Activity – Modeling Moon Phases

This is a simple and fun activity where students utilize models of the Sun, Earth and Moon and determine why moon phases occur.

Objective:
After this activity, students will be able to state the order of the moon's phases from a first quarter moon to the next first quarter moon and demonstrate how the moon's position relative to Earth creates the phases.

CORE concepts covered:

STANDARD I: Students will understand that the appearance of the moon changes in a predictable cycle as it orbits Earth and as Earth rotates on its axis.
Objective 1: Explain patterns of changes in the appearance of the moon as it orbits Earth.
a. Describe changes in the appearance of the moon during a month.
b. Identify the pattern of change in the moon's appearance.

Objective 2: Demonstrate how the relative positions of Earth, the moon, and the sun create the appearance of the moon's phases.
a. Identify the difference between the motion of an object rotating on its axis and an object revolving in orbit.
b. Compare how objects in the sky (the moon, planets, stars) change in relative position over the course of the day or night.
c. Model the movement and relative positions of Earth, the moon, and the sun.

STANDARD IV: Students will understand the scale of size, distance between objects, movement, and apparent motion (due to Earth's rotation) of objects in the universe and how cultures have understood, related to and used these objects in the night sky.
Objective 1: Compare the size and distance of objects within systems in the universe.
b. Compare distances between objects in the solar system.

Materials Needed:

40 - 60 watt light bulb on a stand (lamp with the shade removed).
Extension Cord
A Styrofoam ball on a pencil for each class member.
Pencil and paper
Darkened room
Masking or Duct tape.
(1) 6 inch diameter ball (solid or inflated, a balloon can work in a pinch)
(1) standard stick pin

Preparation:

The activity area should have plenty of space for students to stand and move about as they do this activity. Be certain the lamp or light bulb for the model 'sun' works properly and place it in an area where all class members can see and eventually get into a semicircle on one side of the lamp. The lamp cord should be taped down to prevent tripping. The room should be <u>completely</u> dark

for this activity. You should measure out or step off 53 feet from the position you intend to hold the sun in step 3 below, so that you will be able to show the class the accurate distance scale of the distance between Sun and Earth.

Procedure for Activity

1. Draw or show pictures of our view of new moon (it's dark so we don't see it), first quarter, full moon, and third quarter. Make certain that the students understand the correct order of the phases (this is important for step 7). Ask students what causes its shape to change. Accept all answers and after the discussion, tell students that we'll use two models to discover the true cause for ourselves. Make sure that each student responds with their reason for phases as this will be important when they confront their hypotheses during the activity and will lead to greater retention.

2. First, hold up the 6 inch ball saying, "This is the Sun. It is 6 inches across." Ask students to show you how large Earth would be on this same size scale. After everyone has demonstrated the size with their fingers or arms, either show them the head of a pin or tell them that Earth would be about the size of the head of a pin or the ball in a ballpoint pen. Just over a hundred could be placed in a line across the diameter of the Sun.

3. Now, ask students to show you how far away Earth would be from the Sun. Give them time to move to the proper distance. (53 feet) Most will be amazed that Earth is that far from the Sun. On this scale the Moon would be a little over 1.5 inches ($1\ ^{5}/_{8}$ in. = 4.2 cm.) from Earth. Gather everyone back near the lamp and prepare to pass out the "moons."

4. Explain that to understand why the phases of the moon occur, it is helpful to look at models of the Moon, Earth and Sun. Review with students the importance of safety around the hot light bulb and electrical cord. Have students stand so that each student has a clear view of the lamp with enough space to spin around with an arm extended. Explain that the lamp represents the Sun and that their head represents Earth, their nose is the city where they live. Make sure to point out the limitation of this model by asking, "Now, are you all the correct distance from the sun?"(No) Is the Moon the correct size in relation to Earth (their head)?" (No)

(5) Distribute a 'moon' (Styrofoam ball on a pencil) to each student. The pencil makes it easier to hold and will not interfere with their ability to observe the phases of the moon. Have the students hold the moon model at arm's length. Allow time for free exploration as they try to discover how the sun's light reflects off the ball as they place their moons in different positions around their 'Earth' head. Draw their attention to the fact that both the Moon and Earth are always half lit up by the light from the sun. Also, point out to the students that the spinning 'Earth' (their head) makes the moon rise and set each day, but this does not affect the phases of the moon, the phases are caused by the solely by the movement of the Moon around Earth.

(6) Choose one of the lunar phases (first quarter is a good phase to start with) and ask students to find the position in the moon's orbit where that phase is visible. Encourage students to compare their results and discuss differences. Ask one student who has the right position to state why it is correct. Check for understanding by seeing if all of the students are standing with the "moon" in the same position.

(7) Next have the students model the other phases; for example, full moon, third quarter, and new moon. Challenge them to determine the direction the real moon travels around Earth to create the phases in the correct order (this can be demonstrated by moving the ball from right to left in orbit around their head). When students have mastered the 4 main phases with proper revolution of the moon, then incorporate the "in-between" phases. Have them model waxing crescent, waxing gibbous, waning gibbous, and waning crescent. Ask students how long it takes for the moon to make one complete revolution about Earth. (about 29.5 days)

(8) After the students have had enough time to experiment with the movement of the moon, have them work together to draw a diagram of the moon's position for each of the moon's phases. Ask students to state what causes the phases of the moon. Could they be caused by Earth's shadow? NO. Students should easily be able to see that the shadow is behind Earth, directly opposite from the sun. This cannot explain, for example, the first and third quarter phases.

(9) Lead a class discussion in which students can express their new understandings about the phases of the Moon. Then give students the opportunity to record their new understandings in a science journal or, if they wish to be more creative, in a story, poem, or essay.

Tips and Suggestions

This activity is best done after the students have completed a project of observing the Moon nightly for at least a week and a half to observe and record the change in the Moon's phase.

In step 1, try to avoid making comments on the validity of the theories offered. Ask students to write down their own explanations, based on what they have heard. After the activity, ask students to rewrite their explanations for moon phases and discuss any changes from their previous ideas. Encourage students to do this activity at home with their families or to model the moon phases for younger students and then write about their results.

This activity works best in a dark room with a moderate light. Leave time to prepare if your classroom is not easily darkened or if a proper light is not easy to find. Make sure to try it yourself first. You may need to increase or decrease the brightness of the bulb

depending on your unique room conditions. Dark coverings such as black paper or plastic garbage bags work well to block light from windows.

Because the visualization in this activity can be difficult for some students, consider doing this activity with a smaller group while the rest of the class works on a moon phase chart or another project, or do this activity more than once.

Students usually observe that their own shadows cover the model Moon when it is opposite the light source, simulating a lunar eclipse during the full moon phase. Ask students to hold the model above the shadow of their heads, and tell students that the orbit of the moon almost always takes it above or below Earth's shadow. Only when the alignment is exactly right and the Moon, Earth and Sun are in a straight line will we have an eclipse.