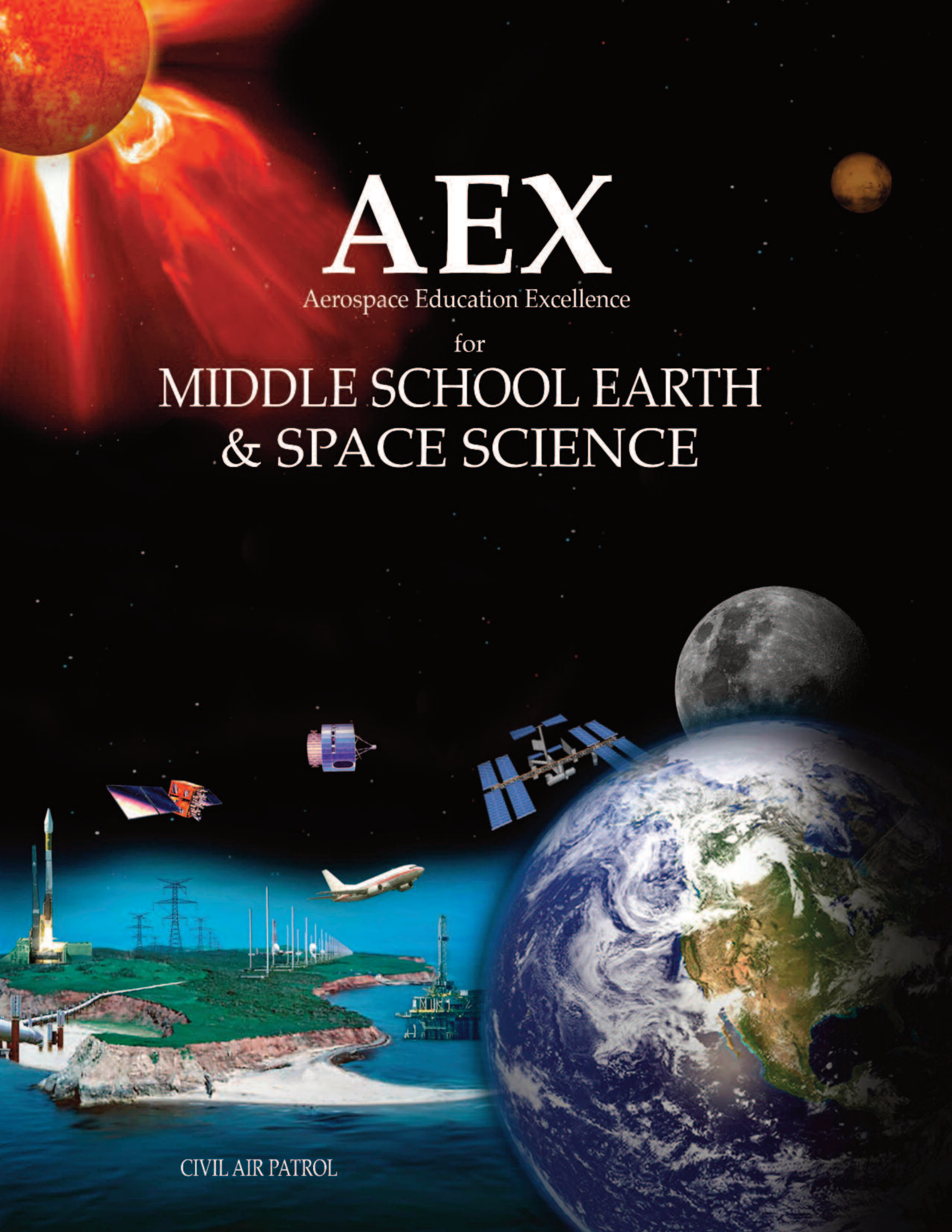
# AEX

Aerospace Education Excellence

for

# MIDDLE SCHOOL EARTH & SPACE SCIENCE



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## Lunar Learning – It Occurs in Phases

**Lesson 11**

**Lesson Reference:** The student simulation demonstrating the phases of the Moon is derived from a NASA Jet Propulsion Laboratory (JPL) lesson located online at http://www.jpl.nasa.gov/education/index.cfm?page=123.

**Objectives:**

- Students will identify the eight phases of the Moon by name and shape.
- Students will simulate the eight phases of the Moon.
- Students will simulate a solar eclipse and lunar eclipse.
- Students will be able to explain why lunar and solar eclipses are rare.
- Students will gain basic lunar facts to help them better describe the Moon and make comparisons to Earth.

**National Science Standards:**

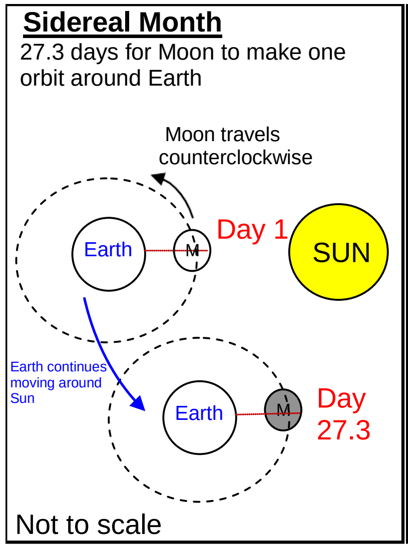
- Content Standard B: Physical Science
  - Properties and changes of properties in matter
  - Motion and forces
- Content Standard D: Earth and Space Science
  - Structure of the Earth system
  - Earth in the solar system

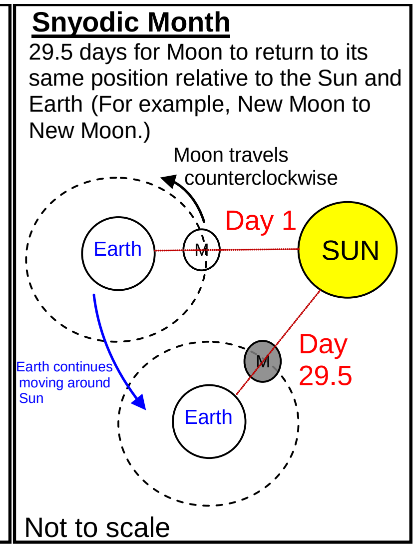
**Background Information:**

Earth's moon is situated in an elliptical (oval-shaped) orbit around Earth. Because it is elliptical and not circular, the Moon's distance from the Earth changes slightly, varying from approximately 252,000 miles (405,555 km) at its farthest point to 221,000 miles (355,665 km) at its nearest point, with the average distance being close to 240,000 miles (386,243 km). About 30 Earths could fit between the Earth and the Moon. While Earth's diameter is about 7,920 miles (12,746 km), Earth's Moon has a diameter of about 2,155 miles (3,468 km), which is close to 1/4 of the Earth's diameter.

Due to a weak gravitational pull (that is 1/6 that of Earth's gravity), the Moon has no atmosphere. The gravity of the Moon is too weak to trap any gases, such as oxygen, carbon dioxide, nitrogen, etc. Because of this, there is no wind or air of any kind on the Moon. Sound travels through air; therefore, there are no sounds on the Moon.

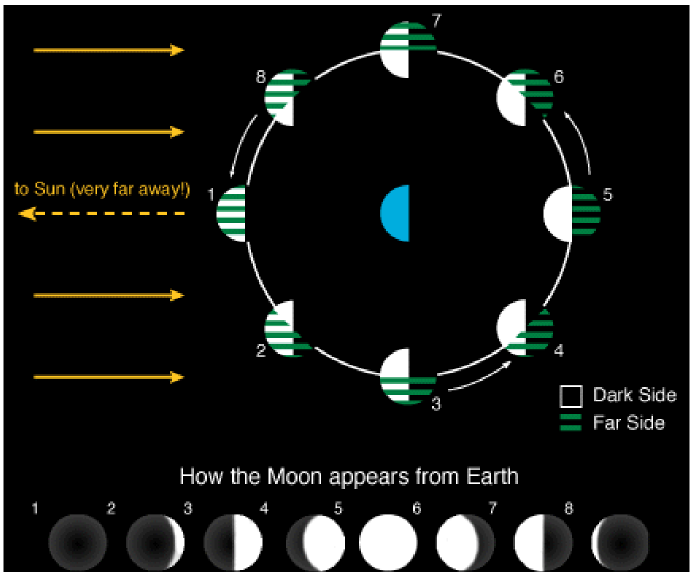
The Moon rotates on its axis in the same amount of time it takes to orbit the Earth; therefore, the same side of the Moon (near side) always faces the Earth. It takes the Moon about 27.3 days to make one revolution around the Earth and reappear against the same background of stars (known as a sidereal month). It takes the Moon about 29.5 days to go from its New Moon phase (where the Moon is aligned between the Earth and Sun), travel around the Earth (which is constantly in motion around the Sun), and return to its New Moon phase position. This is known as the synodic (pronounced sĭ-nŏd'ĭk) or lunar month. Since the length of one day on the Moon is almost a month, daytime on the Moon




lasts about 14 Earth days (one-half the orbit time). Temperatures on the Moon can rise above 250° F (121° C) during the day. Nighttime temperatures can go below -250°F (-157°C).

As the Moon rotates around Earth, its position relative to the Sun changes. The phases of the Moon are explained in detail within the Lesson Presentation (presentation step #9), and the pictures of the Moon phases will help explain the shapes of the Moon that are visible at different times during the month.

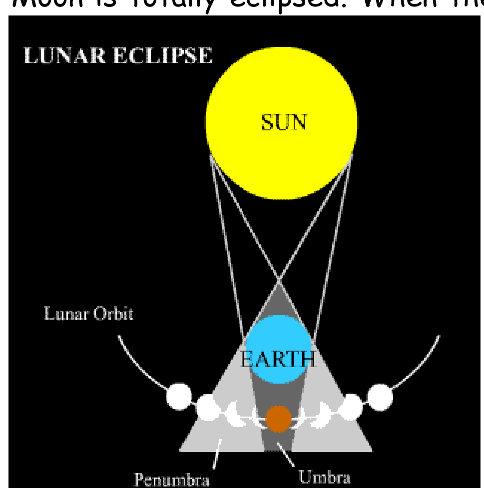



1. New Moon; 2. Waxing Crescent; 3. First Quarter; 4. Waxing Gibbous; 5. Full Moon; 6. Waning Gibbous; 7. Third Quarter 8. Waning Crescent

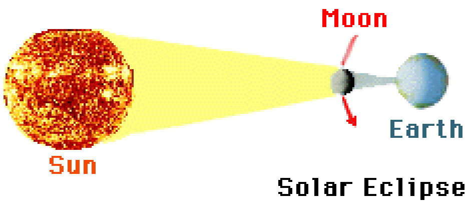
Source: http://starchild.gsfc.nasa.gov/docs/StarChild/questions/phases.html

Sometimes, the Moon passes directly in Earth's shadow. When this happens, part or all of the Moon may not be visible. This is called a lunar eclipse and occurs when the Sun, Earth, and Moon line up in just the right way. If the Moon passes through the penumbra, the light shadow cast by the Earth, the Moon is partially eclipsed. If the Moon passes through the umbra, the darkest part of the shadow cast by the Earth, the Moon is totally eclipsed. When the Earth's shadow prevents the entire surface facing the Earth to be blocked, it is called a total lunar eclipse. If the Moon rotates around the Earth each month, why doesn't a lunar eclipse occur each month? It is because the Moon is tilted about 5° in its orbital path around Earth compared to the orbital path of the Earth around the Sun; therefore, the Moon usually passes a little above or below the Earth. As explained in an article at Space.com:

> *To visualize, think of two Hula Hoops (one inside of the other) — one big and one small — floating on the surface of a pool. Push the*




Source: http://lunar.arc.nasa.gov/science/images/eclipse.gif *inner one down so that half of it is below the surface and half above. When the Moon gets into the ecliptic — right at the surface of the pool — during its full phase, then a lunar eclipse occurs.*




Source: [http://starchild.gsfc.nasa.gov/Images/StarChild/icons/solar_eclipse.gif](http://starchild.gsfc.nasa.gov/Images/StarChild/icons/solar_eclipse.gif)

On rare occasions, a solar eclipse occurs. This can only happen during the daylight hours when the Moon moves directly between the Sun and the Earth, blocking the Sun for a short time as it continues its orbit the Earth. This is rare, however, because the Moon's orbital path around the Earth is tilted at about 5° compared to the orbital path of the Earth around the Sun.

Source: NASA

The Moon consists mainly of solid rock covered with dust, or regolith (loose, fragmental material covering the surface). This fine dust covers the entire surface of the Moon. There are two theories regarding the origin of the dust. Some think the impact of meteoroids striking the surface pulverized lunar matter into dust, which settled to the surface slowly and evenly. Others think the dust is cosmic dust from space that the Moon's gravitational pull brought to the surface. Earth has regolith also; however, as NASA's Exploring the Moon Teacher's Guide explains:

*By contrast, regolith on Earth is a product of weathering. Weathering encompasses all the processes that cause rocks to fragment, crack, crumble, or decay. These processes can be physical (such as freezing water causing rocks to crack), chemical (such as decaying of minerals in water or acids), and biological (such as plant roots widening cracks in rocks). The rock debris caused by weathering can then be loosened and carried away by erosional agents -- running water (fast-flowing rivers, rain, ocean waves), high-speed wind (by itself or sandblasting), and ice (glaciers).*

**A geologist-astronaut does field work on the Moon**
Geologist Harrison H. Schmitt examines a large rock at the *Apollo* 17 landing site. This large boulder contains numerous rock fragments that were smashed together by the huge impact event that made the 750-kilometer Serentatis basin on the Moon.

Source: NASA

Primarily, the Moon has two types of terrain, highlands and lowlands. The highlands are filled with craters surrounded by mountains, and the lowlands are filled with craters that have been flooded with molten lava and appear as dark areas called maria (Latin for sea). The Moon has many different kinds of rocks. Moon basalt is a dark gray rock with tiny holes from which gas has escaped. It closely resembles Earth basalt, but contains different mineral combinations. On the Moon, basaltic lava makes up the dark, smooth surfaces of the lunar plains, which cover about half of the visible side of the Moon.

While there are no oceans, lakes, streams, or polar ice caps on the Moon, scientists had reason to believe that water ice might exist on the Moon due to evidence from the *Clementine* and *Lunar Prospector* missions, unmanned lunar missions in the 1990s. For water to exist, it would need to be in the form of water ice, which would only be possible in a dark or shaded area on the Moon, since areas exposed to sunlight would cause any water to quickly evaporate, and the gases would escape into space due to the Moon's weak gravitational pull. Scientists were excited to find conclusive evidence of water ice on the Moon thanks to data obtained from NASA's *LCROSS* (Lunar Crater Observation and Sensing Satellite) mission in 2009.

Artist's rendering of the LCROSS spacecraft and Centaur separation. Source: http://www.nasa.gov/mission_pages/LCROSS/overview/index.html

Although the Earth and stars are beautiful to observe from the Moon, the Moon is a quiet, barren place with a black sky. To date, only twelve astronauts have walked on the Moon's surface as part of NASA's six *Apollo* missions between 1969 and 1972. Edwin "Buzz" Aldrin (the second man to set foot on the Moon after Neil Armstrong in the *Apollo* 11 mission) described the Moon as "magnificent desolation." Could the Moon contain useful minerals that could be mined and used on Earth? Could humans build a colony that supports life and live on the Moon? Questions and exploration continues.

**Materials:**

- Baseball (or object of similar circumference, approximately 2.9 in or 7.4 cm)
- Small marble (or object of similar size; consider making a clay ball of about 0.7 in or 1.8 cm)
- String (at least 7.5 – 8.0 ft in length)
- Small Styrofoam balls (one per student)
- Wooden skewers or sharpened pencils (one per student)
- Lamp (using bright, incandescent 100-watt bulb or higher with lampshade removed)
- Extension cord
- Computer with Internet and projection system (e.g., LCD projector)

**Advance Lesson Preparation:**

Place one Styrofoam ball on one end of each sharpened pencil or wooden skewer (covering the sharp end).

**Lesson Presentation:**

1. Direct students' attention to the baseball displayed at the front of the room. Tell the students that the ball represents Earth. Ask three volunteers to predict how far away the Moon would be from the Earth, assuming the actual size of the Earth was the baseball and the actual size of the Moon was a marble. (Show the marble.)

As each of the three students make predictions regarding where the marble (Moon) would be placed, have each student stand at the predicted distance from the baseball.

2. Ask the student volunteers how they arrived at their predicted distances. Ask the class what information would be needed to correctly solve this problem. Tell the class that the <u>average</u> distance from the Earth to the Moon is about 238,000 – 239,000 miles (depending on the source used for information), and Earth's circumference is nearly 25,000 miles. This means a total of about 9.5 Earth circumferences is equivalent to the average distance between the Earth and the Moon (238,500 ÷ 25,000).

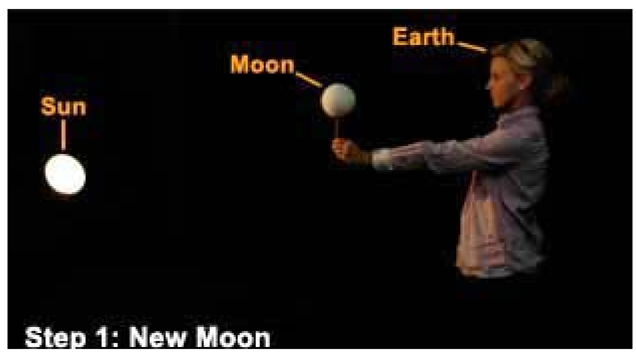
3. Wrap the string 9.5 times around the baseball, marking the stopping point with your finger. Stretch the string from the ball toward the back of the room and hold the marble at the stopping point to demonstrate the scaled distance from the Earth to the Moon. Tell students that the distance from the baseball to the marble is a little over seven feet. If you had used a globe to represent the Earth, the object representing the Moon would have been placed about 30 feet away. Using scaled models of objects and scaled distances is helpful to give us a better understanding of such immense objects and great distances.

   Another way to think about the distance between the Earth and the Moon is to think about how long it would take to drive about 238,000 miles. If a road around the equator existed, and you drove non-stop at approximately 70 miles per hour, you would drive one time around the Earth in about 357 hours, or about 15 days. Remember, that 9.5 times around the Earth equals about the same distance to the Moon (depending on where the Moon is in its orbit around Earth). So, 15 days to drive around Earth once equates to driving almost 143 days to get to the Moon at 70 miles per hour. (Apollo astronauts traveled at thousands of miles per hour and were able to reach the Moon in about three days.)

4. Ask the class the following questions:
   - How long does it take the Moon to move around the Earth?
   - Why are we able to see the Moon from Earth if it is so far away?
   - Why does the Moon's appearance seem to change shape over time?

     Confirm that it takes the Moon about one month (27.3 days) to make one complete revolution around Earth. We see the Moon because: it is so large; it travels high enough and fast enough to stay in its orbit around Earth; and its surface reflects light from the Sun, but there are times during the month when we cannot see the Moon. The Moon's appearance seems to change due to the location of the Moon in its orbit in relation to the Sun. Emphasize that the Moon itself does not actually change shape. We see a recurring pattern of changes in the portion of sunlight reflected by the Moon, and we refer to these as the phases of the Moon.

5. Tell the students that we see a recurring pattern of Moon phases in the night sky. Draw the following shapes on the board and review their names: Crescent (that reveals a small sliver of light), Half Moon (that we refer to as a Quarter Moon – either first of last quarter), Gibbous (which means "humped"), and Full Moon (that reveals a full reflection of one side of the Moon).
6. Tell the students that they will now engage in an activity that will help them understand how the Moon progresses through these phases, resulting in a total of eight phases.
7. Place the lamp in the middle of the room (with the help of an extension cord) and ask the students to form a circle (or ellipse) around the lamp.
8. Distribute a moon stick to each student. Tell the students that the lamp represents the Sun, their head represents Earth, and the white sphere on the stick represents the Moon.
9. Guide students through the following steps to simulate the eight phases of the Moon:
   1) **New Moon:** Instruct students to face the lamp and extend the sphere directly in front of them, raising the sphere enough so they can also see the lamp. (Remind students not to stare at the light bulb.) This view simulates a New Moon. As students look at their moon, they will see that the sunlight is shining on the far side, opposite their view of their moon. From Earth, the New Moon is not seen.



Source: JPL (Jet Propulsion Laboratory) Education at
http://www.jpl.nasa.gov/education/index.cfm?page=123

      Remind the students that as the face the lamp, if their nose was an observer on Earth, the observer would be experiencing daytime on Earth. The intense brightness of the Sun and the location of the Moon in its new moon phase make the Moon impossible to see during the day. If they could land on the side of the ball (the Moon) that is closest to them in this position, it would be dark. The sunlight side of the ball (the Moon) is the side that is closest to the lamp (Sun). Remind students that the Earth would continue spinning on its axis, so in this orientation, an observer on Earth would not see the Moon during the day or night sky.

   2) **Waxing Crescent:** Keeping their arms extended in front of their bodies, have students turn their body and extended arm counterclockwise about 45 degrees. They should face their balls and observe what they now see. They should see the right-hand edge of the sphere illuminated as a crescent. The crescent starts out very thin and fattens up as the Moon moves farther away from the

Sun (as the student begins to turn in a circle). We say the Moon is waxing because we are seeing more of its surface illuminated. Waxing means becoming greater in amount.

As explained by EarthSky, an award-winning online science resource:

> *The Moon's orbital motion is toward the east. Each day, as the Moon moves another 12 degrees toward the east on the sky's dome, Earth has to rotate a little longer to bring you around to where the Moon is in space. Thus the Moon rises, on average, about 50 minutes later each day. The later and later rising time of the Moon causes our companion world to appear in a different part of the sky at each nightfall for about two weeks. Then, in the couple of weeks after Full Moon, you'll find the moon rising later and later at night.*

3) **First Quarter:** Have students continue turning left so their moon and body are now 90 degrees to the left of their original position. The right half of the white ball should now be illuminated. This phase is called the First Quarter.

First Quarter Moon

4) **Waxing Gibbous:** As students continue to turn, they see more and more illuminated surface.

5) **Full Moon:** When students move their moon so it simulates the Moon being directly opposite the Sun, as viewed from Earth, the half viewed from Earth is fully illuminated. Instruct the students to hold their moon high enough so the "sunlight" is not blocked by their head. Using the background information, explain to the students that the Moon is tilted about 5° in its orbital path around Earth, which is why the Moon is typically visible when the Earth is between the Sun and Moon.

Full Moon

6) **Waning Gibbous:** As students continue to turn, they start to see less and less of the illuminated surface, and while they no longer see a Full Moon, the majority of the Moon is still visible. Emphasize that waning means decreasing or diminishing in size or amount.

7) **Third or Last Quarter:** Keep students turning, with arms extended, so they are now three-quarters of the way around from their original position. This is the Third, or Last, Quarter. They should observe that the left half of the white ball is now illuminated. (This is the opposite side of the First Quarter phase.)

This phase of the Moon occurs around 21 days (3 weeks) after the New Moon phase. The Third Quarter moon will appear around midnight and reach its highest point in the sky around dawn. Ask the students about what time the Moon, in its Third Quarter phase, will set. (If students held the Moon in place and continued to "spin on their axis," they would notice that when they faced the lamp, it would represent noon (an observer located at a student's nose would look directly overhead to see the Sun), and they would notice that the Moon would be at a right angle to their right, which represents the Moon that set in the western sky.)

8) **Waning Crescent:** The continued counterclockwise movement brings a thinning crescent and finally a return to a New Moon. From New Moon to New Moon takes about 29.5 days.

10. Help reinforce student learning by stating names of different phases of the Moon and have students orient themselves correctly to simulate the phase stated.

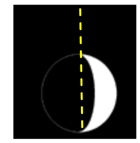
11. Ask the students how long it takes the Moon to complete one orbit (one revolution) around the Earth. Confirm that it takes about 27.3 days, about one month. This is the same amount of time that it takes the Moon to complete one rotation on its axis, which is why we always see the same side of the Moon.

12. Tell the students that on rare occasions, the orientation of the Sun, Earth, and Moon can result in solar and lunar eclipses. Tell students that eclipse is defined as "the partial or complete obscuring, relative to a designated observer, of one celestial body by another." Remind students that eclipses are rare because of the tilt of the Moon's orbital path compared to Earth's orbit around the Sun.

    **Lunar Eclipse:** Ask students to orient themselves in such a way that Earth's shadow totally eclipses a full moon. (Ensure each student's back is facing the lamp (as in moon phase step #5) and that he/she has lowered his/her sphere so that his/her face blocks the light from the ball.) A lunar eclipse can be so slight that it is hard to detect, even with a telescope. At other times, a partial or total eclipse occurs that is easy to see, and everyone on the night side of Earth will be able to see it. Explain that if a lunar eclipse happens, it will only last for a few hours as the Moon continues to travel out of Earth's shadow.

    **Solar Eclipse:** Ask the students to carefully orient themselves in such a way that simulates the Moon eclipsing the light of the Sun. Remind students not to stare directly into the light source. Students will find it helpful to squint their eyes. (Ensure students are facing the lamp with each having his/her sphere blocking part or all of the lamp light and creating a shadow on his/her face.) Part of the Earth is in the Moon's shadow caused by the orientation of the Earth, Moon, and Sun. A solar eclipse can only occur during the day and during the New Moon phase. If a solar eclipse occurs, it will not last long (only a few minutes), and it will <u>not</u> be visible by everyone on the sunny-side of the Earth. Viewers should follow safety procedures for observing a solar eclipse in order to avoid damaging their eyes.

13. Have students return to their seats. Tell the students that a helpful trick to determine whether the Moon is waxing or waning is to imagine drawing a straight line from the bottom, center of the Moon to slightly above the top of the Moon. If the majority of the Moon's illumination is to the right of the imaginary line, it forms the letter "b." Think "birth" and associate this with growing (waxing). If the majority of the illumination is on the left, it forms the letter "d." Think "dying," and associate this shrinking (waning).


This "b" indicates a Waxing Crescent.

14. For review and further explanation, show the following short video clips:
    Phases of the Moon (3 min. 15 sec.):
    http://www.neok12.com/php/watch.php?v=zX5c60455063656c6c595c41&t=Moon

    Eclipse of the Moon (2 min.):
    http://www.neok12.com/php/watch.php?v=zX45704e56606151726a0377&t=Moon

    If further explanation is needed, select one of the Moon or eclipse simulator links listed in the Associated Websites section of this lesson plan.

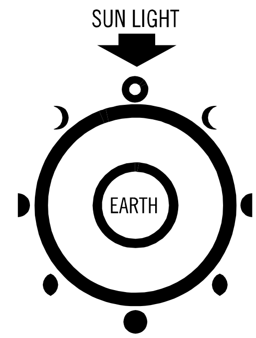
15. (optional) Ask the students to illustrate the phases of the Moon (in order) on a piece of paper (or in a science notebook/journal). Also, have them illustrate and provide a written explanation of solar and lunar eclipses.

**Summarization:**
Review the lesson by asking student volunteers to name and draw the phases of the Moon in order (a different volunteer for each successive Moon phase). Ask the class why lunar and solar eclipses do not often occur. Ask other review questions as appropriate. Remind the students that while they may not pay much attention to the phases of the Moon, the Moon's rotation around the Earth is important. Phases of the Moon may be a factor in scheduling a camping trip. Lunar phases are certainly a consideration for military operations occurring at night. Additionally, the Moon's rotation around Earth helps stabilize our planet in regards to its speed, its slight wobble, and its slight tilt on its axis. The Moon also affects the tides of our oceans, creating low and high tides (with high tides occurring when the Moon is new or full.) Knowing the scientific explanation for the Moon's appearance helps people understand the world around them and the relationship of motion among the Earth, Moon, and Sun.

**Career Connection:** (from http://www.onetonline.org/link/summary/19-2011.00 and http://oceanservice.noaa.gov/facts/oceanographer.html)

<u>Astronomer</u> – The duties of an astronomer include observing, researching, and interpreting astronomical phenomena to increase basic knowledge or apply such information to practical problems. Sample job titles include professor, assistant professor, astronomer, research scientist, and lunar and planetary institute director.

Physical Oceanographer – A physical oceanographer studies the physical conditions and physical processes within the ocean such as waves, currents, eddies, gyres and tides; the transport of sand on and off beaches; coastal erosion; and the interactions of the atmosphere and the ocean. They examine deep currents, the ocean-atmosphere relationship that influences weather and climate, the transmission of light and sound through water, and the ocean's interactions with its boundaries at the sea floor and the coast. Oceanographers must have a keen understanding of biology, chemistry, geology, and physics to unravel the mysteries of the world ocean and to understand processes within it.




**Evaluation:**

- Teacher observation
- Student illustrations as described in step #15 of the Lesson Presentation

**Lesson Enrichment/Extension:**

- Phases Game: Set up - Develop approximately two sets of eight questions regarding the Moon. Make a copy of the sets of questions for each student. Divide students into teams of approximately four members per team. Copy a set of the Moon Phases Cards (shown at the end of this lesson plan) for each team; however, divide the cards into two sets labeled A and B. (The baggie labeled A will have four of the moon phase cards, and the other baggie labeled B will have the remaining four moon phase cards needed to create a complete moon phase cycle.)

  To play – Divide the students into the teams. Distribute the first set of eight questions to each member of each team. Each team member must write the answers to the questions on his/her own paper, and teams may openly discuss answers (but quietly so as not to allow other teams to overhear answers). When a team believes they have the correct answers, a representative from that team should take one worksheet to the teacher to be graded. If all of the answers are correct, the teacher will give the representative Baggie A, along with the second set of eight lunar questions. If all of the answers to the first set of lunar questions are not correct, the teacher marks an "X" on the paper, and the team member must return to his/her team to try make appropriate corrections. (When a representative from that same team tries again, he/she must take a different team member's worksheet that does not have an "X." If a team goes through each team member's worksheet without getting 100% correct, they are no longer in the game.)

  Play continues in the same manner once a team receives the second set of lunar questions. Provided a team gets 100% on at least one team member's worksheet, the team will receive Baggie B (containing the remaining moon phase cards). The first team to place the moon phase pictures in order, beginning with the New Moon, wins.

- Enrich students' understanding of a solar eclipse by following the detailed lesson available at http://www.kidseclipse.com/pages/a1b3c1d1.htm.
- Explore how the Sun and Moon appear to be the same size in the sky by conducting the activity described at http://www.kidseclipse.com/pages/a1b3c2d1.htm.
- Share myths, stories, and historical information concerning eclipses. Visit http://www.kidseclipse.com/pages/a1b3c5d0.htm for this interesting information. Consider asking your students to write a creative story to explain an eclipse.
- Explain the difference between a sidereal and lunar month by showing the animation at http://www.sumanasinc.com/webcontent/animations/content/sidereal.html
- Allow students to play the online game: Lunar Cycle Challenge.
  http://sciencenetlinks.com/interactives/moon/moon_challenge/moon_challenge.html

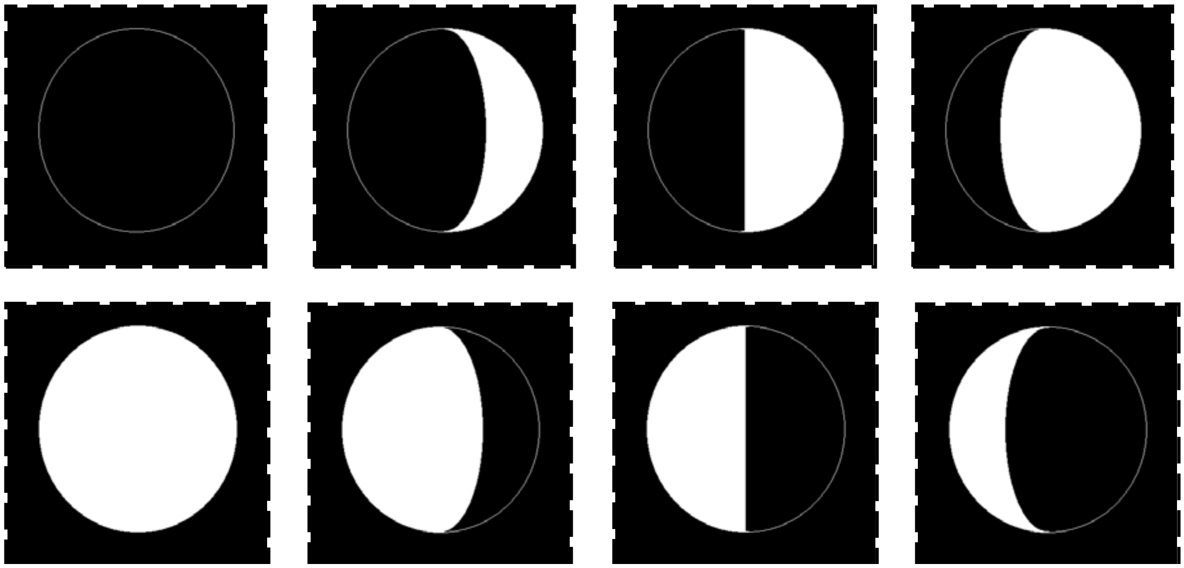
**Associated Websites:**

- Moon Phase Simulators
  http://astro.unl.edu/naap/lps/animations/lps.html
  http://aspire.cosmic-ray.org/labs/moon/lunar_phase3.swf
  http://www.harcourtschool.com/activity/moon_phases/
- Lunar Eclipse Simulator
  http://micro.magnet.fsu.edu/primer/java/scienceopticsu/lunar/index.html
- Moon Phase Video
  http://www.neok12.com/php/watch.php?v=zX6b5c7f0456765261795b6b&t=Moon
- Understanding the moon phases (with links for details regarding each phase)
  http://earthsky.org/moon-phases/understandingmoonphases
- Moon phases song http://www.youtube.com/watch?v=HkvlrWpsnuQ
- Moon Information
  http://www.astronomy.ohio-state.edu/~pogge/Ast161/Unit2/phases.html
  http://science-class.net/Notes/Notes_MoonPhases_7th.htm
  http://science-class.net/Astronomy/MoonPhases.htm (great variety of links)
  http://www.astronomy-for-kids-online.com/themoon.html
  http://www.neok12.com/Moon.htm (links to pictures, games, and videos)
- Sidereal and Lunar Month
  http://starchild.gsfc.nasa.gov/docs/StarChild/questions/question32.html
  http://www.sumanasinc.com/webcontent/animations/content/sidereal.html
- A solar eclipse as seen from the *International Space Station* (29-second video clip)
  http://www.nasa.gov/multimedia/videogallery/index.html?media_id=144197701
- The Moon's orbit and rotation
  http://www.windows2universe.org/the_universe/uts/moon1.html
- Detailed, reader-friendly eclipse information (Moon appears red during total lunar eclipses) http://www.mreclipse.com/Special/LEprimer.html
- Moon and tides: http://home.hiwaay.net/~krcool/Astro/moon/moontides/
- Find moonrise and moonset times each day during a selected month for a selected location http://www.sunrisesunset.com/predefined.asp

- Information about the current position of the Moon for the night sky
  http://earthsky.org/tonight
  http://stardate.org/nightsky/moon (shows monthly calendar)

**Moon Phases Cards**

(a set of 8 cards for Phases Game described in Lesson Enrichment/Extension)



Source: http://solarsystem.nasa.gov/multimedia/gallery/Earth_Heart_01_a.jpg