

INQUIRY LABS – ADVANCED

Reflection and Refraction

How can you model the behavior of light waves, and describe what they do when they bounce off of objects or pass from one medium into another?

Visible light is a form of energy that is given off by natural or human-made objects such as the Sun or a lightbulb. Other objects may reflect light, enabling them to be seen. Light waves change direction as they are reflected by other objects, and may also change speed and direction as they pass from one transparent medium into another. Explore the principles of reflection and refraction as these properties of visible light are investigated.

Focus on Science Practices

SEP 2 Develop and Use Models

SEP 7 Engage in an Argument from Evidence

SEP 8 Obtain, Evaluate and Communicate Information

Materials Per Group

- Cork
- Mirror, plane
- Mirror, support
- Protractor sheet
- Pin
- Semicircular lens, 1
- Water, 100 mL

Safety

Optics materials are considered safe. Do not look through lenses at bright light objects especially the sun, as it can be harmful to the eyes. Follow all laboratory safety guidelines.

Procedure

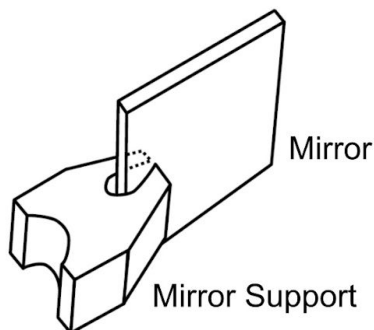
Part I: Reflection

What is the relationship between the angle of incidence and the angle of reflection?

SEP Develop a Model Use the following procedure to explore the relationship between the angle of incidence and the angle of reflection for visible light. The procedure provides directions on how to set up the available equipment and supplies, but does not stipulate how their use might yield pertinent data. Once you have set up the equipment you will be directed to develop a procedure that can help you model the relationship between the angle of incidence and the angle of reflection.

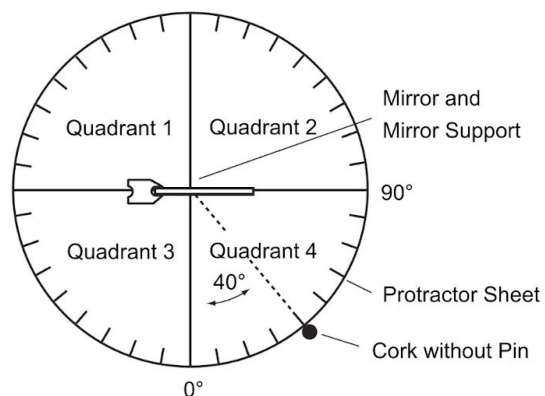
1. Insert the pin into the narrow end of a cork.
2. Place the mirror in the mirror support as shown in Figure 1. Note: Make sure the bottom of the mirror support is flat against the work surface so the mirror stands upright without leaning forward or back.

Figure 1



3. Place the mirror in the center of the protractor sheet as shown in Figure 2. The mirror should be on the horizontal line (90°) on the protractor sheet.

Figure 2



4. Develop a procedure to explore the relationship between the angle of incidence and the angle of reflection using the apparatus you have set up. Record your detailed procedure; and identify the independent, dependent and control variables.

Table 1

Reflection						
Cork Position		Eye Position		Position of Cork with Pin		Observations
Quadrant	Angle	Quadrant	Angle	Quadrant	Angle	
4	40°					
4						
3						

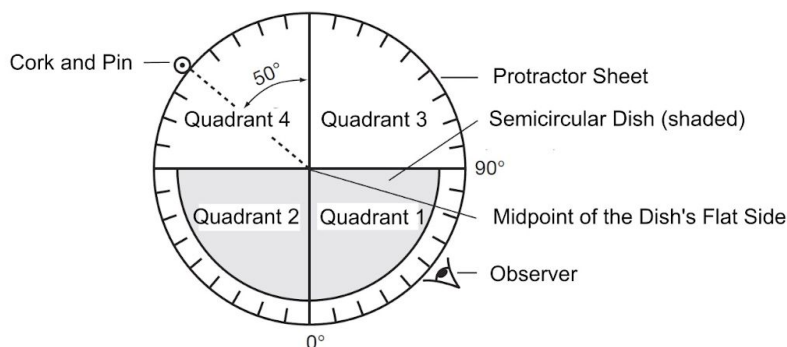
Part II: Refraction

What happens to the direction of light as it moves from one medium into another, does it change?

SEP Develop a Model Use the following procedure to explore whether and how light changes direction when it travels from one medium into another. The procedure provides directions on how to set up the available equipment and supplies, but does not stipulate how their use might yield pertinent data. Once you have set up the equipment you will be directed to develop a procedure that can help you understand what occurs when light passes from one medium into another.

5. Fill the semicircular dish $\frac{3}{4}$ -full with water (approximately 100 mL.)
6. Place the protractor sheet on the work surface so Quadrants 1 and 2 are toward the observer.
7. Carefully place the dish on the protractor sheet so the flat side faces Quadrants 3 and 4, the midpoint line on the dish is centered at the intersection of the quadrants, and the curved section is in Quadrants 1 and 2 as seen in Figure 3.

Figure 3



8. Insert the pin into the narrow end of the cork.

9. Develop a procedure to explore how light bends as it transitions from air into water. Record your detailed procedure and identify the independent, dependent variable and the control variable(s).

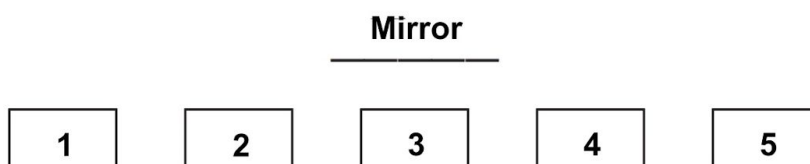
Table 2

Refraction					
Light Transmission	Observations	Pin Quadrant	Pin Angle	Toothpick Quadrant	Toothpick Angle
Air to Water		4	50°		
Air to Water		4	30°		
Air to Water		4	70°		

Analyze and Interpret Data

- 1. SEP Communicate Scientific Information** The relationship between the angle of incidence and the angle of reflection is known as the Law of Reflection. Based on your observations, write the Law of Reflection.

- 2. SEP Evaluate Evidence** Five students are seated at their desks, which are spaced equally apart, in the front row of a classroom (see diagram). The instructor places a large plane mirror on the board directly in front of the middle student. When student 1 looks at the center of the mirror, which student's image will be seen? Use observations from the lab to support your explanation.



- 3. SEP Evaluate Evidence** The archer fish captures its prey by knocking insects off a branch with a stream of water from its mouth. To compensate for the refraction of light as it is transmitted from air into water, would the fish aim above or below the image of the insect it sees? Use observations from the lab to support your explanation.

