

Reflection and Refraction Lab

How can you measure reflection and refraction?

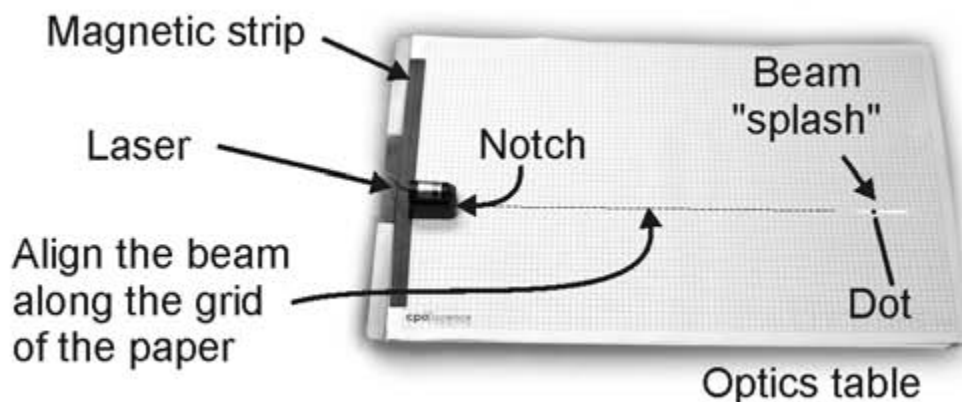
Looking in a mirror, we see a twin of ourselves reversed left-to-right. A fish underwater appears in a different place from where the fish really is. Both of these illusions are caused by the bending of light rays. This Investigation explores reflection and refraction, two processes that bend light rays.

Materials

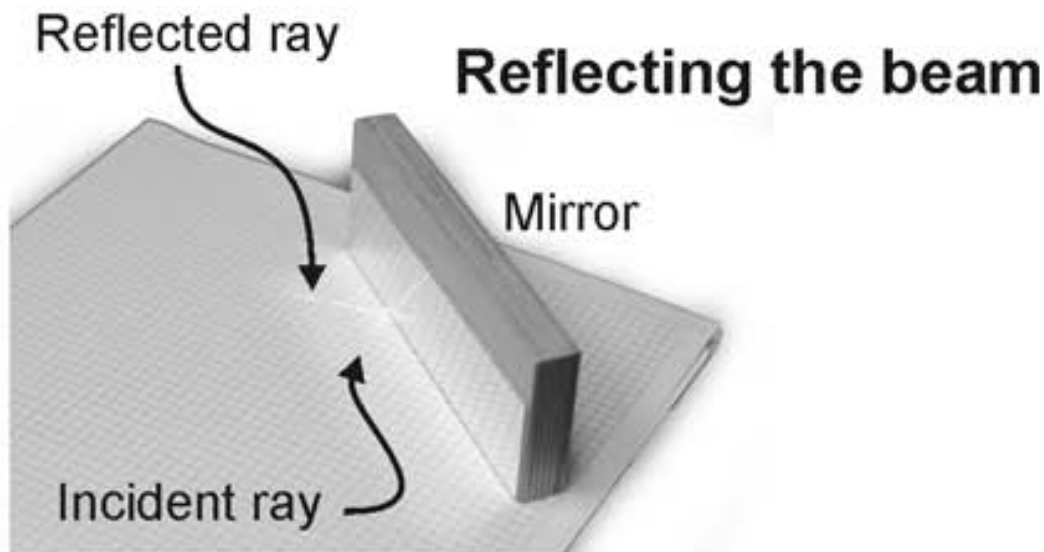
- Light and Optics kit
- Protractor & metric ruler

Observing the law of reflection

- Set a sheet of graph paper on the optics table.
- Connect the laser and put it on the optics table so that the base is **tipped up on the magnetic strip**.
- Align the laser so the beam points down slightly and follows one horizontal line across the paper.
- Draw a dot about 1/3 of the way along the beam "splash" on the graph paper.



- Set the mirror on the optics table so its shiny front surface is on the dot and **draw a line on the graph paper marking the front face of the mirror**.
- Use a pencil to **mark the light rays going toward and away from the mirror**. (Look at the example on the next page to see what your diagrams should look like.)

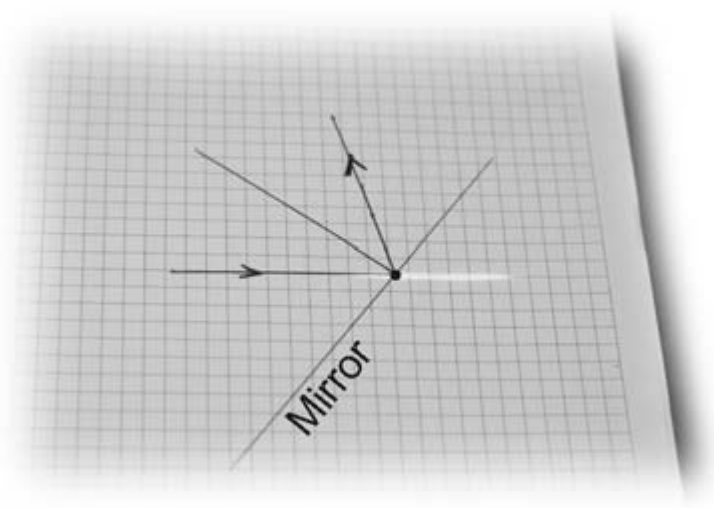


- g. Move the graph paper and do this **three more times at different angles**. You will have four ray diagrams in all.

Thinking about what you observed

A diagram showing how light rays travel is called a **ray diagram**. Lines and arrows on a ray diagram represent rays of light.

Drawing the ray diagram



1. Draw a ray diagram showing the surface of the mirror and the light rays showing the incoming and outgoing rays.

2. Label the incident ray on your ray diagram.
3. Define the incident ray.

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4. Label the reflected ray on your diagram.
 5. Define the reflected ray.
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The law of reflection

- a. For **each** of the four ray diagrams, draw a line perpendicular to the mirror surface at the point where the rays hit. This line is called the **normal line**.
- b. Use a protractor to measure the angle between the normal and the incident and reflected rays.

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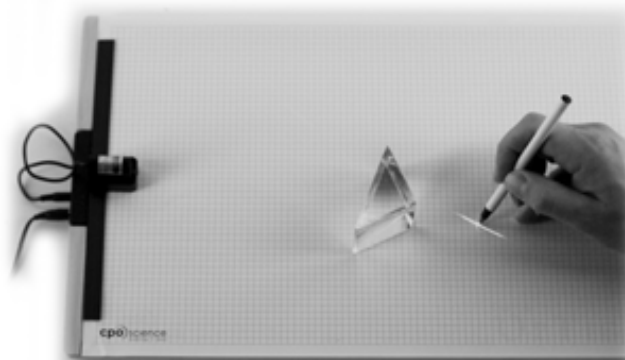
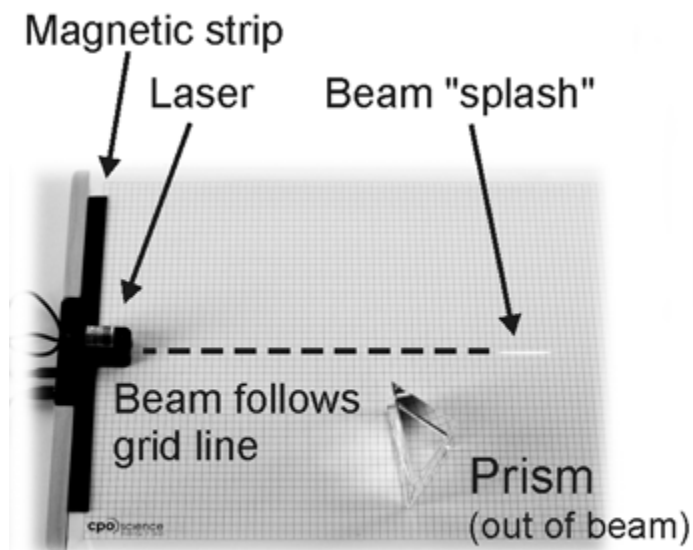
6. Write down your own statement of the law of reflection, describing the relationship between the angles you measured.

Table 1: Angles of incidence and reflection

	Diagram #1	Diagram #2	Diagram #3	Diagram #4
Angle of incidence	7.	8.	9.	10.
Angle of reflection	11.	12.	13.	14.

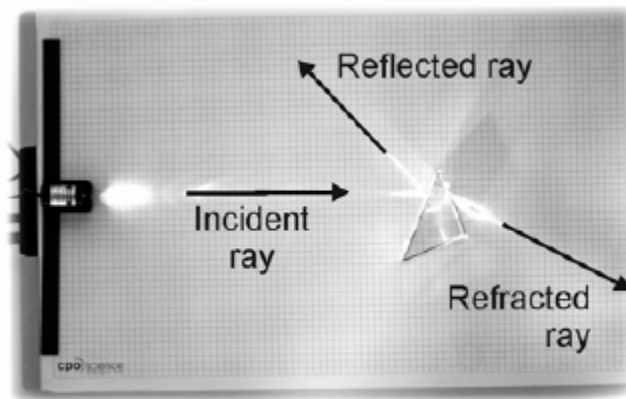
Light rays going through a prism

A prism is a solid piece of glass with polished surfaces. Prisms are useful for investigating how light bends when it crosses from one material to another, such as from air into glass or glass into air.

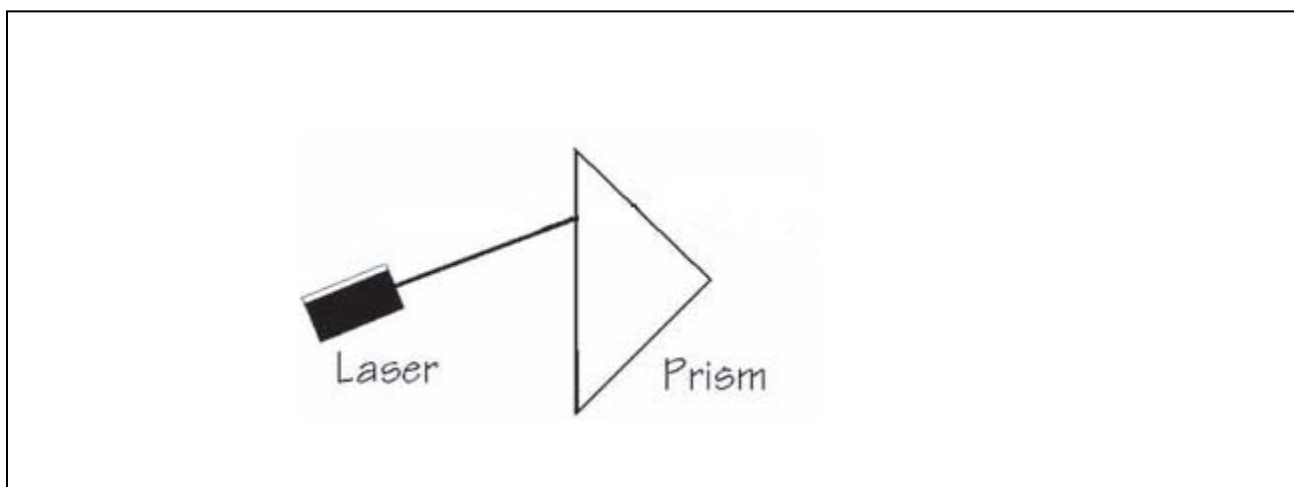


- Set the **laser** on the optics table so that the **base is tipped up on the magnetic strip**. The beam should make an extended splash along the graph paper.
- Set the **prism** into the laser beam so the **beam comes out the opposite short side** (diagram).
- Rotate the prism in the beam and observe where the beam comes out.

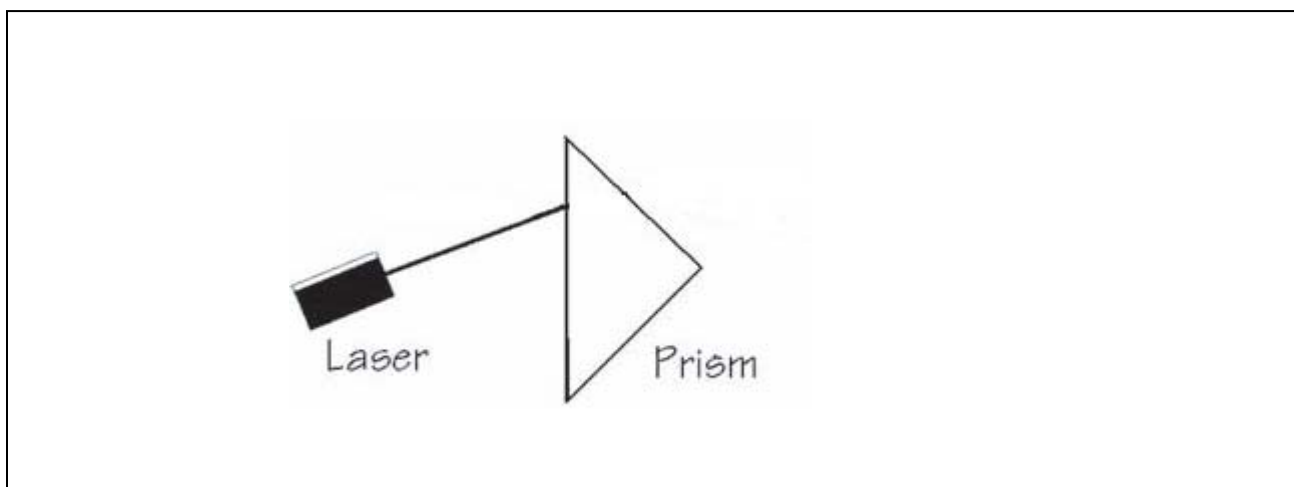
Sketching what you observed



15. Draw a ray diagram showing a laser beam that is reflected passing through the prism



16. Draw at least one ray diagram showing a laser beam that is **refracted passing through the prism**. The refracted ray is the ray that comes out of the prism.

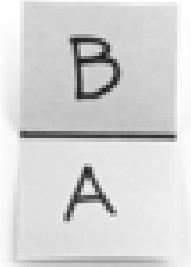


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Seeing reflection and refraction at the same time

Both refraction and reflection often occur when light hits a boundary between materials such as the boundary between glass and air. The amount of light reflected or refracted depends on the angle at which you are looking relative to the surface.

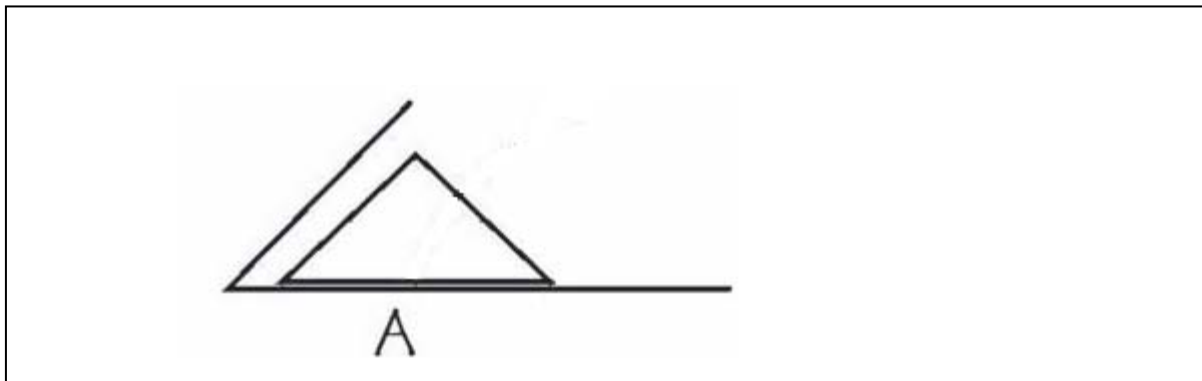
- Take a piece of **graph paper** about the size of a business card and draw a line about 5 centimeters from one edge, dividing the rectangle in half.
- Draw the **letter A** on one side of the line and the **letter B** on the other side.
- Fold the paper on the line** and wrap it around one of the corners of the prism that is **not a right angle**.
- Look into the prism. Move your head up and down to change the angle at which you look.



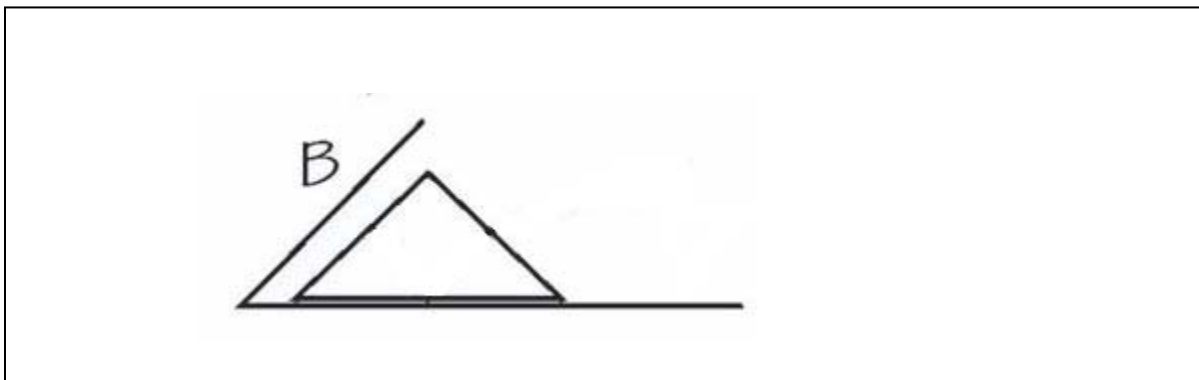
The image in the prism changes as you move your head.

Thinking about what you observed

17. Draw a diagram showing the path of the light that shows refraction when you see the letter A.



18. Draw a diagram showing the path of the light when you see the letter B.



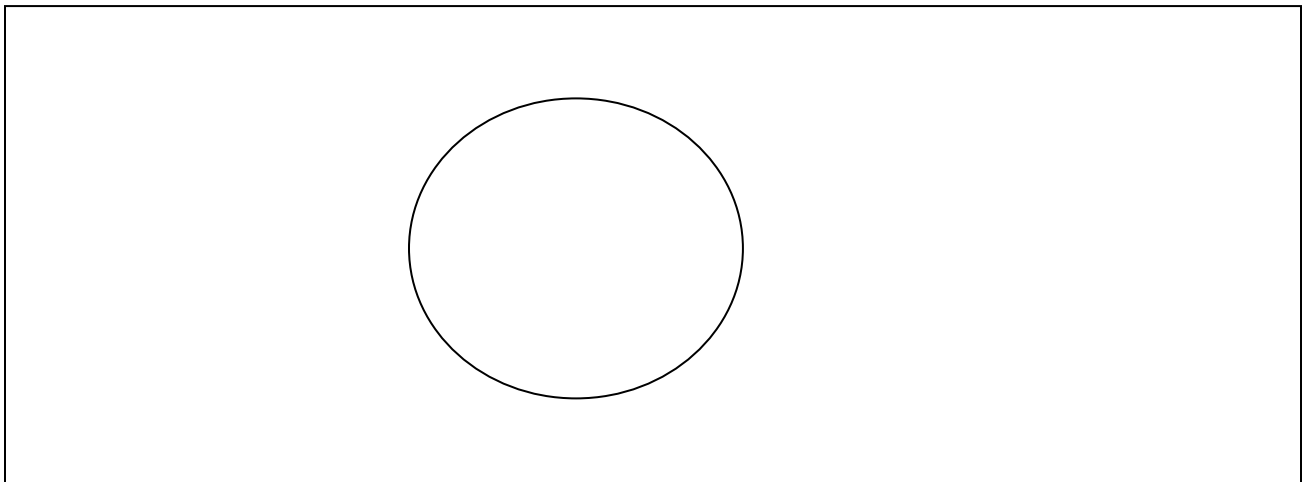
19. Is the image in the prism always reflected or refracted or can there be both reflection and refraction at the same time?

The angle of refraction

- Fill a clear plastic cup about $\frac{1}{2}$ with water.
- Add **one drop (only one!) of milk** to the water in the cup. The milk makes the beam visible passing through water.
- Flip your graph paper over so you have no writing on it.
- Set the cup on the optics table on the backside of your graph paper.
- Use a pencil to **trace around the base of the cup**.
- Shine the laser beam through the cup so it passes off-ter.
- Use an **index card** to find and mark the laser beam going into and out of the cup.



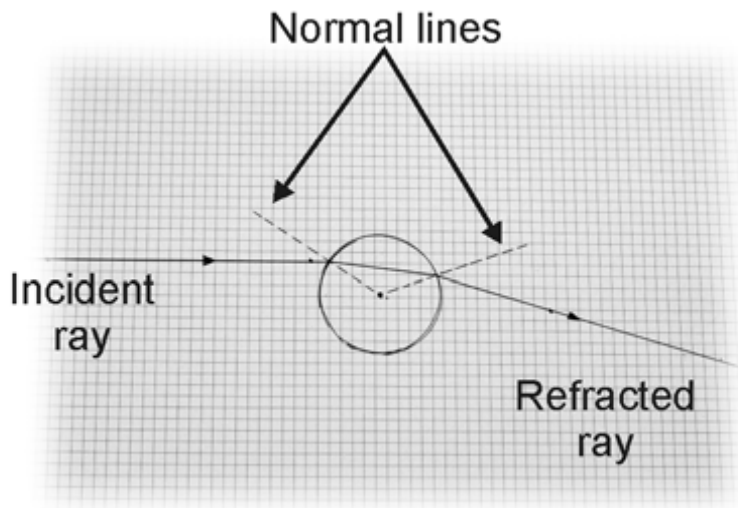
20. Remove the cup and draw the ray diagram.



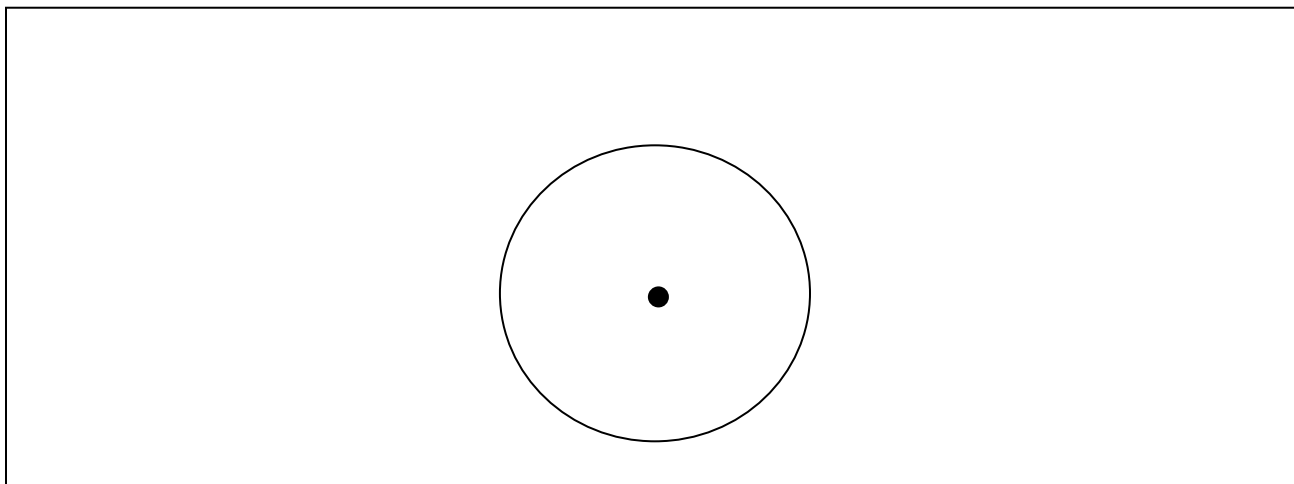
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Thinking about what you observed

The change in direction of a refracted ray depends on the angle with the normal line.



21. Draw the **normal line to the surface at the points where the light ray enters and leaves the cup**. A round cup is convenient because the normal line points toward the center of the circle (the black dot).



21. When the light is going from air into water does the ray bend toward or away from the normal?
(2 pts.)

22. When the light is going from water back into air does the ray bend toward or away from the normal? (2 pts.)
