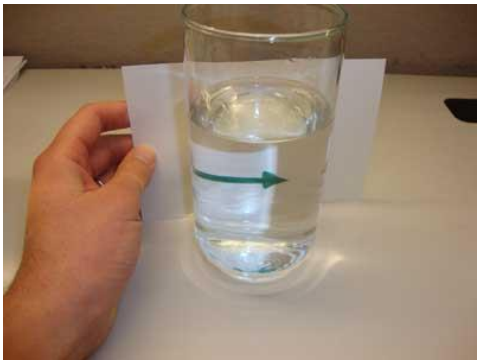
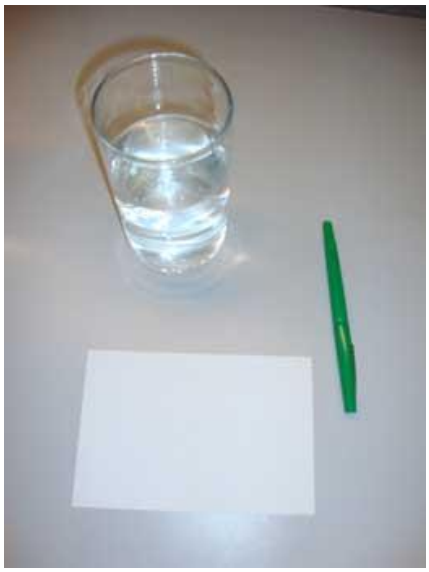
Physics in a Glass: Reversing Arrows



It went that way…I mean that way? Which way does this arrow point? Using physics to give bad directions.

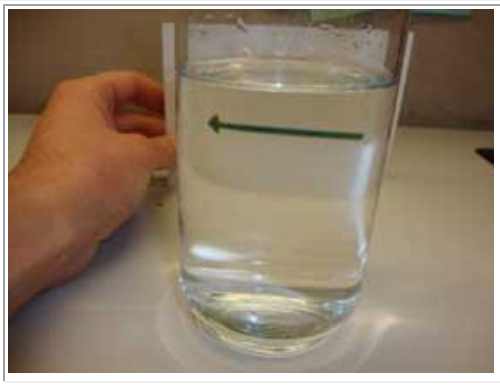
What you Need



- A glass
- Water
- A note card
- A marker

What to Do

1. Fill your glass of water.
2. Draw a horizontal arrow on a note card.
3. Put the note card behind the glass of water and slowly move the note card back. Look through the glass from the front and observe the arrow. What appears to happen to it?

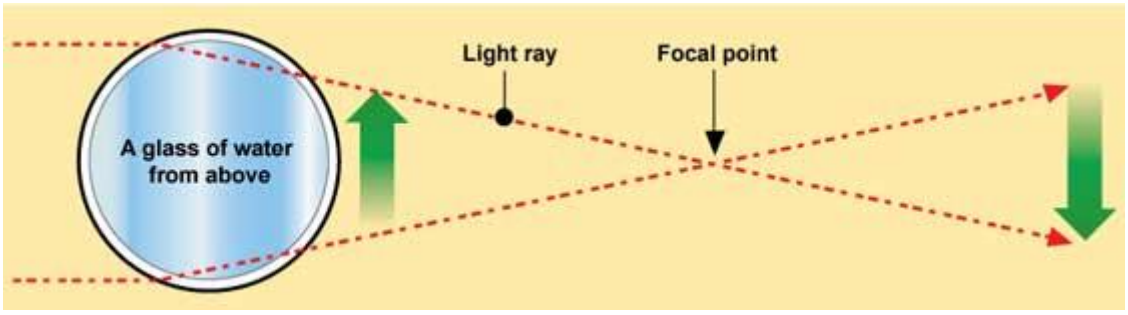


What's Going On?

No, you aren't going crazy and you haven't found yourself with Alice in Wonderland staring at arrows pointing in opposite directions. In fact, you have just demonstrated a physics concept called **refraction**, the bending of light.

When the arrow is moved to a particular distance behind the glass, it looks like it reversed itself. When light passes from one material to another, it can bend or refract. In the experiment that you just completed, light traveled from the air, through the glass, through the water, through the back of the glass, and then back through the air, before hitting the arrow. Anytime that light passes from one medium, or material, into another, it refracts.

Just because light bends when it travels through different materials, doesn't explain why the arrow reverses itself. To explain this, you must think about the glass of water as if it is a magnifying glass. When light goes through a magnifying glass the light bends toward the center. Where the light all comes together is called the focal point, but beyond the focal point the image appears to reverse because the light rays that were bent pass each other and the light that was on the right side is now on the left and the left on the right, which makes the arrow appear to be reversed. The diagram explains this better.



Try This!

- Try using differently shaped glasses. Does the shape of glass affect the distance when the arrow reverses?