ARBOR SCIENTIFIC

Phantom Crystals

P6-2800

INSTRUCTIONAL GUIDE

Contents

- 1 vial containing 25g of Phantom Crystals

Recommended for activity:

- Petri dish (PX-2076)

Background

Light travels at slightly different speeds through different substances. As light waves pass from one transparent substance into another, the waves slow down or speed up and, as a result, refract. Refraction means that the light is pointed in a new direction. The angle at which the light is redirected is called the “angle of refraction.” The angle of refraction is different for each substance and is slightly different for each frequency of light. This is how a prism breaks up white light into a rainbow. The directions of the different colors (different frequencies) are changed due to refraction. Since each color is refracted at different angles, the output is a spread-out display of all the colors that made up the original light.

Refraction is also responsible for the common “broken pencil” illusion. A pencil, partly submerged in water, appears to be broken at the water’s surface. The light from the pencil (the pencil’s image) gets slowed down and refracted as it passes from the water to the glass. It is refracted again (in the other direction) as it passes from the glass to the water. This returns the original angle of the light, but the pencil has been shifted slightly to the side. In fact, the whole background seems “off a bit.”

A ratio, called the “index of refraction,” is used by physicists to describe how much refraction takes place when light travels through one substance into another. Because Phantom Crystals are made up almost entirely of water, they have almost the exact same index of refraction as water. Light will pass from the surrounding water into the crystal without being refracted. Hence, you can’t see it when it is submerged in water. When the crystal is exposed to the air, it instantly becomes visible again. We can see its shape and size because air’s index of refraction is very different than water’s.

Introduction

These carbon-based polymers were designed to be small water-absorbing crystals that may be added to potting soil to help keep plants from drying out.

Phantom Crystals are reported to contain: Non-plantfood Products—25% Hydroxyethel Methacrylate, methacrylic acid, acrylimide copolymer, cross-linked homopolymer for absorption and desorption of water, and 35% silica to stabilize the system.

Set-Up

1. It's a good idea to wash your hands thoroughly before handling the crystals. Oils from your skin can get absorbed onto the crystal and cloud up its surface. Also, try to handle the crystals as little as possible.
2. If bubbles form inside the crystals, try placing the jar in the refrigerator for a few hours to dissolve the excess gas. When the jar is removed and the water warms up, the dissolved gas tends to exit at the water's surface rather than back into the crystals.

Activity

1. Put several Phantom Crystals into a large, clean glass jar and fill it approximately ¾ full with distilled water. Place the lid on and wait a few hours.
2. When the crystals have grown to the point where they appear essentially invisible, pour four or five of them into a clean petri dish. Although they seem to appear like pieces of glass, they are actually quite rubbery.
3. Choose one of the crystals and, touching it as little as possible, attach it to a paper clip.
4. Drop the crystal and paperclip into a clear glass of shallow water. The crystal will seem to disappear.
5. Next, show your students the vial of water with what appears to be a floating or suspended paper clip inside. Let them examine it closely and postulate if it is possible that there may be something in the jar that we cannot see.
6. Lift the paper clip out of the jar and show them the crystal. Put the crystal back in the jar and show them how it disappears as it is submerged in the water.
7. Discuss why we can see the crystal when it is surrounded by air, but cannot when it is surrounded by water.
8. Have the students make predictions of how long it takes the crystals to dehydrate. Try different set-ups:
    a. crystals condensed in glass jar
    b. crystals spread out on a plate

Introduction

Hollow Prism (P2-7020) This equilateral prism has 45mm sides. One end has a hole for adding fluids to study refraction and dispersion. Includes a funnel and stopper.

Refraction Cup with Printed Angles (P2-1225) Fill these semicircular cells with different liquids to observe their refractive properties. Great for showing total internal reflection! Measure angles with the printed protractor.

Laser Refraction Tank (P2-7095) This self-contained unit allows students to measure and study refraction of light.