

Build a Telescope

Educational Goal: Learn the essential ideas behind reflecting and refracting telescopes.

Materials:

- Cardstock
- Aluminum foil
- Spherical fishbowl
- Pieces of paper and pens or pencils
- Tape
- Water
- Flashlights
- Narrow hair comb [optional]
- Laser pointer [optional]

Directions:

0. Setup: Fill fishbowl with water, preferably in an indoor space.
1. Draw a person on a piece of paper. (Not shown in photos.) Shine a flashlight from across the room/table toward the drawing and point out that a lot of the light does not reach the person. Instead, it goes to the side or above them.
2. Ask participants if they can think of a device that collects a lot of light and points it all toward one place where someone can see it. (A telescope! Or binoculars.)
3. Tell participants that telescopes may look different from one another, but all telescopes work in two different ways – and that together you will all make the two kinds of telescopes that exist.
4. Place participants in pairs or small groups. Have each group sit at a table/section in the room.
5. Show participants the foil. Ask if they can think of how to use it to get more light to the person.
 - If they have trouble, demonstrate how by bending the foil they can reflect more light to the person.
 - Once they think of using it like a mirror, pass out pieces of foil, cardstock, and tape.
 - Demonstrate how to smooth out the aluminum foil if it becomes very crumpled. Tell participants that they will not be able to use more foil than they start with.
6. Tape a lit flashlight at the end of each group's table/area. Tell groups that their goal is to get as much light to the person as possible.
7. Once participants have experimented with reflection, bring the group back together and explain that this is how most telescopes work: Light is reflected off a huge mirror to a single point called the focus.
8. Then show participants the filled fishbowl. Ask whether they can think of a way to use the fishbowl to send more light toward the person.
9. Hold a flashlight a bit away from the bowl and show how light's path is bent by moving through the water. If the person is at just the right distance from the fishbowl, a lot of light is bent toward them. Telescopes built like this are called refracting telescopes: They use a lens to focus light instead of a mirror.

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Extensions:

- Create funhouse mirrors: Instead of trying to focus incoming light to one spot, encourage participants to explore how light is reflected by mirrors bent into different curvy shapes.
- Place the fishbowl on a table of a classroom where all shades are lowered. Open just one of the shades. Hold a piece of paper about a foot or so behind the fishbowl, so that the window is ten or twenty feet away from the bowl on one side and the paper is a foot or so away on the other side. If you're lucky, you should get an image of the outdoors projected onto the paper. You can find the focal point by finding the position of the paper where the image is sharpest.
- Use the laser pointer and/or light that passes through the teeth of the comb (rest the comb perpendicular to the table with its teeth down and the flashlight behind it) to show participants the paths of individual light rays.

Example Photos:

