Slides presented at the
2015 NGSS Network Leadership Conference

Elementary School Lesson Presentation

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NEXT GENERATION SCIENCE STANDARDS
For States, By States

Session Layout

- What to look for…
- Lesson
  - Setup
  - Engage in the lesson as a student
  - Closure of the lesson
- What did you see?
- Other important things to look for and final thoughts

What to look for…

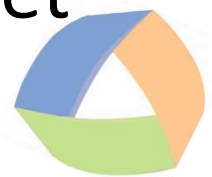
- Recognition of time limitation and that this is a snapshot of the classroom
- Recognition of where we are in implementation

What to look for…

- Used the EQuIP Rubric as a starting place
- Though it is designed to look at curriculum and not instruction, we thought it might provide a good basis to identify and modify questions for this session

A few big ideas from the EQuIP

- Practices, disciplinary core ideas, and crosscutting concepts work together to support students in making sense of phenomena and/or designing solutions to problems
- Provides opportunities for students to develop and use the three dimensions
- Lessons fit together coherently targeting a set of performance expectations



In Context: What to Look for in the Lesson

- Purpose of the lesson
  - How does the lesson help students make meaning of the phenomena while deepening their understanding of the three dimensions targeted by the lesson and building toward proficiency on the PEs?
  - What will this lesson expose students to that would contribute to the overall understanding and how is this made explicit for students?

In Context: What to Look for in the Lesson

- Three dimensions
  - How were the students engaged in three-dimensional learning?
    - Opportunities to use and construct each of the dimensions
    - Dimensions work together to help the students make sense of phenomena or design a solution to a problem
- Coherence
  - How did the lesson fit into a coherent picture that would support students in being able to demonstrate the understandings identified in the standards?

Evidence

I can see it, point to it in a lesson or unit, highlight it, or quote it directly from what is written.

Shedding Light on Light!

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NGSS Unit Bundle

1.Waves: Light and Sound

Students who demonstrate understanding can:

1. **Plan and conduct investigations to provide evidence that vibrating materials can make sound and that sound can make materials vibrate.** [Clarification Statement: Examples of vibrating materials that make sound could include tuning forks and plucking a stretched string. Examples of how sound can make matter vibrate could include holding a piece of paper near a speaker making sound and holding an object near a vibrating tuning fork.]
2. **Make observations to construct an evidence-based account that objects can be seen only when illuminated.** [Clarification Statement: Examples of observations could include those made in a completely dark room, a pinhole box, and a video of a cave explorer with a flashlight. Illumination could be from an external light source or by an object giving off its own light.]
3. **Plan and conduct an investigation to determine the effect of placing objects made with different materials in the path of a beam of light.** [Clarification Statement: Examples of materials could include those that are transparent (such as clear plastic), translucent (such as wax paper), opaque (such as cardboard), and reflective (such as a mirror).] [Assessment Boundary: Assessment does not include the speed of light.]
4. **Use tools and materials to design and build a device that uses light or sound to solve the problem of communicating over a distance.*** [Clarification Statement: Examples of devices could include a light source to send signals, paper cup and string "telephones," and a pattern of drum beats.] [Assessment Boundary: Assessment does not include technological details for how communication devices work.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Planning and Carrying Out Investigations

Planning and carrying out investigations to answer questions or test solutions to problems in K–2 builds on prior experiences and progresses to simple investigations, based on fair tests, which provide data to support explanations or design solutions.

- Plan and conduct investigations collaboratively to produce data to serve as the basis for evidence to answer a question. (1-PS4-1),(1-PS4-3)

Constructing Explanations and Designing Solutions

Constructing explanations and designing solutions in K–2 builds on prior experiences and progresses to the use of evidence and ideas in constructing evidence-based accounts of natural phenomena and designing solutions.

- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena (1-PS4-2)
- Use tools and materials provided to design a device that solves a specific problem. (1-PS4-4)

Connections to Nature of Science

Scientific Investigations Use a Variety of Methods

- Science investigations begin with a question. (1-PS4-1)
- Scientists use different ways to study the world. (1-PS4-1)

Disciplinary Core Ideas

PS4.A: Wave Properties

- Sound can make matter vibrate, and vibrating matter can make sound. (1-PS4-1)

PS4.B: Electromagnetic Radiation

- Objects can be seen if light is available to illuminate them or if they give off their own light. (1-PS4-2)
- Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (Boundary: The idea that light travels from place to place is developed through experiences with light sources, mirrors, and shadows, but no attempt is made to discuss the speed of light.) (1-PS4-3)

PS4.C: Information Technologies and Instrumentation

- People also use a variety of devices to communicate (send and receive information) over long distances. (1-PS4-4)

Crosscutting Concepts

Cause and Effect

- Simple tests can be designed to gather evidence to support or refute student ideas about causes. (1-PS4-1),(1-PS4-2),(1-PS4-3)

Connections to Engineering, Technology, and Applications of Science

Influence of Engineering, Technology, and Science, on Society and the Natural World

- People depend on various technologies in their lives; human life would be very different without technology. (1-PS4-4)

Practices:

- Plan and conduct investigations (1-PS4-1, 1-PS4-3)
- Make observations to collect data that can be used to make comparisons
- Use observations to describe patterns and/or relationships
- Compare predictions
- Ask questions based on observations
- Ask and/or identify questions that can be answered by an investigation.

Core Ideas:

Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam. (1-PS4-2, 1-PS4-3)

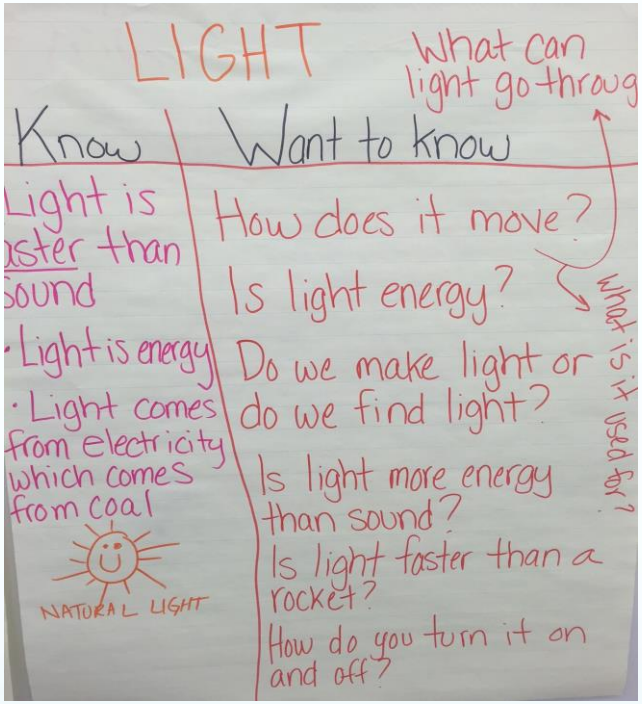
Crosscutting Concepts:

- Simple tests can be designed to gather evidence to support or refute student ideas about causes. (1-PS4-1, 1-PS4-2, 1-PS4-3, 1-PS4-4)
- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

Nature of Science:

Science investigations begin with a question! (1-PS4-1)

The Role of Questions



- Ask questions **based on observations** to find more information about the natural and/or designed world(s).
- Ask and/or identify questions that can be **answered by an investigation.**

Things To Consider As You Think Like A 5 Or 6 Year Old

- You have brainstormed what you know and want to know about light in the prior lesson.
- You have never tested materials with light in a school setting.
- You've discussed in groups when in our lives light is important and what it would be like not to have light.
- You do not yet know about "fair tests" when exploring materials.
- You still use observation (sight and feel in particular) to understand the world around you.
- You are still learning to explicitly note "cause and effect" as a way to explain the world around you.

Planning an investigation

What can light go through?

What can light go through?

What do you think is going to happen when you place different materials in the path of light? Why? Which materials will do what?

What can light go through?

Today you will use the following Habits of Mind:

- Collaborate and inspire teamwork
- Support ideas with reasons why

Today you will use your PICTURE, PEOPLE AND NATURE, and MATH “smarts”

Material Manager and Collaboration Conductor

Materials Manager:

- In charge of retrieving and putting back materials

Collaboration Conductor:

- Tries to solve the conflicts and transform them into new ideas
- Ensures that each person has an opportunity to touch materials
- Ensures that all ideas are heard

What can light go through?

End

What did light go through?

What did light go through?

What happened when light did not go through a material?

Were there some materials didn’t just block light or let light through, but did something else?

How does this compare to what we predicted?

Which materials did what?

How can we answer this question?

What materials do you think will let light through?
Why do you think that will be the case?

Which will let only some light through? Etc.

What materials did what?

End

Present your results

Why did you group the particular items together?

What happens with the materials in each group that makes them the same? What is similar about these materials?

What is different about the materials in different groups?

What do you think caused the light to go through the materials completely, partially, not at all or bounce off the materials? What did you find in your test that supports this?

How did this compare to our predictions of what would be in each category?

Reflection

What are some materials in your house that don’t let light through?

Where have you seen materials that let only some light in?

What are some objects that are made out of materials that let light through?

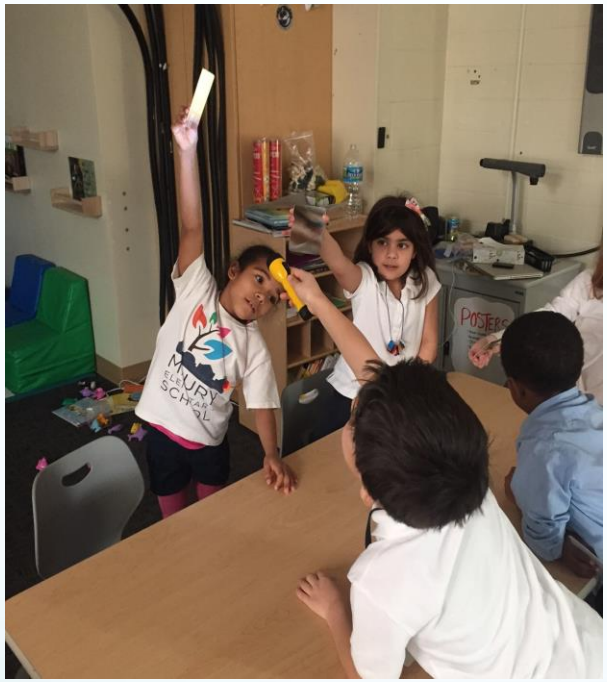
Where have you seen you seen shadows before?

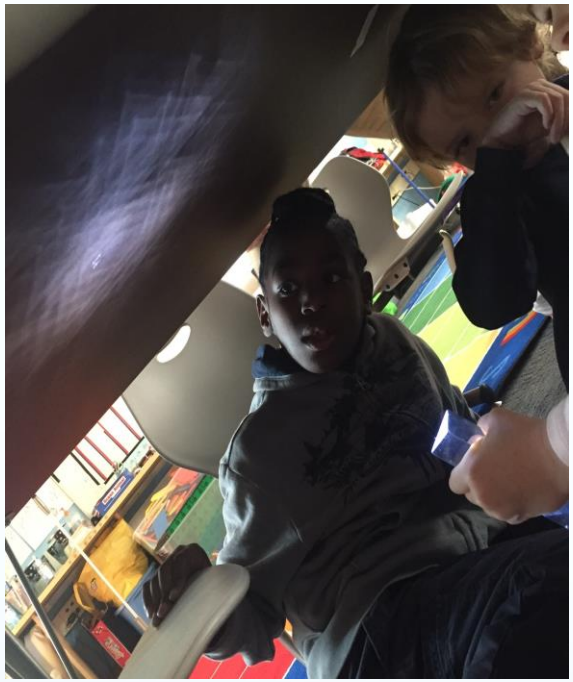
What did we learn about planning an investigation that we should remember next time we want to plan an investigation?

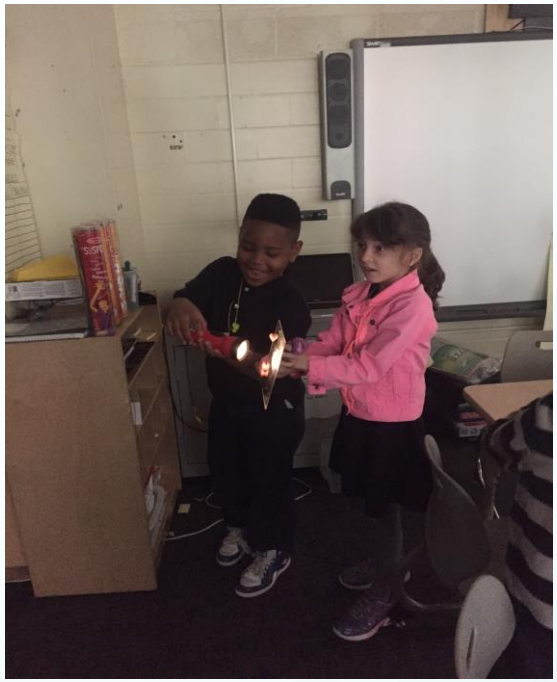
DATA COLLECTION

- **Use and share** pictures, drawings, and/or writings of **observations.**
- **Use observations** (firsthand or from media) to **describe patterns and/or relationships** in the natural and designed world(s) in order to answer scientific questions and solve problems.
- **Compare predictions** (based on prior experiences) to what occurred (observable events).

Exploration and Observation to Rich Investigation







Plan and conduct an investigation **collaboratively** to **produce data** to serve as the **basis for evidence to answer a question**.

Make observations (firsthand or from media) and/or measurements to **collect data** that can be used to **make comparisons.**

Facilitation Questions

How would you describe what you see happening?

How do you know that _____ is causing this?

What happens if you _____?

When you put both materials in the path are you able to tell which materials is causing what? Why or why not? What could we do differently to figure this out?

Facilitation Questions

How did the questions I asked:

- Move students from exploration to planning an investigation?
- Have students articulate what they noticed and what that means, based on their prior knowledge?
- Have students delve deeper into their observations to determine what they know and what they don't know yet?
- Help students consider how they did something, and the relationship between how they did something, and the results that they saw?
- Help students make the connections between what they did and the new information they have learned?
- Help students see the relationships between what they thought was going to happen, what happened, and the test they did to show that?

Crosscutting Concepts

How did the lesson provide opportunities for students to explicitly use the crosscutting concept to understand the phenomena of how light does or does not pass through materials?

How did the incorporation of the crosscutting concept deepen the students' learning experience?

What is different?

This DCI is similar to what students have done in the past, but the practices and crosscutting concepts are more complex and more explicit, which allows for a deeper understanding of the DCI.

What is different from the teacher perspective?

Practices:

- Plan and conduct investigations
- Make observations to collect data that can be used to make comparisons
- Use observations to describe patterns and/or relationships
- Compare predictions
- Ask questions based on observations
- Ask and/or identify questions that can be answered by an investigation.
- Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.

Crosscutting Concepts:

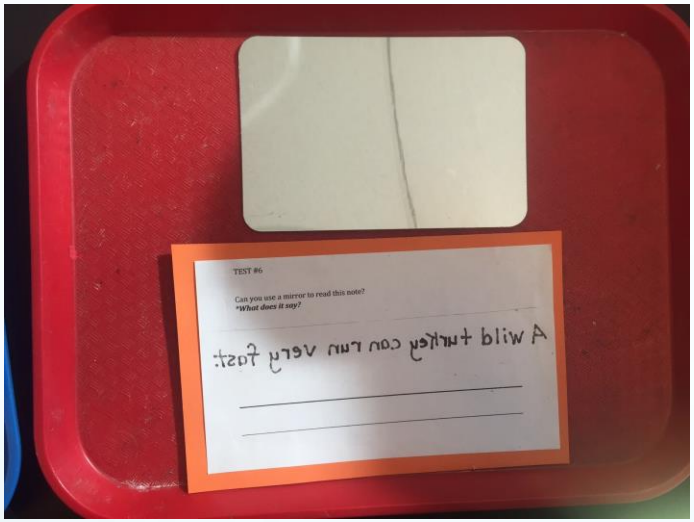
- Simple tests can be designed to gather evidence to support or refute student ideas about causes.
- Patterns in the natural and human designed world can be observed, used to describe phenomena, and used as evidence.

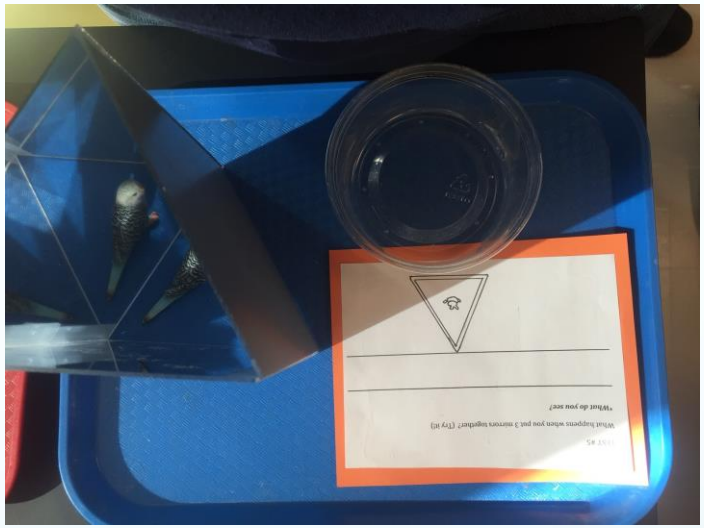
Core Ideas:

Some materials allow light to pass through them, others allow only some light through and others block all the light and create a dark shadow on any surface beyond them, where the light cannot reach. Mirrors can be used to redirect a light beam.

What lessons come next in this unit?

- **Mirror investigation stations**
  - Communicating findings with drawings and words





- **Absence of light investigations (pinhole boxes)**
  - Creating a device to block light
- **Designing a device to use light to communicate over a distance**
  - Real-world connections to light uses

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    - Dimensions work together to help the students make sense of phenomena or design a solution to a problem
- Coherence
  - How did the lesson fit into a coherent picture that would support students in being able to demonstrate the understandings identified in the standards?

Other important things to look for?

What are some other things we would want to see in a high-quality lesson aligned to the NGSS?