THE YARDSTICK ECLIPSE

What Is This About?

You are making a model of the Earth, moon, and sun to demonstrate how they align to produce eclipses. What is a model? It's a simulation that shows how the real Earth, moon, and sun line up, but at a scale you can play with.

The moon and sun each appear to be about 1/2 degree across 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 1/400$_{th}$ 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:

Yardstick (or rulers)

Binder clips

1-inch balls

1/4-inch beads

Long wooden toothpicks or skewers

Index card (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.

Assembling the model

1. 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 is one inch in diameter. That means that one inch = 8,000 miles in our model.

2. 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 bead moon bead to the end of another toothpick.

3. 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.

To Do:

1. On a sunny day, take the eclipse yardstick model outside with another person. NOTE: A bright flashlight in a darkened room can substitute for doing this outside with the real sun.

2. Turn your back to the sun—you are using the real sun in this model—to play with the shadows of Earth and moon.

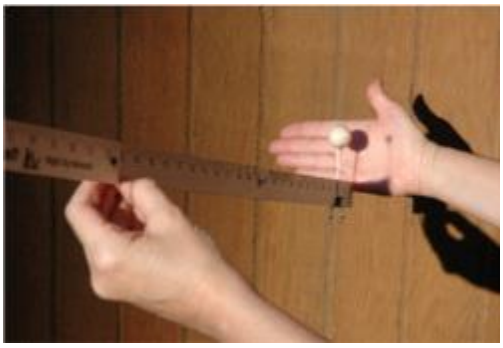
3. Hold the yardstick model up with the Earth ball closest to you (but out of your shadow).

4. Have the other person hold their hand or an index card behind the moon so that you can find the shadow of the moon as a tiny dot.

5. 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*!

6. 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.

7. 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*!



8. Trade places with your partner and repeat the above steps.

Source:

https://eclipse2017.nasa.gov/sites/default/files/NASA_Eclipse_Activity_Guide.pdf