



Meaningful Learning about Light

Title: Meaningful Learning about Light

Estimated Time: 1-2 Periods

Core Ideas (GSE Standards):

S4P1. Obtain, evaluate, & communicate information about the nature of light & how light interacts with objects.

- a. Plan & carry out investigations to observe & record how light interacts with various material to classify them as opaque, transparent or translucent.
- c. Plan & carry out an investigation utilizing everyday materials to explore examples of refraction.

Constructing Explanations and Designing Solutions

Use evidence to construct or support an explanation or design a solution to a problem.

Engaging in Argument from Evidence

Construct and/or support an argument with evidence, data, and/or a model.

Crosscutting Concepts

Patterns:

Patterns can be used as evidence to support an explanation.

Cause and Effect

Cause and effect relationships are routinely identified, tested, and used to explain change.

Energy and Matter

Energy can be transferred in various ways and between objects.

Authentic Scenario

In this phenomena, students investigate key concepts regarding the nature of light. Using translucent beads and colored pipe cleaners, students observe, predict, and explain their ideas. After describing the rather bland beads as specifically as possible, students share ideas regarding how the beads can be changed. Students are then challenged to experiment with the beads and observe whether they can be changed in any noticeable way. While their initial (indoor) attempts are unlikely to be fruitful, amazing changes occur when students are encouraged to take a break outside (with their beads of course).

After observing these changes, students brainstorm possible causes for this colorful transformation. Upon returning to their classrooms, students observe additional changes to their beads as they begin to make sense of these interesting changes. Additionally, they consider the harmful effects of UV light and discuss the importance of sunscreen for proper protection.

Guiding Question:

What causes translucent beads to change in a significant way?

5-E Lesson Format

5E Stage	Student Activities How will students engage actively in the three dimensions throughout the lesson?	Teacher Activities How will the teacher facilitate and monitor student learning?
Engage	<ul style="list-style-type: none"> • Students are given 4-6 translucent beads and a pipe cleaner and are asked to observe the beads closely. • Students generate as many terms as possible to describe their beads. • Students are challenged to measure their beads in at least 2-3 ways. • Students are asked to generate questions that they have regarding the beads. 	<ul style="list-style-type: none"> • Distribute the beads and pipe cleaners. • Encourage students to make careful observations and measurements (ex. mass, length, radius, circumference) • Share and discuss questions that are generated
Explore	<ul style="list-style-type: none"> • Students in groups of 2 are challenged to brainstorm different factors that they think could change the characteristics (properties) of the beads. • Students experiment with these factors to see if any of them produces observable changes in the beads. • Students discuss their observations/results. • Without knowing it immediately, students observe the beads in an outdoor setting. • Students observe changes in the beads when they return to the classroom. 	<ul style="list-style-type: none"> • Encourage students to brainstorm multiple ideas that could change the beads. • Ask/answer appropriate questions to guide student work as they experiment with different factors. • When going outside, make it seem like it is a break so that students are surprised when changes occur. • Encourage students to measure changes in quantifiable ways.
Explain	<ul style="list-style-type: none"> • Students use their observations and data to explain/diagram what they think is causing the beads to change in color. • Students design and perform an experiment to provide evidence to support their cause-effect explanation. • Students read/research information about the beads by reading <i>Understanding Ultraviolet Light</i> article. • Students revise/improve their explanation of how the beads work based on the information obtained during reading/research. 	<ul style="list-style-type: none"> • As needed, reiterate to students the importance of identifying and testing cause-effect relationships. • After the reading, discuss the types of light and the effect of UV light absorption. • Emphasize the dangers of overexposure to UV light and the importance of wearing sunscreen.
Elaborate	<ul style="list-style-type: none"> • As an extension, students test the effectiveness of different sunscreens by using the beads to see how well they block the UV light. • Use various strengths of sunscreen (SPF 4, 15 and 50, for example). • Place the beads in a ziplock bag and apply a layer of sunscreen to the outside of the bag. Use a permanent marker to write the SPF number of the sunscreen you're testing on the outside of the bag. 	<ul style="list-style-type: none"> • As needed, assist students in developing and refining their tests. • Emphasize the importance of product testing and the engineering that is involved in testing procedures. • As needed, assist students in developing a measurable

	<ul style="list-style-type: none"> • Be sure to set-up one bag without any sunscreen coating for comparison purposes. • Expose the beads to sunlight for 4-5 minutes and look for any changes in color. • It is helpful to rate the color of the beads on some sort of measurable scale that indicates the “least” color and the “most” color. 	scale for their beads (1-5, or 1-10 work well).
Evaluate	<p>Formative: Each student presents their revised/improved model of how the UV beads work to their group based on the information obtained during reading/research.</p> <p>Summative: Each group summarizes their revised/improved model of how UV beads work based on the information obtained during reading/research.</p> <p>Students complete journal entries documenting observations, data, discussions, and conclusions.</p>	<p>Formative: Facilitate ongoing questioning & discussion</p> <p>Promote discussion of diagrams/models and explanations.</p> <p>Summative: Evaluate group presentations</p> <p>Evaluate journal entries.</p>

Teacher Notes: This lesson works the best when done in an inquiry manner. Encourage students to brainstorm and then try out as many ideas as possible with respect to factors that may change the beads. A few students may mention (know) that they are UV beads that are sensitive to light. If so, you can have them observe the beads in the classroom light (not UV) and even let them go to the windows to observe what happens when they are exposed to sunlight (luckily glass absorbs most of the UV light).

After experimenting with the beads for several minutes, students will often get frustrated that the beads don't change in any measurable manner. This is actually good as we know science involves a lot more perspiration than inspiration. And even when they go outside, there are many plausible options to explain the beads behavior including temperature, humidity, and fresh air to name a few. Encourage students to test out their ideas and obtain evidence to support their explanations.

Ultraviolet beads can be purchased in bulk from Steve Spangler (www.SteveSpanglerScience.com) or Educational Innovations (www.teachersource.com). While the beads are pretty inexpensive, they can be recycled each year if your budget is tight. You can also purchase a portable UV light from Walmart or other vendors so that you demonstrate the light absorption without having to go outside each time.

Materials needed:

- 4-6 UV beads per student
- 1 Pipe cleaner (also called Chenille Stems or Fuzzy Sticks) per student.
- 1 sun per group (ha ha)
- Various measuring materials such as a scale, ruler, thread for observing/testing beads.
- Portable UV light (optional)
- Lab notebook
- Phone/iPad for taking pictures (optional)
- Sunscreens with a variety of SPF's and zip lock bags (extension activity only)

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