

## Refraction of Light Lab Physics

This week's lab will be using PHET instead of Pivot.  
This is the link for the Phet site.

<https://phet.colorado.edu/>

When the site opens, scroll down until you see a light blue circle with PHYSICS inside. Click this circle. Then select Light & Radiation. Next, find the App called "Bending of Light." Finally, click on the app (you may click on the Play button or the Red 5) You will start the lab using the Intro section.

### Preliminary Investigation

1. Turn the laser on by clicking the red button. You will see light getting reflected and refracted. Now move the laser pointer left and right by clicking and holding on the silver part and moving it. What are some observations you make? Describe them.
2. Now, leaving the pointer at about  $45^\circ$  change the material the pointer is in. It is currently in Air. Click the tab and try several other materials. What are some of your observations?
3. Put the initial material back to Air. Now click on water in the lower material. Change it to several other materials and made record your observations. Is there are way to make the light, go straight from AIR into the lower material.

## PART I

1. For this part of the lab you will stay in the intro section.
2. Keep the starting material AIR, and the lower material WATER.
3. Drag the yellow protractor onto the experimental area. Move it so the AIR/WATER barrier line is just on  $90^\circ$ . The dotted Normal line must be at  $0^\circ$ .
4. Now you will change the incident angle to the angles listed on the table below. Use the protractor to set the Incident angle and find the Refracted angle.

Incident Angle (degrees)	Refracted Angle (degrees)
0	
15	
30	
45	
60	
75	
90	

5. Using Snell's law pick three incident angle and check to see if you PHET gave you the correct refracted angles. Show your work.

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

You will solve for  $\theta_2$

6. Now, let's play with the Intensity Sensor. Drag the sensor onto the screen. It's the green thing on the bottom left.



The circle on the right is the sensor and the readout is the white rectangle. Move the sensor to the reflected ray. Note the Reading. Now checkout the refracted ray. Note the reading. Now move the laser to a high angle with Total Internal Reflection and move the sensor to the reflected ray. Note the reading. What are some observations you can make about Intensity of reflected and refracted light?

## PART II

1. You will repeat the previous experiment with one difference. You will change the upper material from AIR to GLASS.

Incident Angle (degrees)	Refracted Angle (degrees)
0	
15	
30	
45	
60	
75	
90	

2. Glass has a higher index of refraction than water (air was less than water). How did this change the way the Laser Light bent?
3. For all of the angles you got a reflected ray (in Part I and Part II). For part II however, there were no Refracted rays for either 75° or 90°. This is due to Total Internal Refraction.

Total Internal Refraction occurs when light goes from something Thick to something Thin at some bigger angles. As you increase the angle, you get to a point where the light bends so much that it cant escape the material. This is Total Internal Reflection. The reflection you see at the lower angles is just Internal Reflection. It is not total because some light refracts and some reflects. The initial angle where Total Internal Reflection occurs is called the critical angle. For light going from Glass to Water it must be somewhere between 60° and 75°.

4. Use the Laser pointer the find the exact critical angle. Do this by moving it slowly from 60° to 75° and make a note of the exact angle where light no longer refracts.
5. Calculated the critical angle with the formula below.

$$n_1 \sin \theta_c = n_2 \sin 90^\circ$$

$\theta_c$  = Critical Angle ( you will have to use Inverse Sin or  $\sin^{-1}$  for your last calculator step

### Part III

There are 2 Mystery materials available. Use the protractor and laser to find out what the index of refractions are for both Mystery materials. You will need to use Snell's Law. Remember to go from Theta to Degree you do  $\sin^{-1}$