

Phases of the Moon

Based on
http://www.learner.org/teacherslab/pup/act_moonphaseintro.html

Focus on Inquiry

The student will make observations of an Earth-Moon-Sun model system to describe the phases of the Moon.

Lesson Content Overview


This activity asks students to use models of Earth, the Sun, and the Moon system to discover why moon phases occur. Students use a Styrofoam ball to represent the Moon, which will be lit by a single light source in the classroom, to observe how different portions of the ball are illuminated as they hold it in various positions. They create a complete series of phases matching the appearance of the Moon. And they relate moon phases to the positions of Earth and the Sun.

Duration 75 minutes	Setting Classroom	Grouping Whole class	PTI Inquiry Subskills 3.3 , 4.3 , 5.2 , 5.8 , 5.9 , 7.2
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Lesson Components	Estimated Time	Inquiry Subskills Used	Technology Used	Level of Student Engagement	Brief Description
Engage	5 min	None	None	2	Students are engaged in a discussion on the Moon.
Explore	30 min	3.3, 4.3, 5.8	None	3	Students create a model of the moon phases and go through each phase.
Explain	25 min	5.2	None	3	Students go through the lunar phases describing the illumination and identifying the name of the phases.
Expand	10 min	5.2, 7.2	Internet/TV hook-up	3	Students view a video of the lunar phases and identify which phase is shown.
Evaluate	5 min	3.3, 5.9	None	3	Students organize moon phase cards in the correct order.

Level of Student Engagement

1	Low	Listen to lecture, observe the teacher, individual reading, teacher demonstration, teacher-centered instruction
2	Moderate	Raise questions, lecture with discussion, record data, make predictions, technology interaction with assistance
3	High	Hands-on activity or inquiry; critique others, draw conclusions, make connections, problem-solve, student-centered

<h3>Next Generation Science Standards – Inquiry</h3> <p>NGSS Practice 2:Developing and Using Models </p>
<h3>Next Generation Science Standards – Earth Science</h3> <p>MS-ESS1-1 Develop and use a model of the Earth-sun-moon system to describe the cyclic patterns of lunar phases, eclipses of the sun and moon, and seasons.</p>
<h3>Florida Science Standards - Inquiry</h3> <p>SC.7.N.3.2* Identify the benefits and limitations of the use of scientific models SC.8.N.3.1 Select models useful in the investigations</p>
<h3>Florida Science Standards – Earth Science</h3> <p>SC.8.E.5.9* Explain the impact of objects in space on each other, including: 1. the Sun on the Earth, including seasons and gravitational attraction; 2. the Moon on the Earth, including phases, tides, and eclipses, and the relative position of each body.</p>

* Florida Power Standards (2013)

Materials and Advance Preparation

Materials List

Class set:

- overhead projector (or bright light source)

Student materials (1 per student):

- Styrofoam balls (1" in diameter)
- Moon Phase Calendar for current month (Blackline Master #1; see Advance Preparation, Step 1)
- Moon index cards (see Advance Preparation, Step 2. 1 set per student (8 index cards per student).
- Evaluation (Blackline Master #2)

Blackline Masters

1. **Moon Phases** (to be cut in half; see Advance Preparation)
2. **Check for Understanding: Moon Phases**
3. **Common Uses of Moon-related Words in the English Language**

Advance Preparation

1. Download the Lunar Calendar for the month that you will be teaching the lesson. This can be downloaded from StarDate Online, <http://stardate.org/nightsky/moon/>. This can be placed on the top half of a sheet of paper, while the 8 phases of the moon can be placed on the lower half of the sheet. Cut the sheet in half to prepare for the lesson. See **Blackline Master #1** for an example.
2. Obtain small pictures of the 8 phases of the moon (see **Blackline Master #1** – the lower half of the sheet). Cut out each phase and glue/tape it to an unlabeled index card. Be sure to mark to the “top” of each card.
3. Obtain Styrofoam balls (1-2” in diameter) for each student.
4. You will need an open area and access to a bright light source in order to complete this lesson as written.

Lesson Information

Learning Objectives

1. The student will use an Earth-Moon-Sun model (*condition*) correctly (*standard*) to explain why the moon goes through phases during the lunar month (*task*).
2. The student will use, from memory (*condition*), correct (*standard*) vocabulary for each phases of the moon, including the terms, gibbous, waning, crescent, and quarter moon (*task*).

Prior Knowledge Needed by the Students

- None

Background Information

Moon phases occur because as the Moon travels around the Earth, we see different amounts of the surface of the Moon that faces the Earth illuminated. At the *New Moon* phase, the Sun is on the far side of the Moon and so the entire side of the Moon facing the Earth is in shadow. At the *Full Moon* phase, the Moon is now on the far side of the Earth from the Sun and the side facing the Earth is completely illuminated. As the Moon’s position relative to the Sun changes from in between the Sun and the Earth (a New Moon) to the opposite side, with the Earth in between the Moon and the Sun, more and more of the side facing the Earth is illuminated, which is referred to as the *waxing* phases, with the right side always illuminated. Once past the Full Moon, the side facing the Earth begins to fall more and more into the shadow, which is referred to as the *waning* phases and the illuminated side is always the left side.

Lesson Procedure

Engage

Include guiding questions you might ask to help students. If you use a video (include the URL in your lesson plan instructions) or a book (the author, title and publication date), and include questions that you would ask before, during or after the video/book reading selection.

1. Ask students "Has anyone ever heard the statement "Once in a blue moon"? What does this statement mean when it is used? (*It refers to something that rarely happens.*) What is a blue moon? (From EarthSky.org: Blue Moon can be second of two full moons in a month. Or it can be third of four full moons in a season. The next Blue Moon is the second full moon of July, 2015. Refer to a very interesting discussion at <http://earthsky.org/space/when-is-the-next-blue-moon>.)
2. Are there any other statements that you know about the moon? Let students share this they know about common moon/lunar mythology. [Example: Crazy things happen around a full moon. See **Blackline Master #3** for examples.]
3. Give students the moon phase index cards (in mixed order). Ask them to try to put them in the correct order. Use this activity as a means to assess prior knowledge and any misconceptions students will be bringing to the lesson. Have the students set the cards aside (in order) on their desks. You will return to these cards at the end of the lesson.

Explore

1. Distribute the Styrofoam balls to students (1 per student) and have students push a pencil or pen about halfway through their ball.
2. Have students stand up and move into the light of the projector (or bright light source). Everyone should face the projector, but not look directly into the light.
3. Ask students, "We are modeling the Sun-Earth-Moon system, so in our system, what will represent the Sun? (*the projector*). What about this Styrofoam ball on your pencil? (*the moon*). What do we represent? (*the Earth*).
4. As students move through the phases of the moon in their model system, have students concentrate on describing what they see in terms of what portion of the Moon's surface is illuminated. The first time through the lunar phases, begin with $\frac{1}{4}$ turns (new, first quarter, full, third quarter). At this point, do not worry about vocabulary, but the descriptive process. Go through the lunar phases at least twice, focusing on description.
 - 4.1 Everyone face the projector and hold your "moon" in the light of our "Sun" so that you can see the glow around the edge of your "moon." How much of the Moon's surface that is facing you is illuminated? (*none of side facing me is illuminated*)
 - 4.2 Everyone turn 90° to your left. Make sure your Moon is still in the light of our "Sun." Looking at your Moon, how much of your Moon is now illuminated? (*half of the side facing me is illuminated*) Which side of your Moon is illuminated, the right side or the left side? (*the right side is illuminated*)
 - 4.3 Everyone turn another 90° to your left. Make sure your Moon is still in the light of our "Sun." Looking at your Moon, how much of your Moon is now illuminated? (*all of the side facing me is illuminated*)
 - 4.4 Everyone turn 90° to your left. Make sure your Moon is still in the light of our "Sun." Looking at your Moon, how much of your Moon is now illuminated? (*half of the side facing me is illuminated*) Which side of your Moon is illuminated, the right side or the left side? (*the left side is illuminated*)
 - 4.5 Everyone turn 90° to your left. Make sure your Moon is still in the light of our "Sun." Looking at your Moon, how much of your Moon is now illuminated? (*none of side facing me is illuminated; we are back to where we started!*)
5. Now we are going to do 45° turns.
 - 5.1 Everyone face the projector and hold your "moon" in the light of our "Sun" so that you can see the glow around the edge of your "moon." How much of the Moon's surface that is facing you is illuminated? (*none of side facing me is illuminated*)
 - 5.2 Everyone turn 45° to your left. We should all be looking at the corner of the room. Make sure your Moon is still in the light of our "Sun." Looking at your Moon, how much of your Moon is

- now illuminated? (*a little bit of the side facing me is illuminated*) Which side of your Moon is illuminated, the right side or the left side? (*the right side is illuminated*)
- 5.3 Everyone turn another 45° to your left. Make sure your Moon is still in the light of our “Sun.” Looking at your Moon, how much of your Moon is now illuminated? (*half of the side facing me is illuminated*) Which side of your Moon is illuminated, the right side or the left side? (*the right side is illuminated*)
- 5.4 Everyone turn 45° to your left. We should all be looking at the corner of the room. Make sure your Moon is still in the light of our “Sun.” Looking at your Moon, how much of your Moon is now illuminated? (*almost all of the side facing me is illuminated*) Which side of your Moon is illuminated, the right side or the left side? (*the right side is illuminated*)
- 5.5 Okay.... who sees a pattern here? Can you put this pattern into words?
- 5.6 Everyone turn 45° to your left. Make sure your Moon is still in the light of our “Sun.” Looking at your Moon, how much of your Moon is now illuminated? (*all of the side facing me is illuminated*)
- 5.7 Let’s finish our moon cycle. Everyone turn 45° to your left. Make sure your Moon is still in the light of our “Sun.” Looking at your Moon, how much of your Moon is now illuminated? (*almost all of the side facing me is illuminated*) Which side of your Moon is illuminated, the right side or the left side? (*the left side is illuminated*)
- 5.8 Everyone turn another 45° to your left. Make sure your Moon is still in the light of our “Sun.” Looking at your Moon, how much of your Moon is now illuminated? (*half of the side facing me is illuminated*) Which side of your Moon is illuminated, the right side or the left side? (*the left side is illuminated*)
- 5.9 Everyone turn 45° to your left. We should all be looking at the corner of the room. Make sure your Moon is still in the light of our “Sun.” Looking at your Moon, how much of your Moon is now illuminated? (*a little bit of the side facing me is illuminated*) Which side of your Moon is illuminated, the right side or the left side? (*the left side is illuminated*)

Explain

- Go through the phases of the moon, this time asking for students to (1) describe the illumination of the moons’ face that is seen from the earth (Step 5.1-5.8), and (2) to supply the correct vocabulary for the lunar phase. As you move through the lunar cycle, ask students to give their own explanations for what is happening at each phase of the lunar month.

5.1 – New moon

5.2 – Waxing crescent

5.3 – 1st Quarter

5.4 – Waxing gibbous

5.6 – Full moon

5.7 – Waning gibbous

5.8 – 3rd Quarter

5.9 – Waning crescent

Expand

- Students return to their seats. View the Lunar Phases video (<http://www.solarviews.com/cap/moon/vmoon2.htm>). As the video progresses through the phases of the lunar month, ask students to give the correct terminology to each phases and explain why that part of the Moon’s surface is illuminated.
- Give students the Lunar Month calendar for the month that you are teaching the lesson (top portion of Blackline Master #1). Discuss with the students what phase the Moon is currently in and what they can apply to this calendar from what they learned in today’s lesson. Sample questions can include?
 - What phase of the lunar cycle is the Moon in today?
 - On what day is the Moon a New Moon?
 - When does the 3rd Quarter occur?
 - When do the waxing phases of the lunar cycle occur?

WRAP UP.

Bring the lesson to a conclusion by having the students check their card stack from the beginning of the lesson. Did you have your cards in the correct order? If not, then put them in the correct order. Have your shoulder partner check your card stack. With your shoulder partner listening, touch each card and name the phase it represents.

A quick review... close your eyes and visualize the phases of the moon as I ask the questions.... (repeat 5.1 through 5.9)

Let's see how well you understand the phases of the Moon and the Sun-Earth-Moon model we used to learn about the phases. Pass out the **Checking for Understanding: Moon Phases (Blackline Master #2)**.

Evaluate**FORMAL EVALUATION**

1. Attached as Blackline Master #2.

INFORMAL or OPTIONAL EVALUATIONS

1. The two Expand activities can serve as informal evaluations of student understanding.

Supplementary Resources**Teachers**

Henes, Donna. (2004). *The Moon Watcher's Companion: Everything You Ever Wanted to Know About the Moon and More*. Marlowe & Company. 144 pp. ISBN-10: 1569244669

Bringing together a wide range of writings about the moon, from Mother Goose to Joseph Campbell, Galileo to Audre Lorde, Sappho to Black Elk, as well as providing a comprehensive encyclopedia of lunar terminology, a timeline of lunar explorations, and three sections that detail the moon's faces, phases, and known facts, author Henes has created a fascinating compendium of lunar science, myth, folklore, poetry, curious facts, and old wives' wisdom culled from cultures throughout the ages.

Students

Fowler, Allan. (1992). *So That's How the Moon Changes Shape* (Rookie Read-About Science Series) Chicago: Children's Press. 31 pp. ISBN: 0516449176

A simple explanation of the moon and why it changes shape throughout the month. Ages 4-8.

Olson, Gillia M. (2006). *Phases of the Moon*. Pebble Plus. 24 pp. ISBN-10: 0736863400

Brilliant and interesting photographs, easily understood diagrams, and a short, informative text. This book explains that the moon only appears to change shape. A clear diagram names each phase, including less familiar words like "gibbous" and "crescent," included in a short glossary at the end and illustrated with a photograph. There are photos of the tiniest sliver which appear after the new moon, which is really no visible moon at all. Ages 9-12.

Gibbons, Gail. (1998). *The Moon Book*. Holiday House, Inc. ISBN: 0823413640

Identifies the moon as our only natural satellite, describes its movement and phases, and discusses how we have observed and explored it over the years. Ages 6-8.

Miscellaneous

Moon in My Room by Uncle Milton. ISBN: 1400641527

You can hang this light up moon that is authentically sculpted and detailed on your wall. It is internally lit to realistically illuminate a darkened room. Using an automatic or manual function, the 12 main phases of the moon can be shown. Included are a moon discovery guide with calendar, moon phase charts, instructions, a 15 minute CD tour and IR remote control. The built-in light

sensor illuminates the moon when it gets dark and the unit has an automatic shut-off. Cost: ~\$30 (in 2007). Ages 6+

CITATION OF SOURCES.

The Explore activity is modeled from the Private Universe – Moon Phases Activity (http://www.learner.org/teacherslab/pup/act_moonphase.html) beginning with Step 4 under the section entitled “The Activity.”

Private Universe - Moon Phase Activity. (n.d.). Retrieved May 18, 2015, from http://www.learner.org/teacherslab/pup/act_moonphase.html NOTE: this activity was originally created by Schatz, D., and Cooper, D. (1994). *Astro-Adventures*, Pacific Science Center.

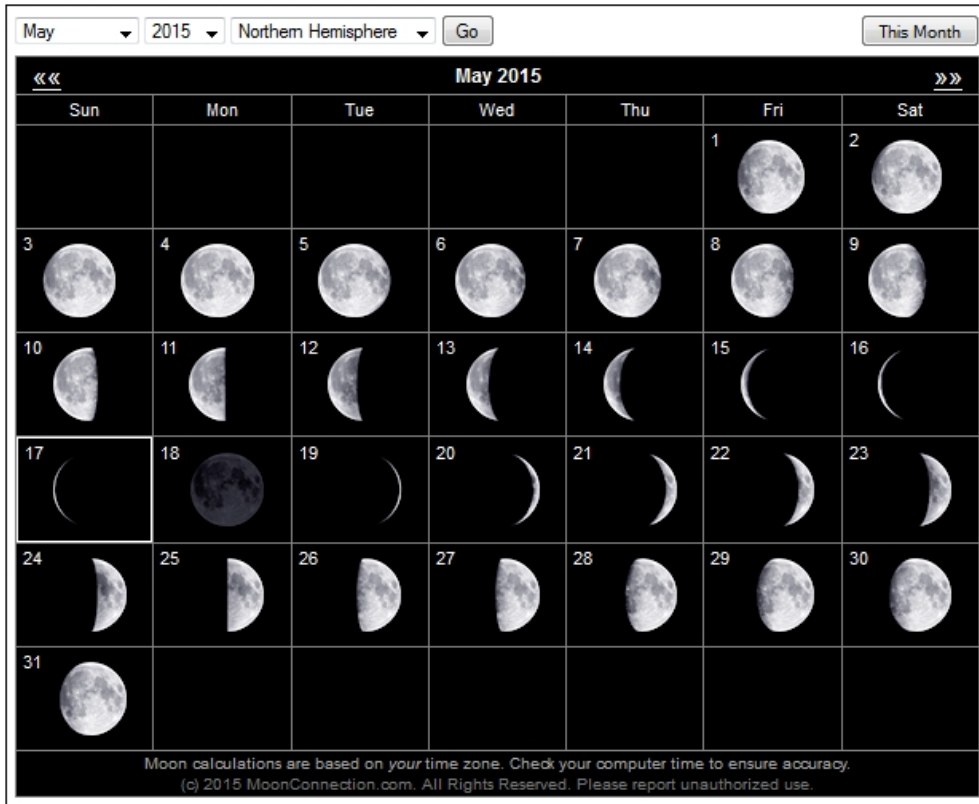
Yes, I cited all materials and resources used in this lesson.

Pam Blanchard

Lesson author signature

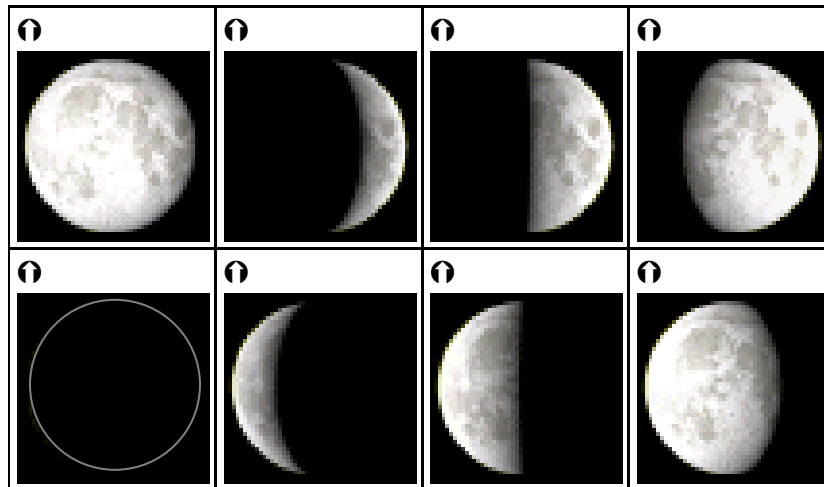
Blackline Master #1

Moon Phases for May 2015



This tool displays the approximate Moon phases for a given month. For official phase times and dates for this month and past months, check our [Sky Almanac](#). Moon rise and set times are available from the [U.S. Naval Observatory](#). Provided by moonguy@google.com. An alternate calendar site is http://www.moonconnection.com/moon_phases_calendar.phtml.

Moon Phases (cut into 8 squares and glue to index cards)



Blackline Master #2



Name _____ Date _____ Student No. _____

Checking for Understanding: Moon Phases



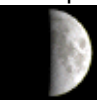

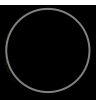









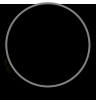



- ___ 1. In the picture to the right, what phase of the moon is shown? (SC.8.E.5.9)
- A. waxing gibbous
 - B. waxing crescent
 - C. waning gibbous
 - D. waning crescent





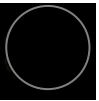



- ___ 2. In our Sun-Earth-Moon model, what represented the Sun? (SC.8.N.3.1)
- A. The projector.
 - B. Myself.
 - C. The Styrofoam ball.
 - D. None of the above.

- ___ 3. Sometimes the Moon looks like this: . And sometimes the Moon looks like this: . What causes the Moon to change its appearance this way? (SC.8.E.5.9)
- A. As the Moon orbits Earth, Earth's shadow covers the Moon.
 - B. Clouds block part of the Moon from our view.
 - C. As the Moon orbits around Earth, we see different views of the Moon's sunlit side.

- ___ 4. Which of the following has the moon phases in the correct order? (SC.8.E.5.9)

A.        

B.        

C.        

D. none of the above

- ___ 5. Which is NOT a limitation of our Sun-Earth-Moon model? (SC.7.N.3.2, PTI 5.9)
- A. The relative distances of the Sun-Earth-Moon model.
 - B. The relative positions of the Sun-Earth-Moon model.
 - C. The relative sizes of the Sun-Earth Moon model.
 - D. All of the above.

Blackline Master #3

Common Uses of Moon-related Words in the English Language

Harvest Moon - this is the full moon that occurs closest to the autumn equinox, which usually occurs in September or October. The name comes because farmers are able to work in their fields into the night because of the moon's bright light in the night sky. See <http://stardate.org/nightsky/moon>.

Lunatic – A lunatic is a person with irrational behavior. The word comes from the Middle English word that meant “moonstruck.” The name is associated with the moon because a superstition held that heavenly bodies directly affected peoples’ behavior on Earth. In 2012, President Obama signed a law banning the word from legislative language. See <http://dictionary.reference.com/browse/lunatic>.

Superstitions

“Crazy people come out on the night of a Full Moon.” (See <http://www.refinery29.com/2014/07/71005/full-moon#slide-2>)

“Women go into labor around the time of a Full Moon.” (See <http://www.refinery29.com/2014/07/71005/full-moon#slide-4>)

“Cutting your hair or fingernails on a Full Moon will cause them to grow fast.” (See <http://impressivemagazine.com/2014/06/11/10-superstitions-about-the-moon/>)

**Nursery Rhyme**

Hey diddle diddle,

The cat and the fiddle,
The cow jumped over the moon.
The little dog laughed,
To see such sport,

And the dish ran away with the spoon.

Famous Songs featuring the “Moon” (<http://moon.nasa.gov/moonsongs.cfm> and <http://www.engine145.com/songs-about-the-moon/>)

Moonlight Sonata (Ludwig van Beethoven, 1801)

Moon River (Audrey Hepburn, 1961)

By the Light of the Silvery Moon (Lillian Lorraine, 1909)

It's Only a Paper Moon (Jim Reeves, 1964)