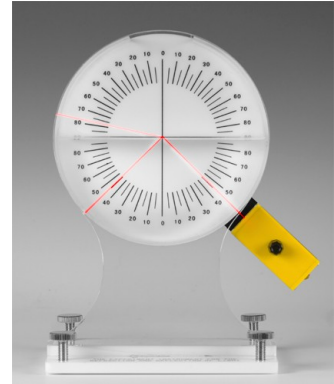


# Laser Refraction Tank

P2-7090



## BACKGROUND:

This self-contained unit can clearly and vividly demonstrate refraction, reflection and total reflection as well as define the critical angles of two different materials. Students can measure as well as study refraction of light. The angle of incident and refractive rays are easily seen with the help of a built-in laser as its light sources. The laser revolves around the circular graduated scale and can be set at any point. Students can easily observe light rays as they travel from air into water, water into air, and water into water.

## KIT CONTENTS:

The unit includes one laser tank (trough), base, one laser pointer and detachable housing unit, and four level-adjusting screws. The laser pointer contains three size AG13 batteries. In addition to the three batteries installed in the pointer, six extra AG13 batteries are included.

## USING YOUR LASER REFRACTION TANK:

1. Place the Laser Refraction Tank on a level and smooth surface.
2. Pour some water into the tank until the water reaches the horizontal line.
3. Adjust the horizontal plane of the liquid using the four level-adjusting screws located on the base.
4. The butterfly nut on the back of the trough can be loosened or tightened to control the tension of the rotating laser arm. Adjust the butterfly nut so that you can move the laser around the Laser Refraction Tank so that the laser stays in place but can still be moved manually when needed.

5. Turn the rotating switch of the laser pointer to open its laser light.
6. Begin with the laser pointer at the  $0^\circ$  line. When the laser pointer is vertical (on the  $0^\circ$  line), the incident light beam is also vertical; that means the incidence angle and the refracted angle are both  $0^\circ$ .
7. Rotate the laser pointer slowly from  $0^\circ$  to a point either above or below the water line and we can find the phenomena of refraction when the light beam has gone through one material into another. As the light beam first goes through a less dense medium (air) and then into a denser medium (water) and the phenomena of refraction is seen.
8. Continue to rotate the laser pointer until the angle of incident has reached the critical angle, then total refraction will be seen.

## CALCULATING THE INDEX OF REFRACTION:

The Law of Refraction (Snell's Law) states:  $n_1 (\sin\theta_1) = n_2 (\sin\theta_2)$

Students can use the Refraction Tank to quickly calculate the index of refraction of water. When the laser is positioned below the water level, as shown above,  $n_1$  is the index of refraction of water.  $n_2$  is the index of refraction of air and equal to 1.0. ( $n$  is a unit-less quantity.)

1. Position the laser below the water level, at an angle that is less than the critical angle (so that total internal reflection does NOT occur.)
2. Record the values of  $\theta_1$  and  $\theta_2$ , remembering to measure each angle from the normal line,  $0^\circ$ .
3. Use Snell's Law to calculate  $n_1$ , the index of refraction of water.
4. Repeat the angle measurements two times, and find an average value for  $n_1$ .
5. Tell students that they will now check their work by moving the laser above the water line. Assign each student group an angle of incidence from air, and ask them to calculate the angle of refraction *into water*. Then they can check their answer experimentally.

The accepted value for the index of refraction of water is **1.33**. The index differs slightly for different colors of light, but the scale of this experiment does not require that amount of precision.

## MAINTENANCE OF YOUR LASER REFRACTION TANK:

1. Store the laser pointer in a dry place.
2. Empty the Refraction Tank prior to storing.
3. The unit is precisely structured. Use it gently.
4. Dust can be wiped clean with a soft dry cloth.
5. When the unit has been used for an extended period of time the laser light may become weak and require new batteries. To replace the three size A13 batteries, unscrew the four screws on the cover of the laser pointer to open the cover and expose the old batteries. Replace the three batteries and then replace the cover and screws.

