Activity: How do Eclipses Work? The Yardstick Eclipse

ASTRONOMICAL SOCIETY of the PACIFIC

What Is This About?

The Moon and Sun each appear to be about 1/2 degree across in the sky. That is about the width of your pinky finger when held at arm's-length. Earth is unique in all the Solar System having a moon that appears to be almost exactly the same size as the Sun.

How is this possible when our Moon is only 1/400th the size of the Sun? It is because the Moon is also 400 times closer! This wonderful coincidence coupled with the fact that the Moon orbits in about the same plane as the Earth allows us to see total solar eclipses every year or two. But how, exactly do eclipses work?

Materials

- Folding yardstick
- Binder clips
- 1-inch ball
- 1/4-inch bead
- Long wooden toothpicks
- Index cards (optional)

Space Science Tie-In

Total solar eclipses are more than just beautiful natural displays. They also help astronomers who study the Sun (called heliophysicists) learn about the Sun's extended atmosphere called the corona. Many spacecraft that observe the Sun create an artificial eclipse by putting a mask over the bright solar surface (the photosphere) to study the much dimmer corona. These masks usually cover more than just the photosphere of the Sun, so the spacecraft only observe the outer part of the corona. A natural solar eclipse allows astronomers to study the lower corona, much closer to the surface of the Sun.

Did you know? There are two upcoming solar eclipses in the US - An annual one October 14, 2023 and a total one April 8, 2024. You'll want to get to the thin path of totality to see the sky go dark in the middle of the day!

For More Eclipse Information and Images —

Astronomical Society of the Pacific — www.astrosociety.org

American Astronomical Society — eclipse.aas.org

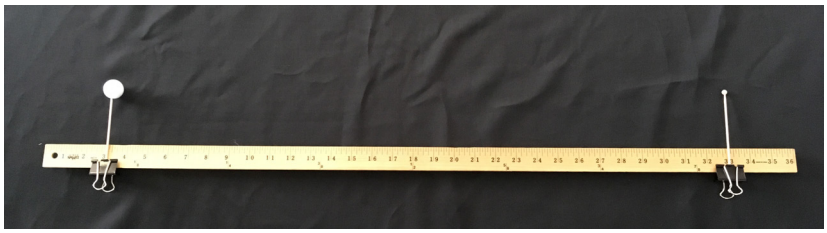
NASA — eclipse2017.nasa.gov

Great American Eclipse - www.greatamericaneclipse.com

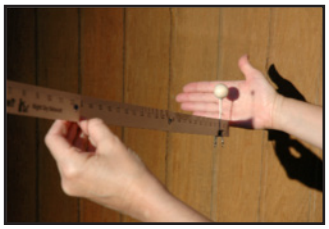
Set Up

You are making a model of the Earth, Moon, and Sun to demonstrate how they align to produce eclipses.

- Unfold the yardstick so that it is straight.
- Put the Earth ball on the end of a long toothpick. Clamp the other end of the tooth pick to the yard stick near one end (at the 2 or 3-inch mark). How large is the real Earth? It's almost 8,000 miles in diameter. The Earth ball in the kit is one inch in diameter. That means that one inch = 8,000 miles in our model.
- How large is the real Moon? It's just over 2,000 miles in diameter, about 1/4 the diameter of Earth. So, the Moon is the 1/4-inch bead in our model. Attach the 1/4-inch Moon bead to the end of another toothpick.
- How far away is the Moon? The actual Moon is about 240,000 miles away from Earth. That's 30 Earth diameters away. So, in our model, each inch on the yardstick represents one Earth diameter. Clamp the Moon toothpick to the yardstick, 30 Earth diameters away from the Earth ball. You now have a scale model of the Earth—Moon system.



Assembled yardstick model



Moon bead casting shadow on Earth ball.

Activities

- We need the Sun* to make our model work! On a sunny day, take the eclipse yardstick model outside with a friend.
- Turn your back to the Sun—you are using the real Sun in this model—to play with the shadows of Earth ball and Moon bead.
- Hold the yardstick model up with the Earth ball closest to you (but out of your shadow).
- Have your friend hold her hand or an index card behind the Moon so that you can find the shadow of the Moon as a tiny dot.
- Can you make an eclipse of the Moon? Move the yardstick model until the Moon bead is covered by the shadow of the Earth ball. That's a lunar eclipse!
- Can you make an eclipse of the Sun? That happens when the Moon is between the Sun and Earth, and the Moon casts its shadow on the Earth.
- Turn the yardstick model around so the Moon bead is closest to you. Slowly adjust the position of the Moon until its shadow falls on the Earth ball. You have just created a total solar eclipse!
- Trade places with your friend, and let her make eclipses.

*A bright flashlight in a darkened room can substitute for doing this outside with the real Sun.

Yardstick Eclipse used with permission of the Astronomical Society of the Pacific
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Adapted from instructions by Edna Devore, SETI Institute