3M Young Scientist Lab

WHELMERS Student Activity | Grades 3–5

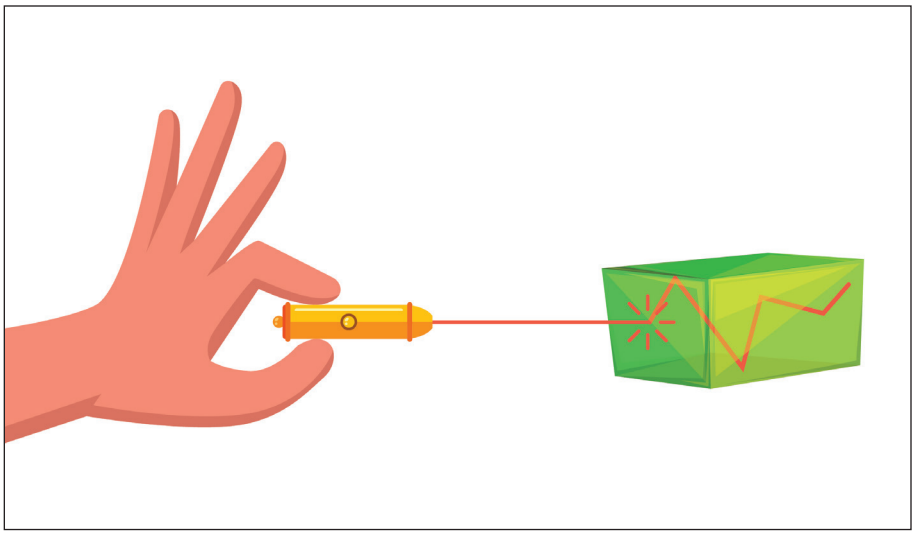
Gelatin Optic Fibers

WHAT YOU NEED:

- An inexpensive laser pointer
- Package of unflavored or light-colored gelatin dessert
- Shallow cake pan
- Spatula
- Mixing bowl
- Ruler
- Piece of paper, plastic wrap, or wax paper

DESCRIPTION

Strips of gelatin dessert and a laser pointer demonstrate total internal reflection.distances without significant degradation.



NEXT GENERATION SCIENCE STANDARDS

- **PS3.A: Definitions of Energy**
  - The faster a given object is moving, the more energy it possesses. (4-PS3-1)
  - Energy can be moved from place to place by moving objects or through sound, light, or electric currents. (4-PS3-2), (4-PS3-3)
- **PS3.B: Conservation of Energy and Energy Transfer**
  - Light also transfers energy from place to place. (4-PS3-2)
  - Energy can also be transferred from place to place by electric currents, which can then be used locally to produce motion, sound, heat, or light. The currents may have been produced to begin with by transforming the energy of motion into electrical energy. (4-PS3-2), (4-PS3-4)

- **PS4.C Information Technologies and Instruments**
  - Digitized information transmitted over long distances without significant degradation. High-tech devices, such as computers or cell phones, can receive and decode information-convert it from digitized form to voice-and vice versa. (4-PS4-3)

WHAT YOU DO

1. Follow the package directions for mixing the gelatin, but use only half the suggested amount of water. The resulting thicker-than-normal gelatin is necessary for this experiment.
2. Pour the gelatin mixture about 1 inch deep into a shallow pan and refrigerate.
3. After the gelatin has set, gently use a ruler and cut it into 1-inch-wide strips, creating strips as long as possible.
4. Use a spatula to remove a gelatin strip and place it on a tabletop. To protect the table top place a sheet of paper, plastic wrap or wax paper under the gelatin strip.
5. Dim the room lights. Point the laser beam through one end of the gelatin strip. Position the laser so the beam will reflect several times off of the interior sidewalls of the gelatin.

WHAT HAPPENS

The boundary surface between the gelatin walls and air acts like a mirrored surface because the gelatin has a higher index of refraction, or tendency to bend the path of light. If light should strike the sidewalls above what's called the critical angle, light will pass through the sidewalls. Below the critical angle, light is reflected as if it were bouncing off a mirrored surface. The critical angle for internal reflection can be observed by adjusting the position of the laser. More efficiently than gelatin, pure glass used in the manufacture of fiber optic cable allows light to pass through undisturbed for long distances.

WHERE IN THE WORLD

Here are a few examples of total internal reflection;

- Fiber optic cables are used to transmit large amounts of data at high speeds over the internet. Communicating with people over the phone has also become much easier with the use of fiber optic cables. There is little to no wait time and the conversations can flow automatically over the distance. Fiber optic cables are also used to deliver cable tv, for home decorations and lighting, advertising signboards, and other secure data transmission systems.
- When swimming in a pool or clear water, it is possible to look up and see what is above the water. If looking out of the water at an angle, a reflection of the bottom of the pool will be reflected on the surface of the water.

Can you think of more ways refraction can be used to solve problems?