

Light Tricks

Overview: Today you get to see the science behind the illusion by learning how light striking an object affects how our eyes see it.

What to Learn: Light can be bent when it passes through materials. The amount that the light bends is called the *index of refraction*. How much light bends depends on the material it’s passing through. This quality is measured for each individual material and is called the *optical density*. The more dense the substance, the slower the light travels through it, and the more the light bends.

Materials

- glass jar
- penny
- laser (optional)
- flashlight
- milk or flour

Light Tricks Data Table

When you do the pencil illusion trick, record your observations.

Water Level:	Water Level:	Water Level:

Experiment

1. Record your observations on the data sheet and in the exercises as you go.
2. Toss one coin into a water glass and fill with an inch of water. Hold the glass up and find where you need to look to see TWO coins.
3. Look through the top of the glass – how many coins are there now? What about when you look from the side?
4. Toss in a second coin – now how many are there?
5. Remove the coins and turn out the lights. Shine a flashlight beam through the glass onto a nearby wall. (Hint – if this doesn't work, try using a square clear container.) Stick a piece of paper on the wall where your light beam is and outline the beam with a pencil.
6. Shine the light at an angle up through the water so that it bounces off the surface of the water from underneath. Trace your new outline and compare... are they both the same shape?
7. Add a teaspoon of milk and stir gently. (No milk? Try sprinkling in a bit of white flour.) Now shine your flashlight through the container as you did in steps 4 and 5 and notice how the beam looks.
8. Use a round container instead of square... what's the difference?

Reading

Have you ever broken a pencil by sticking it into a glass of water? The pencil isn't really broken, but it sure looks like it! What's going on?

Light can be bent when it passes through materials. The amount that the light bends is called the *index of refraction*. How much light bends depends on the material it's passing through. This quality is measured for each individual material and is called the *optical density*. The more dense the substance, the slower the light travels through it, and the more the light bends. To be exact, when a beam of light hits a different substance (like moving from air to water), the wavelength changes because the speed of the light changes.



If you're thinking that the speed of light is always constant, you're right... in outer space, light travels at 186,000 miles per second. But the Earth is covered with an atmosphere, and as soon as the light passes into this thick cloud of nitrogen and oxygen gas, it slows down a bit. The speed of light changes whenever it passes from one material to another, like when it moves from water to ice, or to sunglasses, smoke, fog, or windows. How much the light speed slows down depends on what the material is made of. Mineral oil and window glass will slow light down more than water, but not as much as diamonds do.

Exercises

1. When one coin is in the water, you can actually see two: Are the coins both the same size? Which one is the original coin?
2. In step 2 of the experiment: How many coins are there when viewed from the top of the glass? What about when you look from the side?
3. What happened when you tossed in a second coin?
4. How did your outlines compare?

Answers to Exercises: Light Tricks

1. When one coin is in the water, you can actually see two: Are the coins both the same size? Which one is the original coin? (the smaller coin is the reflection)
2. In step 2 of the experiment: How many coins are there when viewed from the top of the glass? What about when you look from the side? (one coin when looking from above, two when looking through the side)
3. What happened when you tossed in a second coin? (There were four.)
4. How did your outlines compare? (The first was a circle, the second was an oval.)