

## **The Science, Math, and Perception of Reflections**

A playful and artistic approach to science, math, and perception, where the students plan and carry out investigations of reflections.

### **Recommended Grade Level:**

4<sup>th</sup> -8<sup>th</sup> grades

### **NGSS Science & Engineering Practices:**

- *Planning and Carrying Out Investigations.* Collect data about the performance of a proposed object, tool, process, or system under range of conditions

### **Time:**

About 1-2 hours, mainly to purchase materials

### **Materials Needed:**

- 4 x 4 inches  $\frac{1}{8}$  inch plexi mirror
- 4 x 6 inches reflective mylar (3 or 4 mil thick)
- 8 sheets of computer paper
- Color markers or color pencils

### **Background Information:**

Mirrors are highly reflective surfaces that give very clear reflections. There is a precise mathematical order to the way the light is reflected. The law of reflection states that the angle of incidence is equal to the angle of reflection. This law makes it possible to produce some beautiful images when you use the right angles with the right images. Plane mirrors give you a doubling effect on objects that are reflected. You see the object plus the image.

When you hinge two mirrors as shown in photo, the mathematics get more complex and the potential for even more interesting and beautiful creation of images arise. When the two mirrors make a 90-degree angle and a drawing or object is placed in the middle (see photo), you will notice that you have three images plus the original giving you four objects. This can be carried out to a smaller angle such as a 45-degree angle, which will give you 8 images including the object. This angle number of images has a pattern. 360 divided by 90 is 4; 360 divided by 45 is 8. This interesting pattern of the dividend of the 360 divided by a particular angle will give you the number of images (as long as the angle is an integer).

This process is the beginning of understanding kaleidoscopes. The number of angles of a

kaleidoscope will give you a way of predicting how many images will be made.

**To Do and Notice:**

- Have the students draw half images, i.e., half a house, half a flower, half a heart. Have the students hold the mirror at a 90 degree angle to the image. They will notice the image becomes whole, if the orientation is correct. If it is not held in the correct orientation, the idea of mirror symmetry will take center stage.
- Have the students then make a whole drawing and they will discover that the whole object is doubled.
- Have the students make a hinged mirror (two mirrors taped from the back to make book-like device). Have the students experiment with drawing images and have them close the hinged mirror. They will notice that they will get more images. Guide them to find the mathematical progressions that this device will give.
- Have the students make a triangular prism using the reflective mylar, and have them compare and contrast the two devices.

**References**

- The Exploratorium's *Square Wheels and Other Easy-To-Build, Hands-On Science Activities*: [http://www.exploratorium.edu/square\\_wheels/](http://www.exploratorium.edu/square_wheels/)