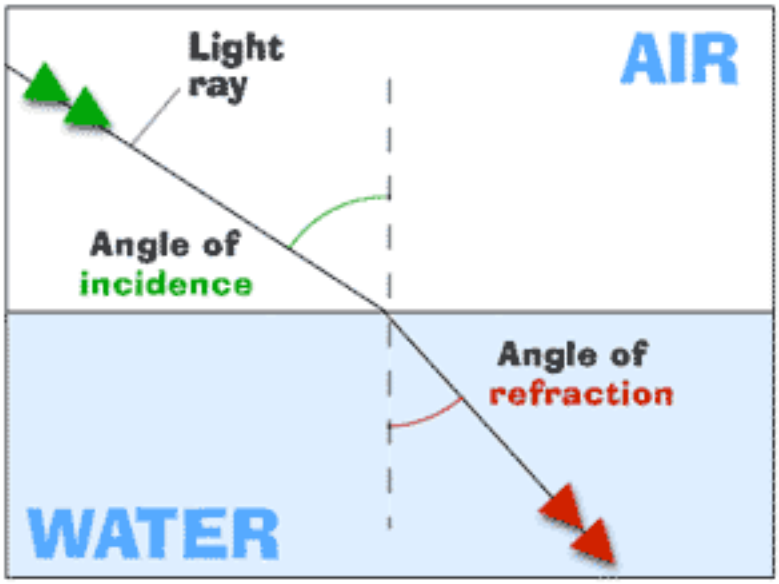
Bending Light Experiment



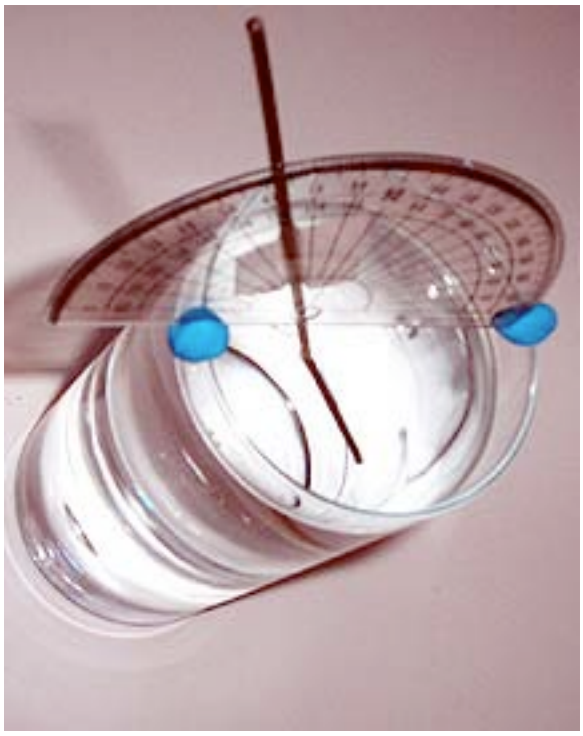
The speed of light (about 3,000,000 meters per second!) is the speed light travels in a vacuum. (A vacuum is a space without atoms or molecules that cannot conduct heat or transmit sound waves.) When light has to travel through a material, such as water, it moves somewhat slower. Putting the brakes on the speed of light causes the light to bend as it passes from one medium (such as air) to another (such as water). This is called refraction. Refraction is what causes a spectrum to form, as different wavelengths of light bend at different angles.

The Angle of Refraction

In the following experiment, you will first observe the angle of refraction as light passes through water. Next, you will see if a different medium, oil, results in a change in the angle of refraction.

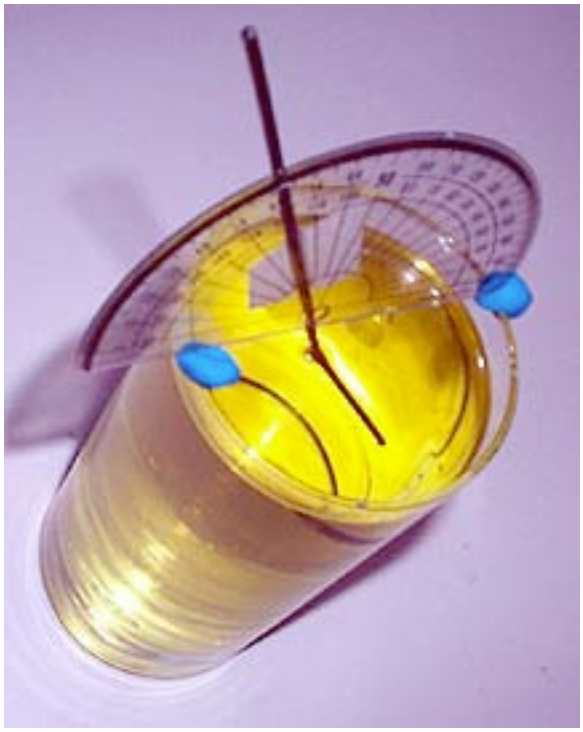
What You Will Need:

- A large water glass, jar, or small glass fish tank (a rectangular container is better than a curved one)
- A protractor for measuring angles
- A piece of thick wire (such as coat hanger wire) about 30 cm long and as straight as you can make it
- Some waterproof tape
- Water and vegetable or mineral oil



To begin, look at the diagram above. What apparently happens to the light as it enters the water? This apparent bending of the light is the result of refraction. Notice the angle of incidence and the angle of refraction. Both angles are measured from a line perpendicular to the oil's surface.

Now, try to observe refraction using the thick wire and a glass of water. Using some waterproof tape, attach the protractor to the wire, about 10 cm from one end as shown below. Mount the protractor so that the wire is at a 60-degree angle. (To calculate the angle of incidence, subtract 60 from 90 degrees to obtain an angle of incidence of 30 degrees.)



Place the wire in and protractor on a full glass of water. Look down the length of the wire and observe the apparent bending of the wire as it enters the water. Next, try changing the angle of incidence. Does the angle of incidence change the degree to which the wire appears bent?

Do you think that the angle of refraction will change with a different kind of liquid? To test your hypothesis, try the above experiment with a container of vegetable oil (or mineral oil) instead of water. Follow the same procedures as above, starting with an angle of incidence set at 30 degrees. How does the resultant angle of refraction for oil compare with that of water?

The Archerfish

The archerfish of Southeast Asia knows all about the angle of refraction. This fish has a specialized mouth and tongue that the fish uses to spit a jet of water at unsuspecting insects resting above the water's edge on overhanging plants. Targeting its prey is a challenge because the light with which the fish sees the insect refracts (bends) as it enters the water. But the fish's tiny brain is aware of the problem of refraction and corrects for it. In this way, the archerfish can hit its prey – even at a distance of more than 1 1/2 meters! Not bad for a fish without a protractor!