

The Disappearing Beaker

Discrepant Event—Physical Properties



Introduction

Students will be amazed as various glass objects seem to vanish when immersed in a beaker of pale yellow oil.

Concepts

- Index of refraction
- Magnification

Materials

Pyrex[®] beaker, unmarked, 250-mL

Magnifying lens

Pyrex[®] test tube with screw cap, 20 × 150 mm

Canola oil, 32 oz

Red and green pop beads, 10

Pyrex[®] beaker, 1000-mL

Procedure

1. Pour approximately 800 mL of canola oil into the 1000-mL beaker.
2. Submerge the 250-mL beaker into the oil. The 250-mL beaker will appear to vanish when it fills with oil.
3. Fill the test tube half full with canola oil. Put 6–8 alternating red and green pop beads in the tube and fill the tube with canola oil. Cap the tube.
4. Submerge the tube into the 1000-mL beaker. The test tube now “fades away” and the beads appear to be floating in the oil.
5. Place the magnifying glass in front of the beaker and beads. The beads are magnified.
6. Immerse the magnifying glass into the oil in front of the beads. The beads are not magnified!

Disposal

Please consult your current *Flinn Scientific Catalog/Reference Manual* for general guidelines and specific procedures governing the disposal of laboratory waste. Pour the canola oil back into its original container. Beakers and other equipment may be washed with regular dishwashing detergent. The oil may be reused several times and then disposed of according to Flinn Suggested Disposal Method #26a.

Tips

- The cleaner the glassware, the better the effect.
- Elevate the beakers, if necessary, to reduce the viewing angle.
- Because glass has internal strains, the refractive index may not be uniform throughout the glass. This may produce a faint outline of the beaker.
- An alternate procedure for making the beaker disappear is to place the 250-mL beaker in the 1-L beaker, fill the 250-mL beaker with oil and allow the oil to overflow into the 1-L beaker.

Discussion

Light travels at different speeds in various transparent media. For example, the speed of light in a vacuum is 3×10^8 m/s, in ice 2.29×10^8 m/s, in glycerin 2.04×10^8 m/s, and in rock salt 1.95×10^8 m/s.

When a light ray travels from one transparent medium through another one, the light ray bends. The larger the difference of the speed of light in each medium, the more the light ray is bent.

To visualize this, construct a normal line to the interface of the two media and extend the line through the second medium (Figure 1). If the speed of light is greater in the first medium, then the light ray in the second medium bends towards the normal line (Figure 2). This bending of light is called *refraction*. In addition, a fraction of the light is reflected off the interface between the two. Objects that are clear can be seen because light is both refracted and reflected at the surface of the object.

The ratio of the speed of light in a vacuum over the speed of light in a specific medium is called its refractive index, n . Because the speed of light in air is so close to that in a vacuum, its refractive index, 1.000293, is usually rounded off to 1.000 for calculations. Water has a refractive index of 1.33. Pyrex glass has a refractive index of 1.474. If a Pyrex glass beaker is placed in another beaker filled with water, the beaker can be seen, but not as clearly as it is seen when the Pyrex glass beaker is in air. The clarity of a transparent object decreases as the refractive index values of two transparent media approach each other, since reflection of light off the interface surface decreases and the angle light is refracted in the second medium also decreases (Figure 3).

When the two media have the same refractive index, as with canola oil and Pyrex glass, there is neither reflection nor refraction (Figure 4), and the Pyrex glass “disappears” in the canola oil.

A simple magnifying lens is a convex lens that refracts parallel light to converge at a single point called the principal focal point, F (Figure 5). The distance from the lens to the focal point is called the focal length, f .

If an object is placed in front of the lens at a distance greater than the focal length, a real, inverted and reduced image is formed behind the lens (Figure 6).

If the object is closer than the focal length, an erect, virtual image is created that is a magnification of the object (Figure 7).

Canola oil has approximately the same refractive index as the magnifying lens. When the refractive index of the lens equals that of the medium in which it is immersed, no refraction of light occurs and therefore the object is not magnified (Figure 8).

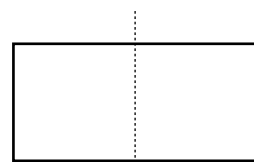


Figure 1.

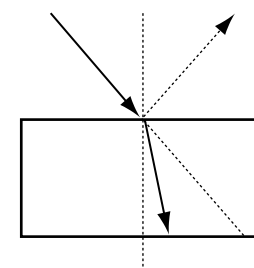


Figure 2.

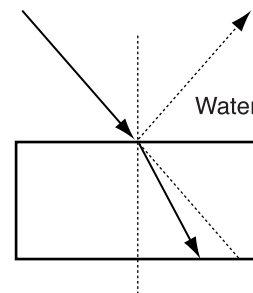
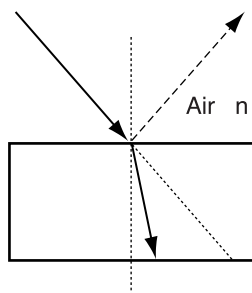


Figure 3.

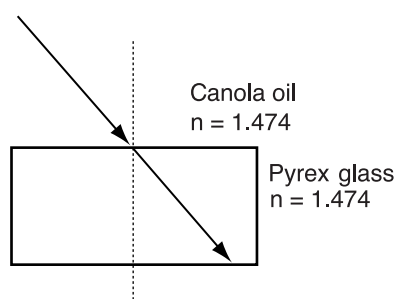


Figure 4.

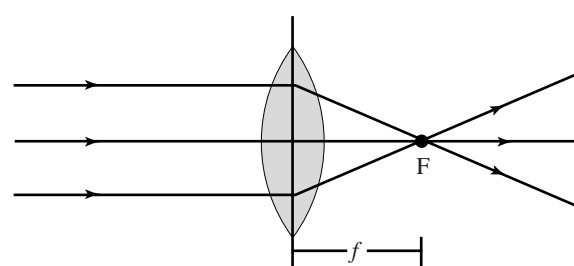


Figure 5.

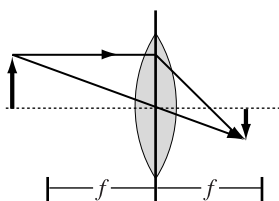


Figure 6.

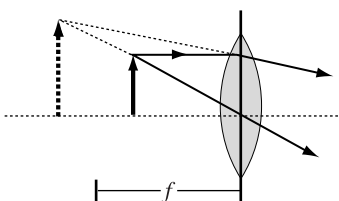


Figure 7.

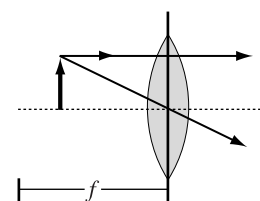


Figure 8.

Connecting to the National Standards

This laboratory activity relates to the following National Science Education Standards (1996):

Unifying Concepts and Processes: Grades K–12

Evidence, models, and explanation

Content Standards: Grades 5–8

Content Standard B: Physical Science, transfer of energy

Content Standards: Grades 9–12

Content Standard B: Physical Science, interactions of energy and matter

Answers to Worksheet Questions

1. Describe what happened in this demonstration.

A large beaker was filled with canola oil. When a smaller beaker was placed inside, the smaller beaker seemed to disappear. The same thing happened to a test tube, though pop beads that were already in the tube did not. A magnifying glass, though it could magnify the pop beads from outside the large beaker, did not from inside.

2. Define the following terms:

- a. Refraction

Refraction is the bending of light towards a normal straight line when it passes through the second of two mediums.

- b. Refractive index

The refractive index of a medium is the ratio of the speed of light in a vacuum over the speed of light in that medium.

3. The greater the difference between the refractive indexes of two materials, the easier it is to see a transparent object. Knowing this, draw a conclusion about the refractive indexes of canola oil and Pyrex glass.

Since the Pyrex glass cannot be seen inside the canola oil, the refractive indexes of the two materials must be the same, as no light is being allowed to reflect or refract off the Pyrex glass.

Acknowledgment

Special thanks to Lee Marek, Naperville HS, Naperville, IL, who provided Flinn Scientific with the instructions for this activity.

Reference

Disappearing Glass Rods; <http://www.rom.on.ca/wwatch/teachers-kit/disappearing.html> (Accessed Jan 2002).

Flinn Scientific—Teaching Chemistry™ eLearning Video Series

A video of the *The Disappearing Beaker* activity, presented by Lee Marek, is available in *Discrepant Event—Physical Properties*, part of the Flinn Scientific—Teaching Chemistry eLearning Video Series.

Materials for *The Disappearing Beaker* are available from Flinn Scientific, Inc.

Materials required to perform this activity are available in the *The Disappearing Beaker—Chemical Demonstration Kit* available from Flinn Scientific. Materials may also be purchased separately.

Catalog No.	Description
FB6264	The Disappearing Beakers—Demonstration Kit

Consult your *Flinn Scientific Catalog/Reference Manual* for current prices.

