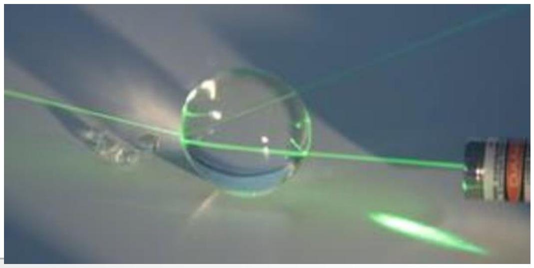
Grow Lenses

P6-2910

INSTRUCTIONAL GUIDE

Contents



- Grow Lens Spheres (P6-2910)
- Instructional Guide

Recommended for activities:

- Dual Red-Green Laser (P2-7679)

Introduction

Grow Lens Spheres are chemically equivalent to Arbor Scientific's Phantom Crystals (P6-2800). 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. It is recommended to wash your hands thoroughly before handling Grow Lenses. Oils from your skin can get absorbed onto the crystal and cloud up its surface. Try to handle the crystals as little as possible. Soaking dry Grow Lenses in different liquids makes for a great open-ended experiment, and soaking them in dyed water makes for a great osmosis demo.

Background

Light travels at slightly different speeds depending on the matter it's travelling through. As light waves pass from one transparent substance into another, the wave fronts are slowed down or sped up and, as a result, refracted. 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 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 and because each color is refracted at a different angle, the light exiting a prism spreads-out displaying of all the colors that comprised the original light.

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 Grow Lenses are made up almost entirely of water, they have the same index of refraction as water. Grow Lenses are crystal clear and they refract light just like water so they become invisible when submerged in water. A comparison of our Grow Lenses Spheres to our Grow Lenses Cubes will reveal tiny air bubbles trapped inside our cubes which can reveal their presence when hiding under water. Air bubbles stand out clearly because the index of refraction of air is significantly different from that of water.

Activities

1. **Preparation:** Put several Grow Lenses into a large, clean glass jar and fill it approximately ¾ full with distilled water and wait overnight (tap water is usually OK). Remember, each Grow Lens will grow to the size of a big marble, so leave a lot of extra room.

2. **General Use:** Once hydrated, Grow Lenses should stay full for a number of days even when out of water. Store them in water for longer periods. They are slippery and fragile! Give students a paper towel to hold their lenses when not in use. Rinse lenses in water if they get dirty.
3. **Image Formation:** Hold the lenses above text and images (either laminate or put pages in a zip top bag) and investigate how images are formed through the lenses.
    a. What happens when the lens is almost touching the text on the page? What happens when it is lifted farther away?
    b. How does the image in the center of the lens compare to the image at the edge?
    c. Approximate the focal length of the spherical lens.
    d. What happens when you flatten the lens?
    e. How is the spherical lens like a human eye? How is it unlike an eye?
4. **Ray Optics:** Use a laser pen with the Grow Lens. (This works best in dim light and with dyed Grow Lenses.)
    a. CAUTION: KEEP LASER BEAMS AWAY FROM EYES. BE ESPECIALLY CAREFUL OF REFLECTIONS WHICH ARE USUALLY JUST AS HAZARDOUS AS A DIRECT SHOT FROM THE LASER.
    b. Explore the way the beam refracts as it enters and leaves the lens. Is it bending toward or away from the normal (a line perpendicular to the surface)?
    c. What happens when you shine the light at different angles?
    d. Can you demonstrate total internal reflection (so that the beam reflects off an inner surface as if it were a mirror)?
    e. Advanced students: Measure the angles and find the lens's index of refraction using Snell's Law. (It is approximately 1.333 – the index of refraction of water.)
    f. Use a flashlight to send parallel rays through the spherical lens, and find its focal point. Does this match your answer from the Images investigation?
    g. Carefully cut the lenses into smaller shapes. (Use a very sharp knife, such as an X-Acto blade or a dissecting scalpel.) Repeat the experiments using hemispheres, triangular prisms, and other shapes.
5. **Osmosis:** Pile salt onto the top of a Grow Lens. Osmosis through the semi-permeable membrane drives salt into the material and, as water streams out, the material shrinks back to its original size. The salted top of the spherical Grow Lens can't tolerate any shrinkage of its outside layer because a sphere already has the minimum ratio of surface area to internal volume. The surface of the shrinking sphere rips open and the Grow Lens collapses into many pieces!

Related Products

Giant Prism (33-0230) Prisms are a classic science teaching tool because of their excellent refractive properties. Equilateral prisms are the best for creating beautiful spectra. 3" equilateral prism, 4" long, it makes bright rainbows from sunlight or artificial sources like an overhead projector.

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.

Optical path Demonstrator (P2-9620) View the entire path of light as it passes through this curved bar. It's made from a unique smoked Lucite™ that scatters light, so students can see total internal reflection and how light travels through fiber optic cables. Size 8.5" curved length.