Exploring Properties—Invisibility

How can scientists make things invisible?

NanoDays™
The Biggest Event for the Smallest Science!

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Try this!

1. Look in the glass beakers. What do you see?
2. Gently lift the craft stick out of one beaker, then the other. What's on the end of the line?

What's going on?

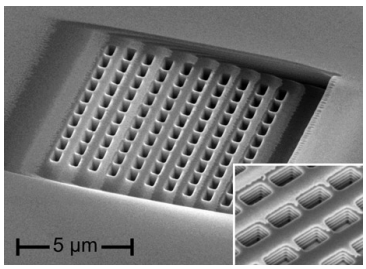
One of beakers has <u>two</u> glass objects in it! Before you lifted the objects out of the water, you might have thought each beaker had only one object—one red and one colorless. The beaker with two objects in it is filled with baby oil, while the beaker with one object is filled with plain water. The colorless object can be hidden in the oil because it's made of borosilicate glass, which has a similar *refractive index* to baby oil. It can't be hidden in the water, because borosilicate glass has a different refractive index from water.

The refractive index indicates how fast light can travel through a material. The higher a material's refractive index, the slower light travels in that material. If two materials have a different refractive index, the speed of the light changes as it moves from one material to the other. This causes some of the light to *reflect*, or bounce off an object, and some of it to *refract*, or bend as it goes through an object.

You can't see the colorless object in the oil, because light traveling from baby oil to glass doesn't change speed very much. It doesn't refract or reflect when it hits the glass, so you don't see the object. It's almost invisible!

In everyday life, you see refraction at work when a straw submerged in a glass of water appears to bend. The light interacts differently with the air outside the glass than the water inside the glass, creating the illusion that the straw is bent.

How is this nano?



Metallic nanostructures that bend light backwards

The way a material behaves on the macroscale is affected by its structure on the nanoscale. Using nanotechnology, it is possible to engineer new materials that can interact with light in special ways. Engineers have created special coatings that control reflection and refraction, improving the energy efficiency of windows and making better solar cells.

Researchers are even experimenting with ways of bending light to cloak objects—making them invisible to the human eye or to surveillance devices. For example, scientists at the University of California at Berkeley have created a tiny "carpet" that makes a three-dimensional object appear flat by reflecting the surface beneath it. Thin, metallic nanostructures create negative refraction, bending light "backwards" in directions it couldn't go in nature.

Think about it…

1. What would you do if you had an invisibility cloak? What do you think other people might do?
2. Would you make rules for how people could use invisibility cloaks?

Technologies and society influence each other. When we use a new technology—whether it's a cell phone or an invisibility cloak—we create new ways of interacting with each other. We work together to figure out when, where, and how it's ok to use the new technology. Eventually, we create norms, rules, and laws that influence how we use it. New nanotechnologies will affect our social relationships, just like any other technology does.