Research

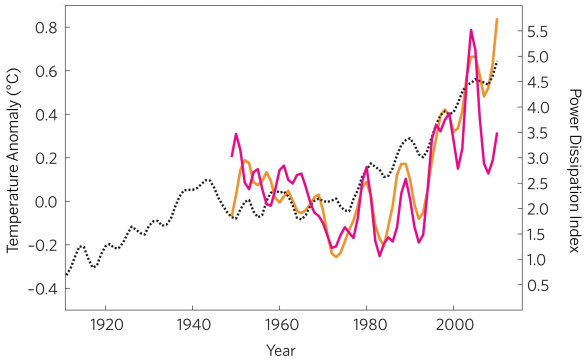
Past, Present, and Future

Our research team develops and applies learning theories situated within classrooms contexts and scientific topics of social relevance

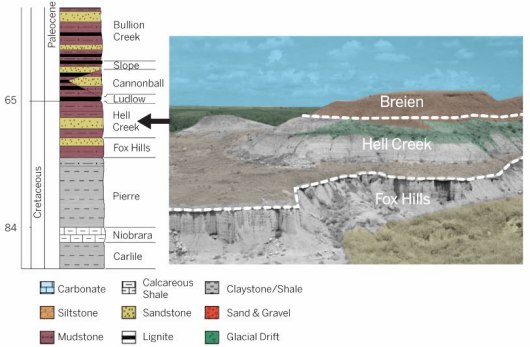
Our research aims toward contributing to a more scientifically literate and civically minded society positioned to solve local, regional, and global problems

Our past projects have investigated students' scientific thinking about scientific issues of social relevance

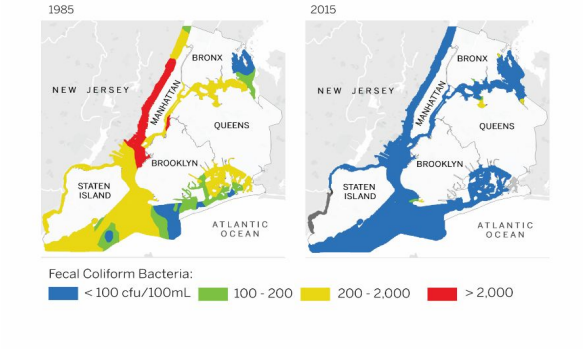
Climate Change



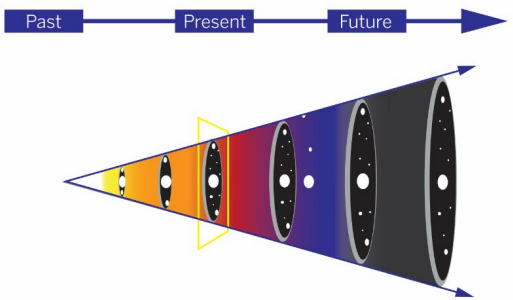
Earth's Past and Present Structure



Water Resources



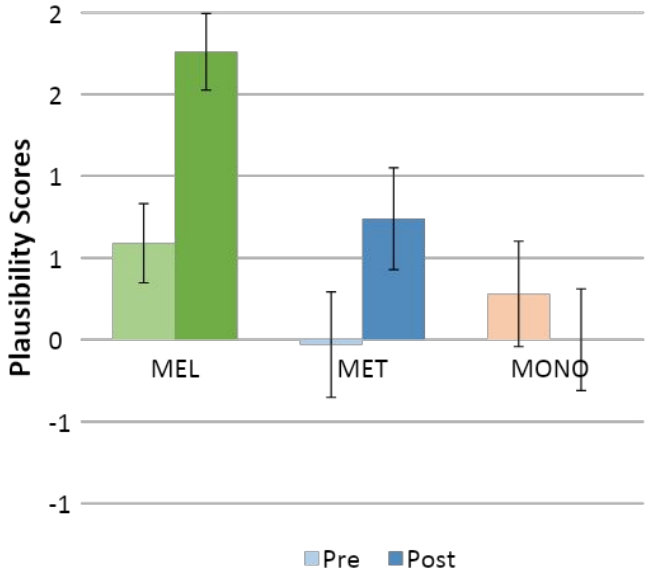
Astronomical Origins

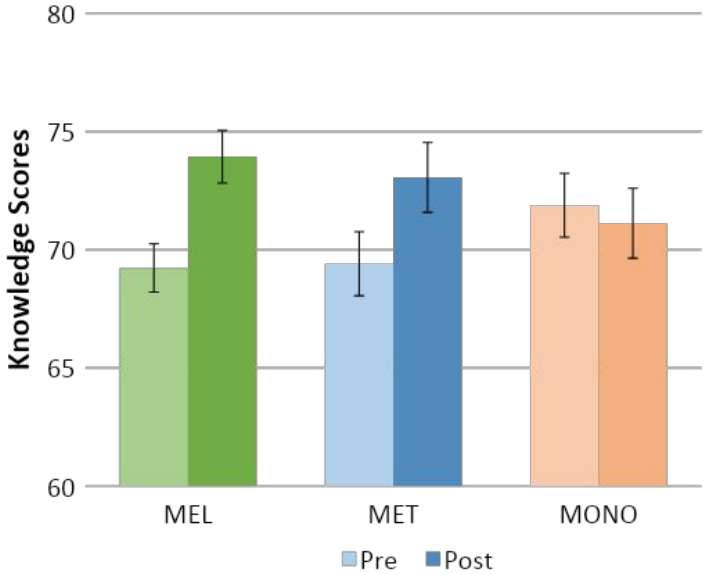


These research projects involve teachers and secondary students (*n* > 1500) in design-based and quasi-experimental research

Classroom settings include urban, suburban, and rural classrooms and schools, with differing demographic characteristics

In an early project phase, a study showed the MEL leads to shifts toward a more scientific judgments and increased science knowledge



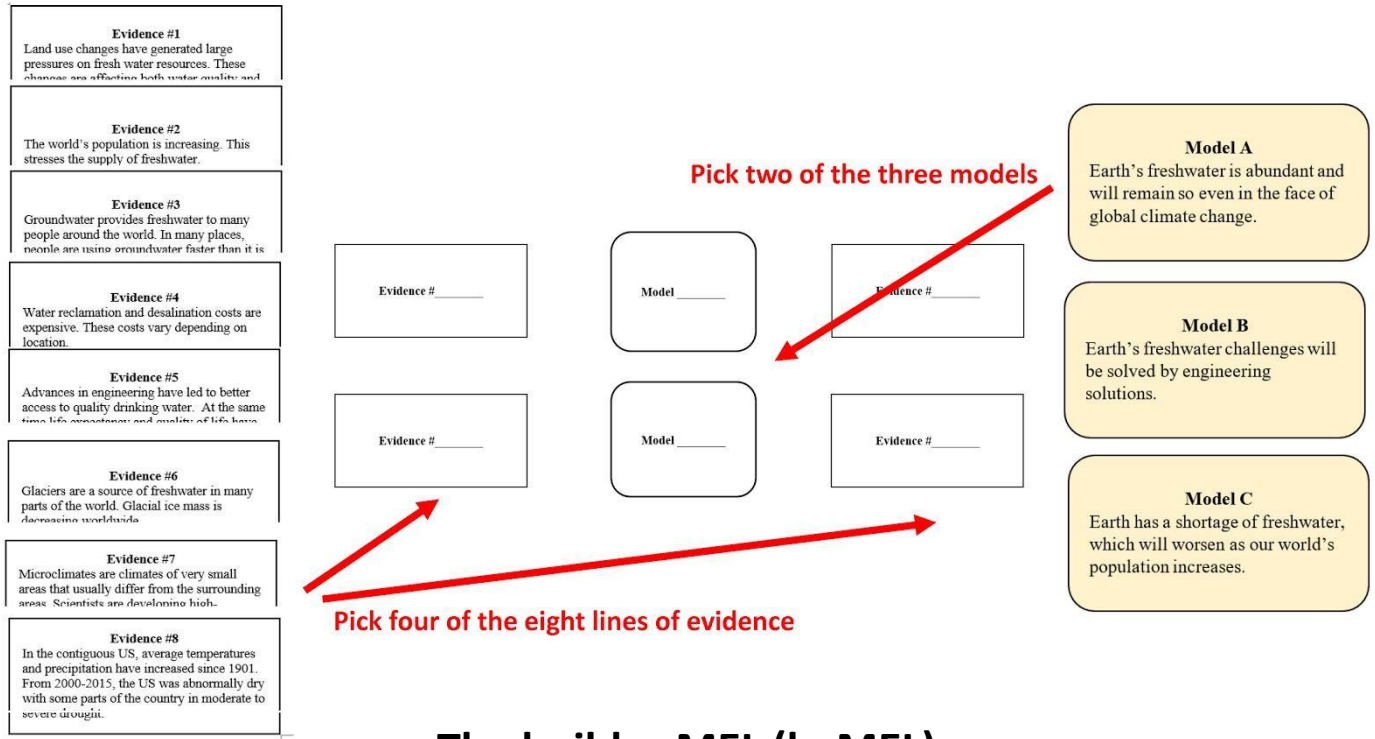


F **(2,61) = 5.67, *p* = .006, large effect size (η^2 = .16)**

Wilks' λ = .893, *F* (2,61) = 3.67, *p* = .03, medium effect size (η^2 = .11)

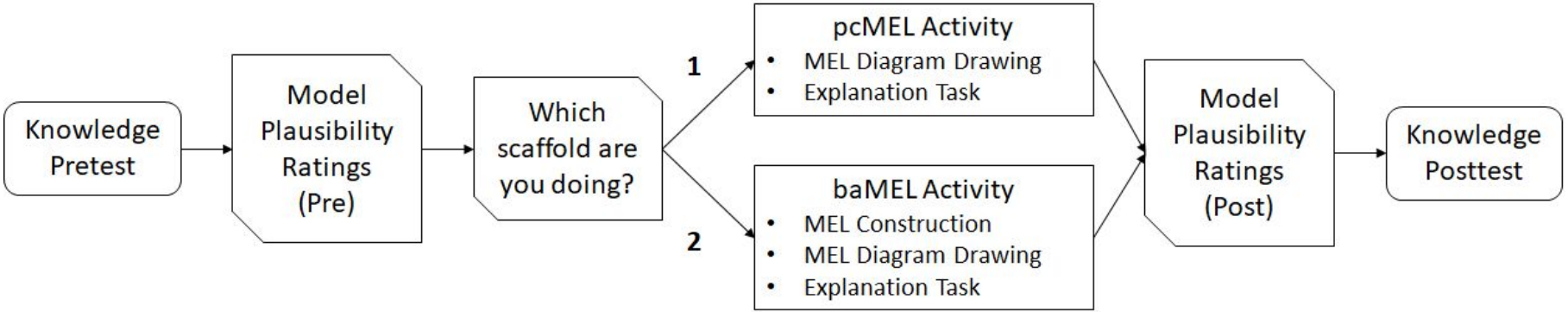
Lombardi et al. (2018)

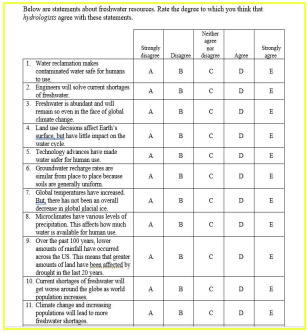
We have also developed and tested a more autonomy-supportive format, with the aim of increasing students' scientific agency



The build-a-MEL (baMEL)

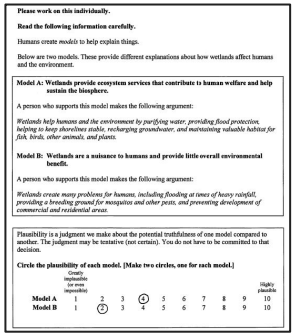
In our classroom studies, most of our “measurements” are embedded within a variety of tasks that are invisible to student participants





Below are statements about freshwater resources. Rate the degree to which you think that *hydrologists* agree with these statements.

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
1. Water reclamation makes contaminated water safe for humans to use.	A	B	C	D	E
2. Engineers will solve current shortages of freshwater.	A	B	C	D	E
3. Freshwater is abundant and will remain so even in the face of global climate change.	A	B	C	D	E
4. Land use decisions affect Earth's surface, but have little impact on the water cycle.	A	B	C	D	E
5. Technology advances have made water safe for human use.	A	B	C	D	E
6. Groundwater recharge rates are similar from place to place because soils are generally uniform.	A	B	C	D	E
7. Global temperatures have increased. But, there has not been an overall decrease in global glacial ice.	A	B	C	D	E
8. Microclimates have various levels of precipitation. This affects how much water is available for human use.	A	B	C	D	E
9. Over the past 100 years, lower amounts of rainfall have occurred across the US. This means that greater amounts of land have been affected by drought in the last 20 years.	A	B	C	D	E
10. Current shortages of freshwater will get worse around the globe as world population increases.	A	B	C	D	E
11. Climate change and increasing populations will lead to more freshwater shortages.	A	B	C	D	E



Please work on this individually.

Read the following information carefully.

Humans create *models* to help explain things.

Below are two models. These provide different explanations about how wetlands affect humans and the environment.

Model A: Wetlands provide ecosystem services that contribute to human welfare and help sustain the biosphere.

A person who supports this model makes the following argument:

Wetlands help humans and the environment by purifying water, providing flood protection, helping to keep shorelines stable, recharging groundwater, and maintaining valuable habitat for fish, birds, other animals, and plants.

Model B: Wetlands are a nuisance to humans and provide little overall environmental benefit.

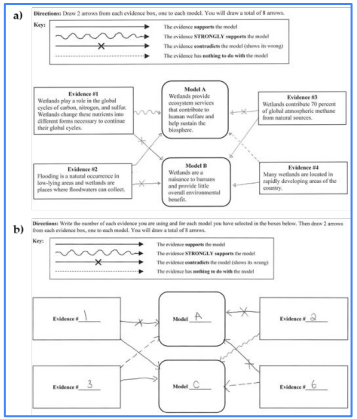
A person who supports this model makes the following argument:

Wetlands create many problems for humans, including flooding at times of heavy rainfall, providing a breeding ground for mosquitos and other pests, and preventing development of commercial and residential areas.

Plausibility is a judgment we make about the potential truthfulness of one model compared to another. The judgment may be tentative (not certain). You do not have to be committed to that decision.

Circle the plausibility of each model. [Make two circles, one for each model.]

	Greatly implausible (or even impossible)									Highly plausible
Model A	1	2	3	(4)	5	6	7	8	9	10
Model B	1	(2)	3	4	5	6	7	8	9	10



a)

Directions: Draw 2 arrows from each evidence box, one to each model. You will draw a total of 8 arrows.

Key:

- The evidence supports the model
- The evidence STRONGLY supports the model
- The evidence contradicts the model (shows its wrong)
- The evidence has nothing to do with the model

Evidence #1: Wetlands play a role in the global cycles of carbon, nitrogen, and sulfur. Wetlands change these nutrients into different forms necessary to continue their global cycles.

Model A: Wetlands provide ecosystem services that contribute to human welfare and help sustain the biosphere.

Evidence #3: Wetlands contribute 70 percent of global atmospheric methane from natural sources.

Evidence #2: Flooding is a natural occurrence in low-lying areas and wetlands are places where floodwaters can collect.

Model B: Wetlands are a nuisance to humans and provide little overall environmental benefit.

Evidence #4: Many wetlands are located in rapidly developing areas of the country.

b)

Directions: Write the number of each evidence you are using and for each model you have selected in the boxes below. Then draw 2 arrows from each evidence box, one to each model. You will draw a total of 8 arrows.

Key:

- The evidence supports the model
- The evidence STRONGLY supports the model
- The evidence contradicts the model (shows its wrong)
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Evidence # 1

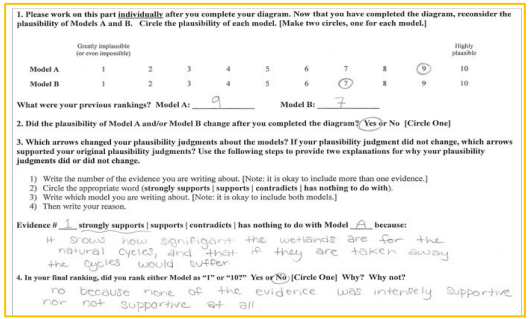
Model A

Evidence # 2

Evidence # 3

Model C

Evidence # 6



1. Please work on this part individually after you complete your diagram. Now that you have completed the diagram, reconsider the plausibility of Models A and B. Circle the plausibility of each model. [Make two circles, one for each model.]

	Greatly implausible (or even impossible)									Highly plausible
Model A	1	2	3	4	5	6	7	8	(9)	10
Model B	1	2	3	4	5	6	(7)	8	9	10

What were your previous rankings? Model A: 9 **Model B:** 7

2. Did the plausibility of Model A and/or Model B change after you completed the diagram? (Yes) or No [Circle One]

3. Which arrows changed your plausibility judgments about the models? If your plausibility judgment did not change, which arrows supported your original plausibility judgments? Use the following steps to provide two explanations for why your plausibility judgments did or did not change.

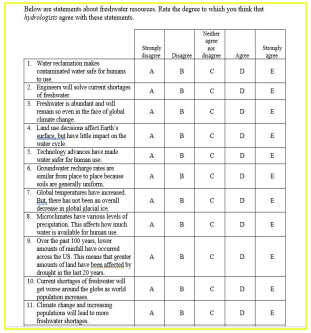
1) Write the number of the evidence you are writing about. [Note: it is okay to include more than one evidence.]
2) Circle the appropriate word (**strongly supports | supports | contradicts | has nothing to do with**).
3) Write which model you are writing about. [Note: it is okay to include both models.]
4) Then write your reason.

Evidence # 1 strongly supports | supports | contradicts | has nothing to do with Model A because:

it shows how significant the wetlands are for the natural cycles, and that if they are taken away the cycles would suffer.

4. In your final ranking, did you rank either Model as "1" or "10?" Yes or (No) [Circle One] Why? Why not?

no because none of the evidence was intensely supportive nor not supportive at all



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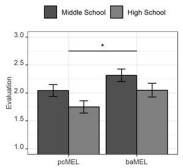
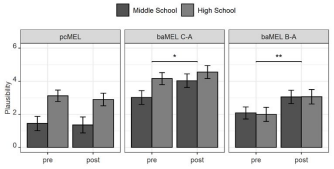
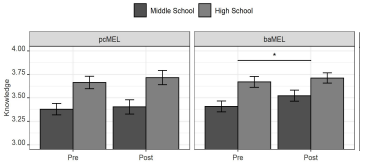
10. Current shortages of freshwater will get worse around the globe as world population increases.	A	B	C	D	E
11. Climate change and increasing populations will lead to more freshwater shortages.	A	B	C	D	E

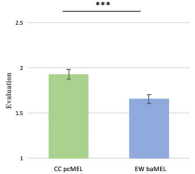
Pilot studies revealed that the baMEL can facilitate more scientific evaluations and judgements, shifts, and knowledge gains

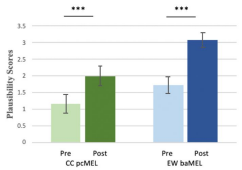


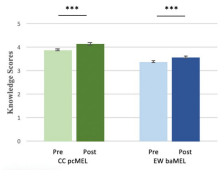




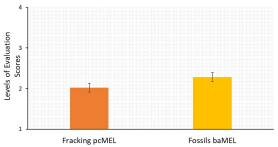
Water Resources (Medrano et al., 2020)

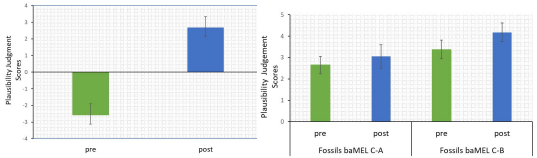


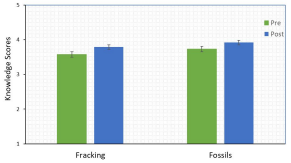




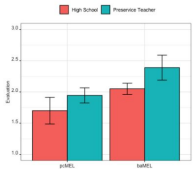
Climate (Bailey et al., 2022)

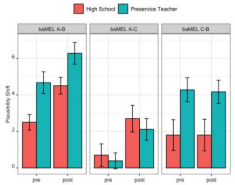


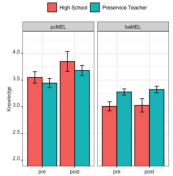




Earth's Past (Klavon et al., 2024)

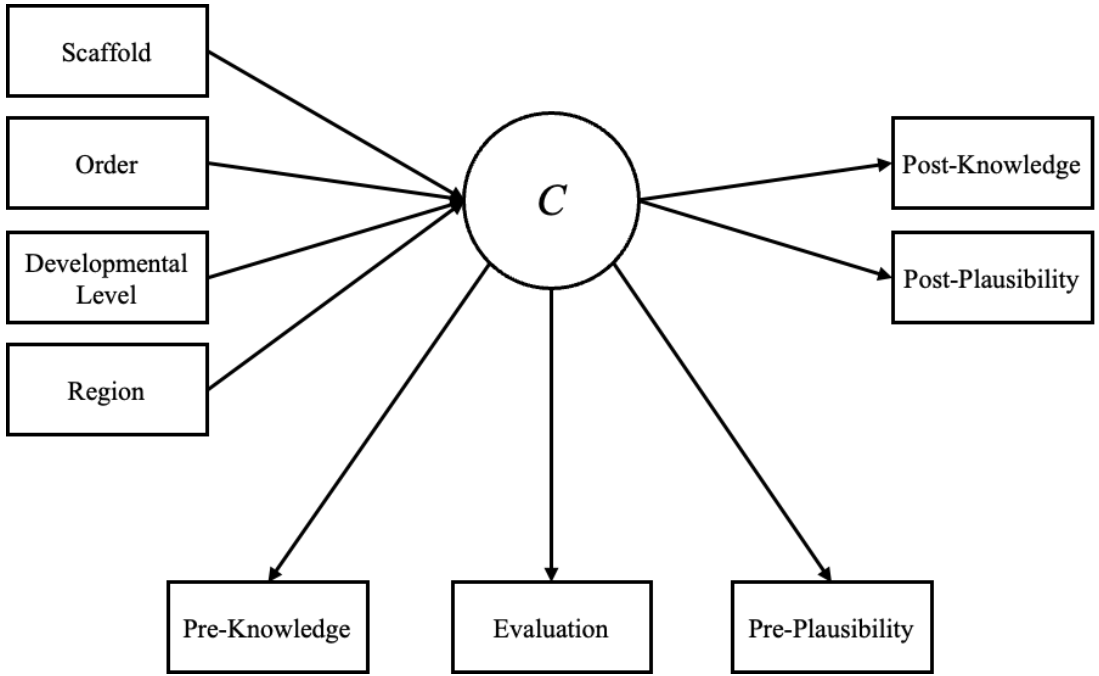






Astronomical Origins (Dobaria et al., 2022)

Recently, we also finished a study involving more 366 middle and high school students in GA and NJ and doing a total of 1191 MELs



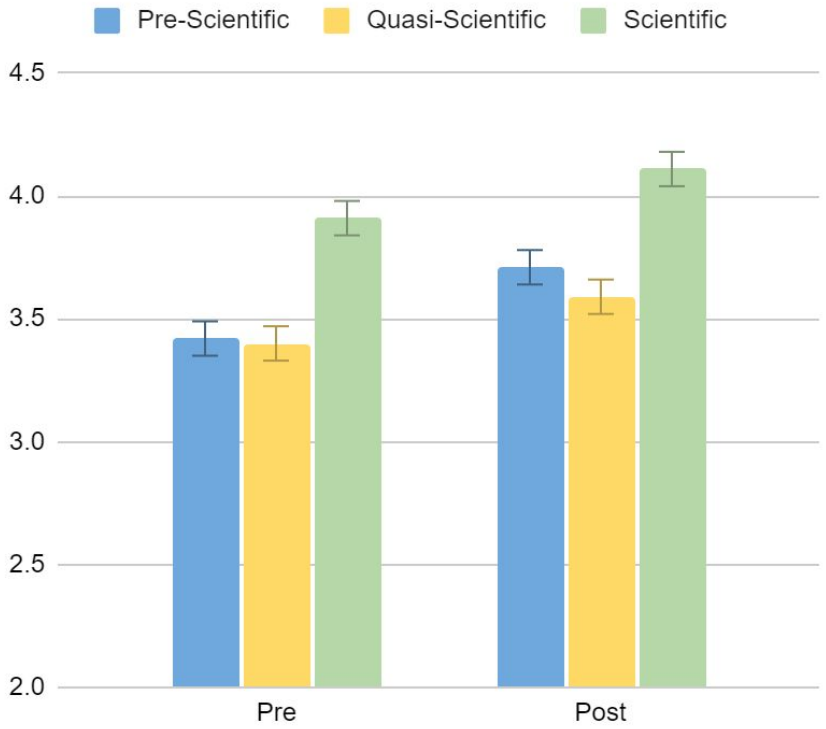
This figure is a graphical representation of the latent profile model (Robertson et al., 2024)

This study identified three profiles of how students approach the MELs (pre-scientific, quasi-scientific, and scientific), with findings revealing…

As students mature in age, their scientific evaluations and judgments advanced

Students demonstrated more refined scientific thinking as they engage with multiple MEL diagrams over time

MELs help optimize science learning regardless of how students approach the task



sciencelearning.net

All of our publications are available here, if you're interested!

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Welcome to the Science Learning Research Group!

SLRG
SCIENCE LEARNING RESEARCH GROUP

NEWS

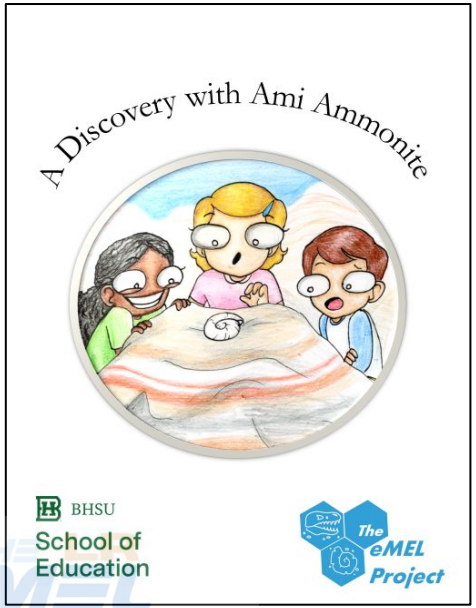
Schoute, Bailey, and Lombardi Publish in Contemporary Educational Psychology April 7, 2025

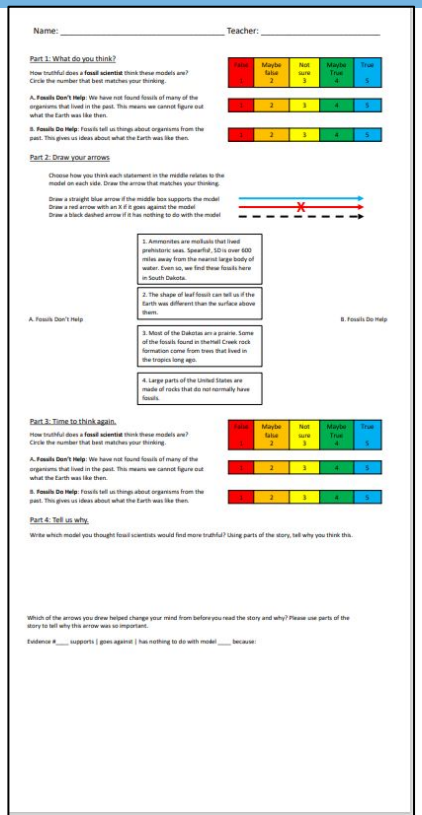
Gans et al. Publish in Journal of Science Education and Technology March 18, 2025

New Research by Dr. Donna Governor on Fostering Curiosity and Respect in Young Learners Through Preserved Specimen


WHAT'S
NEXT

The eMEL Project: The Elementary MEL




Name: _____ Teacher: _____

Part 1: What do you think?

How truthful does a **fossil scientist** think these models are? Circle the number that best matches your thinking.

	False 1	Maybe false 2	Not sure 3	Maybe True 4	True 5
A. **Fossils Don't Help**: We have not found fossils of many of the organisms that lived in the past. This means we cannot figure out what the Earth was like then.	1	2	3	4	5
B. **Fossils Do Help**: Fossils tell us things about organisms from the past. This gives us ideas about what the Earth was like then.	1	2	3	4	5

Part 2: Draw your arrows

Choose how you think each statement in the middle relates to the model on each side. Draw the arrow that matches your thinking.

Draw a straight blue arrow if the middle box supports the model
Draw a red arrow with an X if it goes against the model
Draw a black dashed arrow if it has nothing to do with the model

1. Ammonites are mollusks that lived prehistoric seas. Spearfish_SD is over 600 miles away from the nearest large body of water. Even so, we find these fossils here in South Dakota.

2. The shape of leaf fossil can tell us if the Earth was different than the surface above them.

3. Most of the Dakotas are a prairie. Some of the fossils found in theHell Creek rock formation come from trees that lived in the tropics long ago.

4. Large parts of the United States are made of rocks that do not normally have fossils.

A. Fossils Don't Help B. Fossils Do Help

Part 3: Time to think again.

How truthful does a **fossil scientist** think these models are? Circle the number that best matches your thinking.

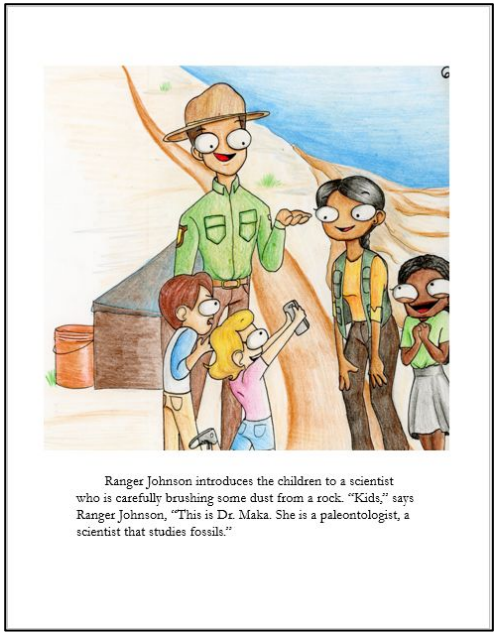
	False 1	Maybe false 2	Not sure 3	Maybe True 4	True 5
A. **Fossils Don't Help**: We have not found fossils of many of the organisms that lived in the past. This means we cannot figure out what the Earth was like then.	1	2	3	4	5
B. **Fossils Do Help**: Fossils tell us things about organisms from the past. This gives us ideas about what the Earth was like then.	1	2	3	4	5

Part 4: Tell us why.

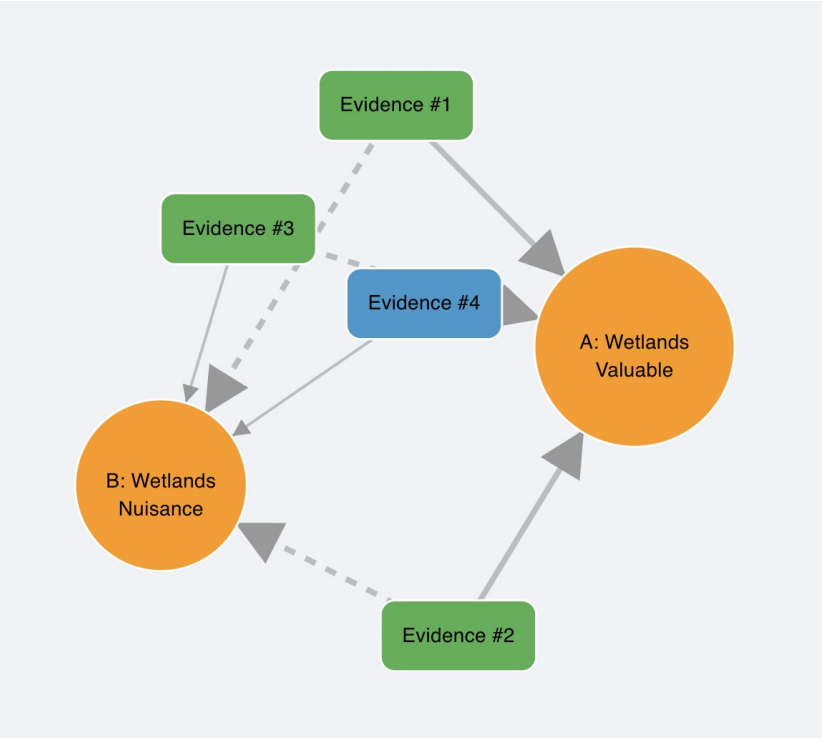
Write which model you thought fossil scientists would find more truthful? Using parts of the story, tell why you think this.

Which of the arrows you drew helped change your mind from before you read the story and why? Please use parts of the story to tell why this arrow was so important.

Evidence #____ supports | goes against | has nothing to do with model ____ because:



Project MELD



Import existing MELs or AI generated
Wider range of topics
Exports student work
Suggests links between evidence
Links to evidence
Basis of next grant proposal

LINK TO INTERACTIVE

Looking at Different Formats

Model A: Nuclear energy is a safe and efficient way to make power. It can meet human energy needs and protect the environment when used safely.

Model B: Nuclear energy has safety risks and environmental problems. Accidents and waste make it too dangerous to use.

Nuclear Energy baMEL Evidence Resources

*Choose **four** of the following lines of evidence to evaluate.*

1	***Big nuclear power plant accidents, like Chernobyl and Fukushima, resulted in environmental damage and long-term health problems for many people.***		
	Instructions: Use lateral reading to evaluate the three references below related to this line of evidence. Eliminate the one that is the least credible and put an X over that reference. In the space below, rate each resource and explain your rating.		
	Accidents at nuclear power plants and cancer risk.	Chernobyl vs. Fukushima: Which Nuclear Meltdown Was the Bigger Disaster?	5 Worst Nuclear Disasters in the World
			
	Credibility Rating (circle): Least ---------- Most **1 2 3 4 5** Explain your rating:	**Credibility Rating (circle):** Least ---------- Most **1 2 3 4 5** Explain your rating:	**Credibility Rating (circle):** Least ---------- Most **1 2 3 4 5** Explain your rating:

LINK TO SAMPLE MEL

LR-MEL (the project's current phase)

- Bringing together MEL activities and Lateral Reading strategies
  - Used by fact checkers to evaluate sources
  - Partnership between science and social studies (& ELA) teachers
- 2022-23 Development of Materials, Bench Testing
- 2023-25 Pilot Testing
- 2025-26 Year 4 Study (this year)

NSF #2201015 and others

THE LR MEL PROJECT

Are you interested in you & your students being a part of next year's study?

We hope to work with 4-6 teachers in PA/NJ

We would visit your classroom ~4 times during the school year

We would collect student work after obtaining student assent & parent consent

We would offer an extra stipend to teachers involved in the study

Who's involved from the project?

- **Janelle -** District research approval process, questions re MEL, payments, overall management
- **Sarah B, Janelle** – Classroom observations, data collection
- **Melike & John (UMD)**– Data management/Office contact
- **Sarah M** - questions re LR
- **Doug** - PI– will be looped in for major concerns/issues
- *Others if needed*

What's involved?

Priority to teams with overlap of students OR 1-2 individuals in Science or ELA who can implement both

Process:

- Introduce building and district leaders, if possible, to Janelle to work on district research approval
- Participate in ~1hr Zoom training on informed consent and review of process
- Collect parent consent / student assent forms, ideally with start-of-year paperwork - we recognize the work involved in this!
- Keep us updated on teaching load, #students, forms, etc.
- Work with Janelle to flesh out your implementation plan (what you'll do and when)
- Teach LR and/or MEL lessons (4+) to ALL relevant class periods, collecting student work
- Be observed and recorded by Sarah or Janelle for one of the class periods each lesson [set]
- Provide feedback about lessons

What do you get?

- Extra work, but extra money
- We give you the materials, you ship back at our expense
- All observations need to be completed for full payment
  - 4 LR/MEL activities
- $2500 each**
  - Two payments (2 observations each)
  - You are responsible for taxes
  - Above and beyond your stipend for this institute

When will you know?

- We'll make decisions soon!
    - Factors include district approvals, driving distance, team opportunities, diverse settings
- Informed consent training TBD in mid-August, before your back-to-school PD starts

Those interested will meet at end of workshop tomorrow with more specific information….

ACKNOWLEDGEMENTS

This research project is supported by the US National Science Foundation (NSF) under Grant Nos. 2201012, 2201015, 2201016, 2201017, 2201018, and 2346657. Any opinions, findings, conclusions, or recommendations expressed are those of the authors and do not necessarily reflect the NSF's views.