Name _____ Period _____ Date _____

MODELING SOLAR AND LUNAR ECLIPSES

If it were not for a chance relationship regarding the size and distance ratios of the sun and moon, total eclipses of the sun and moon would never occur on Earth. The sun is about 400 times the diameter of Earth, but it is also 400 times farther away from Earth than the moon is. Therefore, the sun and moon appear to be nearly the same size in the sky, about 1/2 degree of arc.

In this activity, you will make a scale model of Earth and the moon, and you'll use it to simulate both solar and lunar eclipses.

Part A: Making a Scale Model of the Earth-Moon System

1. Obtain a tennis ball, a paper clip, a piece of yarn or string about a meter long, a penny, and a small piece of scotch tape.
2. Cut a 1-cm slit in the tennis ball with the tip of a pair of scissors or sharp knife.
3. Cut off about 2.5 meters of string and tie it onto one end of the paperclip.
4. Insert the paper clip into the tennis ball and push it in so that it will stay in place during your investigation.

Part B. Modeling Lunar and Solar Eclipses

This activity requires two people.

1. Take the model outside on a sunny day.
2. To model a solar eclipse, hold the penny up toward the sun with a pair of tweezers or your fingers and have your lab partner move the tennis ball into the shadow cast by the penny. Rotate the tennis ball slowly counterclockwise to simulate the rotation of Earth while the eclipse is occurring.
3. Now reverse the positions of the moon and Earth with respect to the sun to produce a total lunar eclipse.
4. The moon's orbit is tilted by almost 6° to the Earth-sun plane. Since the moon has an angular size of 0.5°, the tilt of the path peaks at about 12 moon diameters (12 times 0.5" = 6"). Estimate the maximum distance between the path of the sun and the path of the moon by placing your penny at a position of 12 penny diameters above and below the eclipse line you created in the previous steps.

1. How large a shadow does the penny moon cast on the tennis-ball Earth during a solar eclipse?

2. Is the shadow cast by the penny uniform?

3. The dark part of the shadow is called the umbra, the area of total darkness. Sketch what you think the sun would look like if you were standing in the penumbral shadow (area of partial shadow) of your eclipse.

4. Sketch a diagram that shows how solar eclipses are formed.

5. Sketch a diagram that shows how lunar eclipses are formed.