611-1615 (50-015) Refraction Rod

Warranty and Parts:
We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.

Description:
Our 50-015 Acrylic Refraction Rod is a precision machined and formed light tube. When a light such as a flashlight, LED or laser is shone through one end, the light beam stays in the rod and follows the tube length (even around a loop!) This occurs through the concept of total internal reflection.

Safety Note: Please wear laser safety glasses when using this product with a laser.

Curriculum Fit: Nature of Light, Optics, Refraction, Total Internal Reflection.

What is Refraction?

When light passes through a transparent material, some light passes through. In the case of water or glass, **most** of the light passes through. When light enters one of these transparent materials at any other direction besides head on, the light is bent. The bending occurs just as the light enters. This bending is called refraction.

Experiment 1: Refraction of a spoon in a glass of water.

1) Place a spoon into a clear glass of water.
2) Look at the spoon from the side.
3) Describe what the spoon looks like when you observe it:

Observation:_____

Notice that the spoon looks "bent" at the surface of the water. The "bent" spoon is the result of a change in the direction of light as it goes from air to water.

Experiment 2: Total Internal Reflection.

1) Dim the lights in the room.

2) While holding the Refraction rod in one hand, turn on the laser and shine it through one end.
3) Describe what you see occurring inside the refraction rod.

Observation:_____

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You will see the laser beam inside the refraction rod going in a straight line and being reflected off of the walls as it continues is path. This is the interesting phenomenon called total internal reflection that juxtaposes both reflection and refraction. If a ray of light travels from a medium with a high index of refraction to one having a lower index (such as moving from acrylic into air) it will be bent away from the normal, toward the first medium. If the angle of incidence is great enough, the ray can be bent so extremely that it will never exit the first medium; in this case, the ray will be reflected off the boundary and back into the medium.

Table of some indices of refraction

Material	Index of Refraction
Acrylic	1.495
Air	1.0003
Diamond	2.417
Glass	1.460
Vacuum	1.000
Water	1.333

Experiment 3: Dispersion of Light.

1) Fill a 1000ml or similar beaker of water.
2) Dim the lights again.
3) Set the Refraction Rod so that one of the loops rests in the beaker of water.
4) Shine the laser through one end of the Refraction Rod.
5) Observe what happens this time

Observation:_____

_____

You will notice that this time the light goes through the Refraction Rod and some of the light comes out of the Refraction Rod and disperses throughout the beaker

BENCHMARKS AND STANDARDS

Benchmarks for Science Literacy	National Science Education Standards
Physical Setting 4F.2	**Physical Science**
Something can be "seen" when light waves emitted or reflected by it enter the eye just as something can be 'heard" when sound waves enter the air.	**Transfer of Energy: Light interacts with matter by Transmission, Absorption, or Scattering. To see an object, light from that object must be emitted by or scattered from it and then enter the eye.**

Science First® *is a designer and manufacturer of hands-on science labs. Our products are available from most science education distributors. For more information contact us.*

Related Products:

614-0701 Cylindrical Spectroscope This device is made of optical glass. The optical glass has been carefully machined into a compound prism and convergent lens. Spectrums of many different kinds can be seen through this spectroscope.

654-0010 Refracting Telescope Kit Set of 10- Experiment with each element of a simple 16-power refracting telescope and see how the lenses work when put together without using an optical bench. Galileo's first telescopes lacked precision and clarity. Nevertheless, he made astonishing discoveries with his crude instruments. This simple lab enables students to build a telescope that is similar to Galileo's. Use the telescope and see how it is similar to a pinhole camera . Materials to make 10 telescopes are provided.

614-0101 Hands on Optics: Laser Challenges-Students learn about lasers and explore the law of reflection using mirrors and protractors. They learn to carefully measure light and predict its behavior through a variety of challenges.

614-0102 Hands on Optics: Kaleidoscope Adventures- Students explore multiple reflections and symmetry using mirrors. They will learn some of the unusual properties of periscopes and will build their own kaleidoscopes.

614-0103 Hands on Optics: Magnificent Magnifications-Students observe how light interacts with materials such as glass and plastic and how images can be formed by refraction. They use lenses to focus images and learn how a magnifying glass works. Students use their knowledge of lenses to assemble a refracting telescope and test its resolution.

614-0104 Peculiar Polarization-Students continue their exploration of light by learning what is meant by polarized light. They explore a diverse variety of topics such as birefringence, why we use polarized sunglasses, optically active substances, polarized light from LCD screens, and stress analysis using polarized light. The culminating challenge is a unique activity where students use their knowledge of polarized light to create a work of art.

614-0105 Infrared and Ultraviolet Light-Students learn more about the wave nature of light. They visibly see the differences between ultraviolet, infrared and visible light by constructing a model of the electromagnetic spectrum. Students explore applications of infrared light though the use of television remote controls and an infrared thermometer. Ultraviolet beads are used to detect ultraviolet emissions from black lights. The module concludes with a series of activities where students explore various types of luminescence through fluorescent materials and minerals, glow sticks, and surprising substances that exhibit luminescence.

614-0106 Communicating on a Beam of Light-Students continue their exploration of light with a kinesthetic activity illustrating why light has different colors and the special properties of laser light. They learn about Morse code and how it is used for communication. Students assemble and test their own laser communication system capable of transmitting their voices or music from an MP3 player several hundred feet!