

The Optical Challenge

Have you ever been momentarily blinded by the flash of a camera? How long does the sensation last? While the answer will depend on the source and intensity of the light, it is not uncommon for a spot of light to remain for several seconds after the flash occurs. This is due to a phenomenon called “persistence of vision.” When light enters the retina, cis-retinal is quickly converted to trans-retinal. But it takes much longer for trans-retinal to convert back to cis-retinal.

While light can be emitted from various sources either as a continuous flow or as a very rapid series of flashes, our eyes often do not perceive the difference. Why? Because of persistence of vision. Which common light sources do you think are constant light sources? Which ones do you think are flashing light sources? Try this activity and find out.

Materials

- small, hand-held mirror
- lamp with incandescent light bulb
- television
- other light sources, such as car headlights, streetlights, flashlights, LEDs, and light sticks

Exploration

- Step 1 Darken the room and turn on the lamp with the incandescent light bulb. View the light bulb’s reflection in the mirror. Do not stand too close to the lamp; the image should be small. Now, quickly tilt the mirror back and forth. This moves the image across different regions of your retina. Is the image continuous or discontinuous? Do you think the incandescent light bulb is a constant or flashing light source?
- Step 2 Turn on the television and repeat the experiment. View the television’s reflection in the mirror, and then move the mirror quickly back and forth. Is the image continuous or discontinuous? Do you think the television is a constant or flashing light source?
- Step 3 Try this experiment with as many different sources of light as you can find, classifying each as either a constant or flashing light source.

Challenge

How does this experiment and the physiology of your eye allow you to distinguish between constant and flashing light sources?

The Optical Challenge

This activity can be used to introduce kinetics and to show how it relates to vision.

Concepts

kinetics, constant light source, flashing light source

Expected Student Responses to Exploration

Step 1 (a) The incandescent light bulb appears as a continuous image.

(b) It is a constant light source.

Step 2 (a) The television screen appears as a discontinuous image.

(b) It is a flashing light source.

Step 3 The answers will vary depending upon the light source. If the reflection of the light source appears as a continuous image when the mirror is moved, the light is a constant light source. If it appears as a discontinuous image, the light is a flashing light source. Some expected answers are:

flash light	constant
headlights	constant
LED	flashing
light stick	constant
fluorescent light	constant

Expected Student Answer to Challenge

This experiment was designed to move the light source across different parts of the retina at different times. This means that the reactions converting the cis-retinal and the trans-retinal back and forth occur at different times on different parts of the retina. If the light source is flashing, not all parts of the retina are stimulated to convert the cis-retinal to trans-retinal. This causes the reflection of the light source to appear as a discontinuous image. If the light source is constant, all parts of the retina are stimulated and the reflection of the light source appears as a continuous image.

References

Ron Perkins, Greenwich High School, Greenwich, Connecticut; personal communication.

Kotz, J.C.; Joesten, M.D.; Wood, J.L.; Moore, J.W.; *The Chemical World: Concepts and Applications*; Saunders College Publishers: Fort Worth, 1994; p 306.

Acknowledgment

This activity was developed as a part of the NSF-funded “General Chemistry: Discovery-Based Advances for the Two-Year College Chemistry Curriculum” project, grant #DUE-9354378.