

Seeing & Explaining Patterns in the Moon's Phases

6th grade post-Sly Park Experience Activity

Content Standards:

- NGSS
MS-ESS1-1 Develop and use a model of the Earth-sun-moon system to describe cyclic pattern of lunar phases

Objectives:

- SWBAT demonstrate a working knowledge of how the moon phases are created.
- SWBAT explain a graphed representation of a lunar phase.

Background Info for Teachers: Info from: moonconnection.com

Looking at the poster (https://www.teachervision.com/tv/printables/concepts/es_transparencies_21.pdf):

Sunlight is shown coming in from the right. The earth, of course, is at the center of the diagram. The moon is shown at 8 key stages during its revolution around the earth. The moon phase name is shown alongside the image. The **dotted line from the earth to the moon represents your line of sight** when looking at the moon. The large moon image shows what you would see at that point in the cycle. For the **waning gibbous, third quarter, and waning crescent phases you have to mentally turn yourself upside down** when imagining the line of sight. When you do this, you'll "see" that the illuminated portion is on your left, just as you see in the large image.

One important thing to notice is that exactly one half of the moon is *always* illuminated by the sun. Of course that is perfectly logical, but you need to visualize it in order to understand the phases. At certain times we see *both* the sunlit portion and the shadowed portion -- and that creates the various moon phase shapes we are all familiar with. Also note that the shadowed part of the moon is invisible to the naked eye; in the diagram above, it is only shown for clarification purposes. Finally, please realize this diagram is only meant to demonstrate how the phases work; the small inner moons in the diagram do not show the fact that the [same side of the moon](#) always faces Earth.

So the basic explanation is that the lunar phases are created by changing angles (relative positions) of the earth, the moon and the sun, as the moon orbits the earth.

If you'd like to examine the phases of the moon more closely, via computer software, you may be interested in this [moon phases calendar software](#).

Moon Phases Simplified

It's probably easiest to understand the moon cycle in this order: new moon and full moon, first quarter and third quarter, and the phases in between.

As shown in the above diagram, the **new moon** occurs when the moon is positioned *between* the earth and sun. The three objects are in approximate alignment (why "approximate" is explained below). The entire illuminated portion of the moon is on the back side of the moon, the half that we cannot see.

At a **full moon**, the earth, moon, and sun are in approximate alignment, just as the new moon, but the moon is on the opposite side of the earth, so the entire sunlit part of the moon is facing us. The shadowed portion is entirely hidden from view.

The **first quarter** and **third quarter** moons (both often called a "**half moon**"), happen when the moon is at a 90 degree angle with respect to the earth and sun. So we are seeing exactly half of the moon illuminated and half in shadow.

Once you understand those four key moon phases, the phases between should be fairly easy to visualize, as the illuminated portion gradually transitions between them.

An easy way to remember and understand those "between" lunar phase names is by breaking out and defining 4 words: crescent, gibbous, waxing, and waning. The word *crescent* refers to the phases where the moon is *less* than half illuminated. The word *gibbous* refers to phases where the moon is *more* than half illuminated. *Waxing* essentially means "growing" or expanding in illumination, and *waning* means "shrinking" or decreasing in illumination.

Thus you can simply combine the two words to create the phase name, as follows:

After the new moon, the sunlit portion is increasing, but less than half, so it is **waxing crescent**. After the first quarter, the sunlit portion is still increasing, but now it is *more* than half, so it is **waxing gibbous**. After the full moon (maximum illumination), the light continually decreases. So the **waning gibbous** phase occurs next. Following the third quarter is the **waning crescent**, which wanes until the light is completely gone -- a new moon.

The Moon's Orbit

[Material deleted] Also, looking at the diagram (and imagining it to scale), you may have wondered why, at a new moon, the moon doesn't block the sun, and at a full moon, why the earth doesn't block sunlight from reaching the moon. The reason is because the moon's orbit about the earth is about 5 degrees off from the earth-sun orbital plane.

However, at special times during the year, the earth, moon, and sun do in fact "line up." When the moon blocks the sun or a part of it, it's called a **solar eclipse**, and it can only happen during the new moon phase. When the earth casts a shadow on the moon, it's called a **lunar eclipse**, and can only happen during the full moon phase. Roughly 4 to 7 eclipses happen in any given year, but most of them minor or "partial" eclipses. Major lunar or solar eclipses are relatively uncommon.

Great Printable/Projectable Poster

https://www.teachervision.com/tv/printables/concepts/es_transparencies_21.pdf

Materials:

- Transparency Poster
https://www.teachervision.com/tv/printables/concepts/es_transparencies_21.pdf
- moon phases flip book (1 copy per student on white card stock +5 more for game)/1 teacher copy with answers
<http://www.pedagonet.com/quickies/MoonPhases.pdf>
- colored pencils/crayons
- protractors or basic knowledge of 180, 135, 90, 45 degree angles
- 8 each: flashlight(sun), tennis ball(earth), ping pong ball (moon) **OR 8 copies of the 1st material poster**

Procedures: [one-two forty minute class periods depending on how many extension activities chosen]

- Begin with a Silent Quiz about the Moon's dance in the night sky...students do not answer aloud the questions on the board, but take a silent inventory of their knowledge. [answers provided for later discussion]
 1. Why do we have cyclical moon patterns? [moon is constantly circling the Earth]
 2. How many crescent moons are in each cycle? [two]
 3. How many quarter moons are in each cycle? [two]
 4. How much [what percentage] of the moon is lit in a crescent moon? A full moon?[always 50% trick question]
 5. Is waxing getting bigger or getting smaller? [bigger]
 6. Is the moon only seen at night? [no, it can be seen in the day as well]
- Teacher demonstrates the use of the flashlight as the sun, the tennis ball as the Earth and the ping pong ball as the moon to create light and shadows to make moon phases. [Remember it is the MOON] that moves while the others remain "still"
- Teacher shows how to follow page 2 in flip book to make a new moon.
- Teacher then divides class into eight groups (or however many sets of supplies exist) in which students will work to place the objects in appropriate relations and draw the moon they see [remember they need to look at the moon from the side of Earth facing the moon] on each page of the flip book. **DO NOT CUT FLIP BOOK YET!!!**
- Students then check their drawings/names of phases with the teacher's [moon phase ID cards are included if students do not already know them]
- [This section can be done another day]Students use protractors (or eyeball the angles) to find congruent angles in various moon phases **RECORD THE ANGLES AS LESS THAN OR EQUAL TO 180 DEGREES FOR EASIER COMPARISON LATER** [180 degrees- full and new moon; 90 degrees- 1st and 3rd quarter; 45 degrees-Waxing crescent and Waning crescent; 135 degrees-waxing gibbous and waning gibbous]
- Students cut the Flip Book and see the moon change over a 29 day cycle.
- **EXTENSION ACTIVITY-GAME:** Tape a page from the flip book on the back of each student. Students roam the classroom and other students give hints as to which phase the other students are. No saying the actual name of the phase!! Clues may be the angle of Sun-Earth-Moon, whether the light is increasing or decreasing. **ADDED CHALLENGE:** Find a complete moon cycle from new to full and line up in order.
- **EXTENSION ACTIVITY-GAME:** Place projector light against the wall facing away from the wall (this is now the sun). The teacher stands in the middle of the room s/he is the Earth. The teacher calls a moon phase and the students (all or a selected group) act as the moon and place themselves in the correct position.
- **EXTENSION ACTIVITY-MATH:** Students complete the graph to see a cycle on represented on a graph (see attached)
- **EXTENSION ACTIVITY-LANGUAGE ARTS-**Write a one-two paragraph explanation on one of the following topics:
 1. Explain why we see a different moon at different times of the month
 2. Explain how a waxing and waning crescent are similar and how they are different.
 3. Explain how a waxing crescent and a waning crescent are similar and how they are different.

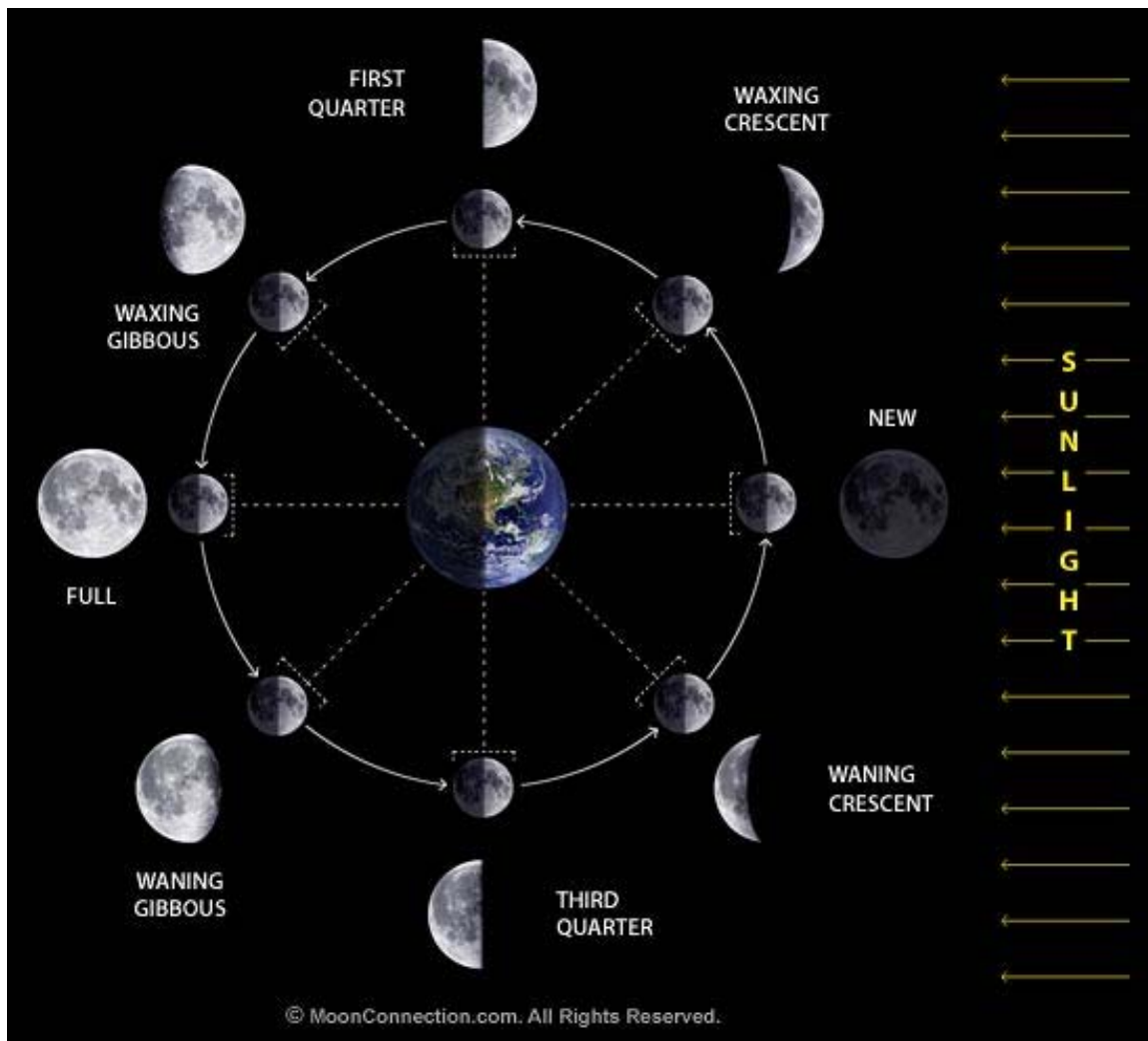
Assessment:

This lesson provides multiple formal and informal assessment opportunities.

The flip-book can be collected and graded or student checked for accuracy.

The extension games provide opportunities for visually seeing who is not catching the concepts.

The Language Arts writing assignment provides a formal process for determining if the students grasp the concepts well enough to explain.



Lunar Phase Graph

180									
135									
90									
45									
0									
	New	Waxing crescent	First Quarter	Waxing Gibbous	Full	Waning Gibbous	Last Quarter	Waning Crescent	New

Moon Phase ID cards on next two pages



New Moon



Waxing Crescent



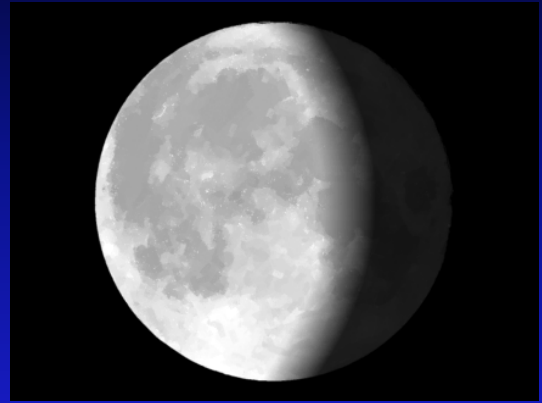
First Quarter



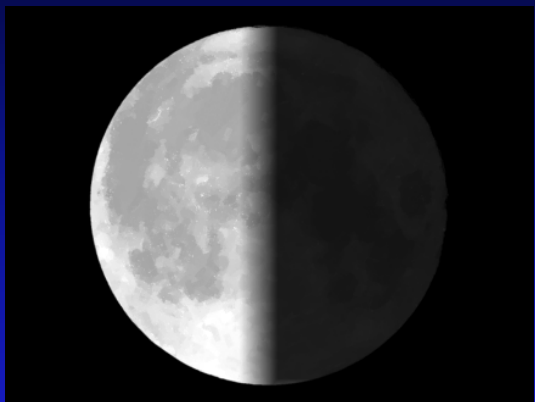
Waxing Gibbous



Full Moon



Waning Gibbous



Last Quarter



Waning Crescent