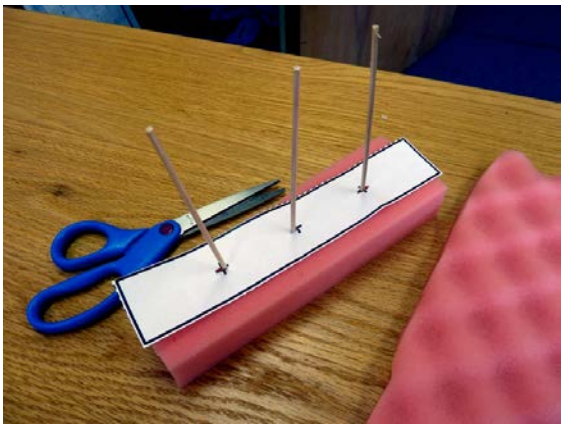
How Telescopes Focus Light

Introduction: How do astronomers build telescopes so they can collect as much information about the universe as possible? Telescopes are like light buckets. Just as a rain bucket collects rain droplets when left outside, a telescope collects packets of light called photons. Photons shine into the telescope in parallel lines, then most telescopes use mirrors or lenses to focus the light from space. In this activity, we will learn how concave mirrors focus light.

Model It: Let's make a foam model of a telescope mirror with incoming and reflected light!

1. Gather your materials.
   - Metal Spoon
   - Foam strips. You can use any fairly dense, soft foam (like the material some computers come packed in) or you can order the material at: www.oneoceankayaks.com. The material is "Minicel Foam". Order the 5/8'' thickness. You can use a utility knife to cut the foam.
   - Template for foam strips at the end of this activity
   - 3 skewer sticks
   - Scissors
   - Tape

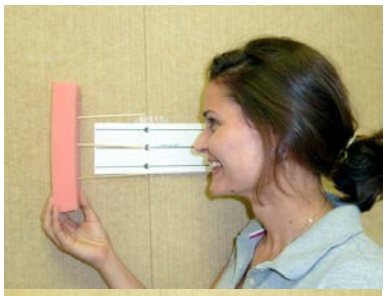


2. Cut the Foam Mirror Template and Incoming Light diagrams from the along the dotted lines. Trim about 1/4 inch off the sharp end of each skewer stick.
3. Place the foam strip template on your foam strip and insert the skewer stick into the foam strip at the marks – try to make them as vertical and parallel as possible.
4. Remove the template
5. Loose sticks? If the sticks in the foam get loose after several uses, you can either: glue them into the holes by wiping the end of the each stick over a glue stick, or move each stick just to the right or left and make a new hole.
6. Tape the Incoming Light diagram horizontal on a wall at eye level.

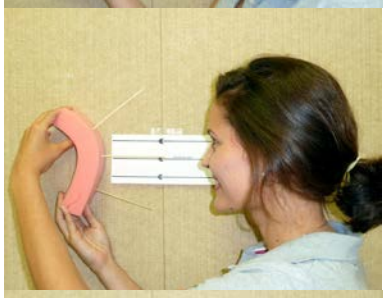
The incoming light is always parallel, so we can use the Incoming Light lines for any telescope design. Your foam represents a telescope mirror. You can bend it and twist it to experiment with different mirror designs. The skewers represent the reflected, or outgoing.

Let's see how the shape of our telescope mirror (i.e. our foam) affects the pattern of the reflected light! Pretend that you are using your foam mirror model to "image" your own face. Stand with your head at the tail end of the Incoming light arrows. Then hold the foam mirror model with skewers facing toward you at the far end of the incoming light arrows.

1. To model a flat mirror, allow the foam model to remain straight. When you look into a flat mirror, the light comes straight back out at you. The top skewer is where your forehead is and the bottom skewer is where your chin is.



2. To model a convex mirror, gently curve the foam strip toward you so the skewers spread out. Now the incoming light from your forehead is reflected higher up above your head, and the incoming light from your chin is reflect lower down toward your neck. Look into the outside part of your metal spoon to see the image this produces.



3. To model a concave mirror, gently curve the foam strip away from you so the skewers bunch up and cross each other. NOW where is the reflected light from your forehead and chin pointing? Look at your reflection from the inside of your metal spoon to see the image a concave mirror produces.

Reflect:

- How do convex mirrors affect an image?
- How do concave mirrors affect an image?
- Why do you think astronomers choose to design telescopes with concave mirrors?
- Why do you think it might be important design very smooth mirrors? (Hint: Push the foam so there is a small bump in the curve surface. How does this affect the position of the skewers?)

Adapted by The Skynet Junior Scholars Module Development Team from "It's all Done with Mirrors: How telescopes use mirrors to focus light from distant objects" from the Night Sky Network.

Foam Strip Template