Name: Group:

Class: Date:

Mirror, Mirror: Student Worksheet

Introduction

Mirrors are everywhere: in our cars, bathrooms, shinny metal surfaces, water, and windows. Large astronomical telescopes use curved mirrors (a rigid glass or polymer coated with a metal) to focus star light on to electronic detectors. In any of these circumstances, the Law of Reflection holds.

Materials

Each student team:

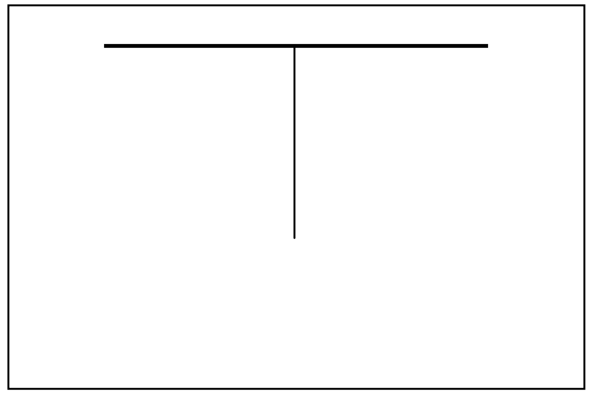
- Pen and pencil
- Laser pointer
- 2 Binder clips
- 1 Flat mirror (back silvered)
- Letter size (8.5 x 11 inches) white paper
- 1 Protractor

Engage

Name mirrors you have encountered today. For instance, you may have looked into a bathroom mirror this morning.

Explore

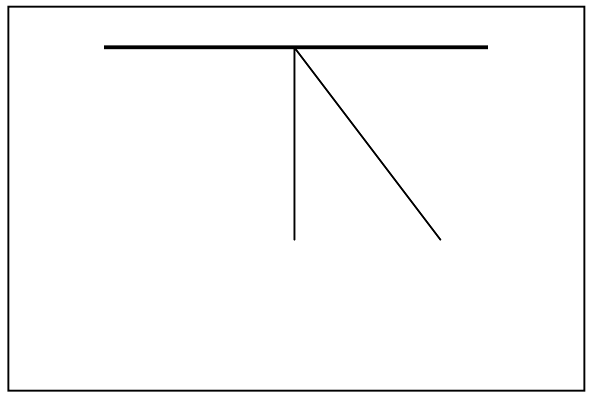
1. Using a pen, draw a straight line on your graph paper. Label it "mirror".



2. Mark a central point on the line where the graph paper's grid intersects your line, and label it "reflection point".

3. Using your pen and protractor, draw the normal line. The normal should be perpendicular to the "mirror" line. Label the normal line "normal".

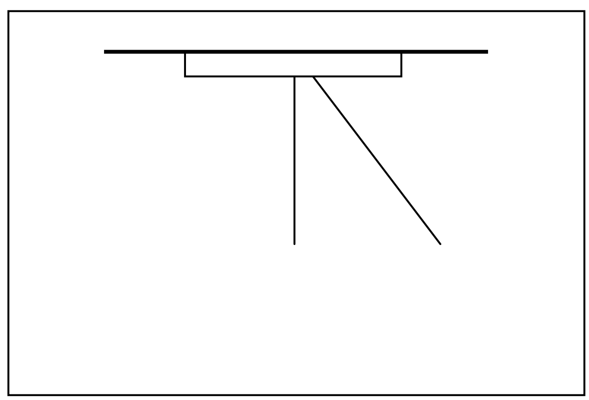
4. Using the protractor and pencil, draw an incoming angle to your "reflection point". You may choose an angle between 20 and 50 degrees from the normal. Label this new line "incident ray".



5. Using the protractor, measure the angle between the "incident ray" and the "normal". Write the angle measurement on your graph paper.

6. What do you think will happen when the laser's incident ray strikes the mirror? Draw a dotted line to represent your "hypothesis ray".

7. Place the flat mirror so the back of the mirror is on the "mirror" line. On the graph paper, carefully trace a pencil line along the front side of the mirror. This line marks the edge of the glass surface.



8. Turn the laser pointer on. **Never look directly at the laser beam or allow it to shine in someone's eyes.** Use the binder clip to maintain the laser pointer in the ON position. If you need help seeing the laser beam, ask your teacher for assistance. Make sure that the laser beam follows the "incident" line, and clearly shows a reflected beam on the other side of the normal line.

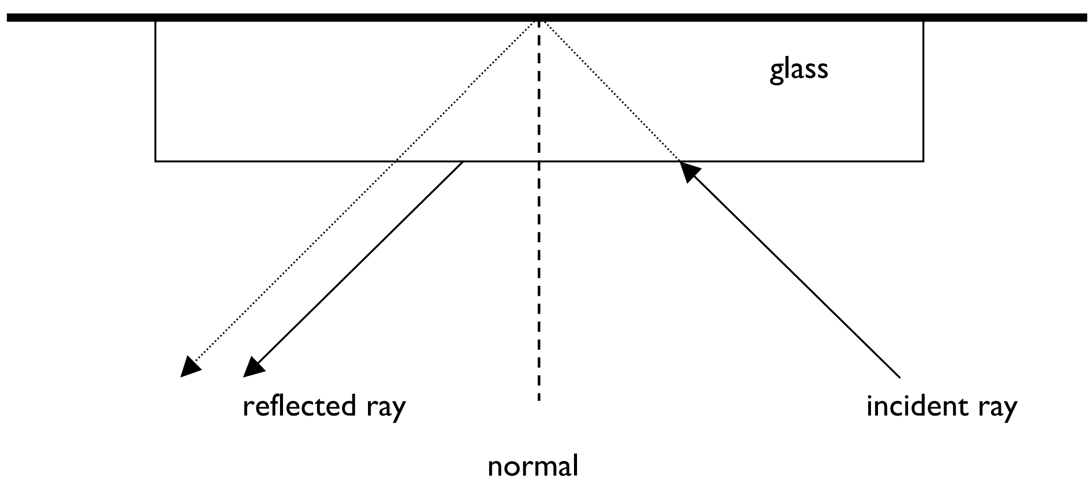
9. Mark the reflected laser ray in several places (at least 3) along the laser's reflected beam. Do not disturb the laser pointer's position. Turn the laser pointer off when you are done.

10. Using your protractor, line up the reflected ray's marks, and draw a straight line that intersects the "mirror" line. Measure the angle between the reflected ray and the normal.

Explain

1. Did the law of reflection work with the flat mirror? Explain.

2. Based on your data, where do you think the actual reflection point lies on the "mirror" line?



3. What do you think happened to the incident laser beam inside the glass based on your observation data?

Elaborate

1. Read the following StarDate scripts:
    "William Parsons" June 17, 2000 and "Return of the Leviathan" June 18, 2000; "McDonald's 107-inch Telescope" November 26, 2003 and "Staying Busy" November 27, 2003.

How do these scripts relate to your investigation of reflection?

2. What Are Astronomers Doing? Telescopes (http://mcdonaldobservatory.org/research/telescopes/)

Explore the telescopes at McDonald Observatory. Where are the mirrors?
Based on your mirror experiment, where do you think the reflective coating is on the telescope's primary mirror – front or back side? Explain why.

Elaborate

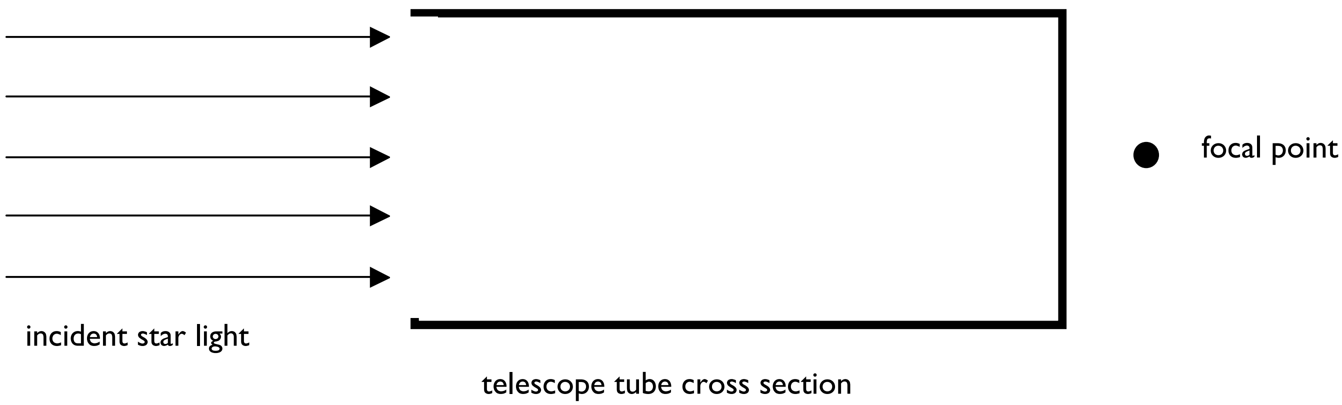
Creative problem solving:

3. Make a reflecting telescope work: Where should you place 2 mirrors in order to direct all the incident star light to the focal point?

Hints:

a. You may shape the two mirrors any way you like.

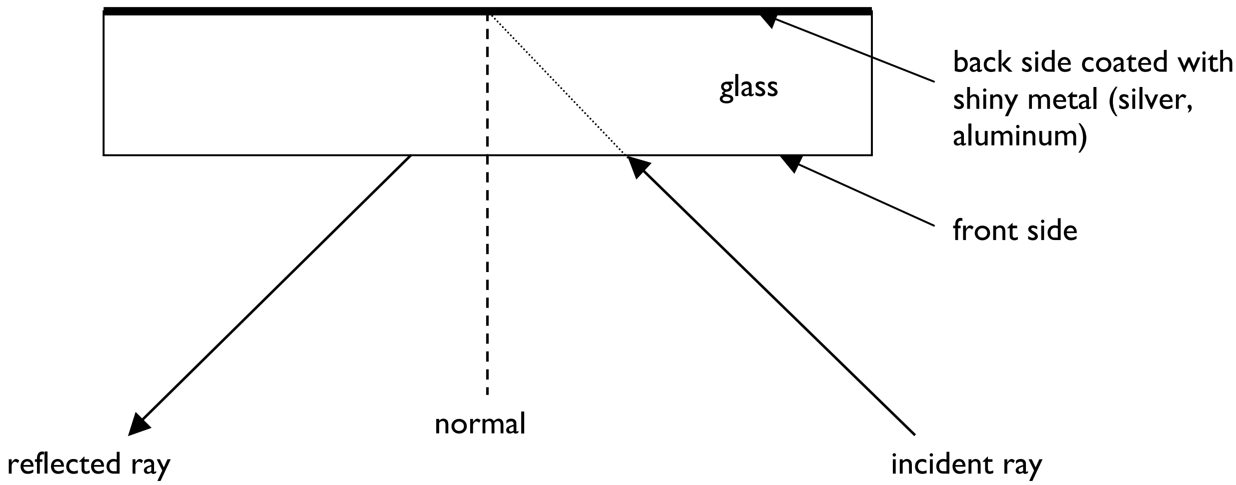
b. You may cut holes wherever you think you should.



Evaluate

1. How would the reflection ray change if you ran an experiment with a front-silvered mirror? The reflective coating is on the front side of the glass . In your experiment you used a back-silver mirror, where the glass protected the reflective coating.

Back silvered mirror experiment:



Front-silvered mirror experiment: