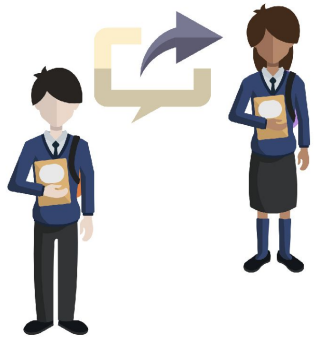
Assessing Student Work

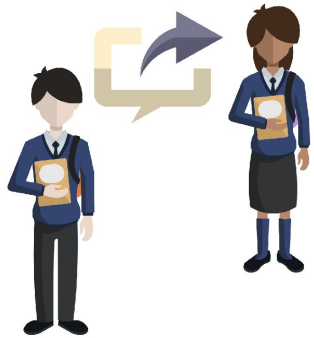
Why Assess Student Work?

What are the purposes of assessment?



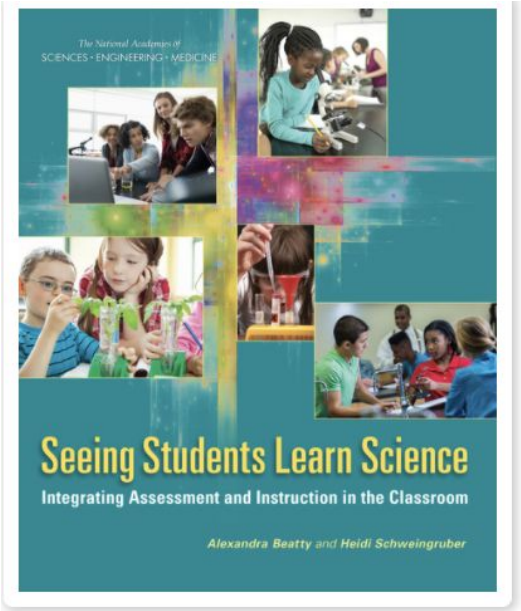
Why Assess Student Work?

- Reflect and determine evidence and extent of student learning.
- Deepen our understanding of how students learn science.
- Reflect and assess intent and quality of the task.
- Analyze and clarify learning outcomes.
- Determine evidence and implications of effective teaching.
- Discuss and suggest teaching strategies.
- Inform our own learning needs as teachers.



Characteristics of 3D Assessment

1. Should be varied to represent the breadth of all 3 dimensions.
2. Can include informal discussions, tasks, traditional quizzes, artifacts, computer simulations, projects.
3. Tasks that include multiple components to provide evidence of all three dimensions.
4. Attention to the connections between scientific concepts.
5. Line between instruction and assessment can be blurred as assessment is embedded in the learning experience.

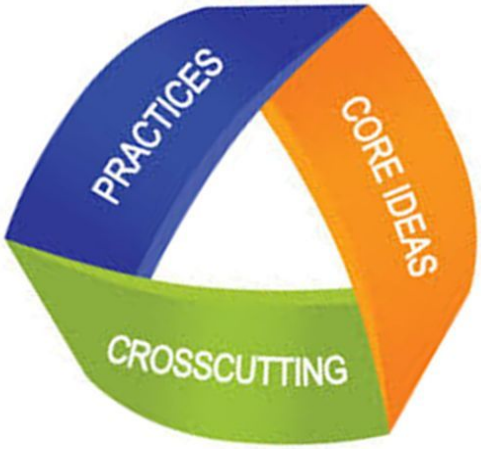


Let's Brainstorm about Assessment of the MEL activities…

At your tables:

How would you assess the MEL diagram and/or explanation task to gauge whether students are learning?

Let's discuss…..

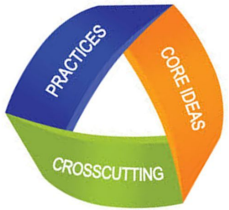


We recommend only assessing the explanation task (not the diagram) and only in a formative assessment mode

Evidence # 1 **strongly supports** | supports | contradicts | has nothing to do with Model A because:
It not only contradicts model B, but this evidence provides direct answer or evidence to back up "sustain the biosphere" and in the benefits listed, "global cycle" support is critical to human welfare

Students must judge both the quality and the relevance of each line of evidence in relation to each model. The MELs grant students agency to take responsibility for their own learning.

A MEL activity is one lesson in a unit of instruction to fully develop students' understanding of a few standards



Science and Engineering Practices

How can fireflies communicate to attract a mate?

Scientists	S	E	Engineers
Science helps us explain phenomena. *Phenomena* are naturally occurring events that have a cause.			Engineering helps us solve problems. *Criteria* are the rules that need to be met.

How can I design a device to sort trash?

Asking Questions

Ask answerable questions about something they can't yet explain.

Defining Problems

Describe a problem's criteria and limits.

Developing and Using Models

Use a model to predict what will happen.

Use models to help test solutions.

Planning and Carrying Out Investigations

Plan procedures.
Collect data.
Test explanations.

Test design ideas.
Decide if the ideas solve the problem.

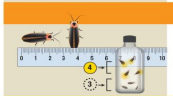
Analyzing and Interpreting Data

Use tools such as tables and graphs to...

Look for patterns in the data.
Does the data support the explanation?

Compare results for different designs.

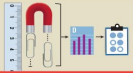
Using Mathematics and Computational Thinking



Use math to...

Develop models and make predictions.
Analyze data.
Look at patterns.

Develop models of different design ideas.
Predict—will a plan work?
Analyze data.

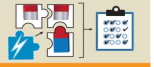


Constructing Explanations

Develop theories based on evidence to explain a phenomenon.

Designing Solutions

Develop and improve solutions to problems.
Do solutions meet criteria?

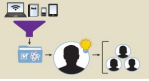


Engaging in Argument from Evidence

Decide on the best explanation for a phenomenon.
Base it on evidence and science.

Select and improve the best solution to a problem.
Base it on evidence from tests and rules.

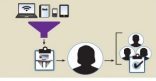
Obtaining, Evaluating, and Communicating Information



Use books and other media to learn more.
Decide if the sources are good ones.

Tell others about their ideas.

Tell others about the rules for the design ideas.



www.carolina.com/ssftc

Smithsonian Science Education Center

Smithsonian | SCIENCE for the classroom | CAROLINA

Crosscutting Concepts

Patterns

Is there a pattern?

Is there evidence that supports this pattern?

What caused this pattern?

What predictions can I make based on this pattern?

Cause and Effect

What is the evidence for a cause and effect relationship?

What are other possible causes?

How can I test this cause and effect relationship?

How is this relationship the same or different from others I have found?

Scale, Proportion and Quantity

How does this system look at a smaller scale?

How does this system look at a larger scale?

How will this system change if we change the scale?

How can we study nature at this scale?

Systems and System Models

What parts make up this system?

How do they work together?

What are the limits of this system?

In what ways is this system like others?

How can we improve the function of the system?

Energy and Matter

What does energy do in this system?

What is the role of matter in this system?

How are energy and matter related in this system?

How does matter enter and exit the system?

Structure and Function

How does the structure support the function?

How does the function depend on the structure?

How can the structure be improved?

How does the structure limit the function?

Stability and Change

What causes change in this system?

If the system is changing, what could make it become more stable?

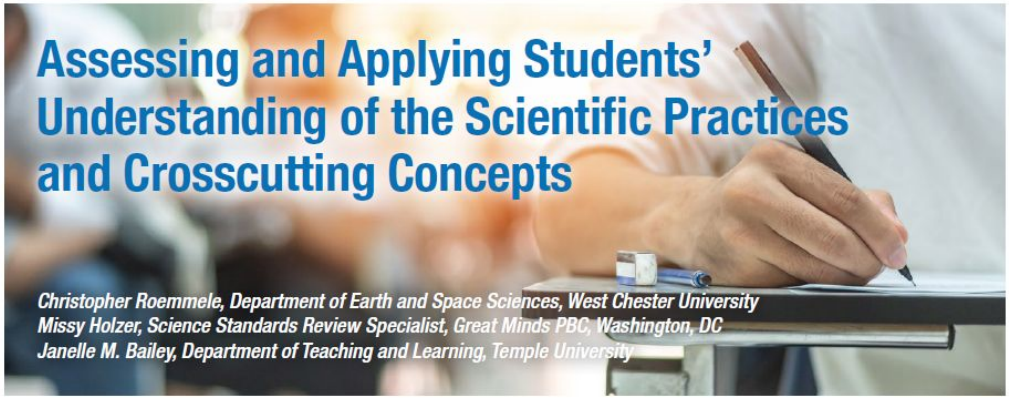
What causes stability in this system?

If the system is stable, what could cause it to change?

Assessing Student Work

Take 5 to read p.27-28, then we'll discuss!

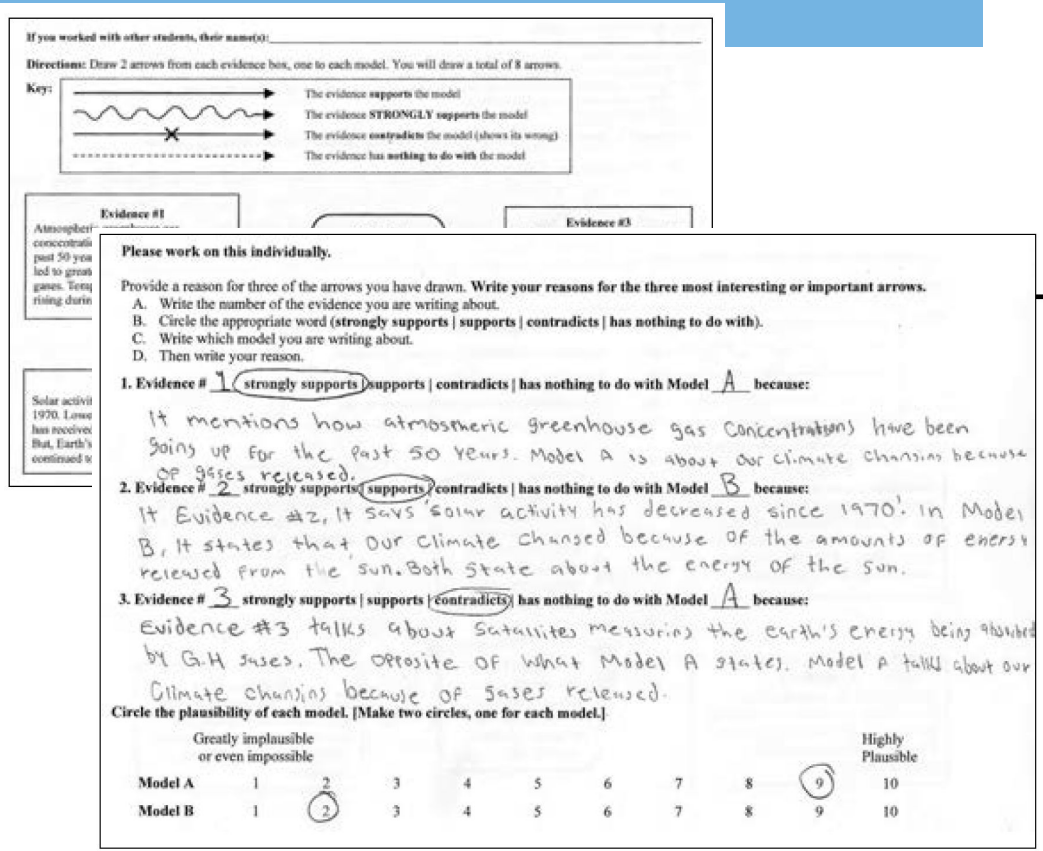
- *Based on what you read in the article, how would you assess student learning?*
- *What criteria you would look for when assessing student learning?*
- *What would a rubric look like?*



From the Fall 2020 issue of *The Earth Scientist.*

Assessing MEL Student Work Samples

1. Start by identifying the goal of the MEL - what was the goal of the Wetlands, Soil or Energy MELs we did earlier?
2. How would you know if students met this goal?



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

Evidence #3

Please work on this individually.

Provide a reason for three of the arrows you have drawn. **Write your reasons for the three most interesting or important arrows.**

A. Write the number of the evidence you are writing about.
B. Circle the appropriate word **(strongly supports | supports | contradicts | has nothing to do with).**
C. Write which model you are writing about.
D. Then write your reason.

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

It mentions how atmospheric greenhouse gas concentrations have been going up for the past 50 years. Model A is about our climate changing because of gases released.

2. Evidence # 2 **strongly supports | (supports) | contradicts | has nothing to do with Model** B **because:**

It Evidence #2, it says 'solar activity has decreased since 1970'. In Model B, it states that our climate changed because of the amounts of energy released from the sun. Both state about the energy of the sun.

3. Evidence # 3 **strongly supports | supports | (contradicts) | has nothing to do with Model** A **because:**

Evidence #3 talks about Satellites measuring the earth's energy being absorbed by G.H gases. The opposite of what Model A states. Model A talks about our Climate changing because of gases released.

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

Assessing Student Explanation Task

- Assessing proficiency in SEPs and CCs
  - SEPs: Developing and Using Models, Analyzing and Interpreting Data, Constructing Explanations, Engaging in Argument from Evidence
  - CCs: Cause and Effect, Stability and Change
- Types of responses in the rubric:
  - Mastering
  - Approaching
  - Developing
  - Beginning
- How would you describe each? What would each "look" like in a student work sample? What would you put in the rubric?

The MEL2 Team has developed a rubric that focuses on four SEPs (scientific & engineering practices) and two CCs (crosscutting concepts) using [NGSS appendices.]

MEL Explanation Task Rubrics

Science and Engineering Practices Rubric				
Science & Engineering Practice	**Mastery**	**Approaching**	**Developing**	**Beginning**
Developing and Using Models	The explanation clearly and accurately evaluates the merits and limitations of the different models of the phenomenon in order to select the most plausible model based on the evidence.	The explanation evaluates the merits and limitations of one of the two different models of the phenomenon in order to select the most plausible model based on the evidence.	The explanation has little or no evaluation of the merits or limitations of one of the two different models of the phenomenon in order to select the most plausible model based on the evidence.	The explanation does not evaluate the merits or limitations of either model, or the explanation is erroneous, in order to select the most plausible model based on the evidence.
Engaging in Argument from Evidence	The student's written explanation accurately and precisely identifies the strength or weakness of the evidence to model link based on comparing and integrating how evidence supports or contradicts a particular model using several lines of data from the multiple evidence texts.	The student's written explanation accurately identifies the strength or weakness of the evidence to model link, but the student's analysis may not be well integrated and/or may be missing comparisons to another model, with only a moderate level of justification using the data from the evidence texts.	The student's written explanation has some inaccurate information in identifying the strength or weakness of the evidence to model link, with little integration of the data from evidence texts or weakly justifying their reasoning with evidence from the texts or incorrectly applying one of the evidence pieces.	The student's written explanation conveys inaccurate information or does not identify the strength or weakness of the evidence to model link, with no integration of the data from evidence texts or justification with evidence or incorrectly lines of evidence

Let's look at our rubrics!

This is an analytical rubric, gauging:

1. Levels of performance
2. Criteria (i.e., the SEPs)
3. Detailed descriptors

Please take a look at the rubric...

What do you notice?

Would you use all four SEPs when assessing student work? Would you use only one SEP? Or some other combination?

What Does it Look Like?

Criteria: *Constructing Explanations*

Beginning

- *"Ev. #1 is stating that a lot of increases in temp. are being"*
- *"Fracking fluids and wastewater can be the cause of normal tectonic"*
- *"Show increase and decrease since Industrial Revolution."*

Statements are incomplete, erroneous, don't make sense, unrelated or wrong.

Developing

- *"Talks about how human activity affects Earth"*
- *"E3 has nothing to do with MA because it doesn't talk about fracking at all and just totally goes to natural causes."*
- *"they talk about two different things."*

Statements are correct but superficial, restate the obvious but no elaboration.

What does the rubric say?

What Does it Look Like?

Approaching

- *"The evidence talks about how the sun's energy is decreasing, but model B is stating how the Sun's energy is increasing"*
- *"In Model A its talking about fracking causing earthquakes and evidence #1 said that fracking causes stress on the crust."*
- *"Because the climate is currently changing due to the sun and the energy released"*

Statements provide correlation between model and evidence, provide additional elaboration

Mastery

- *"Most earthquakes occurs near a fracking site which may tell us that fracking causes earthquakes." "E3 has nothing to do with MA because it doesn't talk about fracking at all and just totally goes to natural causes."*
- *"If the increase in greenhouse gases which keep Earth's energy from escaping to space is caused by humans then it is human's responsibility the climate increase."*

Statements elaborate on relationship between model and evidence with clear or implied, cause-and-effect relationship

Let's Do #1 Together….

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

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

[Note: you may have to look at your previous ratings if you do not remember what they were. Ask your teacher for assistance.]

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.

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

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

Evidence 1 states that wetlands are important in global cycles and help humans through these cycles.

2. Evidence # 2 **strongly supports | supports | contradicts | has nothing to do with Model** A **because:**

Evidence 2 states that wetlands collect floodwater, therefore saving people from the damages of floods.

Wetlands MEL Explanation Task (11/30/2014)

MEL/baMEL	SEPs	CCCs
Climate Change	*Engaging in Argument from Evidence* *Constructing Explanations* *Analyzing and Interpreting Data*	*Cause & Effect*
Moon Formation	*Developing and Using Models* *Engaging in Argument from Evidence* *Constructing Explanations*	*Cause & Effect*
Fracking	*Engaging in Argument from Evidence* *Constructing Explanations* *Analyzing and Interpreting Data*	*Stability & Change*
Wetlands	*Constructing Explanations* *Engaging in Argument from Evidence* *Constructing Explanations*	*Stability & Change*
Freshwater Resources	*Engaging in Argument from Evidence* *Constructing Explanations* *Analyzing and Interpreting Data*	*Cause & Effect*
Extreme Weather	*Engaging in Argument from Evidence* *Constructing Explanations* *Analyzing and Interpreting Data*	*Cause & Effect*
Fossils	*Engaging in Argument from Evidence* *Constructing Explanations*	*Stability & Change*
Origins of the Universe	*Engaging in Argument from Evidence* *Constructing Explanations*	*Stability & Change*

Evaluate for:
SEPs:*Constructing Explanations and Engaging in Argument from Evidence*
CCC: *Stability and Change*

Norms for Evaluating Work Together

Please…

1. Be in the spirit of dialogue
2. Try to focus on what the students' actually write (i.e., what you observe)
3. Try not to focus on what you might infer from the students' writing
4. Try not to focus on what you think the students should know or be able to do
5. Be aware of your biases

Activity: Assessing Student Explanations

Working in Pairs & Groups:

- Work with a partner, and assess the samples by identifying the quality of the student response.
- Discuss your findings with your table –identify the evidence supporting your evaluation!
- Be prepared to support your claims!

https://tinyurl.com/LRMEL15A

THE LR MEL PROJECT

Reflection: Assessing Student Samples

Things to think about:

- How did you evaluate the work samples?
- Which rows [SEPs] of the rubric were easier to use? Which [SEPs] rows were more challenging to use? Why?
- What other things did you notice? What other thoughts about assessment do you have?

Keeping in mind student learning:

- At what level do we want students to support their claims?
- How do we GRADE them, or do we not grade them?

ACKNOWLEDGEMENTS

This research project is supported by the US National Science Foundation (NSF) under Grant Nos. 2201012, 2201013, 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.