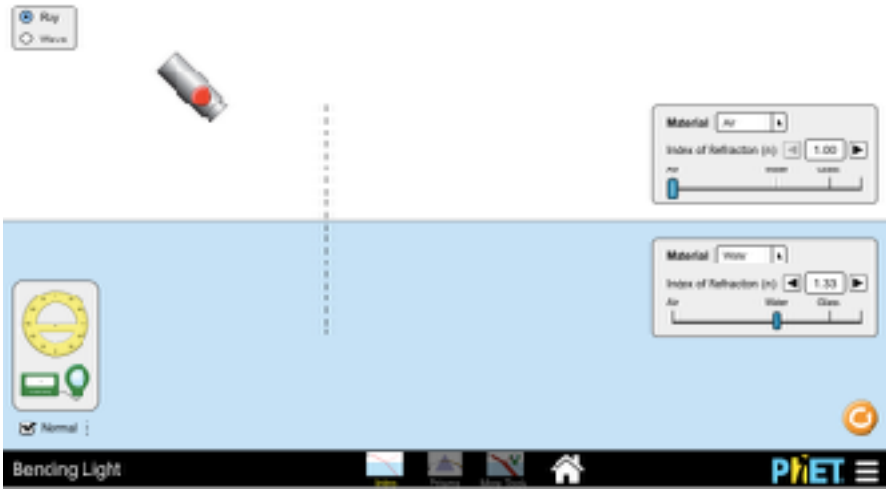
Refraction & Speed of Light

In this activity students will be exploring the speed and intensity of light in a variety of media using the “Bending Light” PhET simulation.

Open the simulation by clicking on the link:

https://phet.colorado.edu/en/simulation/bending-light

Take a look at the explanatory video via YouTube:
https://youtu.be/v_Y4O73XdQc

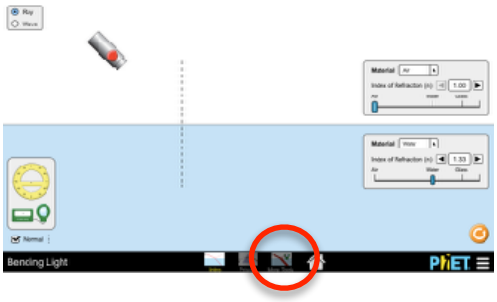


Learning Objectives

By the end of these activities it is hoped that students will have an acquired the following skills:

- Following explicit instructions to gain acquired knowledge
- Understand what happens to the speed of light when it passes through denser media and relating it to the refractive index
- Understand how the angle of refracted light changes when the light angle of incidence changes.

Activity A: Speed of light as it passes through a denser medium.



- Make sure you have pressed the “More Tools” button on the bottom of the page so the screen looks like the image opposite.
- Note the “**Normal**” is the hatched vertical line at 90^{o} to the boundary. Make sure you have **AIR** at the top and **WATER** below it.

- Rotate the light source so it is pointing straight down the **Normal** line.
- Turn the light source on. You should now have the light passing in a straight line down the normal.
- Drag the speed indicator and place it next to the **Incident** line passing through the AIR.
- **What does the speed indicator read in terms of “c”. Note: “c” is the speed of light?**

- Now drag the speed indicator and place it over the light passing through the WATER.
- **What does the speed indicator read in terms of “c” now?**

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- Now change the medium that the light is passing into to GLASS by clicking on the area shown by the red circle. The colour of the media will change to purple.
- Do exactly the the same thin with the light and speed indicator and complete table 2 below:

Table 2:

Speed of light in AIR	
Speed of light in GLASS	

- **Which media slows light down the most? State how you know and why you think this?**

- **Conclude what happens to the speed of light when it passes from a less dense media in to a more dense media?**

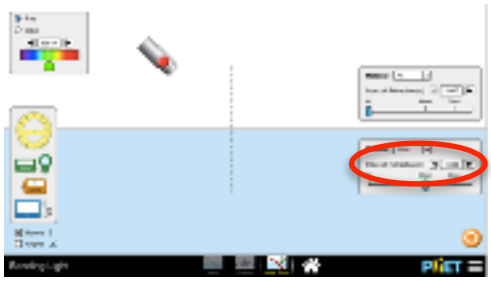
  Justify your statement using the data you have collected

- **What do you think will happen to the speed of light if it goes from water to air? Why?**

- **The refractive index 'n' is calculated as the speed in air divided by speed of light in a media. Use your data to calculate the refractive index for water and glass.**

- **Now compare the above two answers to the refractive index given for each media in the simulation. What do you notice?**

  Are they identical if not why not?



Activity B: Intensity of light as it passes through a denser medium.

- Use the situation of light passing into **WATER** from **AIR**.
- Switch the light on.
- Now use the intensity meter to determine the light intensity of the light coming from **AIR**, then that being refracted through the **WATER** and also the light reflected back into the **AIR**.
- Complete table 3:

Table 3:

	Light Intensity (%)
Incident Light	
Refracted Light	
Reflected Light	

- **Add the refracted light % and the reflected light % together. What do you notice?**

- **Snow is made of water thus it must refract light. Use the above evidence to explain why often people going on a ski holiday end up very tanned?**

SUMMARY:

- **As a beam of light enters a denser media what happens to it?**

- **What effect does the answer given above have to the path travelled by the light through the secondary media?**

- **The degree with which the speed of light is altered from that in a vacuum is termed what?**

- **Often when light is shone on a secondary media there is reflection as well as refraction. What can you state happens to all the light energy in the reflected and refracted rays?**
