural causes in the past doesn’t necessarily mean it’s naturally caused now.
Lesson 3 – Past and Present

• Addresses the challenges of deep-time and stochasticity

• Milankovitch cycles

• Puts anthropocentric climate change into perspective

“Our sun is more than four billion years old, and has already reached about half its life expectancy. It is now time to plan for the future of mankind, and a positive first step is the election of someone willing to face this problem...”
http://www.kcvs.ca/site/projects/JS_files/HistoricClimateChange/history.html
Lesson 4: Extreme weather

FACT Risk from extreme weather is increasing, albeit some forms of extreme weather are more confidently linked to global warming than others.

MYTH Extreme weather always happens, so warming isn’t making extreme weather worse.

FALLACY Jumping to conclusions: Just because extreme weather happened in the past doesn’t mean climate change isn’t having an influence now.
Lesson 4 – Extreme Weather

• Focuses on the connection between extreme weather and climate

• Identifies extreme weather events / conditions in student’s area?

• Uses local data
Examples from NCSE Teacher Ambassadors

• David Amidon – Lake effect snow in upstate New York

• Bonnie Bourgeois – Snow melt and drought in Salt Lake City, UT

• Nina Corley – Flooding on Galveston Island, TX

• Kim Parfitt – Wildfires in Wyoming

• Erin Stutzman – Snow melt, wildfires and insect infestation in Idaho
https://crt-climate-explorer.nemac.org
Lesson 5: Climate solutions

FACT  There are multiple strategies to reducing carbon emissions, and there are realistic paths to preventing climate change if we try many solutions at once.

MYTH  Renewables like solar or wind are not enough to solve climate change.

FALLACY  Cherry picking: focusing on just one or a few possible solutions ignores that solving climate requires a multi-pronged strategy.
Lesson 5 – Solutions

- Utilizes the Wedge Stabilization Strategy Game (various options)
- Focuses on unique opportunities in student’s area
- Focuses on identifying local responses (Project Dropdown)
Summary of Solutions by Overall Rank

This table provides the detailed results of the Plausible Scenario, which models the growth solutions on the Drawdown list based on a reasonable, but vigorous rate from 2020-2050. Results depicted represent a comparison to a reference case that assumes 2014 levels of adoption continue in proportion to the growth in global markets.

NOTE: Energy Storage (utility-scale & distributed), Grid Flexibility, Microgrids, Net Zero Buildings, and Retrofiting were not modeled independently to avoid double counting impacts from other solutions.

<table>
<thead>
<tr>
<th>Rank</th>
<th>Solution</th>
<th>Sector</th>
<th>Total Atmospheric CO2-EO Reduction (kt)</th>
<th>Net Cost (Billions US$)</th>
<th>Savings (Billions US$)</th>
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<tbody>
<tr>
<td>1</td>
<td>Refrigerant Management</td>
<td>Materials</td>
<td>89.74</td>
<td>N/A</td>
<td>$922.77</td>
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<td>2</td>
<td>Wind Turbines (Onshore)</td>
<td>Electricity Generation</td>
<td>84.80</td>
<td>$1,225.37</td>
<td>$7,425.00</td>
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<td>3</td>
<td>Reduced Food Wastes</td>
<td>Food</td>
<td>70.53</td>
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<td>4</td>
<td>Plant-Rich Diet</td>
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<td>66.11</td>
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<td>N/A</td>
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<td>5</td>
<td>Tropical Forests</td>
<td>Land Use</td>
<td>61.23</td>
<td>N/A</td>
<td>N/A</td>
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<td>6</td>
<td>Educating Girls</td>
<td>Women and Girls</td>
<td>59.80</td>
<td>N/A</td>
<td>N/A</td>
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<td>7</td>
<td>Family Planning</td>
<td>Women and Girls</td>
<td>59.60</td>
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<td>$80.80</td>
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<td>Silvopasture</td>
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<td>15</td>
<td>Afforestation</td>
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<td>Conservation Agriculture</td>
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<td>20</td>
<td>Nuclear</td>
<td>Electricity Generation</td>
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<td>$2.88</td>
<td>$1,713.40</td>
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TMEO Lessons

• https://ncse.com/teach/sandbox

• Shared Google Drive Folder at https://drive.google.com/open?id=1CYJtr91pZHBHyaqjKXjCdt-B235Zcbq (or e-mail me for the links 😊)

• ACE Recorded Webinars at https://vimeo.com/acespace
Contact me

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• NCSE.com/teach
  • Teacher Newsletter
  • Classroom Resources
  • Dealing with Denial