**Ages:**
5th grade – high school

**Duration:**
10 minutes

**Materials:**
One penny and one quarter per pair of students

Overhead projector, or elmo, or video projector

Projected image of student overhead

## ~ LPI Education/Public Outreach Science Activities ~

# The Penny Moon and Quarter Earth

Adapted from a Physics Forum activity at: http://www.phvsicsforums.com/

### Overview –

The students will use a penny and a quarter to model the Moon's rotation on its axis and revolution around the Earth, and demonstrate that the Moon keeps the same face toward the Earth.

### Objective –

The students will:

- Demonstrate the motion of the Moon's rotation and revolution.
- Compare what we would see of the Moon if it did not rotate to what we see when its period of rotation is the same as its orbital period.

**Before You Start:** Do not introduce this topic along with the reason for lunar phases; students may become confused and assume that the Moon's rotation is related to its phases.

Prepare to show the student overhead projected for the class to see.

### Activity –

1. Ask your students to describe which parts of the Moon they see.
   - *Does the Moon turn? Can we see its far side?* Allow time for your students to discuss this and share their opinions.

2. Hand out the pennies and quarters so that each pair of students has both. Tell the students that they will be creating a model of the Earth and Moon.
   - *Which object is Earth?* [the quarter] *Which one is the Moon?* [the penny]

3. Turn on the projected student overhead. Invite the students to move the penny around the quarter, but ask them to keep Lincoln's nose facing the quarter, so the people on planet Quarter can always see Lincoln's nose.
   - *Did the Moon (penny) make a complete rotation on its axis? Did the Moon (penny) make a complete revolution, or orbit, around the Earth?* (Yes. The Moon completed a rotation and a revolution.)
   - *What can you conclude about the Earth's rotation and revolution from this demonstration?* (The Moon's rotation and revolution occur in the same time period, approximately one month. That is a very slow rotation compared to the Earth's 24 hour rotation cycle!)
   - *Can you and a friend explain – or demonstrate - why we always see the same face of the Moon?*

4. Let the students know that the Moon takes 27.3 days to orbit around the Earth. Inform them that the Moon also takes 27.3 days to rotate, or spin on its axis. Invite them again to share whether we ever see the far side of the Moon.

### Extensions –

1. Conduct demonstrations with an Earth globe and a Moon ball (a plastic ball with a face drawn on one side will suffice.)

2. Conduct the kinesthetic activity, *Facing the Moon*.

## *Background —*

The Moon's period of revolution, or orbit, around the Earth is 27.3 days, which is identical to the Moon's period of rotation, or spin. Because of this, we only see the front side of the Moon.

This wasn't so at first. Over time, the Moon became tidally locked with the Earth—just as the Moon exerts tidal forces on the Earth, our planet also exerts tides on the Moon, slowing down its rotation until it matched its revolution.

The Moon also has two different periods of revolution, depending on your frame of reference. The Moon takes 27.3 days to orbit the Earth exactly 360 degrees, or with respect to the stars (a "sidereal" month). Because the Earth is moving around the Sun, while the Moon orbits the Earth, there is a different period for Moon phases (such as new moon to new moon)—it takes the Moon 29.5 days to complete a lunar phase cycle (a "synodic" month).

## *Ties to Standards —*

**Connections to the National Science Standard(s)**
Content Standard D Earth and Space Science, (grades 5—8): Most objects in the solar system are in regular and predictable motion. Those motions explain such phenomena as the day, the year, phases of the moon, and eclipses.

**Principles & Standards for School Mathematics**
Geometry Standard for Grades 3-5: Specify locations and describe spatial relationships using coordinate geometry and other representational systems
Reasoning and Proof: Instructional programs from PK through grade 12 should enable all students to make and investigate mathematical conjectures

**Texas TEKS**
Scientific investigation and reasoning. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions and knows the contributions of relevant scientists. The student is expected to:

(A) in all fields of science, analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student;
(B) use models to represent aspects of the natural world such as a model of Earth's layers;
(C) identify advantages and limitations of models such as size, scale, properties, and materials;

**3rd grade Science Concept Standards (TEKS)**
(8) Earth and space. The student knows there are recognizable patterns in the natural world and among objects in the sky. The student is expected to: (C) construct models that demonstrate the relationship of the Sun, Earth, and Moon, including orbits and positions…

**5th grade Science Concept Standards (TEKS)**
(8) Earth and space. The student knows that there are recognizable patterns in the natural world and among the Sun, Earth, and Moon system. The student is expected to: (D) identify and compare the physical characteristics of the Sun, Earth, and Moon.

**6th grade Science Concept Standards (TEKS)**
(11) Earth and space. The student understands the organization of our solar system and the relationships among the various bodies that comprise it. The student is expected to: (A) describe the physical properties, locations, and movements of the Sun, planets, Galilean moons, meteors, asteroids, and comets.

# The Penny Moon and the Quarter Earth Student Overhead

Place a penny and a quarter as shown below. The penny represents the Moon, and the quarter represents the Earth. The time elapsed represents one month, or one lunar cycle.

Now, move the penny counter-clockwise to this position (making sure Lincoln is *always* facing Washington):

Next, move the penny to this position:

Then, move it around another quarter turn:

Last, move Lincoln back to his original position (still facing Washington):