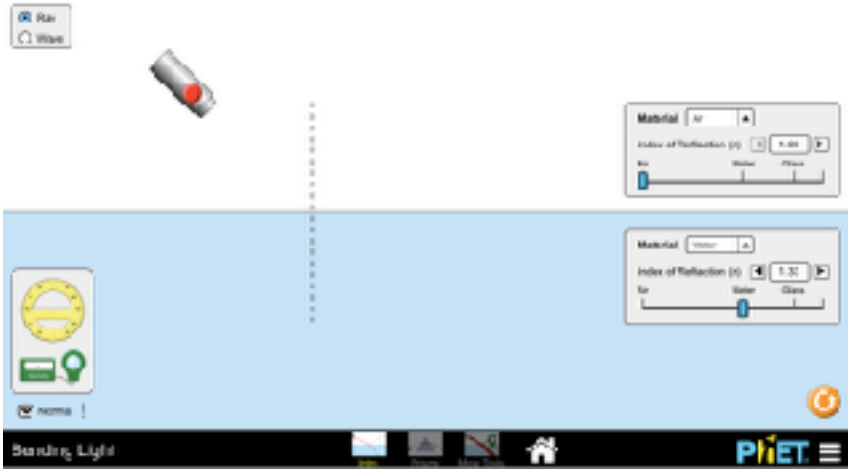
Critical Angle & Total Internal Reflection

In this activity students will be exploring the how light emerges from a media and eventually forms a critical angle where no light emerges. They then explore what happens once you go beyond this angle. The "Bending Light" PhET simulation will be used to show this.

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
- Determine the critical angle fro measurement and calculation
- Understand what happens to light once you go pass the critical angle.
- Linking total internal reflection to fibre optic cabling.

Author: Simon Lees 2017

Activity A: Determining the critical angle

- As long as you are in the "**Intro**" or "**More Tools**" page that is fine.
- Toggle so that there is water on the top layer and air on the bottom layer by clicking on the **Material** button.
- 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 light source anticlockwise away from the **Normal**.
- **What do you notice happening as the light emerges into the air?**

- Take a screenshot of this and place it in the area below:

Screenshot of light entering into the air

- Keep dragging the light source round
- **What happens to the refracted ray the further away from the Normal the incident ray gets?**

- Keep on dragging the light source until the refracted ray disappears.

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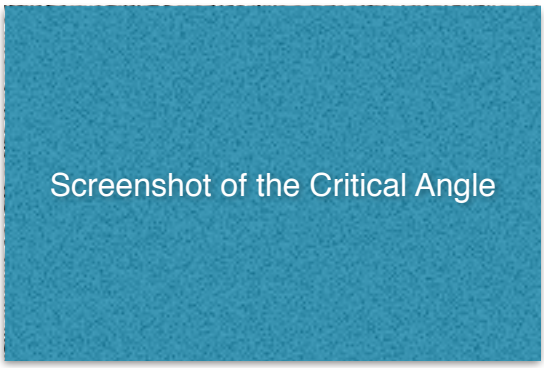
- **Use the protractor to measure the incident angle for this situation and write it below. This is the CRITICAL ANGLE:**

- Take a screenshot to show of this situation and paste it in the area below:



- The critical angle can be calculated using Snell's law where the refractive angle is always 90°.

$$n_i \sin\vartheta_c = n_r \sin 90^o$$

- **Calculate the critical angle for light passing from water n = 1.33 into air n = 1. Compare this with the value you measured. What do you notice?**

- **Now change the medium of water for glass n = 1.50 and calculate the critical angle for light passing from glass into air. Then measure it using the simulation. What do you notice.**

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Activity B: Total Internal Reflection

- Now move the light beyond the critical angle
- **What happens?**

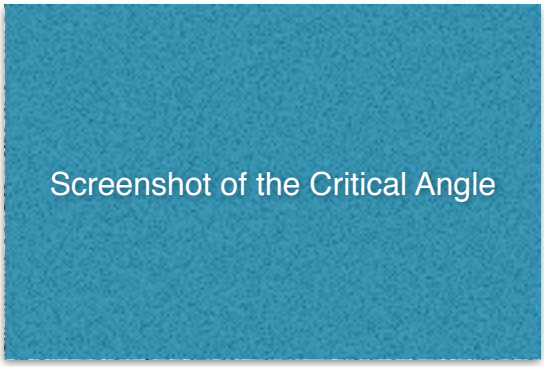
- **Measure three incident and reflective angles and complete table 1:**

Table 1:

Incident Angle	Reflective Angle

- **What law applies here?**

- Take a screenshot of one of these angles and paste it in the area below.



Questions continue on the next page

- **This phenomenon is used in fibre optic cabling. Research how this works and briefly explain how total internal reflection is a major part of the process.**

SUMMARY:

- **What is the critical angle?**

- **How can the Snell's law formula be utilised to find the critical angle?**

- **What is total internal reflection?**

- **What law is utilised in total internal reflection?**