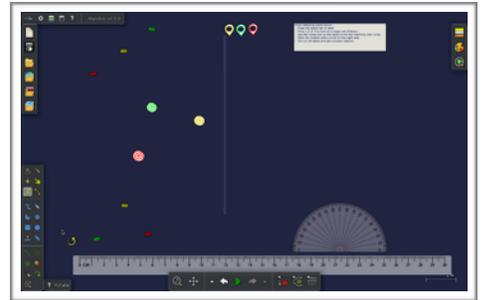


## Part 1: Plane Mirrors

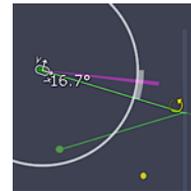
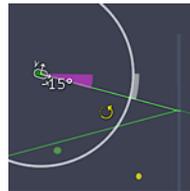
This activity will model, using Algodo, the mirror lab experiment from class. With a physical model, students are asked to look into the mirror from two different angles to find the image of three points in a mirror. The intersection of the two sight lines is the location of the virtual image of each point. In the Algodo version, there are three targets on the left side of a mirror, and three sets of colored laser lights to provide the sight lines. One color at a time, the student should rotate the two lasers so that the beam reflects to hit the target on the left. Some of the light from the laser is transmitted through the mirror, and can be used to find the image where they intersect. Students should place the matching color marker at the point of intersection, then use the virtual ruler and protractor to complete the measurements.



$$\theta_i = \theta_r$$

### Directions:

- Press the space bar or start button.
- Press 1,2 or 3 to turn on a single set of lasers. It is recommended to only use one at a time.



-Use the rotate tool to turn the lasers and hit the matching color target with a reflection from the mirror. Remember from training that keeping your mouse inside the rotation circle will only allow rotations of 15° at a time, with the mouse outside the circle you can freely rotate the laser.



-Find the intersection of the transmitted light. Mark the location with a marker on the right side. Use the “move” tool to drag the markers.

When making measurements, take your time and use the zoom and pan features of Algodo to get a close and accurate measurement of all angles. You may move and rotate the protractor or ruler tools. Do not change the dimensions of the tools.

Measurements and conclusions.

1. Turn on all lasers and **create a screen capture.**
2. Put the screen capture in a word or pdf document. Also answers the following questions.

	<b>D</b>	<b>D</b>	<b><math>\theta</math></b>	<b><math>\theta</math></b>
Red Laser				
Yellow Laser				
Green Laser				

**Question 1:** Compare the distances of the target dots to the mirror with the distance from the mirror to the image dots.

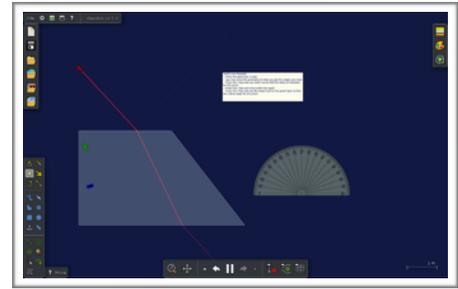
**Question 2:** Compare and contrast the size and alignment of the triangle formed by the objects (the target dots) with your image (the placed markers).

**Question 3:** The images formed in this lab are virtual images (not real). What does this mean to you?

## Part 2: Refraction

This activity will model, using Algodo, the refraction lab experiment from class and will use the Snell's Law equation to find the index of refraction for the simulated glass. During the physical model experiment, students look through the glass to align the direction of light entering the glass with the light that is transmitted through. A construction is performed by connecting these lines to find the path of the light in the glass itself.

Using the lasers in the Algodo simulation, the path of the light will be clear to follow so that students can make careful measurements of the appropriate angles.



$$n_r \sin \theta_r = n_i \sin \theta_i$$

### Directions:

- Press the space bar or start button.
- Press 1,2 or 3 to turn on a single set of lasers. It is recommended to only use one at a time.
- When making measurements, take your time and use the zoom and pan features of Algodo to get a close and accurate measurement of all angles.
- You may move and rotate the protractor.
  
- Using the RED laser first, simply measure the angles in the air and in the glass.

**Question 3:** *At the top of the glass, what is the angle of incidence (entering the glass), the angle of refraction (inside the glass), and the index of refraction for the glass?*

**Question 4:** *At the bottom of the glass, what is the angle of incidence (inside the glass), the angle of refraction (leaving the glass), and the index of refraction for the glass?*

- Using the BLUE laser, simply measure the angles in the air and in the glass.

**Question 4:** *What is the angle of incidence, the angle of refraction, and the index of refraction for the glass?*

- Using the GREEN laser, rotate the laser to find the critical angle. You will find that there is a break point somewhere on the bottom of the glass. Aiming the laser to the left of this point allows for transmitted light, to the right of the break point the green laser will be totally reflected and stay inside the glass. Rotate the laser carefully to find that point and **get a screen capture**.

The critical angle in the more dense material (the glass) is the incident ray at the limit where the light is reflected, and therefore creates a refracted angle of 90 °

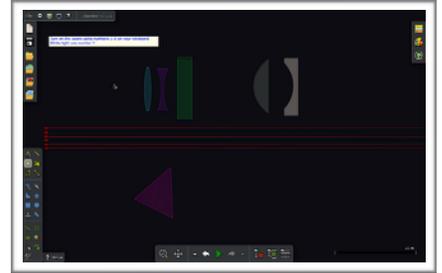
**Question 5: What is the critical angle and the index of refraction for the glass?**

	$\theta$	$\theta$	$n = \frac{\sin\theta_r}{\sin\theta_i}$
Red (top)			
Red (bottom side)			
Blue			
Green		90	

### Part 3: Optics Bench

Time to explore

The objects in this activity include: a diverging lens, a converging lens, a diverging mirror, a converging mirror, and two planes of glass. Use combinations of the lasers or the white light source to investigate the result of using each of the objects or combinations of them. Pressing the numbers 1 through 6 will allow you to use single or multiple lasers. Pressing the number 7 will toggle the white light source. You may move or rotate the objects on the screen to study each.



	What did this do to light rays?	How do you think this lens or mirror could be used?
		
