Light and Waves E-Learning Activity

Background

This activity aims to guide your understanding of how waves react to meeting a boundary in the medium that they are travelling. As you go through this activity take time to investigate and ‘play’ with the E-Learning Applet to discover all that you can about the phenomena that take place.

Instructions

Download the app from:

<http://phet.colorado.edu/en/simulation/bending-light>

Click on ‘Download’ and then run it.

Refraction

With the App now open click on the tab at the top that says ‘More Tools’. Click on ‘Wave’ in the top left corner. Turn on the laser by clicking on the big red button. Describe the output of the laser. What do the red lines represent?

Move the laser up and down and describe the change that you see:

Now move the laser closer to the boundary. Observe what is happening at the boundary. Describe why the ‘refracted’ beam gets thicker.

Now consider why the reflected ray’s width does not change.

Click on the orange meter in the ‘toolbox’ in the bottom left corner and drag it onto the screen. Place the arrow of the speed meter in the refracted ray and then the reflected ray. Does this confirm your findings?

Describe why the refracted ray bends.

Put the speed meter away and drag the ‘time’ meter out. Without moving its sensors move it so one goes into the reflected ray and the other into the refracted ray. Observe what is on the screen of the meter. Explain what this indicates is the same about the light ray in both media?

Put the time meter away. Drag out the green meter and put the white circular part in the ray and the meter reading anywhere you can see it. Note that you can drag the two parts of the intensity meter separately. Describe what happens to the intensity of the refracted ray as you change the angle. Note also that you may need to move the meter to keep it in the ray.

Repeat the process with the reflected ray. Describe the relationship between the intensity of the refracted ray and that of the reflected ray.

While keeping the laser in one place (close to 90o) change the lower material to ‘custom’. Slide the slider that changes ‘n’ (the refractive index of the material) back and forth. What do you observe and why do you think this happens?

Now insert the speed meter into the beam as you change the refractive index of the lower material. Describe what happens and why.

Total Internal Reflection

Put all the meters away. Change the lower material to air and the upper material to glass. With the laser at the top drag the laser toward the boundary. Describe why the refracted ray refracts towards the boundary.

Move the laser to the top of the screen again and select ‘ray’ in the top left corner. Drag the laser slowly towards the boundary observing the refracted ray as you do. Stop when the refracted ray disappears. Measure the angle of the reflected ray using the protractor in the tools menu. What angle have you just measured?