Chapter 4: The Law of Reflection

Student Worksheet

Objective:
Demonstrate the law of reflection and use the concept to predict the path of a laser beam.

Engage:
How many ways do you use mirrors in your daily life? Create an exhaustive list. Which uses would be the most difficult/dangerous to live without?

Introduction:
Light moves in a straight-line path unless interrupted by a gravitational field. When a light beam hits an object, it reflects off the object at the same angle. This is the law of reflection. In this lab you will set up different scenarios with laser beams and mirrors to explore the law of reflection.

Your Task:
Work in groups of two or three to use laser pointers and mirrors to gain a strong understanding of the law of reflection.

Procedure:

Never look directly into a laser beam, never point one at anyone's face. Keep laser pointers off when not in practical use – batteries run down very quickly. If you need help seeing the beam of light, ask your teacher for help.

Part 1

1. Label the page of graph paper "Law of Reflection Part 1"

2. Draw a straight line a few inches from the long side of your graph paper as in Figure 1 below.

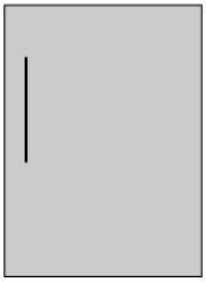

Figure 1

3. Draw a ray to intersect the line you drew at any angle. See Figure 2 below.

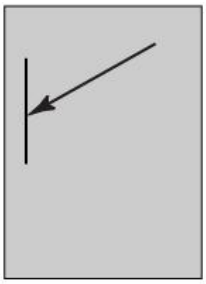

Figure 2

4. Use your protractor to measure the angle you constructed. See Figure 3 below.

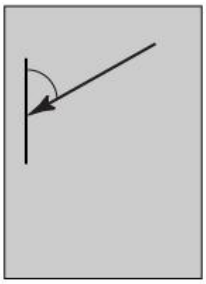

Figure 3

5. Draw another ray bouncing off the point of intersect at the same angle. See Figure 4 below.

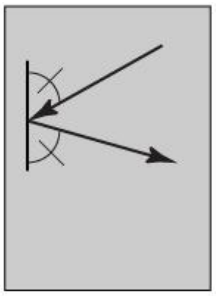

Figure 4

6. Set up a flat mirror on the original line you drew. You may need to lean it against a book if you do not have a mirror holder.

7. Turn on the laser pointer. Use a binder clip to keep the laser pointer on.

8. Align the light beam with the incident ray, pointing toward the mirror.

9. Trace the reflected ray on your graph paper.

10. Record your results and observations. Were you able to match the beam to your line? Why or why not? Did anything surprise you?

11. Repeat steps 5-9 with a front-silvered mirror. Record your results and observations. How did the results change if at all?

Part 2

1. Label the page of graph paper "Law of Reflection Part 2"

2. On this piece of paper construct an equilateral triangle with sides about 20 cm in length. Use a protractor to ensure your angles each measure 60 degrees.

3. Label the vertices 1, 2, and 3.

4. Draw a line through each vertex to represent where you think the front-silvered mirror should go in order to have the laser beam follow the perimeter of the triangle you drew. By now, your triangle should look like the triangle in Figure 5 below.

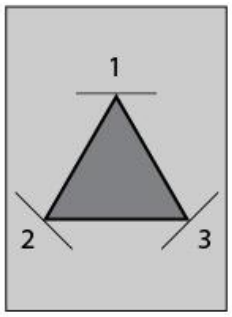

Figure 5

5. Place the mirrors.

6. Secure a binder clip to the laser pointer to keep it on.

7. Place the laser pointer along one of the lines of your triangle.

8. Your triangle is complete if the beam of light hits the back of your laser pointer.

9. Record you observations and results on the paper outside the triangle.

Part 3

1. Label the page of graph paper "Law of Reflection Part 3"

2. Draw two lines that meet in a corner at right angles. These lines will serve as mirror placement lines.

3. Draw an incident ray coming at an angle toward one of the mirrors.

4. Using the law of reflection draw the path the ray of light should take.

5. Draw this for a total of 4 light rays coming in at different angles. You should notice a pattern in the results.

6. Set your mirrors along the right-angled lines you drew in step 2.

7. Turn on the laser pointer. Use the binder clip to keep it on. Test your 4 drawn rays by using the laser.

8. Record your observations and results.

Conclusion:

1. What differences did you find between a flat mirror and a front-silvered mirror in part 1? What do you think accounts for those differences?

2. How would using a flat mirror instead of a front-silvered mirror change your results in parts 2 and 3?

3. In part 2, what conditions would make the light beam not return to the laser pointer?

4. What do you notice about the direction of the reflected ray in part 3?

5. How could you draw an incident ray in part 3 that does not get reflected back parallel to the incident ray? Why is this so?

Extend:

- Neil Armstrong and Buzz Aldrin left a corner reflector on the Moon in order to get exact measurements of the distance from the Earth to the moon. Investigate the corner reflector. Construct one of your own. Record your observations and results. Explain how this device would be used to calculate the distance to the Moon. **A good source for this information can be found on the NASA *science* website. Search for the corner reflector on the moon to begin your investigation.**

- In this lab you used a laser pointer as your light source. A television remote control emits light as well. However, since it is light with an infrared wavelength, we do not see it. Can you set up a mirror so you can turn on the television while pointing the remote control away from the television? Can you use more than one mirror? How wild a set up can you make to turn on the television? Some regular point and shoot cameras (even cell phone cameras) can see infrared light. Take a picture of a remote control while you are pushing a button to see if you can see a little bit of infrared light.

- Set up two mirrors facing each other with an object between them. Investigate what conditions are necessary to create an endless amount of images. Explain how this works.