Invisibility with Refraction

Objective: Through learning about the refractive index and pairing objects with similar refractive indexes, students will be able to make an object seem to disappear.

Procedure

1. Ask students to respond to the following prompts in their science journals for five minutes: Why do we see objects? Why do we see through some objects? How can we use science to turn an object invisible? What is reflection?

2. Turn and talk - Tell table groups to discuss their responses and come up with a group response to each question (5 minutes). Share responses.

3. Tell students that today they will be learning about reflection and refraction to turn objects invisible.

4. Invite students to observe their reflection in the window as compared with a mirror. Ask: Why is your reflection transparent in the window? Share.

Materials:

- Glass rod
- Narrow glass test tube
- Glass beaker or bowl
- Mineral (baby) oil or corn oil

5. Explain: Reflection is what lets you see yourself in a mirror. Light hits your face, scatters away in all directions, and when that light hits a mirror, some of that light is reflected back into your eyes. When you look at your reflection in a window, you look transparent. This is because some of the light reflects back, but not as much as a mirror. Whenever light goes from one clear substance to another, some of the light is reflected if the speed of light is different in the two substances.

Vocabulary

Reflection: the return of light or sound waves from a surface

Refraction: a directional change of light as it moves through different densities

The Refractive Index: the ratio of the speed of light in different transparent materials. The speed of light in a vacuum over the speed of light in a transparent material is the formula for the refractive index. The higher the refractive index, the slower the speed of light, and the greater the reflection.

Because light slows down when it goes from air into glass, the inner window surface reflects some light. When it goes from inside the glass back into the air outside, another reflection happens as it speeds up again - we are seeing the reflected light. If the speed of light does not change as it enters or leaves two different substances, then no light is reflected. No light reflected means we cannot see that object.

That is why when light travels from one transparent material to another, some light makes it through, and some light is reflected- the light that is reflected is what we're seeing. If there's a change in speed when the light enters a material, there will be a greater reflection.

6. Hand out note taking sheet (below) and have students complete it as they watch the Impossible Science video.

7. Give students oil, beaker or glass bowls, glass rods and/or glass test tubes.

8. Have students work with partners to recreate the experiment watching the glass rods disappear and the glass test tubes disappear as they are filled with oil.

Assessment:

Students should write a paragraph explaining how refractive index affects visibility of transparent objects.

Challenge Option:

Challenge option: Find other items with similar refractive indexes (such as water and clear water gems from a craft store) to recreate the experiment.

Safety Note:

Adult Supervision Recommended

Watch the companion video here:

Lesson Plan by Whitney Gallagher based on the "Impossible Science" series.
Find more at impossiblescience.com

NOTE TAKING SHEET

IMPOSSIBLE SCIENCE INVISIBILITY WITH REFRACTION!

1. Define the following
    1. Refractive Index
    2. Refractive index of water:
    3. Refractive index of a glass rod:
    4. Refractive index of oil:

2. What happens when the speed of light is different in two clear substances when light passes from one to the other? *Some of the light is reflected.*

3. What happens when the speed of light does not change as it enters or leaves two different substances? *No light is reflected, and we cannot see that object.*

4. Why does the glass rod seem to disappear when it enters the oil?
   The rod dipped in oil vanishes because they have the same refractive index.

5. Why does the glass rod remain visible in water?
   The rod dipped in water is visible because of the difference in the speed of light/refractive index.

IMPOSSIBLE SCIENCE AT HOME