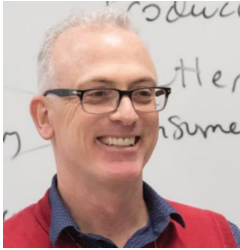




Teaching Students to Evaluate Sources and Claims

Pre-Workshop Webinar #2

LR-MEL Project Investigators



Doug Lombardi
U Maryland



Sarah McGrew
U Maryland



Donna Governor
U North Georgia



Carla McAuliffe
Institute for Global
Environmental
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**Lorraine Ramirez
Villarin**
U North Georgia



Janelle Bailey
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Missy Holzer
Science Curriculum
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Gale Sinatra
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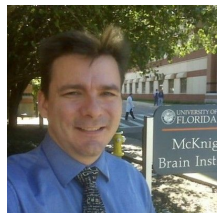


Chantelle Renaud-Grant
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Planetary Science Institute

LR-MEL Master Teachers



Penny Kline and Derek Piper
Vickery Creek Middle School (GA)



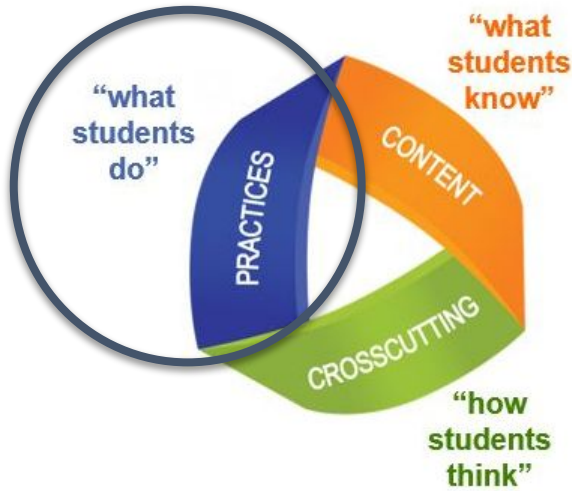
Andrea Johnson and Mike Magnotta
Philadelphia Performing Arts: A String
Theory Charter School (PA)

Webinar Outline

- 3-D Teaching and Learning
- Science and Engineering Practices
- MEL Architecture
- Website Overview
- Next Steps



Shift in Science Education: 3-Dimensional Science Learning



What does 3-D Teaching and Learning look like?

- Students DOING science
- Phenomena based
- Solving problems
- Real-world applications
- Project based learning


Science & Engineering Practices

Science and Engineering Practices

- 1 Asking Questions and Defining Problems
- 2 Developing and Using Models
- 3 Planning and Carrying Out Investigations
- 4 Analyzing and Interpreting Data
- 5 Using Mathematics and Computational Thinking
- 6 Constructing Explanations and Designing Solutions
- 7 Engaging in Argument from Evidence
- 8 Obtaining, Evaluating, and Communicating Information

Science and Engineering Practices

1 Asking Questions and Defining Problems



I can wonder about the world and write it as a question

2 Developing and Using Models




I can create ways to model real world situations.

3 Planning and Carrying Out Investigations




I can plan and carry out investigations.

4 Analyzing and Interpreting Data




I can understand and explain what data means

5 Using Mathematics and Computational Thinking




I can use math strategies to explain my thinking.

6 Constructing Explanations and Designing Solutions




I can come up with solutions and explain why.

7 Engaging in Argument from Evidence



I can use proof to support my findings.

8 Obtaining, Evaluating, and Communicating Information



I can collect, understand, and show my information.

Science

- **S2**: Develop and use models
- **S6**: Construct explanations and design solutions

Social Studies

- **SS6**: Take informed action

- **SS1/S1**: Develop questions and define problems
- **SS2/S3**: Plan and carry out inquiries and investigations
- **SS4/S7/E5**: Develop claims and arguments using evidence
- **SS5/S8/E3/E4**: Communicate and critique conclusions and information
- **SS5/S8/E2**: Build a strong base of knowledge through content-rich texts
- **SS3/S4/E5/E6**: Value, gather, analyze, and evaluate data and evidence

- **E1**: Demonstrate independence in reading complex texts and writing and speaking about them
- **E7**: Understand other cultures and perspectives through reading, listening, and collaborations

English/Language Arts

Engaging in Argument from Evidence

- Compare and evaluate competing arguments in light of currently accepted explanations, new evidence, limitations, constraints, and ethical issues
- Evaluate the claims, evidence, and/or reasoning behind currently accepted explanations to determine the merits of arguments



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Arguments Evaluate Claims and Evidence

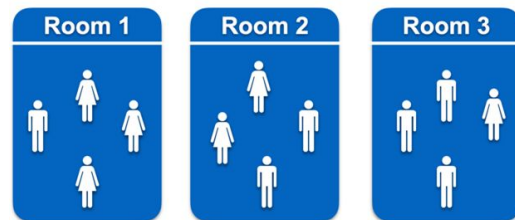
SS4/S7/E5: Develop claims and arguments using evidence

In Breakout Rooms:

- How does each content area support students to reach this goal?

Regroup:

- What did you discover?
- Where are the overlaps?



Familiar Instructional Strategies



Claim-Evidence-Reasoning

- Claims: A proposed answer to a question
- Evidence: The information used in an argument to support the claim
- Reasoning: Justification that links the claim and evidence.

Scientists construct MODELS to explain evidence

Claims vs. Models

CLAIMS

- An answer to a question
- An assertion based on results of an investigation
- Requires justification to support the claim

MODELS

- An explanation of a phenomenon
- A hypothesis that leads to new questions
- Predicts or describes how and why a phenomenon occurs



EVIDENCE is the foundation for both claims and models!

Model of the Water Cycle

USGS
science for a changing world

The heat of the sun provides energy to make the water cycle work.

The sun evaporates water from the oceans into water vapor.

This invisible vapor rises into the atmosphere, where the air is colder.

The water vapor condenses into clouds.

Volcanoes emit steam, which forms clouds.

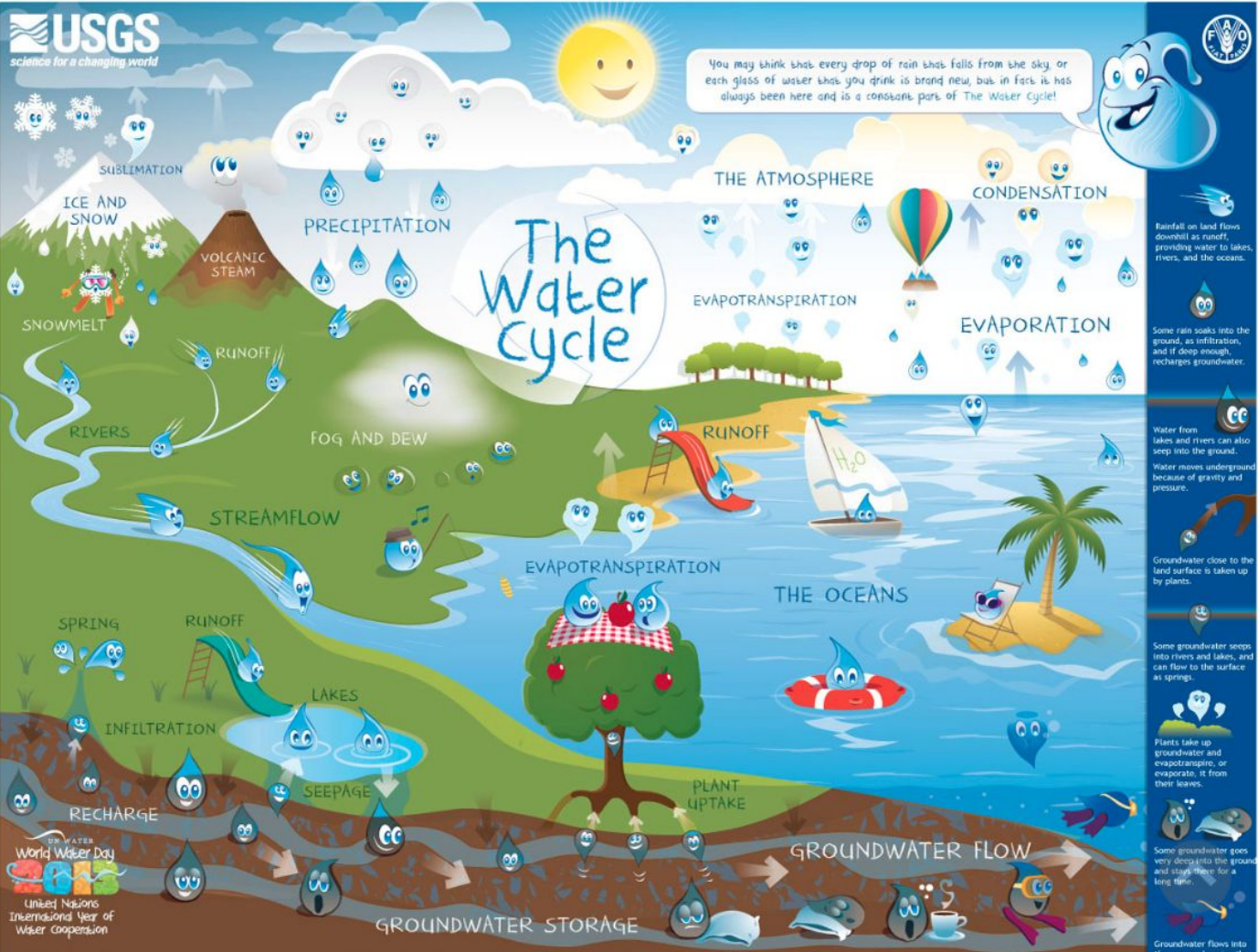
Air currents move clouds all around the Earth.

Water drops form in clouds, and the drops then fall to Earth as precipitation (rain and snow).

In cold climates, precipitation builds up as snow, ice, and glaciers.

Snow can melt and become runoff, which flows into rivers, the oceans, and into the ground.

Some ice evaporates directly into the air, skipping the melting.



Rainfall on land flows downhill as runoff, providing water to lakes, rivers, and the oceans.

Some rain soaks into the ground, as infiltration, and if deep enough, recharges groundwater.

Water from lakes and rivers can also seep into the ground.

Water moves underground because of gravity and pressure.

Groundwater close to the land surface is taken up by plants.

Some groundwater seeps into rivers and lakes, and can flow to the surface as springs.

Plants take up groundwater and evaporate, or transpire, it from their leaves.

Some groundwater goes very deep into the ground and stays there for a long time.

Groundwater flows into the oceans, lakes, and rivers.

MEL Architecture: Evaluating Models

When using the Model-Evidence Link (MEL) activities, explanatory models are introduced and students evaluate models using plausibility judgments

What is Plausibility?

Chat Box!!!!



Plausibility of Models Explaining Climate Change

Name: _____ Date: _____ Teacher: _____ Period: _____

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 for why global temperatures have increased over the past 100 years and average sea levels have increased over the past 50 years.

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 (not certain). You do not have to be committed to that decision.

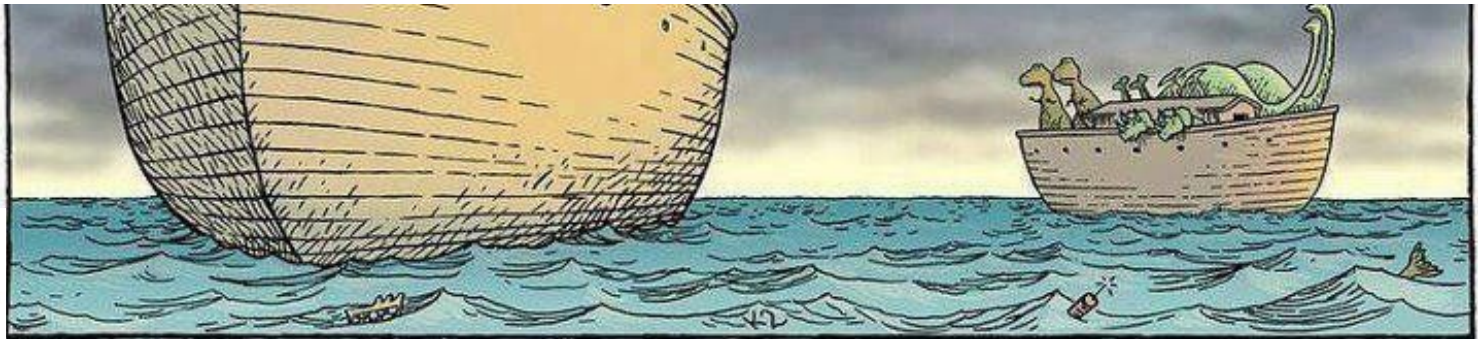
Circle the plausibility of each model. [Make two circles, one for each model.]

	1	2	3	4	5	6	7	8	9	10
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 more scientific way to think about claims, evidence, and reasoning



Simultaneously evaluating how well scientific evidence supports competing claims and rendering a plausibility judgment on each claim



The Plausibility Ranking Task

How do scientists change their plausibility judgments?

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.

Scientists may change their plausibility judgments about scientific ideas.

They do this by looking at the connections between evidence and the idea. Evidence may:

1. *Support* an idea
2. *Strongly support* an idea
3. *Contradict* (oppose) an idea
4. Have *nothing to do* with the idea

Which type of evidence do you think is most important to a scientist's plausibility judgment? Use numbers 1 to 4 to rank each evidence. (1 = most important and 4 = least important). Use each number only once.

Type of evidence	Your ranking
Evidence supports the idea	
Evidence strongly supports the idea	
Evidence contradicts (opposes) the idea	
Evidence has nothing to do with the idea	

When instructed, flip over to Page 2

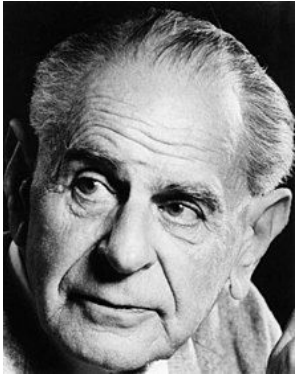
Prior to this webinar
we asked you to take a
survey....

The Plausibility Ranking Task

	1	2	3	4	TOTAL
▼ Evidence supports the idea	4.17% 1	29.17% 7	50.00% 12	16.67% 4	24
▼ Evidence strongly supports the idea	45.83% 11	16.67% 4	20.83% 5	16.67% 4	24
▼ Evidence contradicts (opposes) the idea	29.17% 7	50.00% 12	20.83% 5	0.00% 0	24
▼ Evidence has nothing to do with the idea	20.83% 5	4.17% 1	8.33% 2	66.67% 16	24

Here are the results of the survey as of 6:00 pm today....

What About Contradictory Evidence?



Falsifiability makes explanations scientific, that is, scientific explanations must be open to be able to be proven wrong (i.e., false)

--Karl Popper

“Theories can never be proven, only disproven”



Falsifiability

The Plausibility Ranking Task

- Now that you've heard a bit more about plausibility and falsifiability, let's re-rank the four types of evidence.
- Go to <https://www.surveymonkey.com/r/2025PRT2>

Carefully read the following paragraph.

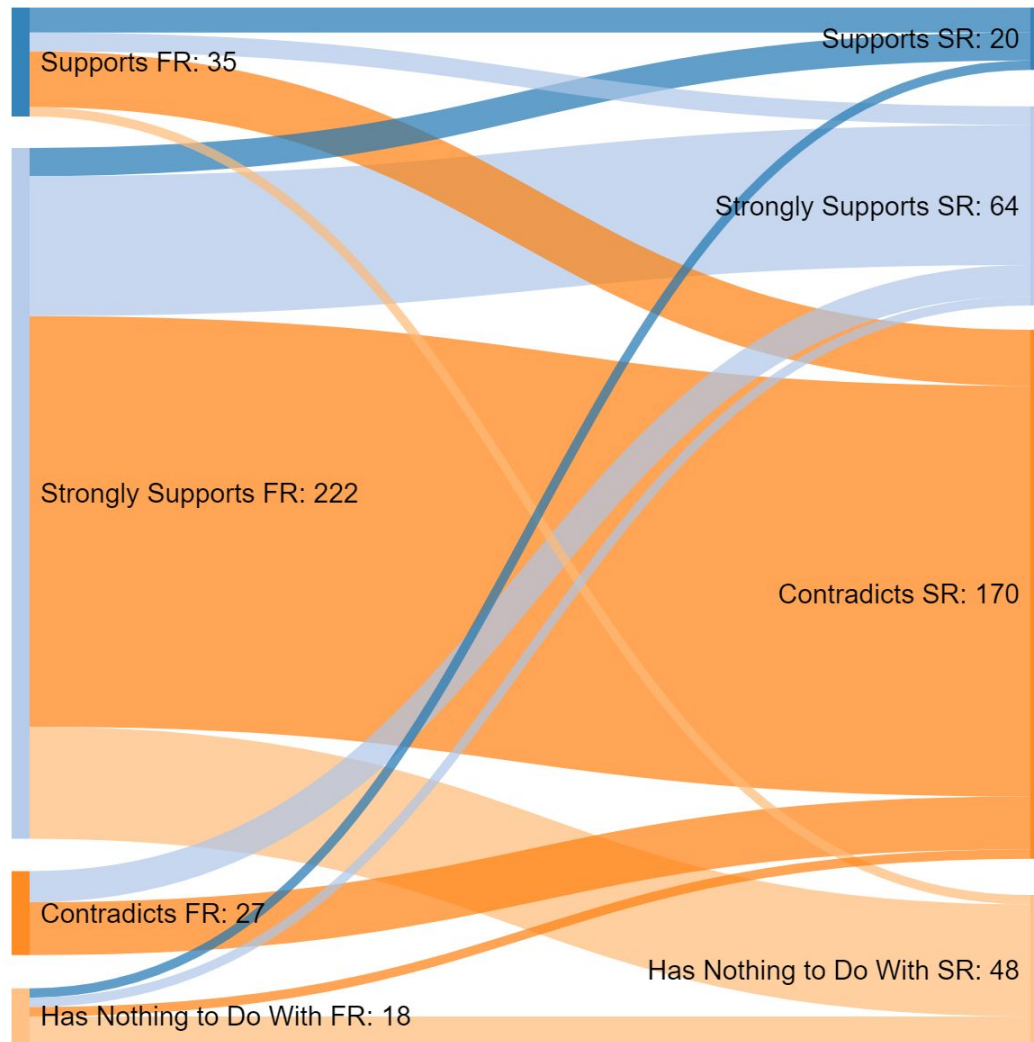
Scientific ideas must be *falsifiable*. In other words, scientific ideas can never be proven. But, ideas can be disproven by opposing evidence. When this happens, scientists must revise the idea or come up with another explanation. *Falsifiability* is a very important principle when evaluating scientific knowledge.

As a reminder, scientists may change their plausibility judgments about scientific ideas and they do this by looking at the connections between evidence and the idea. Evidence may:

1. *Support* an idea
2. *Strongly support* an idea
3. *Contradict* (oppose) an idea
4. Have *nothing to do* with the idea

With *falsifiability* in mind, *re-rank* each evidence from 1 to 4. (1 = most important and 4 = least important). Use each number only once.

Type of evidence	Your ranking
Evidence supports the idea	
Evidence strongly supports the idea	
Evidence contradicts (opposes) the idea	
Evidence has nothing to do with the idea	



Contradictory evidence promotes shifts in plausibility judgments about explanations, demonstrates the process of scientific evaluation, & deepens students' knowledge

The Plausibility Ranking Task (p2)--*your new responses*

	1	2	3	4	TOTAL
▼ Evidence supports the idea	2.86% 1	28.57% 10	65.71% 23	2.86% 1	35
▼ Evidence strongly supports the idea	11.43% 4	48.57% 17	17.14% 6	22.86% 8	35
▼ Evidence contradicts (opposes) the idea	77.14% 27	8.57% 3	8.57% 3	5.71% 2	35
▼ Evidence has nothing to do with the idea	8.57% 3	14.29% 5	8.57% 3	68.57% 24	35

MEL Architecture

Step 1: Evaluating Models

Students are asked to evaluate competing scientific models

Plausibility of Models Explaining Climate Change

Name: _____ Date: _____ Teacher: _____ Period: _____

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 for why global temperatures have increased over the past 100 years and average sea levels have increased over the past 50 years.

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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 (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.]

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

MEL Step 2: Examining the Evidence

Evidence #1: Atmospheric greenhouse gas concentrations have been rising for the past 80 years. Human activities have led to greater releases of greenhouse gases. Temperatures have also been rising during these past 80 years.

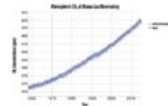


Figure 1. Carbon dioxide levels in the atmosphere. Credit: Wipac Images
The symbol for carbon dioxide is CO_2 . These levels have been increasing (Figure 1). CO_2 in the atmosphere absorbs infrared energy emitted by Earth. People call CO_2 a greenhouse gas because it keeps some of Earth's energy from escaping to space.

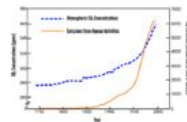


Figure 2. CO_2 released by human activities. Credit: Wipac Images
Figure 2 shows increasing releases of CO_2 by the human activity of burning fossil fuels, including coal, gasoline, natural gas, and wood. Burning fossil fuels releases CO_2 into the atmosphere.

Evidence #2: Solar activity has decreased since 1970. Lower activity means that Earth has received less of the Sun's energy. But, Earth's temperature has continued to rise.

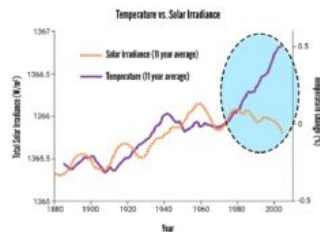


Figure 3. Solar activity levels over time. Credit: Wipac Images
The Sun's brightness is one way to measure solar activity. In Figure 3, the dashed line shows the Sun's brightness. Since 1970, the Sun's brightness has been decreasing. The solid line on the graph shows Earth's temperature. The graph shows that temperatures are increasing while solar activity is decreasing. The region outlined by the dashed oval shows where solar activity is decreasing and temperature is increasing.

Evidence #3: Satellites are measuring more of Earth's energy being absorbed by greenhouse gases.

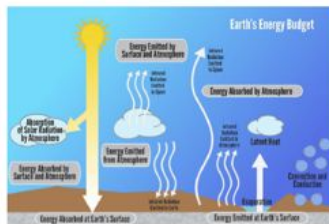


Figure 4. Earth's energy budget. Credit: Wipac Images
Figure 4 shows Earth's energy budget. Earth absorbs about half of the Sun's energy. Most of the Sun's energy comes to Earth as visible light. Earth radiates that absorbed energy as invisible light called infrared. Some of this infrared energy is absorbed by the atmosphere and sent back to Earth. Some escapes into space. Over time, NASA satellites orbiting Earth have recorded less infrared energy leaving Earth's atmosphere.

Evidence #4: Increases and decreases in global temperatures closely matched increases and decreases in solar activity before the industrial revolution.

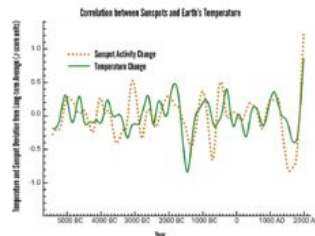


Figure 5. Sunspot activity and temperature over time. Credit: Wipac Images
In Figure 5, sunspot activity is the dashed line. Solar activity increases when the Sun has more sunspots. The solid line shows temperature. The shapes of the sunspot and temperature curves match closely. Peaks in the temperature are near peaks in sunspot activity. Dips in temperature are near dips in sunspot activity.

These data show sunspot activity and temperature for the past 5000 years. These data are based on evidence collected from tree rings. Some of the tree rings are from trees that are still living. Some of the tree rings are from ancient trees that have died.

MEL Step 3: Connecting Evidence to Models

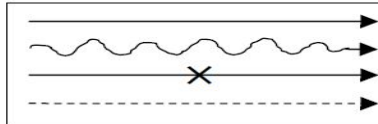
Complete the
MEL diagram
using the
evidence texts
as a resource

Name: _____ Date: _____ Teacher: _____ Period: _____

If you worked with other students, their name(s): _____

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

Atmospheric greenhouse gas concentrations have been rising for the past 50 years. Human activities have led to greater releases of greenhouse gases. Temperatures have also been rising during these past 50 years.

Model A

Our current climate change is caused by increasing amounts of gases released by human activities.

Evidence #3

Satellites are measuring more of Earth's energy being absorbed by greenhouse gases.

Evidence #2

Solar activity has decreased since 1970. Lower activity means that Earth has received less of the Sun's energy. But, Earth's temperature has continued to rise.

Model B

Our current climate change is caused by increasing amounts of energy released from the Sun.

Evidence #4

Increases and decreases in global temperatures closely matched increases and decreases in solar activity before the industrial revolution.

Types of Arrows

Supports



Strongly Supports



Contradicts



Has nothing to do with



Evidence #1

Atmospheric greenhouse gas concentrations have been rising for the past 50 years. Human activities have led to greater releases of greenhouse gases. Temperatures have also been rising during these past 50 years.

Model A

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

Evidence #3

Satellites are measuring more of Earth's energy being absorbed by greenhouse gases.

Evidence #2

Solar activity has decreased since 1970. Lower activity means that Earth has received less of the Sun's energy. But, Earth's temperature has continued to rise.

Model B

Our current climate change is caused by increasing amounts of energy released from the Sun.

Evidence #4

Increases and decreases in global temperatures closely matched increases and decreases in solar activity before the industrial revolution.

Break Out Rooms!

Click [here](#) for evidence texts

MEL Step 4: Model Re-Evaluation & Explanation

**Explain your
reasoning**

**Re-evaluate the
Models using
Evidence-based
reasoning**

Name _____ Date _____ Teacher _____ Period _____ Topic _____

Please work on this part individually after you complete your diagram.

1. Now that you have completed the diagram, reconsider the plausibility of Models A and B (and C, if there is one). Circle the plausibility of each model. [Make one circle 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
Model C (if there is one)	1	2	3	4	5	6	7	8	9	10

2. For the model you selected as most plausible, explain why you think so.

Evaluating the Explanation Task

3. Which arrows changed your plausibility judgments about the models? If your plausibility judgment did not change, which arrows supported your original plausibility judgments? Consider 2 lines of evidence. For each line, does it support, strongly support, or contradict one of the models? Why? When writing your explanation, consider the following:

- Use the specific information from the evidence text and figures to support your response. Ex: when looking at graphs or figures, be sure to describe the patterns in the data.
- Describe any cause and effect relationships found in the text.

Evidence #_____strongly supports | supports | contradicts | has nothing to do with Model_____because:

Evidence #_____strongly supports | supports | contradicts | has nothing to do with Model_____because:

Evaluate students claims using evidence-based reasoning

Project Website: <https://serc.carleton.edu/mel/index.html>



The screenshot shows a web browser displaying the Project Website. The address bar shows the URL <https://serc.carleton.edu/mel/index.html>. The page has a blue header with the title "Evaluating Sources and Claims". Below the header, there is a sidebar on the left with a navigation menu. The main content area features a title "Lateral Reading-Model-Evidence Link Diagrams (LR-MEL) Project" and a text box describing the project's purpose. Below this is a line graph showing atmospheric carbon dioxide levels over time. The graph has a y-axis labeled "carbon dioxide level (parts per million)" ranging from 180 to 480, and an x-axis labeled "years before today (0 = 1950)" ranging from 400,000 to 0. A horizontal line at approximately 280 ppm is labeled "For centuries, atmospheric carbon dioxide had never been above this line". The graph shows a fluctuating line that rises sharply after 1950, reaching a "current level" of approximately 415 ppm. A label "1950 level" points to the start of the sharp rise at 280 ppm. Below the graph, a caption reads "Climate Change: Increases in atmospheric carbon dioxide since the Industrial Revolution".

Teach the Earth Portal

Model-Evidence Link Diagrams Project

- About
- Teaching Resources
- Professional Development

Evaluating Sources and Claims

Lateral Reading-Model-Evidence Link Diagrams (LR-MEL) Project

The purpose of our project is to promote students' civic and scientific evaluations of sources and alternative claims when confronted with controversial and/or complex socioscientific issues in the Earth and environmental sciences. We do this by integrating English Language Arts (ELA) and social studies classrooms—focused on *source evaluation*—with science classrooms—focused on *evaluating connections between lines of evidence and alternative explanatory claims*. We are developing, implementing, and testing complementary Lateral Reading (LR) and Model-Evidence Link (MEL) scaffolds that include instructional materials and methods in both social studies and science classrooms. Issues students explore range from climate change and extreme weather to freshwater availability and food security along with many others.



carbon dioxide level (parts per million)

For centuries, atmospheric carbon dioxide had never been above this line

current level

1950 level

years before today (0 = 1950)

Climate Change: Increases in atmospheric carbon dioxide since the Industrial Revolution

Project Overview

The Lateral Reading-Model-Evidence Link Diagrams (LR-MEL) project is investigating how deeper evaluations might promote changes in students' epistemic judgments, including source trustworthiness, and claim plausibility, toward a more civically-minded and scientific stance. We are also developing and implementing three-day summer institutes and follow-on professional development to help middle and high school ELA, social studies, and science teacher teams use LR (in ELA and social studies) and MEL (in science) scaffolds to facilitate students' critical-analytic thinking, evidence-based reasoning, and core disciplinary knowledge.

Lateral Reading - Source Evaluation



Webinar Evaluation Survey

Please fill out a Webinar Evaluation Survey at:

<https://www.surveymonkey.com/r/37LMQPX>

(this will also be emailed out)

Please fill out this survey by Friday May 23, 9pm EDT



Questions?

For general questions, use the Chat Box to ask them.

For specific questions, email us at MEL2institutes@gmail.com

DON'T LEAVE!

We need you in our Institute groups for some last minute business items!

Thank you - We look forward to seeing you at the institutes!



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.