

**Document Id:** 03\_10\_04\_2

**Date Received:** 2004-03-10 **Date Revised:** 2004-06-01 **Date Accepted:** 2004-06-07

**Curriculum Topic Benchmarks:** S3.2.1, S3.3.2, S3.3.4, S3.3.6

**Grade Level:** Upper Elementary [3-5]

**Subject Keywords:** Moon, lunar, phases

**Rating:** easy

## **The Cause of the phases of the Moon**

**By:** Glenn Simonelli, Lakeview Elementary School, 6405 S. Main St., Bloomington, IN 47401 e-mail: gsimonel@indiana.edu

From: The PUMAS Collection <http://pumas.jpl.nasa.gov>

© 2004, California Institute of Technology. ALL RIGHTS RESERVED. Based on U.S. Gov't sponsored research.

This activity is frequently used to show the causes of the lunar phases. Generally a teacher tells students how to position the ball to show a full moon, a crescent moon, etc. This particular lesson is a little different in that the students have to figure out on their own how the balls need to be positioned.

This lesson makes a good follow-up to a lesson about the motions of the Earth, Moon and Sun (such as PUMAS Example 03\_10\_04\_1), but it can also stand as an independent lesson.

### Materials:

White Styrofoam balls, or something similar, at least 2" diameter, for each student  
Blank overhead transparencies and overhead markers – one for each group of four or five students

### Procedure:

Discuss the lunar phases. In front of the room draw pictures of, and have the students identify the new, crescent, half, gibbous and full moons.

If this lesson follows the PUMAS lesson on the motions of the Earth, Moon and Sun, teachers should ask students what they remember from that lesson about the motion of the Moon. If this lesson is used independently, teachers should take a moment to explain that the Moon orbits the Earth approximately once every 28 days.<sup>1</sup> Teachers could also have two students model the motion of the Moon around the Earth.

---

<sup>1</sup>This lesson can also be preceded with a month of Moon-watching so that students can see the different lunar phases for themselves. However, teachers should be aware that most of the waning phases will not be visible to most students because the Moon does not become visible until after students' bedtimes.

Create groups of four students. Tell the groups that they will need to determine the positions of the Earth, Moon and Sun during each of the five lunar phases illustrated on the board, and then create a diagram showing them. Give each group a blank overhead transparency and an overhead marker.

Ask students, “If you were the Earth and the ball was the Moon, show me the motion of the Moon.” (*Students should make the ball move around themselves.*) Tell students that they should hold the ball slightly above their heads as they move it around.<sup>2,3</sup>

Darken the room as much as possible.<sup>4</sup> Turn on a single bright light. (An overhead projector works well if set in a corner facing out into the classroom, but warn students to look away as you first turn it on.) Tell students that the light is the Sun, they are the Earth and the ball is the Moon. Standing in place, they should move the Moon around checking the shadows that form on it, trying to spot the different lunar phases. They should try to figure out the positions of the three objects for the different lunar phases. Some students

---

<sup>2</sup> If students hold the ball below the level of their heads, their shadows will make the Moon dark, leading to the common misconception that the new Moon occurs when the Earth moves between the Sun and the Earth. In effect, the students’ shadows on the balls are creating lunar eclipses. Although it is tempting to use this phenomenon to teach the cause of lunar eclipses, this is best saved for a separate lesson. Trying to combine the cause of the lunar phases with the cause of lunar eclipses in one lesson is likely to lead to confusion.

It is reasonable to ask, however, why we don’t have a lunar eclipse every month, when the Earth moves between the Sun and the Moon. The reason is that the Moon’s orbit is tilted. Sometimes the Moon is above the Earth’s shadow and sometimes it is below. A lunar eclipse occurs only when the Moon is directly in the Earth’s shadow—that is, when the Moon is opposite the Earth and lying directly on a line connecting the Sun and the Earth.

<sup>3</sup> Teachers might also want to mention that this activity is not being done to scale. If you are using 2” balls, students’ arms would need to be over 23 feet long to hold the balls the correct distance to show the Moon’s distance from Earth at scale.

<sup>4</sup> This is to make the shadows easier to see. It is not to imply that the Moon is only visible at night. In fact, the Moon is often visible during the daytime. This can be explained with the following demonstration:

Have students face the overhead light. Ask them what time of day this position corresponds to. (12:00 noon). Ask them to turn one quarter of a turn and hold the moon directly in front of themselves. What is the phase of the Moon? (Half Moon). What time of day does this position represent? (6:00 PM, or around sunset). Now ask the students to keep the Moon in the same position but slowly turn their heads back about half the distance between 6:00 PM and noon. About what time of day does this represent? (3:00 PM, or late afternoon) Can they still see the Moon out of the corner of their eyes? (They should be able to see it.) This shows how the Moon can often be seen during the daytime.

will discover it right away, others will need more time. It may take a while for all students to discover the position, and the room is likely to become somewhat chaotic at first. Also, it is possible that not all students will have access to the light from the projector at first. Ask students to be patient. Students that figure out the solution quickly can point it out to other students, but they should then sit down so they are not blocking the light for other students.

Once everyone has seen the different phases on the ball, students should get in their groups. They should collaborate on their diagrams, deciding how best to illustrate the positions of the three objects for the different lunar phases. If students disagree about the relative positions, they can get back up to test their ideas. After the groups have completed their diagrams, they should share them with the class. During this time the instructor can check the diagrams for accuracy. It should be noted that many students have difficulty creating two-dimensional representations of three-dimensional phenomena, so it is important that teachers listen to their students' explanations of these diagrams when checking for understanding.

This lesson can be followed up with a lesson about the cause of the Earth's seasons (such as PUMAS Example 03\_10\_04\_3).