CFAES College *of* Food, Agricultural, *and* Environmental Sciences

4-H Solar Eclipse Activity

Topic: Space Science • **Estimated time**: 30 minutes • **For pairs and groups (INTERMEDIATE to ADVANCED level)**

Small Moon, Big Sun 3

Words in **bold** are defined at the end of the activity.

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A total solar eclipse is a rare and awe-inspiring **astronomical** event that occurs when the moon completely covers the sun, temporarily blocking out its light. As total darkness consumes the **path of totality**, the temperature could drop, stars and planets could become visible, and animals could behave as if it were nighttime. But we know the moon is smaller than the sun, so how does the moon cover the sun?

Learning Outcomes
Project skill: Understanding the spatial relationships of the Earth, sun, and moon during a solar eclipse event • **Life skill**: Problem solving. • **Educational Standard**: NGSS MS-ESS1-1. Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons. • **Success indicator**: Makes an analog model of a solar eclipse event.

The Ohio State University Extension

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Materials

- coin (one, such as a penny, nickel, dime, or quarter)
- measuring tape
- masking tape
- paper plates (various sizes, any color)

Be sure to complete this activity in a long space, such as a hallway or gym.

What To Do

1. Tape any paper plate to a wall at eye level.
2. Stand in front of the plate while holding the coin in your hand at eye level. Stretch your arm straight out in front of you and hold the coin against the plate.
3. Close one eye and look at the coin with the plate in the background. Begin taking steps backward while holding the coin straight out. Stop when the coin appears to be the same size as the paper plate (covers the entire plate when you line up the coin and plate).
4. Using masking tape, mark the ground where the backs of your feet have stopped.
5. Measure the distance (length) in inches from the masking tape to the plate (Lp) and write it in the first row of Table 1. Always be sure to label the unit of measure.
6. While holding the coin straight out, measure the distance in inches from your shoulder to your fingertips (Lc). Write this distance (length) in the second row of Table 1.
7. Calculate the **ratio** of the distance between the plate (Lp) and the coin (Lc) from your eyesight by dividing the two measurements (Lp ÷ Lc). Round your results to the nearest one (whole number). Record your result in Table 1.

This result tells you how much farther the plate is from your eyes compared to the coin. If the quotient (answer) is 6.25, then the plate is 6.25 times farther from your eyes than the coin. See Example 1.

Example 1:

Length to plate (Lp)	*75 inches*
Length to coin (Lc)	*12 inches*
Plate/coin length ratio rounded to nearest one (Lp ÷ Lc)	*6*

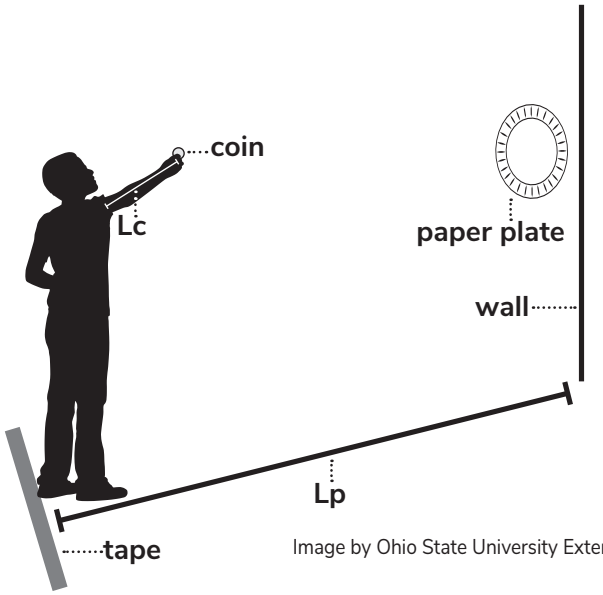


Image by Ohio State University Extension

8. Measure the diameter of the paper plate (Dp) in inches and write it in the first row of Table 2.
9. Measure the diameter of the coin (Dc) in inches and write it in the second row of Table 2.
10. Calculate the ratio of the diameter between the plate (Dp) and the coin (Dc) by dividing the two numbers (Dp ÷ Dc). Round your results to the ones place. Record your results in Table 2. This tells you how much bigger the plate is compared to the coin.

    For example, if the quotient (answer) rounded to the nearest one is six, then you can say that the plate is six times bigger than the coin. See Example 2.

Example 2:

Diameter of plate (Dp)	*6 inches*
Diameter of coin (Dc)	*.955 inches*
Plate/coin diameter ratio rounded to the nearest one (Dp ÷ Dc)	*6*

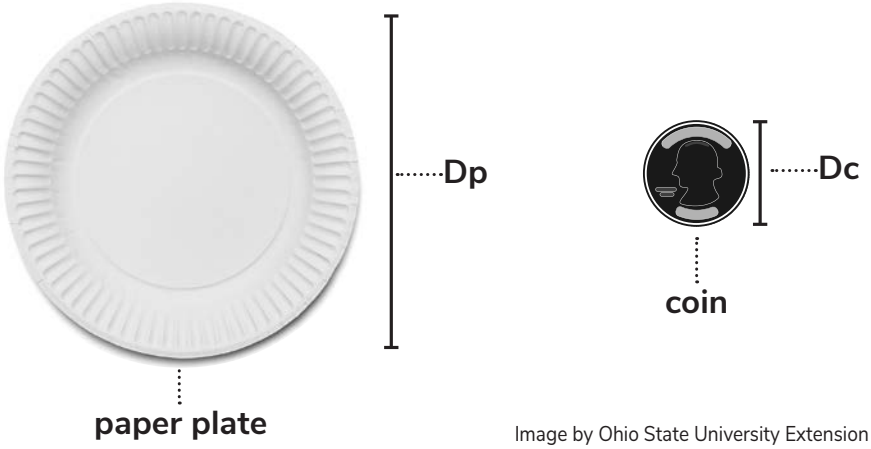


Image by Ohio State University Extension

Table 1

Length to plate (Lp)	
Length to coin (Lc)	
Plate/coin length ratio rounded to the nearest one (Lp ÷ Lc)	**Distance Ratio**

Table 2

Diameter of plate (Dp)	
Diameter of coin (Dc)	
Plate/coin diameter ratio rounded to the nearest one (Dp ÷ Dc)	**Diameter Ratio**

11. Compare your distance and diameter ratios, what do you notice?

12. Repeat the experiment using a plate of a different size. Record your results in Table 3 and Table 4.

Table 3

Length to plate (Lp)	
Length to coin (Lc)	
Plate/coin length ratio rounded to the nearest one (Lp ÷ Lc)	**Distance Ratio**

Table 4

Diameter of plate (Dp)	
Diameter of coin (Dc)	
Plate/coin diameter ratio rounded to the nearest one (Dp ÷ Dc)	**Diameter Ratio**

13. Compare the resulting distance and diameter ratio.

14. Repeat the experiment using a plate of another different size. Record your results in Table 5 and Table 6.

Table 5

Length to plate (Lp)	
Length to coin (Lc)	
Plate/coin length ratio rounded to the nearest one (Lp ÷ Lc)	**Distance Ratio**

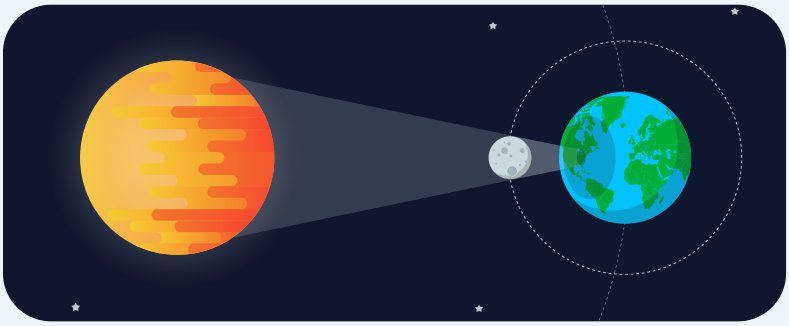
Table 6

Diameter of plate (Dp)	
Diameter of coin (Dc)	
Plate/coin diameter ratio rounded to the nearest one (Dp ÷ Dc)	**Diameter Ratio**

15. Compare the resulting distance and diameter ratios.

More Challenges

Build a model to represent the size and distance differences among the sun, moon, and Earth!



Background

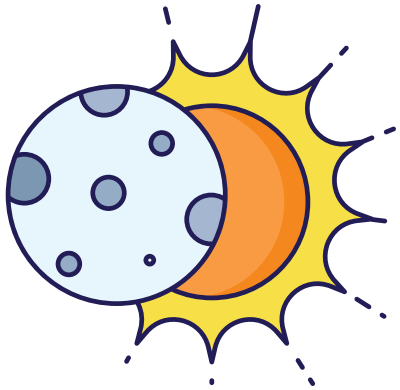
We know the moon is much smaller than the sun. In fact, the moon is about 400 times smaller than the sun. This means that if the sun were the size of a basketball, the moon would be about the size of a pinprick or a single dot made by a sharp pencil. How can such a small moon cover the big sun? The answer is in the distance between Earth and the sun and Earth and the moon.

When we look at an everyday item and hold it closer to our eyes, it will appear bigger compared to when the same item is held farther away from our eyes. The same **phenomenon** occurs when we observe objects in the sky from Earth: an object closer to Earth will appear bigger compared to the same object when it is farther away from Earth.

Even though the moon is 400 times smaller than the sun, it is also about 400 times closer to Earth compared to the sun. Because of these similar ratios in distance and size, the moon and the sun actually appear to be similar in size when we observe the sky from Earth. This is why, when the moon moves in front of the sun, the moon can cover the sun completely.

Did you know?

The moon is slowly pulling away from Earth, which means the time will eventually come when the size ratio of the moon and sun will no longer match their distance ratio. Sometime in the future, the moon will appear too small to create a total solar eclipse.



Vocabulary

- **astronomical**. Relating to the study of objects outside earth's atmosphere.
- **path of totality**. The path of the moon's shadow across Earth's surface.
- **phenomenon**. An observable fact or event of scientific interest.
- **ratio**. A number that shows the relationship between two amounts.

Learn more!

Watch "Greek Physics: Calculating the distance to the Sun and Moon" and learn how Aristarchus determined the distance to the sun and moon based on several observations.
youtube.com/watch?v=urgYWNCN-RA

Sources

"How Is the Sun Completely Blocked in an Eclipse?" NASA Science Space Place. spaceplace.nasa.gov/total-solar-eclipse/en

"Eclipse: How can the little Moon hide the giant Sun?" NASA Sun-Earth Day. sunearthday.nasa.gov/2007/materials/eclipse_smallmoon_bigsun.pdf

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For more solar eclipse activities, visit **go.osu.edu/4hsolareclipse**.

Talking It Over

SHARE What happens during a solar eclipse?

REFLECT How does the distance of the sun and moon impact an eclipse?

GENERALIZE Why is the sun's distance from Earth important to us?

APPLY Why is it important to know the distances between planets and stars?