# Disappearing beaker

## The Idea

This demonstration lets you makes a beaker invisible.

## What You Need

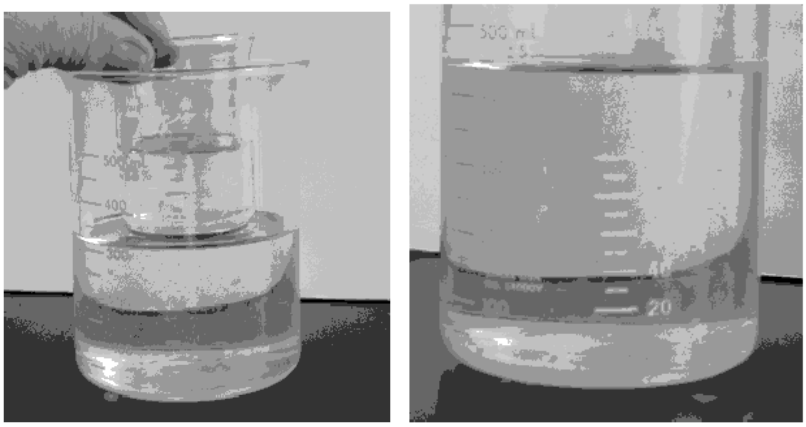
- 1 Large Beaker
- 1 Small Beaker that is small enough to fit inside the Large Beaker (for best results, the small beaker should have no markings on it)
- Vegetable Oil
- Tongs
- Broken Pyrex Glass (Optional)

## Method

1. Place the smaller beaker inside the larger beaker.
2. Fill the small beaker and the large beaker with the oil until the small beaker is submerged.
3. Observe what appears to happen as the level of the oil rises and finally covers the smaller beaker.

## Expected Results

As the oil level rises above the beaker, the glass can no longer be seen.



## Additional "Trick"

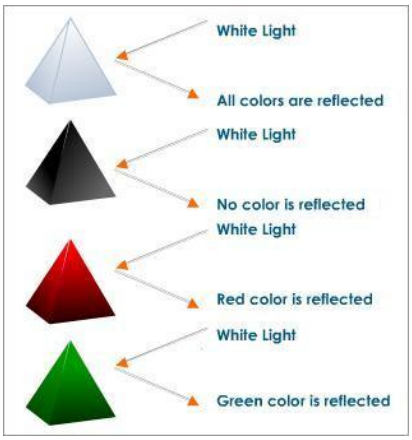
1. Set up the two beakers and oil as above. (Do this before your "audience" is present.)
2. Pour the broken Pyrex glass into the oil in the beaker, explaining to your audience that you are going to "recycle" the broken glass.
3. Wait a few seconds, then use the tongs to take hold of the rim of the smaller beaker (with the broken glass inside), and raise it out of the oil. You have "turned the broken glass into a brand new beaker".

## Why does it happen?

To understand how this works consider the following elementary example.

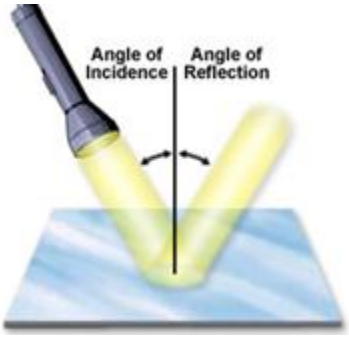
Although it appears that one object is in the second picture. There are really two objects but since they have the same "**color**" it looks like one solid object.

This brings up what is **color**? Well the physics of color comes down to **wave length**. Light is emitted from a source (Like a flashlight or the sun) and reflects off of different materials. The **wave length** of light that the object shoots back at your eyes is what we see as color.



Going back to our previous example the two objects reflect the same color, so you cannot perceive where one object ends and the other begins since your eyes are getting hit with the same wave length.

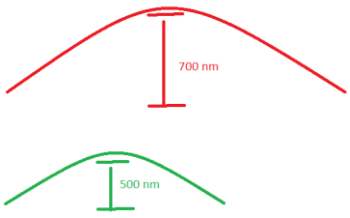
**Wave length** is a lot like "**size**". Since the "change" between one wave lengths to another is super small, we cannot actually process the change in "size". So what you think is "color of an object" is your perception of the reflected **wave "size**".




An object like a mirror reflects everything, so we observe no color change. But a red object is "red" because the **wave "size"** is the red "size" (700-635 nm). Below is a table of the colors we can say and their respective sizes.

| color | Wave "Size" |
|---|---|
| red | ~ 700–635 nm |
| orange | ~ 635–590 nm |
| yellow | ~ 590–560 nm |
| green | ~ 560–490 nm |
| blue | ~ 490–450 nm |
| violet | ~ 450–400 nm |

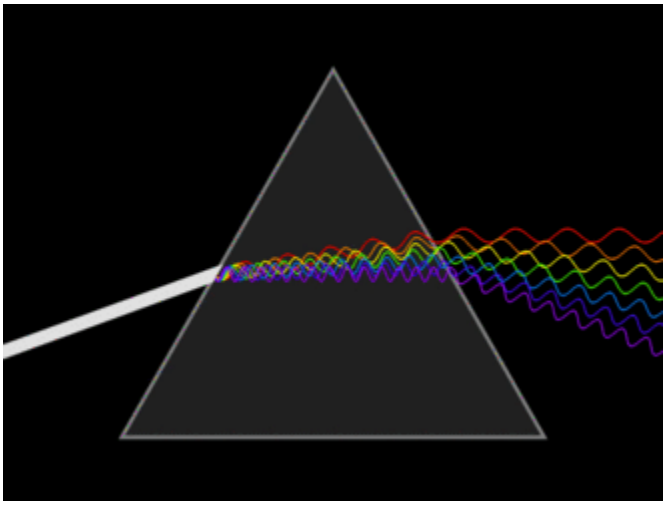
For instance, when the **wave size** is 500 nm (nm=Nano meters, which is .000000000500) the color you "see" is green.




Since you see objects due to the light they reflect, what happens when you immerse an object that reflects almost the same light? You can't see where one object starts and the other one ends. Thus, it appears as if the object "disappears."

The last thing you need to know to understand why the demonstration works is refraction. Since the objects are **"clear",** they also do something else to light called **refraction**.

**Refraction** refers to light changing speed as it moves from one medium to another. This happens the same way if a person was running and all of a sudden had a giant block of water dropped in front of them. They would not be able to go as fast in the water as out of it. When you change the speed of a wave you change the wave "size".



Scientists characterize the change as the **index of refraction**. **The index of refraction** dictates how light changes as it pass through an object.

If an object immersed in a liquid has an index of refraction that is different than the object, some of the light is refracted through the object and some is reflected back to the observer. However, if the object has exactly the same index of refraction as the immersed object, the light will neither reflect nor refract at the interface between the object and the liquid it is immersed in. In that case, the object will appear to be invisible.

Both vegetable oil and Pyrex glass have a nearly identical **index of refraction** of about n = 1.474, making them "disappears" when inside of one another.