Modeling Moon Phases

Why does the moon change shape throughout the month? By modeling a moon rotating around yourself as Earth, students learn moon phases in a kinesthetic fashion that for many will finally make sense.

Time

- 30-40 minutes

Grade

- 1-4

Next Generation Science Standards

- 1-ESS1-1 Use observations of the sun, moon, and stars to describe patterns that can be predicted. ESS1.A Patterns of the motion of the Sun, Moon, and stars in the sky can be observed, described, and predicted.
- ESS1.B The orbits of Earth around the Sun and of the Moon around Earth, together with the rotation of Earth about an axis between its north and south poles, cause observable patterns. These include … different positions of the Sun, Moon, and stars at different times of the day, month, and year.
- 5-ESS1.B: Earth and the Solar System. The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns.

Utah Common Core

- K.2.2 Observe and describe changes in the day and night.
- 2.2.2a Observe, describe, and record patterns in the appearance and apparent motion of the moon in the night sky.
- 3.1.2 Describe the movement of Earth and the moon and the apparent movement of other bodies through the sky.

Materials

- 1 Styrofoam ball for every student
- 1 pencil for every student
- A lamp with shade removed to represent the sun

Do Ahead

- Darken your room before the activity. The darker the room the better
- If working with younger students, put the ball and pencil together before the activity.
- With younger grades invite volunteers to assist with the activity.
- Watch the teacher video on the video tab.

This lesson plan is adapted from:

Moon Modeling- http://www.nsta.org/publications/press/extras/moon.aspx

Directions

- Darken the room—the darker, the better. Give each student a pencil and a foam ball. Explain that the foam ball, stuck on the end of a pencil, is a model of the Moon; the lamp is a model of the Sun; and the students' heads represent Earth. Before the guided activity below, give students time to explore the model and test different ideas about what causes Moon phases. Next, guide students through the following activity to model how the Moon changes shape.

- With their faces toward the lamp, students hold the balls slightly above their heads so that they have to look up a little to see them. In this position, students cannot see the lighted side of the ball. This is called a *new Moon*.

- Tell students to turn their bodies slightly to the left while still looking at the ball and holding it a little above their heads. They should turn until they see a tiny sliver of the lighted side—a *crescent Moon*.

- Ask- Where does the Moon's light come from? (The light is coming from the Sun and is reflected off the Moon.) Some people think that the Moon phases are caused by the Earth's shadow. How does this model disprove that misconception? (The shadow of my head, which represents the Earth, is nowhere near the Moon in this position. It is behind me.)

- Instruct the students to keep turning to the left and soon they will see more of the lighted half of the ball. This is called a *quarter Moon.*

- Have them turn a little more and almost all of the ball will be lit. This is called a *gibbous Moon*.

- Students can keep turning until they see all the lighted half of the ball. This is a *full Moon*.

- As students continue to turn in the same direction, they will see less and less of the lighted part of the ball. First they will see a gibbous Moon, then a quarter Moon, then a thin crescent Moon, and finally they will be back to the new Moon.

- Tell students that the shapes they have observed in this activity are called the *Moon phases*.

- Have students go through the orbit several times. Ask them to chorally respond with the name of each phase as it is modeled.

- Point out that no matter where they are in the Moon's orbit, half of the Moon is always lighted by the Sun. Sometimes we see the whole lighted half from Earth (full Moon), sometimes we see almost all of the lighted half (Gibbous Moon), sometimes we see half of the lighted half (quarter Moon), sometimes we see only see a tiny sliver of the lighted side (crescent Moon), and sometimes we can't see any of the lighted half (new Moon). The portion we see from Earth depends on where the Moon is in its orbit around the Earth.

Extensions

- For older students you can ask them to demonstrate a solar and lunar eclipse with the props. Why do we not have eclipses each month? There are some good videos on the video page to show the answer.

- Try demonstrating the rotation and revolution of the moon. Divide students into groups of 2. Have the "Moon" student begin by facing the "Earth" student, then proceed to orbit. The orbiting student will find that if she carefully swivels her body 1/4 turn for each 1/4 orbit around the “Earth”, then she will always be facing inward as she completes a full circle. Her back will never be visible to the "Earth" student in the center. Now switch.

- For older students challenge your "Earth" student to rotate a month for each single full rotation of the "Moon" student, approximately 30 times. The "Moon" student must rotate quite slowly.

- Check for older student understanding of moon phases with the Lab Sheet.

Background for Teachers

(Adapted from Kinesthetic Astronomy: Moon Phases, California Academy of Sciences, 2015)

The Moon is a natural satellite of planet Earth, taking about a month to revolve all the way around our planet. Its orbit is very nearly circular; it stays about 380,000 kilometers away from us as it moves counterclockwise (as viewed from a northern hemisphere perspective). It also stays fairly close to the Earth's equatorial plane (an imaginary extension of Earth's equator out into space).

As you may expect, the Moon doesn’t just revolve, it also rotates about its own axis – but in quite an interesting fashion. Over the millennia, the Moon has become "locked" into a special kind of motion around the Earth. It rotates on its axis at the *same pace* as it revolves around the Earth. As a result, the Moon keeps the same face toward us throughout its orbit. You may hear astronomers talk of the “nearside” and “far side” of the moon. While Earthlings can only view the nearside, astronauts and spacecraft have successfully taken images of the far side.

The observed phase of the Moon is determined by its position relative to Earth and the Sun. In the 29.5- day period that the Moon takes to orbit the Earth, it will appear as different shapes because of our planet’s viewpoint. In actuality, half of the Moon’s surface is being hit by sunlight. But, because of our relative positions, we’ll see the Moon swell from the new Moon, through the crescent, to the first quarter, to the swollen gibbous moon, and then the full Moon, before waning to the new Moon again.