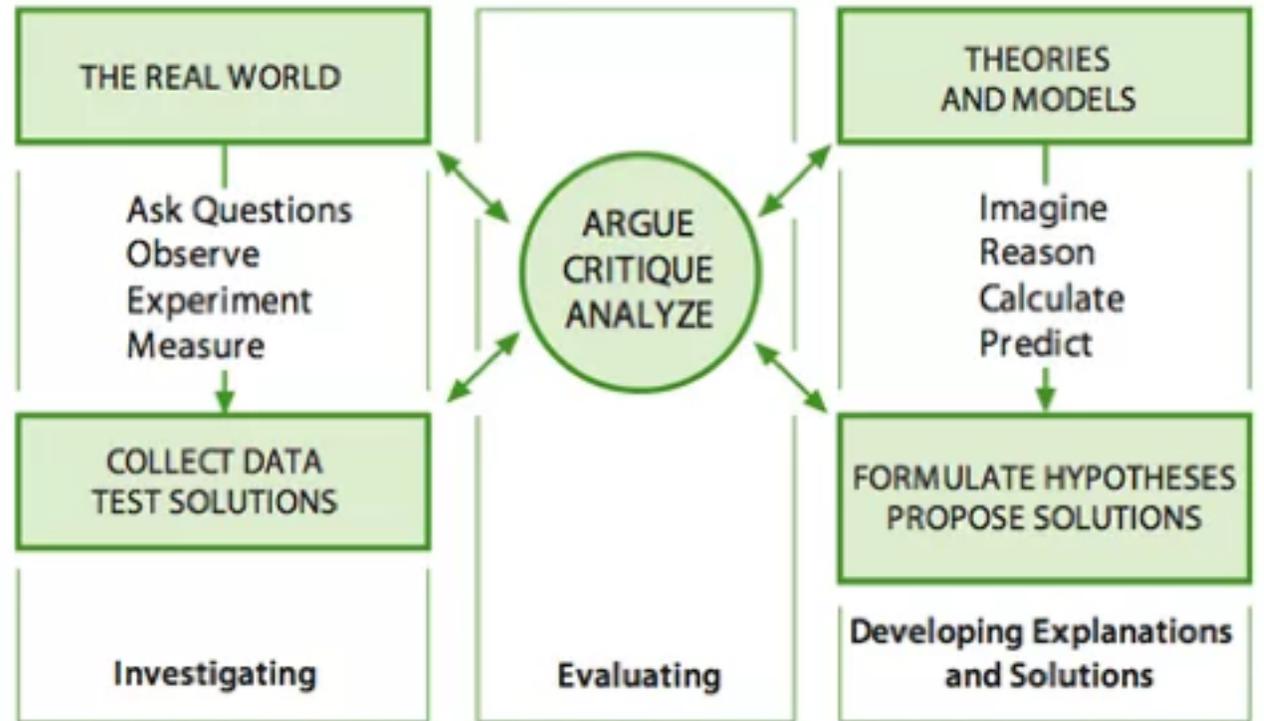
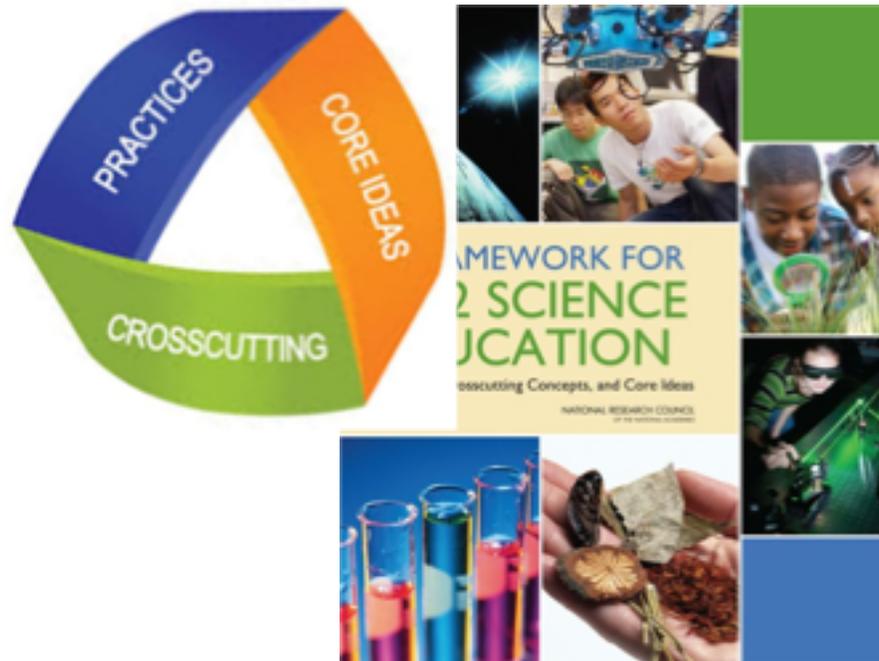




MEL Architecture
Theory to Practice

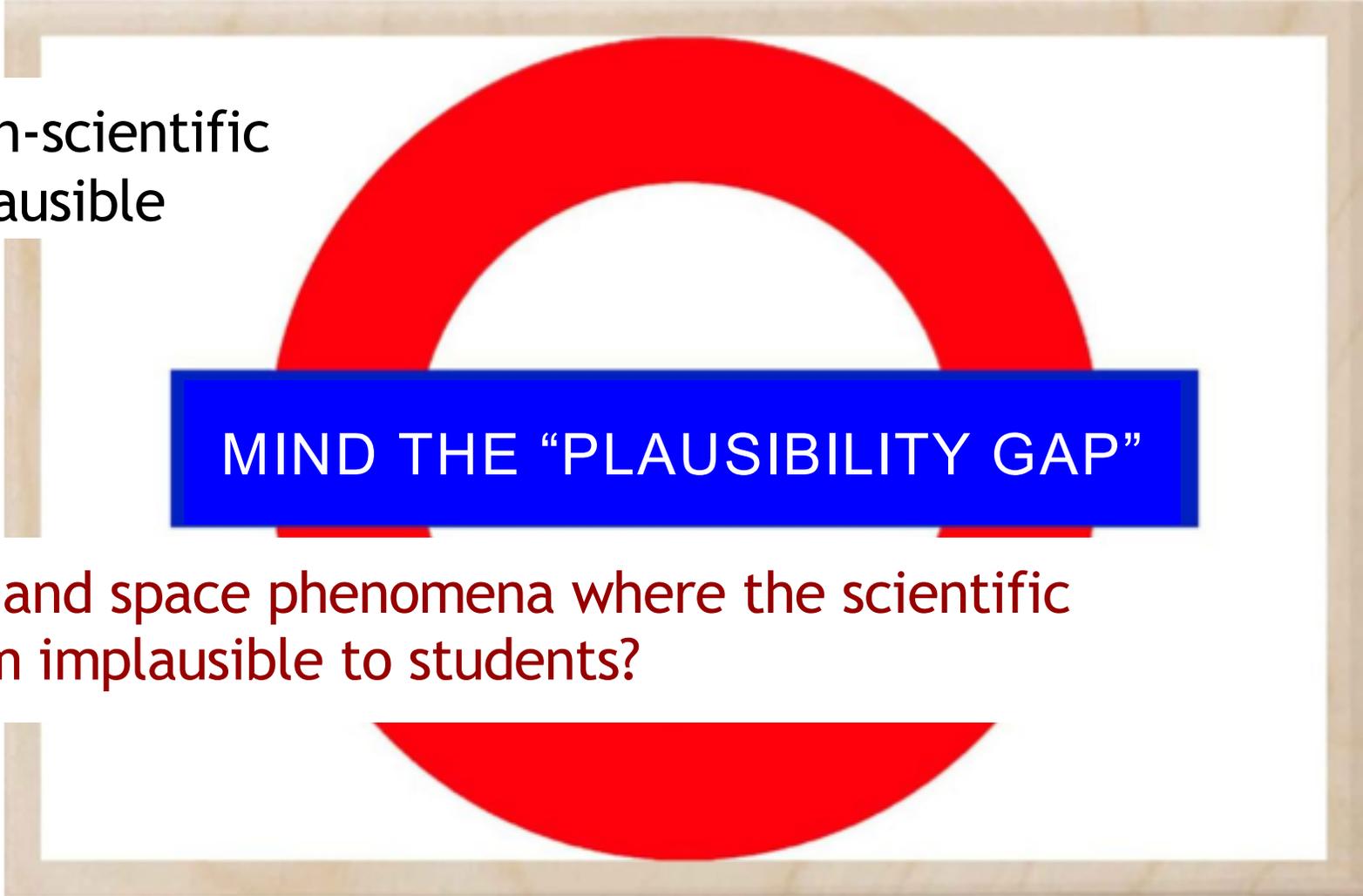
Scientific literacy involves both knowing (1) *what* scientists know and knowing (2) *how* scientists know what they know



Evaluation as argument, critique, and analysis is central to scientific thinking and knowledge construction

Students may find that scientific explanations (hypotheses and theories) about a phenomenon to be implausible...

...and competing, non-scientific explanations to be plausible

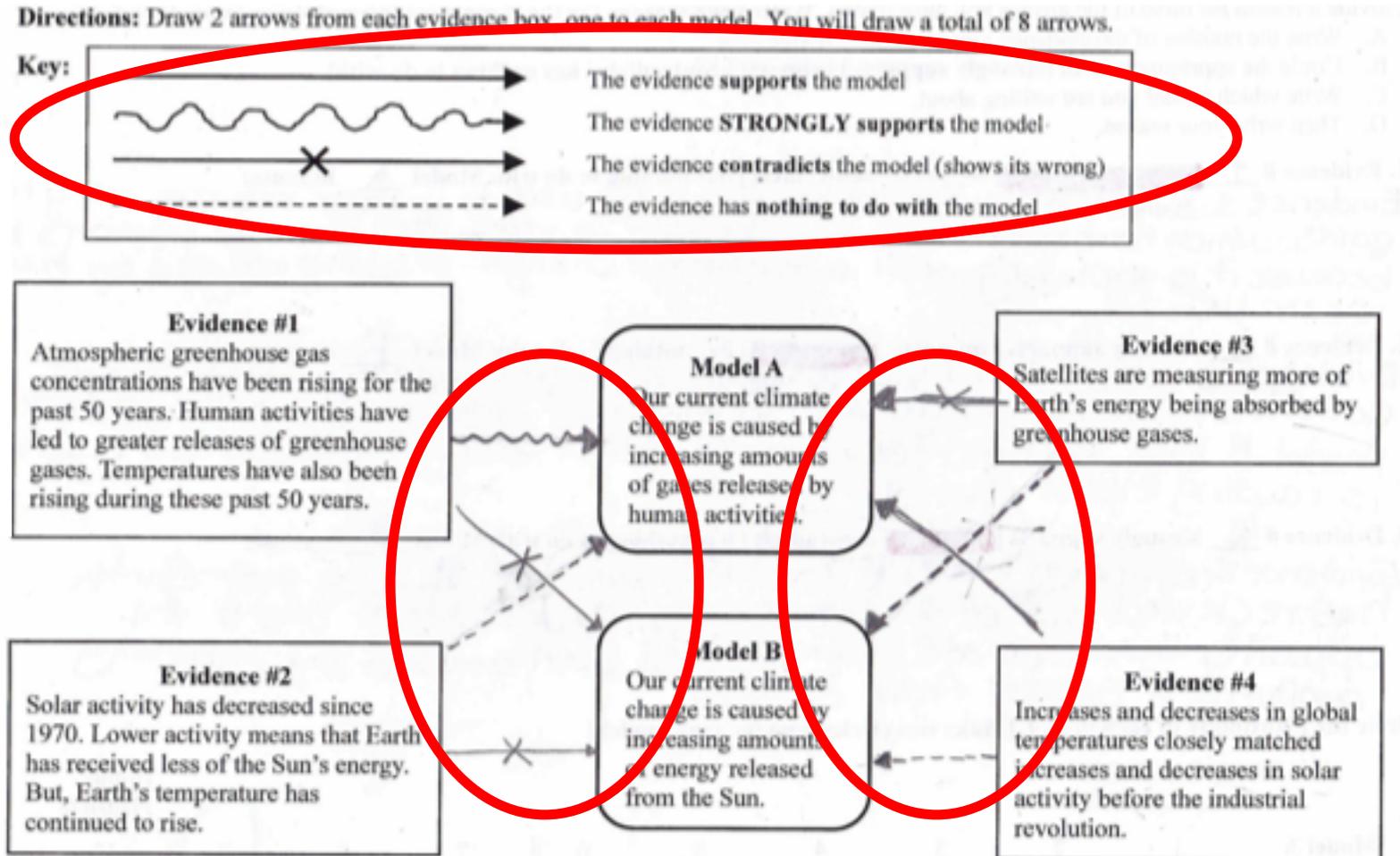


MIND THE "PLAUSIBILITY GAP"

What are some Earth and space phenomena where the scientific explanation may seem implausible to students?

The MEL diagram is a scaffold designed to help students think scientifically...

...by (1) promoting students' evaluations about the connections between evidence and alternative explanations about a phenomenon



The MEL diagram is a scaffold designed to help students think scientifically...

...and (2) explicitly appraising & re-appraising the plausibility of both alternative explanations

Model A: Climate change is caused by humans who are releasing gases into the atmosphere.

A person who supports this model makes the following argument:

A few gases in Earth's atmosphere prevent some of Earth's energy from escaping out into space. Human activities are increasing the amount of these gases in the atmosphere. Therefore, humans are causing climate change.

Model B: Climate change is caused by increasing amounts of energy released from the Sun.

A person who supports this model makes the following argument:

The Sun is the main source of energy for planet Earth. Scientists have shown that for thousands of years Earth's average temperature increases when the Sun releases more energy. Therefore, the Sun is causing climate change.

Plausibility is a judgment we make about the potential truthfulness of one model compared to another. The judgment may be tentative, and you do not have to be committed to that decision. Circle the plausibility of each model. [Make two circles, one for each model.]

	1	2	3	4	5	6	7	8	9	10
Model A						6				
Model B						6				

1. Evidence # 1 strongly supports | supports | contradicts | has nothing to do with Model A because: Evidence 1 says that human activities have led to greater releases of greenhouse gases, which have been rising for the past 50 years. This strongly supports because it is explaining that our climate change is being caused by human activities.

2. Evidence # 1 strongly supports | supports | contradicts | has nothing to do with Model B because: Evidence 1 contradicts Model B because evidence one says that human activities have led to greater releases of greenhouse gases, while Model B says that increasing amounts of energy from the sun is what is causing climate change.

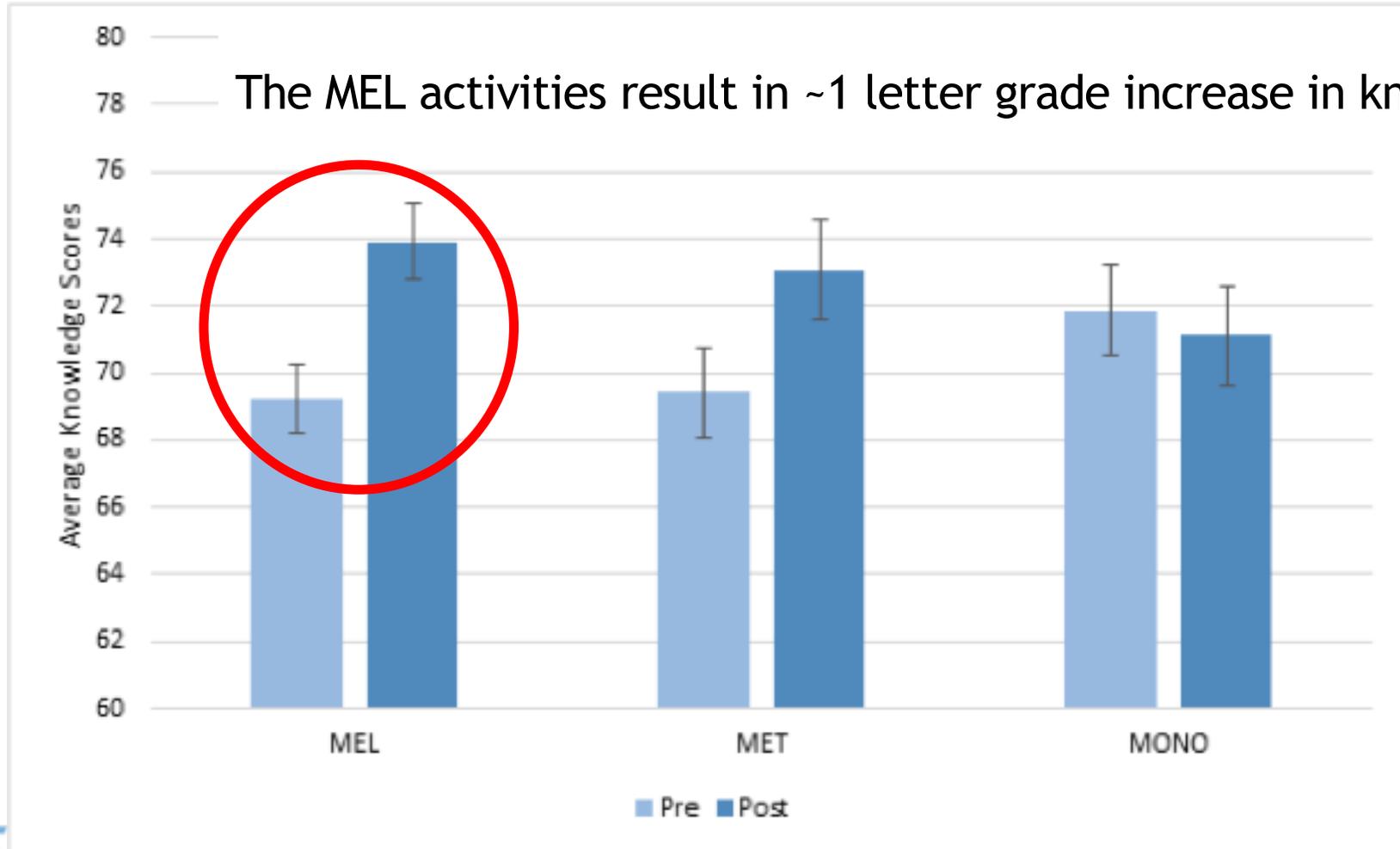
3. Evidence # 2 strongly supports | supports | contradicts | has nothing to do with Model B because: Evidence 2 contradicts Model B because evidence 2 says that Earth has received less of the sun's energy, and Model B says the opposite, that climate change has been caused by increasing amounts of energy from the sun.

Circle the plausibility of each model. (Make two circles, one for each model.)

	1	2	3	4	5	6	7	8	9	10
Model A									9	
Model B		2							9	



Good news...evaluation & plausibility reappraisal of alternative explanations deepen student learning!



But, some bad news...students did not reflect scientific thinking outside the context of the MEL activities



Enter the idea of “conceptual agency,” where students construct and evaluate their own MEL diagram

Students who exercise conceptual agency are authors of their own contributions, accountable to the classroom learning community, & have the authority to think about and solve issues (Nussbaum & Asterhan, 2016)



We hypothesize that the Build-a-MEL (aka the baMEL) will increase students' conceptual agency

Freshwater Build-a-MEL

Evidence #1
Land use changes have generated large pressures on fresh water resources. These changes are affecting both water quality and availability.

Evidence #2
The world's population is increasing. This increases the supply of freshwater.

Evidence #3
Groundwater provides freshwater to many people around the world. In many places, people are using groundwater faster than it is replaced by precipitation.

Evidence #4
Water reclamation costs have gone down in the past several years. These costs vary depending on location. Making use water drinkable costs more than reclamation.

Evidence #5
Advances in engineering have led to better access to quality drinking water. At the same time life expectancy and quality of life have improved.

Evidence #6
Estimates of groundwater recharge on a large scale may not take into account the subsurface differences in sediment type or thickness. This underestimation may offset any future negative impact on water quality.

Evidence #7
Glaciers are a source of freshwater in many parts of the world. Glacial ice mass is decreasing worldwide.

Evidence #8
Most climate predictions are on regional scales. Microclimates are local areas where precipitation and temperatures are influenced by vegetation cover, topography, and human activity. Large-scale predictions may not accurately reflect local trends in freshwater availability.

Evidence #9
In the contiguous US, average temperatures and precipitation have increased since 1901. From 2000-2015, the US was abnormally dry with some parts of the country in moderate to severe drought.

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 it's wrong)
- The evidence has nothing to do with the model

Evidence # _____	Model _____	Evidence # _____
Evidence # _____	Model _____	Evidence # _____

Model A

Earth's freshwater is abundant and will remain so even in the face of global climate change.

Model B

Earth has a shortage of freshwater that can be met by engineering solutions.

Model C

Earth has a shortage of freshwater, which will worsen as our world's population increases.

To build a MEL, pick four of these nine lines of evidence



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