

Penumbras, Umbra, and Shadows

Estimated Time: 30 minutes

SUMMARY: We cannot talk about the sun without talking about shadows. In this activity you will use two balls and a flashlight to create a penumbra, umbra, and simulate types of eclipses.

WHAT YOU'LL LEARN

- The path of the moon around the Earth affects the way the sunlight strikes the earth
- Three types of solar eclipses
- The difference between penumbra and umbra

Materials Used	Resources Used
<ul style="list-style-type: none"> • Flashlight • Table or level surface • Blank wall • Ping Pong ball or similar size round object • Globe or volleyball sized object 	<p>Picture depictions of eclipses:</p> <ul style="list-style-type: none"> • https://www.nasa.gov/audience/forstudents/5-8/features/nasa-knows/what-is-an-eclipse-58 <p>Interactive map of the total solar eclipse in 2024:</p> <ul style="list-style-type: none"> • https://eclipse.gsfc.nasa.gov/SEgoogle/SEgoogle2001/SE2024Apr08Tgoogle.html

WHAT TO DO

1. Find a flat surface to set your flashlight on. If you have a round flashlight, use books or other heavy objects to keep the light in one place. Just make sure your light is not obstructed. Aim the beam of light at a blank wall. Make your room as dark as you can for the best demonstration.
2. When there is a solar eclipse, the Moon is between the Sun and the Earth. In this demonstration, your globe or volleyball is the Earth and your ping pong ball is the Moon. Your flashlight will represent the Sun, although in reality, the Sun is much larger than the Earth.
3. Practice the movement of the Earth and the Moon—the Moon rotates around the Earth, and the Earth rotates around the Sun. You might need a partner for this.
4. For the first demonstration place your Earth close to the wall. Hold your Moon so that it is close enough to cast a shadow on the surface of Earth. You should see two shadows, one that is a tight circle, and one that is a little hazy outline of the circle. Move the Moon closer and farther from the Earth until you see the Penumbra (outside fuzzy shadow) and the Umbra (completely dark shadow). Where the dark Umbra hits on your Earth, this is a total solar eclipse. Places in the Penumbra are experiencing a partial solar eclipse.
5. Now move your Moon closer to your sun. You might see a Penumbra, but carefully look at the Moon from the Earth's perspective. You should see that the Moon blocks out the center of the Sun but not a ring around it. This is similar to an annular eclipse where the Moon is distant enough from the Earth to not block the Sun. Annular eclipses are more common than total solar eclipses.
6. Finally, let's try a lunar eclipse. A lunar eclipse happens when the Earth is between the Sun and the Moon. How can you simulate a lunar eclipse using your set up?
7. What kind of observations can you make about the Sun when it is eclipsed by the Moon?

TIPS

- Estimate on your Earth model where your house would be. Make your model Moon create a total eclipse over your house! Consult the [map on NASA](#) and see if you are in the path of totality for the 2024 total solar eclipse!
- Scale up your models. See how large of a sun you can project onto the Earth. As you get larger the umbra and penumbra should be more obvious.
- Try drawing and tracing the shadow cast by your moon on a paper. Color the penumbra one color and the umbra a different shade.