Investigating the Center of the Galaxy Using Wave Properties

Introduction

If you look up at the sky on a cloudy night, you probably won't see many stars. This is because the clouds block starlight. Just as light interacts with materials on Earth, so, too, does it interact with materials in the vacuum of space. In this lesson, you will explore what happens when light waves hit a surface and how these basic properties help scientists "see" somewhere pretty far away…the center of our galaxy!

What To Do

Step 1. Observe the piece of black cloth your teacher has put under a lamp. Touch it. What do you feel? What do you think is happening to the light hitting the cloth?

Step 2. Get a laser pointer, small mirror, and a piece of clear, colorless plastic from your teacher. **IMPORTANT SAFETY NOTE: Do not point the laser pointer directly at anyone, it could seriously damage their eyes!**

Step 3. Point the laser pointer at the mirror and turn it on. Describe what you see. What do you think is happening to the light?

Step 4. Now point the laser pointer at the piece of clear, colorless plastic and turn it on. Describe what you see. What do you think is happening to the light?

Step 5. Return all of the materials to your teacher.

Step 6. Answer the analysis questions below, reading the Bite when instructed.

Analysis Questions

A model of light interacting with three different materials (**a, b, c**) is shown in **Figure 1.**

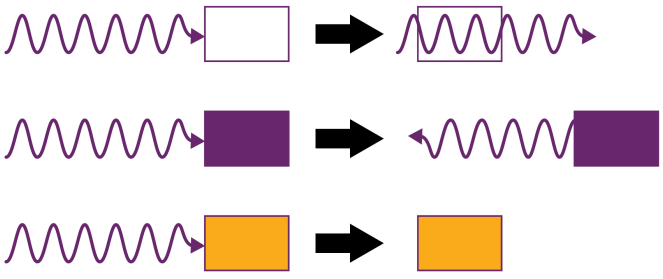

Figure 1. A Light Wave Hitting Three Different Objects. Light interacts with objects in one of three basic ways, (**a–c),** depending on the properties of the object.

1. Examine **Figure 1.**
   a. Describe, in your own words, the interaction between light and the object in **a**.

   b. Describe, in your own words, the interaction between light and the object in **b.**

   c. Describe, in your own words, the interaction between light and the object in **c.**

The scientific terms for what can happen when light interacts with an object are:

- **Reflection**: When a wave meets a material and changes direction as a result.
- **Transmission**: When a wave meets a material and then passes right through.
- **Absorption**: When a wave meets a material and is blocked. When this happens, the light transfers its energy to the material.

2. Think about the laser activity again.
   a. Determine which process (reflection, transmission, or absorption) is represented in each part (a, b, and c) of **Figure 1**. and fill in the table below.
   b. Determine which material that you examined (mirror, black cloth, or plastic) is represented in each part (a, b, and c) of **Figure 1** and fill in the table below.

Part of Figure 1.	Reflection, Transmission, or Absorption?	Mirror, Black Cloth, or Plastic?
a.		
b.		
c.		

STOP & read Science Bite:
Viewing the Center of the Milky Way

3. Is visible light transmitted through dust clouds in space? Use evidence from the Science Bite to support your answer.

4. The diagram below models two different wavelengths of light.

a. Which wave (1 or 2) has a longer wavelength? Explain how you know.

b. Based on information from the Science Bite, which wave would be more likely to be transmitted through the dust cloud in **Figure 1** of the Bite? Justify your answer.

c. With which wave (1 or 2) is the dust cloud going to act more like the piece of plastic? Explain how you know.

d. With which wave (1 or 2) is the dust cloud going to act more like the black cloth? Explain how you know.

5. Draw a model of a light wave with a long wavelength encountering a dust cloud in space. Clearly show whether the light is reflected, absorbed, or transmitted. It might be helpful to look back at the models shown above Question 1.

6. A student says, “Light needs air to travel.” Do you agree or disagree with this statement? Use information from the Science Bite to justify your answer.

7. A student shines a red laser pointer at a mirror and observes that the light is reflected. They state, “The light only exists at the laser pointer, at the mirror, and at my eye. There is no light in the air between these objects.” Do you agree or disagree with the student’s claim? Explain your answer.

8. How does light being blocked by a dust cloud help scientists understand the 3-dimensional structure of our galaxy?

9. **Connect to the Big Question**. Why is it useful for scientists to be able to observe the galaxy using multiple wavelengths of light and not just visible light? How does that impact what you think it means to observe? Are there other things in space or on Earth that you’d want to see in different wavelengths of light?