Lesson 8: Teacher Reference 1

Extension Opportunity: Surface Scattering and Everyday Phenomena

Activity 1: Disney Concert Hall Reading

Time
45 min

Materials per student
1 *Reading: Walt Disney Concert Hall Case Study* (There is a color copy of the reading in the *Student Edition*. The Lexile range for the reading is 810L-1000L.)
1 highlighter (optional)
slides U-X (optional)

Procedures
Cluster related phenomena that pertain to shiny and reflective surfaces. From the Related Phenomena list and Self-Documentation Collection, point out that many of students' ideas and experiences were about highly reflective surfaces like mirrors, smooth countertops or materials, and calm water. Pose the question, *Why are some materials "shiny" or "reflective"?* Elicit students' initial ideas.

Listen for students to suggest these ideas:

- The materials are really smooth.
- The materials are coated in something to make them this shiny.
- The materials are designed in a way to cause reflection.
- The light shines on the materials in a certain way because it only happens at certain times.

Introduce a real-world case study. Display **slide U**. Say, *I found a case where a famous building was really shiny. It was so shiny that it was blinding people and drivers when light reflected off of it. They had to modify the building to change how it reflected light so it wouldn't blind people anymore. This case may give us clues as to why shiny objects reflect light in certain ways and what they did to the surface to make it less shiny.*

Pass out 1 copy of the *Reading: Walt Disney Concert Hall Case Study* reading to each student. They can use this handout version to annotate.

Use the close reading strategies. Review the close reading strategy steps with students (**slide V**), pausing at each step.

1. Ask students what the main questions are that we are trying to answer using this reading. Students may suggest questions like the following:
    - Why do some materials make a "mirror reflection"?
    - What do shiny objects reflect so much light?
    - Cue students into the DQB questions related to mirrors and mirror reflections. If necessary, co-construct a question the class agrees encompasses the DQB questions in this category. Articulating a question reminds the students of the purpose for what they are trying to do and the type of information to look for within the reading. Explain that reading this case study will help them answer this question.
2. Give students 10 minutes to read the reading on their own.
3. Reread the first paragraph aloud together. As you read, pause and highlight a few ideas that could help answer the question(s).
4. Then, give students about five minutes to continue reading on their own, highlighting key ideas, and analyzing the images embedded in the text. Remind students to be selective about what they highlight and look for things that help answer their question(s).
5. Tell students to work with a small group (or with a partner) to summarize the key ideas from the reading that answer the question(s).

Discuss the reading as a class. Display **slide W**. Facilitate a brief class discussion. The purpose of this discussion is to summarize the idea that light reflects differently off smooth and rough surfaces and to make personal connections to this idea.

Suggested prompt	Sample student response
What key ideas did you summarize that help us answer our questions?	*Light reflects in a V shape off any surface. When the surface is smooth, all the light goes in the same direction. When the surface is rough, all the light scatters.*

Share and explain related experiences of being "blinded" by light. Display **slide X**. Revisit the idea that people were "blinded" by light reflecting in a specific direction off the Walt Disney Concert Hall.

- Have students share experiences they have had where light reflected off smooth surfaces in a V shape and almost "blinded" them.
- If you believe your students are ready, you can introduce the term *specular reflection* as a way of describing when all the light reflecting on a surface reflects off at the same angle or in the same direction. Otherwise, use "reflects in the same direction".

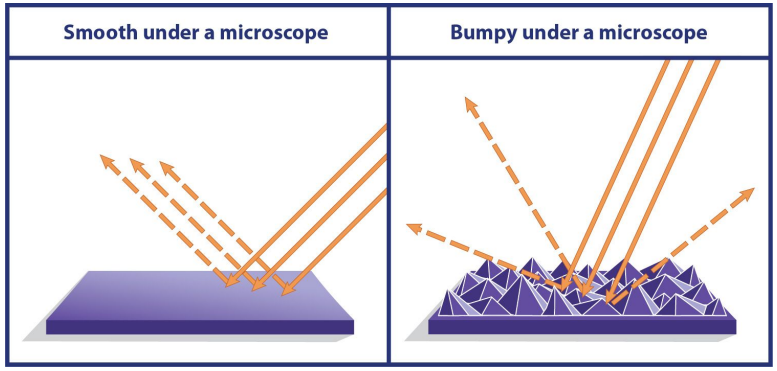
Share and explain related experiences of light scattering off rough surfaces.

- Have students share experiences they have had where light scattered in all directions off a rough surface.
- If students struggle to come up with ideas here, move straight to the next demonstration of light reflecting off different materials. After this experience, have them think about other objects in the classroom that have rough surfaces.

Activity 2: Observations of Scattering and Discussion

Time

25 min



Materials per group
1 8" x 8" piece of aluminum foil
1 8" x 11" piece of paper
1 8" x 8" piece of cardboard
1 8" x 8" mirror (edges taped)
1 8" x 8" glass (edges taped)
1 flashlight
slides Y-AB (optional)

Procedures
Use the model from the reading to explain "blinded" and "scattering" experiences.

- Demonstrate how you can shine a flashlight on a mirror and it will reflect a focused beam of light onto the ceiling or nearby wall. Explain that students will test how well a material focuses the reflected light or scatters it in all directions.
- Arrange students in small groups, each with a bin of investigation materials.
- Darken the classroom.
- Have students work together to test different materials in terms of how much they focus or scatter reflected light (as shown in the images below)

Scattered beam off aluminum foil	Focused beam off a mirror

Facilitate a Consensus Discussion. Bring the class together for a Consensus Discussion to agree on what we've figured out. During the discussion, display **slides Y-AA**, which include microscope images of the materials students tested as well as the model for specular reflection and scattering. Have students use the microscope images and model to share why the microscale surfaces of each material would reflect light in different ways.

Return to students' Related Phenomena. Display **slide AB** and construct an explanation for why some surfaces are "shiny" and can "blind" us when light reflects off them. Transition to using the ideas about light interacting with smooth surfaces to explain why such surfaces can cause mirror reflections. Prompt students to consider how light reflecting off a mirror or really smooth surface could cause a mirror reflection, but light off a rough surface does not. Project the model on **slide Z** to help facilitate the discussion.

As the class comes to consensus, consider having your students add an entry to their Progress Trackers in their science notebooks. While students' update their Progress Trackers, update the class's Science Ideas chart with the new ideas the class agreed upon.

KEY IDEAS

Purpose of the discussion: The purpose of this discussion is to come to consensus on how light behaves differently depending on whether the material has a smooth or rough surface at the microscale.

Listen for these student ideas:

- When light shines on surfaces that are *rough* at the micro scale, it scatters in all directions.
- When light shines on surfaces that are *smooth* at the micro scale, it reflects in the same direction.

Activity 3: Using Models to Explain Everyday Phenomena

Time
20 min

Materials per student
1 *Explaining New Phenomena*
slide AC (optional)

Procedures
Use the model to explain a related phenomenon. Tell students that you have two related phenomena where the same object reflected light in different ways. Pass out 1 copy of *Explaining New Phenomena* to each student and display **slide AC**. Give students time to read the two options. Answer any questions students have to understand the context. Then, give students time to select one option and record their explanation using the model for specular reflection and scattering of light. If you have time, when everyone is done, have a few students share their explanations.