

Course and Section _____

Names _____

Date _____

REFLECTION AND REFRACTION SIMULATION

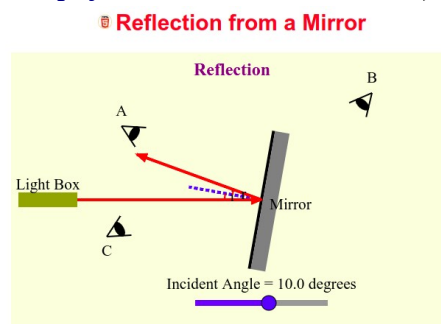
Introduction

The purpose of this activity is to study how light reflects off a shiny surface, and how it refracts when entering a transparent material.

Submit your answers using Blackboard.

1 - Reflection

Open the simulation (<http://sahyun.net/physics/html5/reflection.htm>)

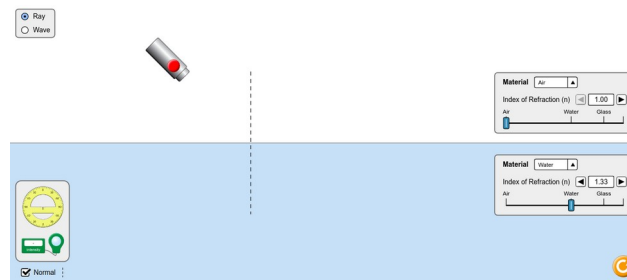


The angle of incidence and reflection are labeled i and r respectively. You can vary i by moving the blue dot at the the bottom. Use the following letters to provide your answers

1. If you decrease i what happens to the value of r ?
2. How does the value of i compare to r ?
3. For which i does light hit directly the center of observer A's eye? (deg)
4. For which i does light hit directly the center of observer B's eye? (deg)
5. For which i does light hit directly the center of observer C's eye? (deg)
6. What happens to the ray of light when $i = 0$?
7. At what incident angle will the angle of incidence sum together with the angle of reflection to make a right angle? (deg)

2 - Refraction

Open the simulation (<https://phet.colorado.edu/en/simulation/bending-light>).



Run the simulation and select *Intro*

Light source: Ray. Material above: Air. Material below: Glass.

You can move around the light source and vary the angle of incidence. Use the protractor located on the bottom left corner to measure the angles.

8. If you decrease the angle of incidence what happens to angle of refraction?
9. How does the angle of incidence compare to the angle of refraction?
10. If you decrease the index of refraction of the material below what happens to angle of refraction?

Use the intensity detector located on the bottom left corner.

11. If you increase the index of refraction of the material below what happens to the intensity of the refracted ray?

Set the angle of incidence at 60 degree.

Light source: Ray. Material above: Air. Material below: Glass.

12. What angle of refraction do you measure with the protractor? (deg)
13. What angle of refraction do you obtain using Snell's Law? (deg)
14. Calculate the % error of the values obtained in question 9 and 10.

Select Material above: Air. Material below: Mystery A.

15. What is the index of refraction of Mystery A?

Open the link https://en.wikipedia.org/wiki/List_of_refractive_indices

16. Which material best matches the result of your calculation in question 15?

3 - Critical Angle

Restart the simulation (click the bottom right yellow button).

Light source: Ray. Material above: Water. Material below: Air.

Start with an angle of incidence of about 60 degree and slowly decrease it.

17. The refracted ray disappears when the angle of incidence is larger than which value?

When the angle of incident is larger than the critical angle, the light hits the air' surface and it 'bounces back' into the water.

18. What is the name of the optical effect?

Select Material above: Mystery B. Material below: Air. Repeat the procedure
19. What is the index of refraction of Mystery B?

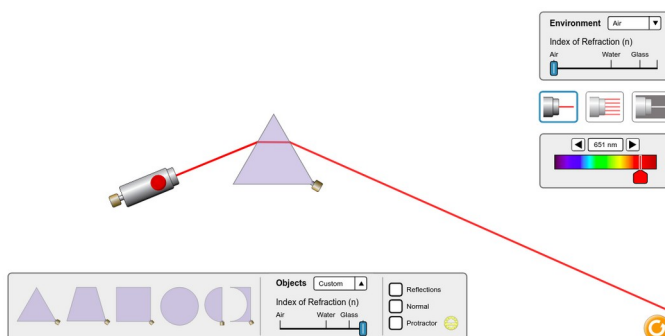
Open the link https://en.wikipedia.org/wiki/List_of_refractive_indices

20. Which material best matches the result of your calculation in question 19?

4 - Prism

Start over the simulation <https://phet.colorado.edu/en/simulation/bending-light> and select *Prism*.

Select the prism shape located in the bottom left and drag it in the center. Move the light source as shown in the following image



Set the index of refraction to its max possible value (all the way to the right). The goal is to find the index of refraction of the prism using Snell's law. Select the Protractor and display the normal.

Measure the incident and refracted angles where the ray enters the prism.
Measure the incident and refracted angles where the ray exits the prism.
Input the values of your measurements in the table.

21. What is the index of refraction calculated using the data at the entry point?

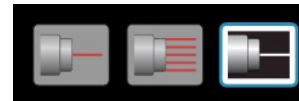
22. What is the index of refraction calculated using the data at the exit point?

23. What is the percentage difference between the two values of the index of refraction?

24. Look at the surface where the light exits from the material to the air, as you change the color of the ray of light from blue toward red, how does the refracted angle change?

Select white light and dark background by clicking the last icon on:

25. What is the name of the physical phenomenon effecting the white light that you are observing ?



5 – Focal Point of a Lens

Start over the simulation Bending Light and select Prism.



Select multiple rays by clicking the middle icon on:

The basic principle on how a lens works (in order to magnify an image for example) is the bending of light due to refraction. You will study more in details the process of image formation on your next activity but the key concept is the notion of the focal point: a point where the rays of light meet.

Focal point:



This point exists only if the refracting material satisfies precise geometrical conditions.

Try the multiple rays beam to pass through each object of the different shape below



A

B

C

D

E

26. Which of the above objects has the property to focus the rays of light to one point?

27. How does the distance of the focal point to the object change as you increase the index of refraction of the object ?