Invisible Glass

This curious bit of science is about how light refracts, or changes direction as it passes through various things.

Safety considerations:
Glass vessels are used in this activity. It is recommended that teachers undertake a Curriculum Activity Risk Assessment (CARA) process. It is recommended that students are briefed as to the risks of cuts and the use of gloves when handling materials should be considered.

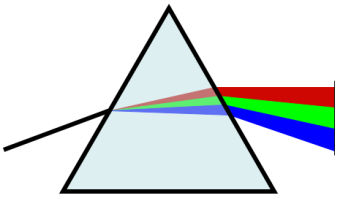
Aim:
To try and make a beaker become invisible.

Materials:
A prism (to make a rainbow), small Pyrex (borosilicate) beaker (the less markings on it, the better), a larger glass container (or larger beaker) to sit the smaller beaker in, vegetable oil.

What to do:
The Prism
Find a beam of sunlight and wiggle the prism in it until you strike the correct angle, at which point a rainbow of colours will appear.

The Invisible Glass
Take the small beaker and place it inside something larger and transparent (another beaker or a glass jar). While people watch, slowly add vegetable oil to the little beaker until it overflows and is eventually submerged within the larger container.

What's going on and what did you find out?
The Prism
When at the correct angle, the beam of white sunlight hits the prism and begins to diffract, or change direction due to the speed of the light through the glass at that angle. The blue light is slowed down slightly more than the red (and all the colours in between are in between). As a result the blue light is bent or refracted slightly more than other colours and the whole rainbow spectrum spreads out in a wonderful pattern.



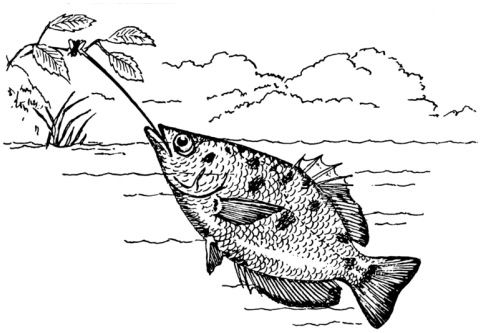
The Invisible Glass
The small beaker was made of a special kind of glass (often also used to make kitchenware that gets very hot). It is borosilicate glass but is also known by the brand name Pyrex. It is much better at withstanding changes in temperature without cracking or breaking. It also just happens to refract light the same amount as vegetable oil. The effect of this is that the beaker is easy to see in air or water as it refracts the light differently to them, but almost impossible to see when submerged in the oil, as light behaves the same in each of them as it passes through, rendering it invisible.

Extension ideas and real world links:

The most spectacular example of refraction (and maybe the best known) is the rainbow. When there are small drops of water in the air and the sun is at the right angle (behind you and you are looking about 40 degrees up) you will see a rainbow. Each drop is behaving like the prism and the rainbow you see is unique. Someone standing next to you will be seeing light from a different set of rain drops.

Another easy place to notice refraction in water is in a pool. When you look into the pool from an angle, something under the water actually appears in a slightly different place than it actually is. Likewise, if you are underwater and look up and out, things outside the pool appear quite differently. This has impacts for things that hunt around the water. When Indigenous Australians go spearfishing, they can't aim directly at the refracted image of the fish, but instead at a slightly different angle (where the fish really was).

Archer fish *(pictured right)* live in water, but hunt by spitting jets of water up and out of the water at insects nearby. They also have to take into account refraction (which they do automatically) in order to capture their prey.



A nice additional resource from Queensland Museum covers this too.

Curriculum links:
(ACSSU080) Light from a source forms shadows and can be absorbed, reflected and refracted.
(ACSSU074) Natural and processed materials have a range of physical properties, these properties can influence their use.