raft
RESOURCE AREA FOR TEACHING

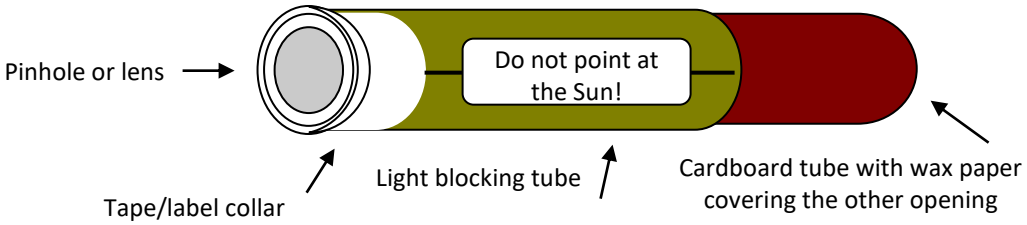
Topics
Light, Optics, Refraction

Materials
- ✓ Convex lens, 10 cm focal length, 1½" diameter
- ✓ Tube, 1½" x 6" long
- ✓ Opaque file folder or cardstock
- ✓ Foil squares, 3"
- ✓ Wax paper, 3"
- ✓ Tape
- ✓ Portion cup w/ lid, ¾ oz
- ✓ Hole punch
- ✓ Scissors
- ✓ Pushpin, pin or equal poking object

Learning Standards
NGSS: Physical Science, Wave Properties (Light), Reflection & Transmission

Image Viewer

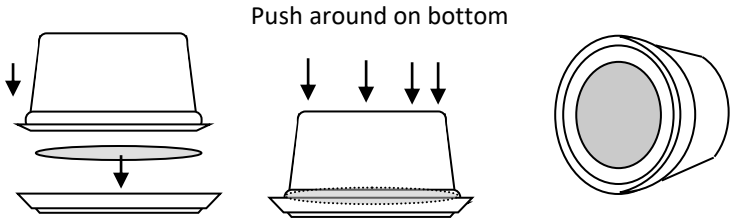
See what the eye sees!



Explore images formed by a pinhole and a lens. See what the eye really "sees" – an inverted image!

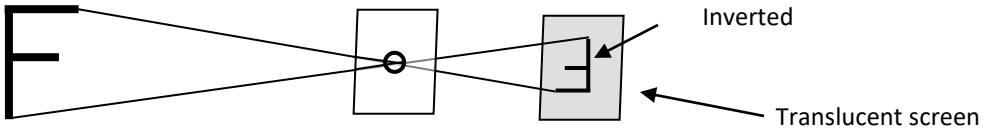
To Do and Notice

1. Assembly: Cover one end of the 1½" diameter cardboard tube with the 3" wax paper square. Pull the wax paper down around the sides of the tube and secure with tape. The wax paper should be as flat as possible over the end of the tube.
2. Wrap an 8" x 8" section of the opaque file folder around the cardboard tube. Roll so the darkest side will be on the inside. Secure the long edge with tape.
3. Print the warning "Do not point at the Sun!" on the side of the file folder tube.
4. Pull the open end of the inner tube ¾th of the way out of the outer tube. The goal is to achieve a smooth telescoping fit between the tubes. Adjust as needed.
5. Cover the open end of the outer tube with a 3" foil square. Pull the foil edges down around the sides of the tube and secure with tape. **Note:** The foil needs to be easily removable.
6. Make a small pinhole in the center of the foil with a pushpin or equal object.
7. Mount convex lens (Note: Glass lenses can break!): Cut a 1" hole in the center of a portion cup and its lid.
8. Place the lid upside down on a flat surface. Unwrap the convex lens and pick it up, touching **only** the edges of the lens. Clean the lens, if needed. Place the lens in the center of the upside down lid.
9. Place the portion cup, regular opening downward, over the lens/lid. Gently push down on the cup bottom, going around, until the cup snaps into the lid (see next page). The lens will be mounted on the outer tube later in place of the foil.
10. Investigate: Point the pinhole opening of the image viewer at a brightly lit distant view (ideally in a dark room). Put the open end of the image viewer to your eye and look through it. Slide the tubes in and out. Note any changes seen due to sliding the tubes in and out.
11. What difference does having a larger or smaller pinhole make in the image seen on the wax paper screen?
12. Observe moving cars or people with the image viewer. Which direction are the cars or people moving?
13. Observe brightly lit areas about 3 ft away. Slide the tubes in and out and note your observations.
14. Replace the foil with the lens/portion cup combination. Use tape to secure the lens to the tube as needed. Repeat steps 10 to 13. How are the images, formed by a lens, different from those formed by a pinhole?

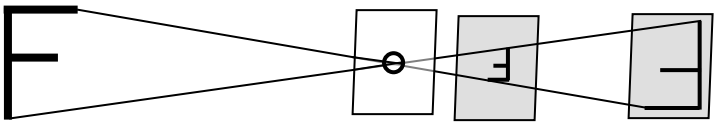


The Science Behind the Activity

A pinhole can form a focused image because the material around the pinhole blocks the light rays that would create a blurry image. The image will be relatively dim because only a little of the light emitted by or reflected from the object can enter the pinhole. A larger pinhole will permit more light to enter, creating a brighter but blurrier image. The larger the pinhole the blurrier will be the image.

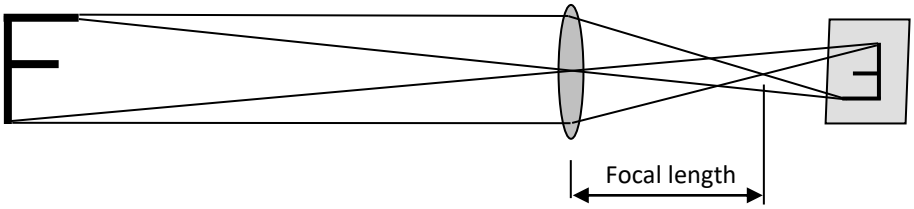


The images on the translucent screen will grow larger as the screen is moved farther from the pinhole or smaller if moved closer. A pinhole can form a focused, inverted image over a range of distances from the pinhole.



Images are in focus when the screen is moved closer or farther away

Replacing the pinhole with a lens allows more light to enter. However, the lens will form a focused, inverted image at only one distance, based on the lens's focal length and the distance to the object.



Focused image is formed at a set distance from the lens, as determined by the lens's focal length and distance to the object

SAFETY NOTE: Convex lenses converge and concentrate light rays. **Pointing a lens or viewer toward the Sun could cause eye damage**! The Sun's rays could also accidentally focus into a hot spot and cause a fire.

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