**Teacher Guide**

**Unit:** Introduction to Models

**Main Idea:** Developing arguments based on reasons as they pertain to modeling.

**Lesson Timeline:** 2 Days Total

Lesson 1 – 15 minutes – Earthquakes and Reasons

Lesson 2 – 65 minutes – Volcano and Model Comparisons

**Day 1:** – (15 min) Earthquakes and reasons

(25 min) Volcanoes

**Day 2:** - (40 min) Model comparisons

**Objectives:**

Students will be able to:

* Support claims with reasons in a scientific context
* Evaluate and respond to the science claims and reasons of others

**Standards**

**CPI 5.1.8.D.1**: **Engage in multiple forms of discussion in order to process, make sense of, and learn from others’ ideas, observations, and experiences.** Science involves practicing productive social interactions with peers, such as partner talk, whole-group discussions, and small-group work.

**CPI: 5.1.8.D.2:** **Engage in productive scientific discussion practices during conversations with peers, both face-to-face and virtually, in the context of scientific investigations and model-building.** In order to determine which arguments and explanations are most persuasive, communities of learners work collaboratively to pose, refine, and evaluate questions, investigations, models, and theories (e.g., argumentation, representation, visualization, etc.).

**Assessment:** No assessment

**Materials:** PowerPoint: PRACCIS Intro to Models Slides Day 1

**Do now:**  Students will generate a list of ideas for making buildings safer in an earthquake zone. See PowerPoint slide 1 for details.

**Closure:** These two students sent the following message to the City Council. Which student gives better reasons for the kind of buildings that should be built? Explain Why? See PowerPoint slide 14 for student responses comparison.

**Homework:** No Homework

**Modifications:** Planned by the teacher as it fits the needs of their particular students.

**Important Note:** This is only a ½ day a lesson. The volcanoes activity should be started promptly following the conclusion of this activity. As a transition, make sure that students realize they will continue to use their reason stems in the next activities.

**Procedure:**

**Slide 1 (2 min):** Do now. Have the slide projected so that students entering the room can have time to work on it. Give students about 1 minute to work on it after the bell rings for the start of class. Spend about 1 minute getting student responses to the prompt. Prompt students to give reasons for their suggestions. Simple prompts like “Why do you suggest that?” will work here as it transitions to slide 2.

**Slide 2 (1 min):** As a debriefing from the Do Now emphasize to students that scientists and non-scientists, like lawyers and accountants, give reasons for their suggestions.

**Slide 3 (1 min):** The goal is for students to develop a habit of articulating reasons, asking others for reasons and generating productive disagreement. The content is somewhat secondary at this point because they don’t have a lot of evidence to support their arguments.

**Slide 4 (5 min):** On the board create 3 columns with the headings shown on the slides. Ask students to contribute phrases that they have been using. In advance plan a couple of stems that will fit in each category. If students are not particularly forthcoming first offer some of the things you hear them say during the discussion on slide 5. If they still have little to contribute offer a few suggestions (the ones you previously thought of) and see if that can help seed the discussion a bit. Note, not all disagreement stems need to be really nice. Some of it can just be matter of fact. For example, “I disagree with \_\_\_\_ because of \_\_\_\_.” We of course don’t want students to be mean spirited, but sugar coating is not necessary either.

**Slide 5 (3 min):** Have students work in **groups**. Have students practice using the stems for their discussion. Quickly model this for students by using a couple of stems yourself and then direct them to do the same. Circulate among the students and make note of language related to giving reasons, asking for reasons or disagreement. When appropriate offer praise for good use of the stems. Be careful to target the use of the strategy i.e. “That is a good use of the “X” stem.”

**Slide 6 (3 min):** Revise the list based on suggestions from students. Prompt with good things you heard as you were circulating if no new ideas are forthcoming.

**Slide 7 (0.5 min):** Emphasize that to reach their conclusions scientists also discuss different ideas and use lots of reasons.

**Slide 8 (0.5 min):** In general wood buildings are better in an earthquake because the beams and joints and can bend and flex.

**Lesson:** 2 – Volcanoes and Models

**Objective:**

Students will be able to:

* Support claims with reasons in a scientific context
* Examine and respond to the science claims and reasons of others

**Standards**

**CPI: 5.1.8.A.3: Predictions and explanations are revised based on systematic observations, accurate measurements, and structured data/evidence.** Use scientific principles and models to frame and synthesize scientific arguments and pose theories

**CPI 5.1.8.D.1**: **Engage in multiple forms of discussion in order to process, make sense of, and learn from others’ ideas, observations, and experiences.** Science involves practicing productive social interactions with peers, such as partner talk, whole-group discussions, and small-group work.

**CPI: 5.1.8.D.2:** **Engage in productive scientific discussion practices during conversations with peers, both face-to-face and virtually, in the context of scientific investigations and model-building.** In order to determine which arguments and explanations are most persuasive, communities of learners work collaboratively to pose, refine, and evaluate questions, investigations, models, and theories (e.g., argumentation, representation, visualization, etc.).

**Assessment:** No assessment

**Materials:**

Word Doc: PRACCIS Intro to Models Teacher Guide

Word Doc: PRACCIS Intro to Models Student Packet

PowerPoint: PRACCIS Intro to Models Slides Day 1

Powerpoint: PRACCIS Intro to Models Slides Day 2

**Homework:** No Homework

**Modifications:** Planned by the teacher as it fits the needs of their particular students.

**Procedure:**

A. Volcano Models Activity. **20 minutes total**

1. **(1 min.)** Read the top introduction to the students as a class on the top of page 1 (Slide 9). Direct students to use these ideas to think about what a scientific model is. Do not hold a class discussion at this point. Assure them that the purpose of this activity is to find out what *they* think, first individually, and then after they discuss in pairs.
2. **(6 min.)** Read the section beginning “Let’s think about models of how volcanoes erupt” on page 1 (Slide 10) to the class. Direct students to circle the images that they think is a scientific model. This is done **individually**. There are 12 models presented on pages 1 and 2 (Slides 11 and 12).
3. **(12 min.)** Use slide 13.In **pairs** students then discuss the images they circled as scientific models on pages 3 and 4. Make sure students are giving reasons for their answers during the pair works. Pairs then circle the images they agree on that represent scientific models. If some students have not discussed all the models, that is all right.
4. **Closure (1 min):** Use Slide 14. Ask for one or two pairs of students to offer what they think scientific models are. At this point, just accept whatever answers they give and say that you’ll all be working on these ideas again tomorrow.

End of Day 1

Start Day 2. This has two parts, B and C, which total 40 minutes.

B. Which model is better? **25 minutes total**

1. **Do Now (1 min.)** On slide 1. Have students read the top of page 5 of the volcanoes packet.
2. **(1 min)** On slide 2. Introduce the activity by reading highlights from the top of page 5 to the students. Explain to them that they will follow the same basic procedure on each page. Instruct them to read the top part carefully, because sometimes the questions are slightly different.
3. **(1 min)** On slide 2. **Individually**, students decide which butterfly model is better on page 5. Students circle their answer in the individual answer box at the bottom of the page.
4. **(3 min)** On slide 3. **In pairs**, students discuss the model they picked. Make sure students are giving lots of reasons for their answers during this discussion. Emphasize this to any groups that you feel are falling short, but do not comment on the content of their ideas—just whether they are giving and asking for reasons, and disagreeing where appropriate (of course, they will not always disagree).
5. **(0.5 min)** On Slide 3-4. Students then select a final answer in the box provided at the bottom of the page. Make sure students do not change their initial answer.
6. **( 4.5 min)** On Slides 5-7. Students will complete these three steps (3-5) for the models on page 6 as well. Again, briefly encourage students to give reasons and disagree where appropriate.

Again, during group work, focus on the norms for giving reasons and expressing disagreement when appropriate. Do not comment on the content of their ideas; instead, comment on whether they are giving and asking for reasons, and disagreeing where appropriate (of course, they will not always disagree).

1. **(15 min)** Slides 8 and 9.Students are presented with a variety of models on pages 7-12. Introduce each of the first set of models by reading the top of page 7 to the students (also shown on slides 8 and 9). Here students are asked to determine which model is better to explain a specific scientific phenomenon. During the pair work discussion, students are asked to discuss four questions. Make sure students are answering these questions. Give feedback on group work as in steps 4 and 6 above—focusing on norms and not on the content of what students are saying.

Emphasize to students that it is all right if they do not finish all the pairs. Urge them not to rush, but to take their time to give reasons and disagree with each other whenever appropriate. Tell students that you hope they will finish at least pair 5, but it is fine if they go on and do more if they have time (after fully discussing each pair).

C. Characteristics of good models- **5 minutes total**

1. **(5 min)** On slide 10. Once students discuss and review all the models in the activity, they then think about and list 6 characteristics of good models, Page 13. Students then rank their list of characteristics (1=best, 6=least importance).
2. **(Concurrent with C.1.)** Go around the room to get a sense of what the characteristics the students are writing down as they are working.

D. Final discussion (also serves as closure). **10 minutes total**

1. **Closure (10 min)** Lead a class discussion about the model

On slide 11. Each class will make a list of criteria. Please do not inform students that they will be generating a class list until after they have listed their 6 characteristics. If time permits, have students evaluate the pairs of models on Slides 12-19 for the class list of criteria they just generated.

A. Core question: What are the characteristics—the criteria—for good models?

(What we mean by “criteria” for good models are the characteristics that good models have. These are the criteria for good models. You have just written six of your ideas about criteria for good models on your paper.)

Elicit ideas from students. When students give their ideas, probe deeper with questions such as these, with different criteria substituted for the blanks:

1. Why should good models \_\_\_\_\_\_\_ (fit the evidence, be simple, show steps, fit the evidence, etc.)?

Why is it important to put this on our list?

What do other people think about Sarah’s criterion?

2. Which model shows an example of this criterion?

Which model shows a step by step process?

What in this model makes you think that this shows a clear step by step process?

What is an example of a model you looked it that has good fit with the evidence?

Why do you think it fits the evidence well?

What is an example of a model that is really clear?

Which of the models that you looked at was *not* clear?

Why do you think it was not clear.

IN SHORT, PLEASE ENCOURAGE STUDENS TO DO THESE TWO THINGS:

1. Explain their reasons for why particular criteria are important.

2. Explain why particular criteria are or are not found in different models that they looked at.

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| SOME CRITERIA TO AIM FOR  Allow scope for students to generate their own criteria. You will have the rest of the year to take this initial list and modify and refine it.  However, there are two criteria that you should push for, if students don’t spontaneously bring them up on their own. (And it is likely that all of these *will* be brought up by students.) But just in case, here are three useful criteria, and some ideas for eliciting them just in case students don’t.  1. Something like: *Fit with evidence.* If students do not bring this up spontaneously, ask them about Pair #3 on page 7 (the food poisoning models).  2. Something like: *Shows all the steps.* You could have them look at Model A in Pair #1 (Butterly model A). Ask them if the model would be as good if it only showed the egg, the caterpillar, and the adult, and left out the other steps. They will likely readily agree that it needs to show all the steps. (This idea of showing steps is a first step toward getting them to think about mechanisms.)  3. Something like: *Gives an explanation*. If students do not bring this up, ask them about Model A in the global warming pair (Pair #6, page 10). |

Emphasize to students that they will be able to use these criteria to help decide how strong or weak evidence is throughout the rest of the year, and indeed throughout their lives! And emphasize that they’ll be adding to and refining this list this year.