Refraction PhET Lab

Purpose: To investigate the behaviors and characteristics of light when it bends due to refraction. These properties and characteristics will be true for all other EM waves - and sound as well.

Questions:

What happens to the speed of light as it goes from air to water?

- Hypothesis:

What happens to the frequency of light as it goes from air to water?

- Hypothesis:

What happens to the wavelength of light as it goes from air to water?

- Hypothesis:

Procedure:

Go online and search for "phet bending-light", or go to the PhET website http://phet.colorado.edu/en/simulation/bending-light, and run the sim. Mess around with the controls and tools provided on the Intro tab; your first tasks are:

- Learn how to turn the beam on and off,
- Learn how to change the beam to a wave,
- Learn how to change the angle of the beam.

Write down the steps you needed to do to accomplish each task.

You will be systematically learning about changing angles in **refraction**

- Which beam is best suited for measuring angles, the ray or wave?
- Which tool should you select for measuring angles, the protractor or intensity meter?

-Using this setup and tool, you will investigate and discover:

- How the **angle of refraction** compares to the **angle of incidence**, measured from the **normal**, when going from air to water,
- How changing the **index of refraction** of the bottom material changes the angle of refraction,
- How changing the index of refractions of both materials changes the angle of refraction. What conditions produce no refraction? What conditions produce maximum refraction?

Write down the steps you needed to do to accomplish each task, and in a table, record your observations for each.

Investigate the materials further: set the *top* material to be water, and the *bottom* one to be air. Systematically investigate and discover:

- How the angle of refraction compares to the angle of incidence, measured from the normal, when going from water to air,
- At what angle of incidence does something different happen that did not occur in the first investigations? Describe what happens to the refracted beam at this **critical angle**.
- How changing the index of refraction of the bottom material changes the angle of refraction,
- How changing the index of refraction of the bottom material changes when the critical angle appears,
- How changing the index of refractions of both materials changes the angle of refraction. What conditions produce no refraction? What conditions produce maximum refraction?

Write down the steps you needed to do to accomplish each task, and in a table, record your observations for each.

You are now ready to investigate the beam itself. Click on the More Tools tab, and change your beam to a wave.

- Using the speed tool, investigate the connection between the **index of refraction** of the bottom material and the **speeds of the beams** in air and in the bottom material.

Write down the steps you needed to do to accomplish this task, and in a table, record your observations; what equation connects the above two variables?

- Using the time tool, investigate the connection between the **index of refraction** of the bottom material and the **frequency of the beam** in that material compared to the beam in air. Observe the **wavelength of the beam** in the material compared to its wavelength in air (you may slow down or pause the sim for this).

Write down the steps you needed to do to accomplish each task, and in a table, record your observations.

BONUS:

- Using the equation you found for the index of refraction, find the index of refraction of **mystery materials A & B**. Search online and theorize what these materials might be.
- Investigate and report what effect **changing the color** (wavelength) of the beam has on any of the refraction behaviors you already recorded.

Conclusion:

What were your hypotheses, and were they validated by the results of your investigations? If not, what did you learn? Summarize what conditions are necessary for refraction to occur, and how changing those conditions changes the amount of refraction. What conditions cause exceptional behavior?