Name: _____ Date: _____ Class: _____

Title: What are the Different Types of Solar Eclipses?
Student Sheets

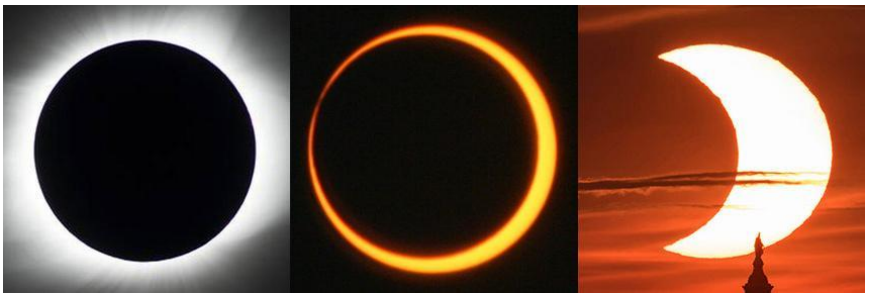
Remember to never look directly at the Sun without proper safety equipment.

Guiding Questions:

- **Predict:** Why do you think something small like the Moon can block something large like the Sun?

Steps:

1. **Examine these images of the three types of solar eclipses.**



Total Solar Eclipse **Partial Solar Eclipse** **Annular Solar Eclipse**
Credits: Total eclipse (left): NASA/MSFC/Joseph Matus; annular eclipse (center): NASA/Bill Dunford; partial eclipse (right): NASA/Bill Ingalls

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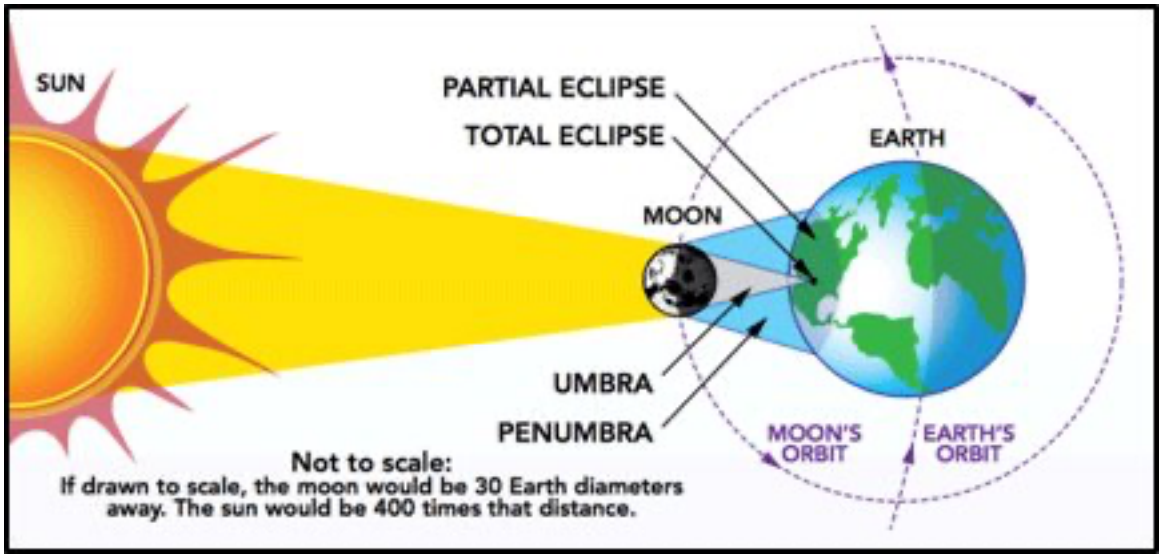
2. **Gather Background Information: Total vs. Partial**

Umbra and Penumbra



The Moon's shadow has two parts. The penumbra is the faint outer shadow of the moon. Partial eclipses are seen from within this shadow. The umbra is the dark inner shadow of the moon. Total eclipses are seen from within this shadow. | Credits: NASA's Goddard Space Flight Center

Read: The difference between a **total and partial eclipse** is where in the Moon's shadow the observer is located.

Observers in the **umbra** shadow will experience a **total solar eclipse**. Observers in the **penumbra** shadow will experience a **partial solar eclipse**. The umbra shadow is much smaller, making experiencing a total solar eclipse more rare.

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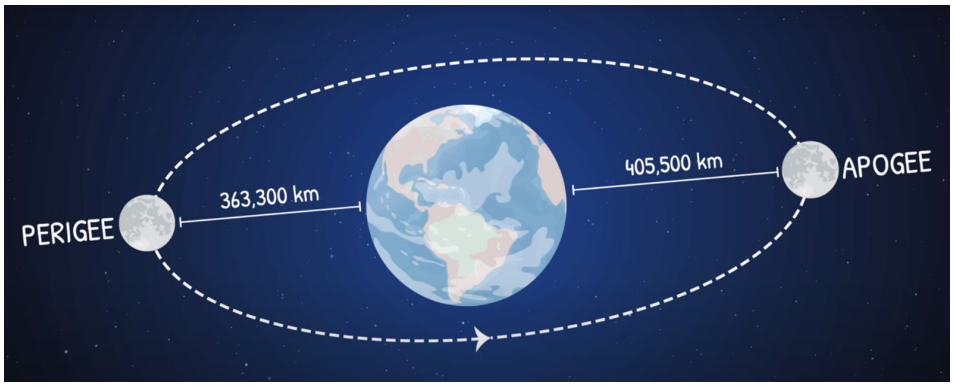
3. **Gather Background Information: Total Vs. Annular**

Perigee and Apogee



This image shows the difference between a Moon at its closest point to Earth, when supermoons occur, and at its farthest. Credit: NASA/JPL-Caltech

Read: The difference between a **total and annular eclipse** is the distance between the Moon and the Earth. The reason that the Moon is not always the same distance from the Earth is because the shape of the Moon's orbit around the Sun is in the shape of an **ellipse**, or an oval. During a solar eclipse, if the Moon is closer to **perigee**, the eclipse would be total. If the Moon is closer to **apogee**, the eclipse would be annular.

The Moon's orbit is only slightly elliptical, meaning that it is very close to a circle. But when you are dealing with large distances in space, even a slight elliptical shape can make a difference! This elliptical orbit also explains supermoons, which occur when the Moon is full and is closest to the Earth in its orbit. Most moon and planetary orbits are elliptical, and a truly circular orbit is rare in the universe.

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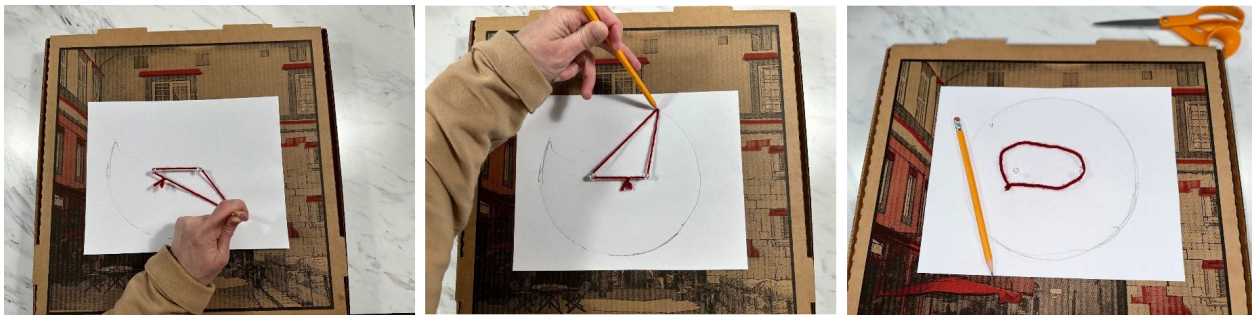
4. **Model:** You can model the shape of an ellipse with a piece of yarn, two pushpins, a piece of cardboard, a piece of paper and a pencil.
    a. Find a piece of cardboard bigger than the size of a piece of paper. A pizza box works nicely.
    b. Put a piece of paper on top of the cardboard.
    c. Tie your yarn in a loop. The loop should be about half the size of the width of the paper.
    d. Push the two pushpins through the paper into the cardboard, about 2 inches apart to begin.
    e. Loop the yarn around both pushpins.
    f. Use your pencil to stretch the yarn into a sort of triangle, keeping the yarn tight.
    g. Draw an ellipse by moving your pencil around the pushpins.
    h. Experiment with the shape of the ellipse by moving the pushpins closer or farther apart from one another. Draw an ellipse with the pushpins very close together. That will approximate the shape of the Moon's orbit.
    i. Remove the pushpins and choose one of the holes and label it as Earth.
    j. Draw the Moon at perigee and apogee on the orbit and label them.
    k. Experiment with the shape of the ellipse by moving the pushpins closer together and farther apart.



Steps to draw an eclipse., Credit: Christina Milotte/NASA HEAT

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Exploring the Math: The phenomenon of a total solar eclipse can occur because of the ratio between the size of the Moon and the Sun and the distance between each object from Earth. The Sun is 400 times bigger than the Moon, but the Moon is 400 times closer to Earth than the Sun. This perfect ratio allows the Sun and the Moon to appear about the same size in the sky. Even a slight variation in this ratio determines if observers experience a total solar eclipse or an annular solar eclipse. If the Moon is farther away in its elliptical orbit around Earth, observers will experience an annular solar eclipse.