Professional Development Situation: Training

Skill Focus: Modeling Science Practices

Time Required: 75 minutes

DEVELOPING AND EXPANDING YOUTH EXPLANATIONS

Participants will learn how to support youth to engage in science practices through an Exploring Soil Ecology activity.

Agenda

Welcome - 5 minutes

Introduction – 10 minutes

Hands-on Learning and Practice - 45 minutes

- Exploring Soil Ecology
- Sharing & Explaining Findings video-based learning module

Conclusion - 15 minutes

Materials

- Computer with Internet connection, projector and speakers
- Nametags
- Blank paper
- Markers or colored pencils
- Chart paper and markers
- One copy of Science and Engineering Practices for each participant.
- One copy of Exploring Soil Ecology Guide for each participant.
- One copy of Modeling the Jam Jar Experiment for each participant
- Materials for Exploring Soil Ecology
    - Prepare soil jars in advance (1 per group) – see Exploring Soil Ecology Guide for instructions
    - Labels or tape
    - Water

- Sticks to stir (1 per group)
- Tape measure or ruler

Before the Session

- **Read this training guide** to become familiar with the content and allow time to personalize the activities to best suit your presentation style. Watch all videos and read informational materials.
    - *Italics indicate text that can be read aloud or emailed to participants.*
- Send reminder email about the training. Determine if any participants require accommodations (sight; hearing; etc.).
    - *The next professional development opportunity to enhance our STEM skills will be on DATE at TIME at LOCATION. Our focus for this session will be "Modeling Science Practices". Let me know if you require any accommodations to participate in the training. I am happy to answer any questions you have and look forward to seeing you at the workshop. I can be reached at CONTACT INFO.*
- Gather all materials needed for the training.
- Develop a list of possible questions participants might have during the training. Create potential responses to be explored through informal conversation. Review any key terms or ideas that may be unclear.
- On the day of training, test the audio and video equipment.
- Set out supplies for the Exploring Soil Ecology activity. Arrange supplies so each group can easily pick up what they will need (trays or small boxes can make this much easier).

Training Outline

Welcome (5 min)

- Greet participants as they arrive. Make sure everyone feels welcome and comfortable in the learning environment. Pass out nametags.
- Introduce yourself and the focus of the session: "Modeling Science Practices".
- Ensure participants are aware of the locations of restrooms facilities, refreshments, etc.
- Post or read aloud the following text:
    - *Our job as staff and volunteers working with youth is to FACILITATE, SUPPORT and ENCOURAGE the development of STEM skills using QUESTIONING and MODELING of science and engineering practices.*

Introduction (10 min)

- Pass out the Science and Engineering Practices Handout. Have participants to review the practices in the handout.
    - *Which ones have you engaged in in the last two weeks with your youth?*
    - *Which are most difficult to engage in?*
    - *What do you think "Developing and Using Models" entails? What do you know about modeling? (responses may include drawing images of the experiment, using mathematical modeling, using diagramming)*
    - *What do you think " constructing explanations" involves? What sort of activity would allow youth to practice constructing explanations?*
    - *Today we will practices using a model and constructing explanations with the Exploring Soil Ecology activity.*

Hands-on Learning (45 min)

- For this portion of the training, you will follow the Exploring Soil Ecology activity. Divide participants into teams of three or four.
    - Hand out the Exploring Soil Ecology guide from www.soil-net.com, which includes a pie chart worksheet.
    - *In this activity, you will add water to your soil sample, observe it for a minute, then stir the mixture. After that you let it sit. We will come back to it later to see what happens. As the water settles, different layers will appear.*
    - Have each team send one person to gather supplies for their group.
- **Give participants time** to start the activity (add water, observe soil, and stir the soil). The soil will have time to settle as the group completes the next parts of the activity.
- As they work, encourage them to **write down any questions** that come to mind about the activity.

Highlighting Science Practices

- Cue up the skill video from Sharing & Explaining Findings video-based learning module (the second video, 2:50 minutes long).
    - *As we watch this video, notice how Andrea supports understanding of the soils model and encourages youth to develop their explanation based on their observations and data. You can take notes on your handout if you want to.*
- **Watch the video** together and use the Pair and Share strategy for a brief discussion - have participants share their observations with one or two people sitting next to them.

- Pull out the Science and Engineering Practices Handout, and have participants reflect on which practices are part of this activity. Encourage them to take notes on their handout.
    - *What kinds of science practices would youth engage in as they do this activity?*
- **Discuss** each of the science and engineering practices and whether they were present in the activity.
    - *Do youth conduct an investigation? (yes)*
    - *Do youth use a model? (yes)*
    - *Who initiated the investigation? (the facilitator, not the students)*
    - *Do youth analyze and interpret data? (yes)*
    - *Do youth construct explanations using their data? (yes)*

Making Sense of Models

- **Note:** It is likely that participants will need time to make sense of modeling as it's indicated in the NGSS, which is different than many people think of modeling. The NGSS vision of modeling includes many types of models, including mathematically-based models (like those we think of in physics, like F = M*A) or models that include components and relationships (like most food webs).
- Pass out the Modeling the Jam Jar Experiment handout or display images on a slide.
    - *Now we are going to compare two models that scientists have used to illustrate what happens with soil. These are scientists' models; we wouldn't use them with youth.*
- Optional: Draw a Venn diagram to compare the models on a public place so everyone can contribute.
    - *What does model one show us? (It connects a map, a cross-section of the soil, and shows weathering over time. It uses variables to represent parts of the system. It uses arrows to show parts and relationships.)*
        - *Note: Model One has the goal of representing the processes occurring in one specific area.*
    - *What does model two show us? (It also has parts and relationships, it uses a background image to give context, it shows the relationship of farm waste to soil, it shows a process that occurs over time.)*
        - *Note: Model Two illustrates a finding from a study that modeled the effect of farm waste.*
    - *Is our jam jar a good model? (Not really; if we draw the layers we are showing a diagram but not really a causal relationship or an example of how a process*

works. Science tries to explain why things occur, not just to diagram how they are, although observation is part of data gathering. The jam jar does allow good data representation and close observation.)

Collecting and Interpreting Data

- Bring the group back to the Exploring Soil Ecology activity. Teams will finish their observations and create their pie charts.
    - *Observe the soil and water in your jar. Is it starting to settle out?*
    - *As the water settles, different layers should appear. The largest and heaviest particles will settle to the bottom of the jar. The next layer sill be silt particles which are smaller and weight less than sand and pebbles. Clay particles are even smaller, and will separate out last. Organic material will float on top of the water and will not settle.*
- Give participants time to create their pie charts
    - *Use your tape measure/ruler to measure the layers in your jar. Then use the colored pencils to create your pie chart.*
    - Encourage everyone to continue to write down questions that come to mind as they create their chart.
- When participants are finished working, debrief.
    - *What questions arose for you as you did this activity?*
        - *How did you explore them? What are your findings?*
    - *What effect did it have to write down your questions? (encouraged curiosity)*
    - *Were you surprised by how many science practices were part of this activity? Why?*

Conclusion (15 min)

- **Help participants to reflect** on how they can apply this learning in their practice.
    - *Think about the upcoming activities you have planned. Which of the science and engineering practices could you highlight as part of those activities?*
    - *Developing and using models is really challenging for youth. How might you use models in your program and help youth understand how they can use models in science and engineering?*
    - *Take time to plan this out; what will these models look like? They can be posters, whiteboard, or other kinds of representations.*
- **Brainstorm ideas together** and record them on a piece of chart paper "Using models."

- Think about the next steps that you want to put into action. Write some notes to take with you about what you want do next when you get back to your program.

After the Session

- From notes you took on the pieces of chart paper, compile a list of strategies for organizing, recording and documenting experiments/experiences shared by the group. Share this in your follow your follow-up email to participants.
- Within 2-3 weeks of the training, email participants:
    - *Thank you for your participation in the recent Click2Science training on "Modeling Science Practices". I hope you found it useful. Attached are some strategies the group discussed during the training. Consider meeting with a co-worker, supervisor, or friend to share the modeling goals you are working on. I look forward to continuing our learning at the next session on SKILL/FOCUS on DATE at TIME at LOCATION. Please let me know if you have any questions. I can be reached at CONTACT INFO.*

Want to Earn Credit? Click2Science has teamed up with Better Kid Care to provide continuing education units. Check it out at: http://www.click2sciencepd.org/web-lessons/about

Science & Engineering Practices

From the Framework for K-12 Science Education

National Research Council. (2012). A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas. Washington, D.C: The National Academies Press.

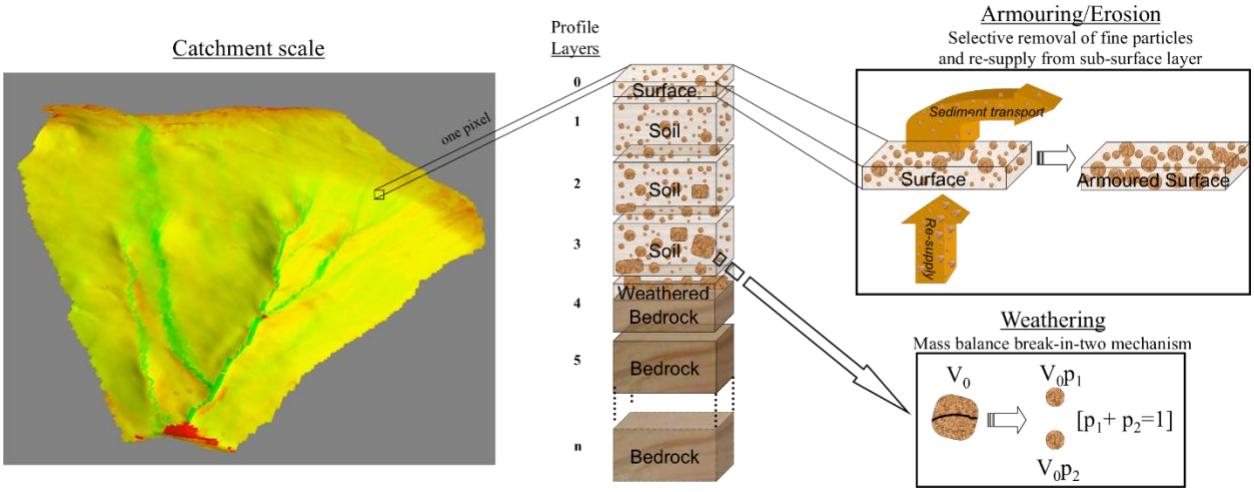
As part of scientific inquiry, youth will regularly engage in:

1. **Asking questions (for science) and defining problems (for engineering)**
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 (for science) and designing solutions (for engineering)**
7. **Engaging in argument from evidence**
8. **Obtaining, evaluating, and communicating information**

Note: These practices are not meant to stand alone, but to be used in conjunction with science content and crosscutting concepts. They should also be driven by youths' interests and developing identities. Read more at www.nextgenscience.org

Modeling the Jam Jar Experiment

Model 1 (Credit: Surface Modeling Lab at the University of Alabama)



Model 2 (Credit [Scotti et al., 2015])