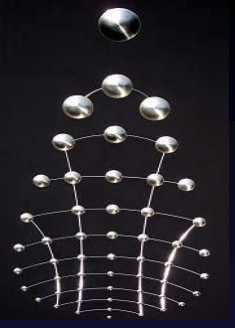


PHANTOM CRYSTALS

What to do

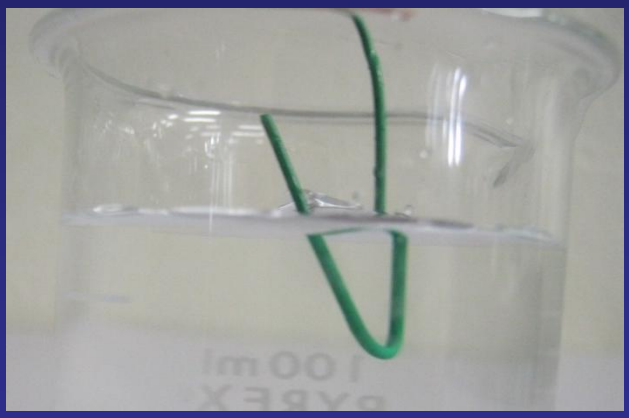
1. Pull a crystal out of the water

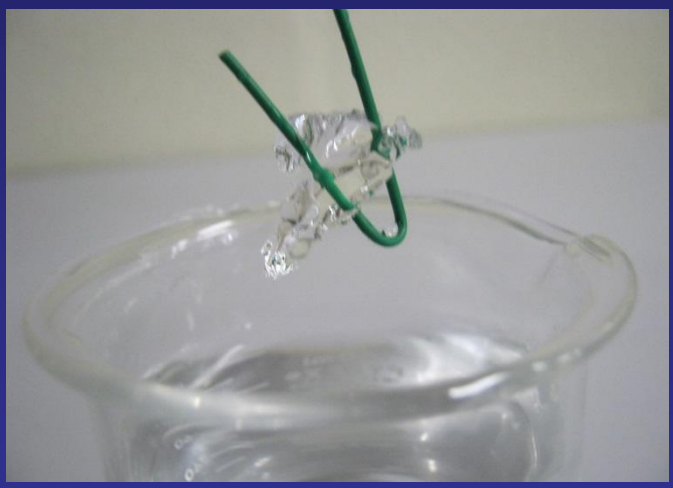
The refractive index of a substance tells us the amount by which the speed of light changes in a substance compared to the speed of light in a vacuum. This is given by the equation:

$$n = c/v$$

Where n is the refractive index, v is the velocity at which light travels in the substance and c is the speed of light in a vacuum.
The refractive index of a vacuum is exactly 1, while air has a refractive index of 1.00028. This means light is travelling almost as fast through air as it would in a perfect vacuum. Water, on the other hand, has a refractive index of about 1.33.

Phantom crystals disappear when they are submerged in water because their refractive index is very close to that of water. However, when they are pulled out of the water, they become visible again. This is because their refractive index (being the same as water) is different to air and light is distorted at the air-crystal interface.





The refractive index also determines the extent to which light is refracted, or bent, as it enters a different refractive index. This is because the wavefront of the light bends when its speed changes on entering the substance. This relationship is given by Snell's Law:

Where n_1 and n_2 are the refractive indices of the first and second substance, and θ_1 and θ_2 are the angles from the normal of the light in the first and second substance.

The refraction of light at the surface of water is easy to see. Objects which are partially submerged appear bent at the surface. Try this for yourself by placing half of your hand in water.

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