NASA Spotlite Interactive Lesson

Moon Phases and Shadows
Grades 4-8

Teacher Packet

NASA Spotlite Interactive Lesson Guide

This NASA eClips™ Spotlite Interactive Lesson supports existing curriculum and should be used as one of many strategies to build students' understandings of science content. The goal of this 5E lesson is to correct the science misconception. Through watching a student-produced video (Engage), completing activities (Explore), learning new vocabulary collectively using a Frayer Model (Explain), and applying new information (Extend/Elaborate), students will develop an understanding of the science content and how to correct the science misconception.

This PDF document should be downloaded to use the interactive features. The hyperlinks included in this document open PDFs or webpages and may perform differently based on the device being used. Links may have to be cut and pasted into a web browser to open.

Try using Adobe Acrobat Reader and Flash Player for optimal performance of all interactive features included in this guide.

What are NASA Spotlites?

NASA Spotlites are 90-120 second student-produced video segments that address common science misconceptions as determined by reputable assessment sources such as the National Assessment of Educational Progress (NAEP), National Science Foundation (NSF) Factual Knowledge Questions, and the Misconceptions-Oriented Standards-based Assessment Resources for Teachers (MOSART).

NASA Spotlites are designed to increase scientific literacy in a standards-based classroom. By producing Spotlite videos, students gain production experience, as well as deepen their understanding of science content. Approved NASA Spotlites can be found at the NASA eClips website. https://nasaeclips.arc.nasa.gov/

Animated 5E Instructional Model

5E Model

The 5E instructional model consists of five stages for teaching and learning: Engage, Explore, Explain, Elaborate (or Extend), and Evaluate.

NASA eClips™ Guides use the 5E constructivist model developed by Roger Bybee. Constructivism is an educational philosophy that promotes student-centered learning where, students build their own understanding of new ideas. The 5E instructional model consists of five stages for teaching and learning: Engage, Explore, Explain, Extend (or Elaborate), and Evaluate.

Lesson Information

Science Misconception
The phases of the Moon are caused by shadows cast on its surface by other objects in the solar system.

Standards
Next Generation Science Standards
5-PS1-3: Make observations and measurements to MS-ESS1-1
Earth's Place in the Universe
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.
ESS1 - 1 Earth's Place in the Universe
Use observations of the Sun, Moon, and stars to describe patterns that can be predicted.
ESS1.A: The Universe and Its Stars
Patterns of the apparent motion of the Sun, the Moon, and stars in the sky can be observed, described, predicted, and explained with models.

Objective
In this lesson, students will correct the common misconception that moon phases are caused when shadows are cast on the Moon by other objects. They will learn new vocabulary to develop their understanding of this scientific concept, and apply this vocabulary to explain how moon phases are caused by the Moon orbiting Earth.

Time Frame
Between two and three 45-minute class periods:
Day 1 - Engage and Explore
Day 2 - Explain and Elaborate/Extend
Day 3 – Evaluate

Safety
Review digital citizenship before students use online resources.

Materials
Assessments
Per student: copy of pretest and posttest

Frayer Model Activity
•Per small group: copy of a digital Frayer Model (alternatively, this can be printed)
•Per classroom: chart paper for posting final vocabulary definitions

Background Information
o We see the Moon because the Moon's surface reflects the Sun's light.
o During the course of a month, the Moon orbits (makes a revolution) once around Earth.
o The half of the Moon facing the Sun is always lit and the half of the Moon facing away from the Sun is dark.
o Moon phases are a result of seeing different portions of the side of the Moon lit by the Sun.

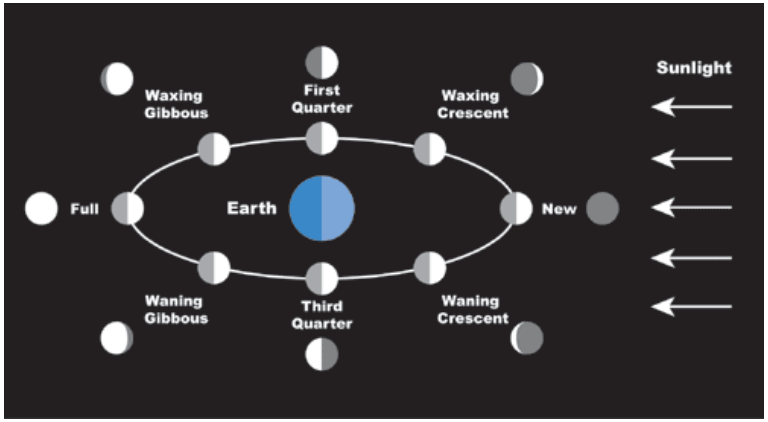


Image credit: spaceplace.nasa.gov

Lesson Information

- As the Moon orbits around Earth, the amount of the sunlit side that we see changes. Seeing different fractions of the Moon's sunlit half creates the phases of the Moon.

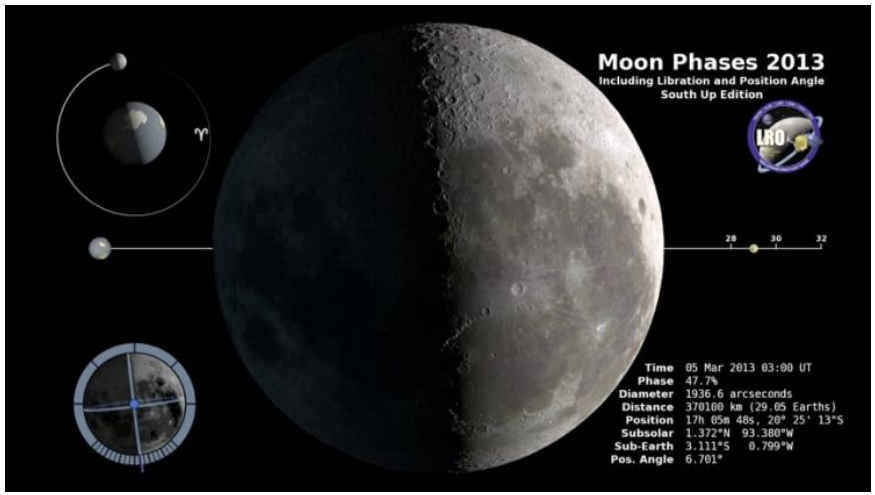


Image credit: https://svs.gsfc.nasa.gov/4118

- Each of the distinct eight moon phases has its own name. In the course of approximately one month, the Moon will move through all eight phases before the pattern begins again.
- When the Moon and Sun are on opposite sides of Earth, we see the side of the Moon that is completely illuminated. We call this a full moon. When the Moon and Sun are on the same side of Earth, we see the side of the Moon that is not illuminated. We call this a new moon.
- As the Moon revolves around Earth, we have different perspectives of the sunlit portion of the Moon. Moving from the new to the full moon, we begin to see a small portion of the Moon's sunlit half, forming what we know as a crescent moon. As we see increasing amounts of the lit portion, we say the phase is waxing. When the Moon is one-quarter of the way through its cycle, we see half of the sunlit side of the Moon, or its first quarter phase. As the Moon continues to wax (we see more of the sunlit portion) a gibbous moon is formed. Once we see the entire sunlit portion of the Moon from Earth, we are back to seeing a full moon.
- After seeing the full moon, this cycle of phases then repeats itself but in reverse. We begin to see slightly less of the sunlit side of the Moon. This is described as waning. Observers from Earth will see a gibbous moon (that looks something like a football), then the last or third quarter moon, a crescent or sliver of a moon, and then finally the entire dark side of the Moon (the new moon).

Target Vocabulary

moon phase, revolve, revolution, waxing, waning, new moon, crescent, first quarter, gibbous, full moon, pattern

Remind students to save responses.
Suggested steps:
Under "file" choose "save as."
Type your name in front of the document name.
Choose "save."

This icon identifies the suggested directions and information to read to students.

Engage

Pre-Assessment

Probe for students' prior knowledge using the pre-assessments.

1. Pretest items are located on page 12. Student packets contain a pretest.
2. Essential question.
3. Discussion questions below.

Essential Question

What causes the phases of the moon?

Today's Lesson

In today's lesson you will learn about the phases of Earth's Moon. Using interactive Frayer Models, you will learn key vocabulary that will help you form a clearer understanding of what causes the Moon's phases.

What do you already know about the phases of Earth's moon?

True or False: The phases of the Moon are caused by shadows cast on its surface by other objects in the solar system.

Select the best choice.
This statement is TRUE.
This statement is FALSE.

Spotlite Video

Next, you will watch a short video on what causes the phases of the Moon. As you watch the video, pay close attention to any new vocabulary.
(Example vocabulary: moon phase, revolve or revolution, waxing, waning, pattern, shadow, reflection)

NASA Spotlite: Moon Phases and Shadows

Video Links - NASA Spotlite: Moon Phases and Shadows
NASA eClips™ Website - https://nasaeclips.arc.nasa.gov
NASA eClips™ YouTube - https://youtu.be/_5AG2dFxe4s

Explore

Class Discussion
Use the questions to lead the class in a discussion.

1. What causes the Moon to shine?
2. Why does the Moon look like it is changing its shape?
3. What causes the phases of the Moon?

Explore Activity

Visit the Moon interactive at Moon.NASA.gov. From the tools menu, select phases.

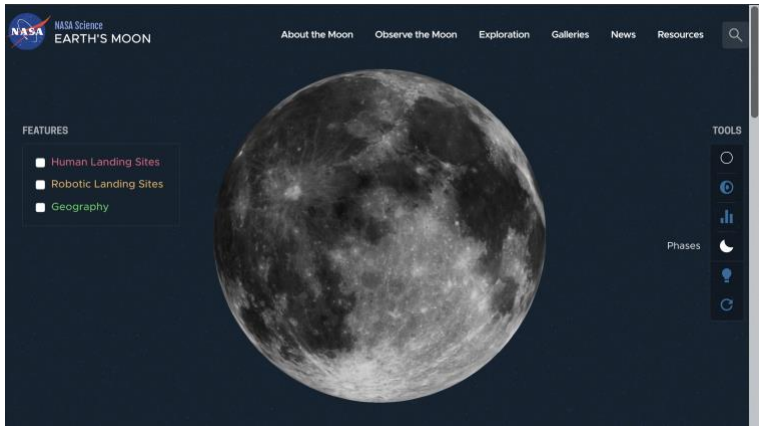


Image credit: Moon.NASA.gov

A slider bar will appear.

Select today's date. What phase is it today?

What phase was it 2 days ago?

What phase will it be a week from today?

How would you describe the pattern you see in the changing moon phases?

As you move the slider to the new moon, is the Moon still visible?

Explore

Think-Pair-Share

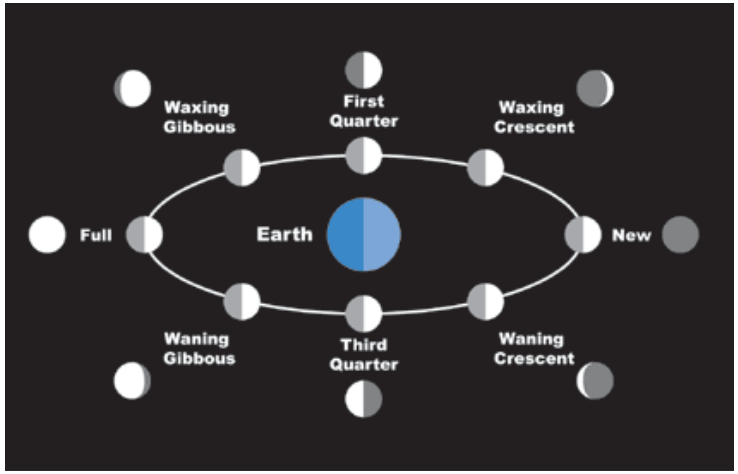


Image credit: spaceplace.nasa.gov

In this image of the phases of the Moon, where is the Sun?

Let's compare your answers!

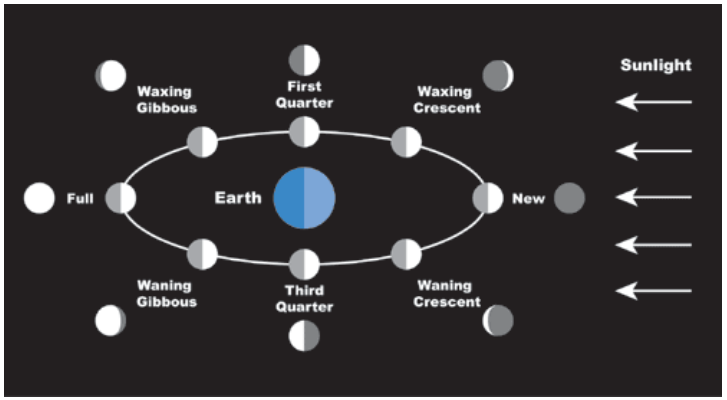


Image credit: spaceplace.nasa.gov

Explain

Vocabulary Development

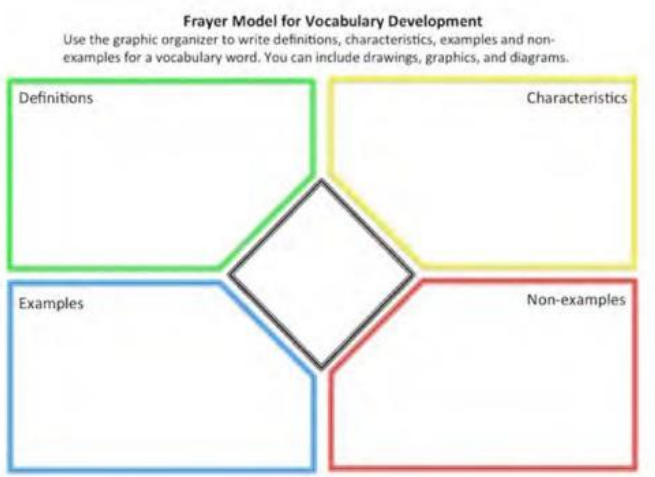
As a class, use the Frayer Model to help students develop a conceptual understanding of key vocabulary.

1. Place the word "orbit" in the center of the graphic organizer. (See page 12 for a fillable Frayer Model. Student packets contain a fillable Frayer Model.) Facilitate a discussion with students exploring why this word is key vocabulary to this study.
2. Ask students to brainstorm characteristics of "orbit" and add responses to the area with the corresponding heading on the graphic organizer.
3. Ask students to continue their exploration as they research the topic using a variety of resources including their textbook and notes.
4. Next, ask students to add examples and non-examples in the Frayer Model. Emphasize the higher-level thinking skill of comparing and contrasting.

How are the examples alike/different than the non-examples?

5. Using the information provided, ask students to develop their own definition of the word "orbit" that is clear and concise. An example is in the Answer Key section of this document (page 16).
6. After completing the example together, assign a new vocabulary word to each group of students to work on collaboratively.

Now complete a new Frayer Model with a partner. Select one word from the key vocabulary list and fill in the graphic organizer. We will share some as a class.

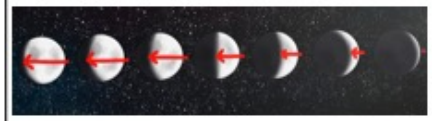
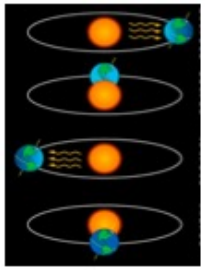
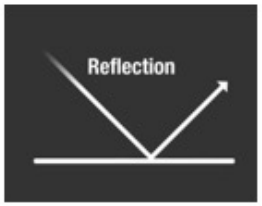


7. Groups will share their Frayer Models and lead discussions to check for understanding of each vocabulary word. Refer to definitions in the Answer Key (page 9).
8. Compile and post final definitions so all students have access for later reference.

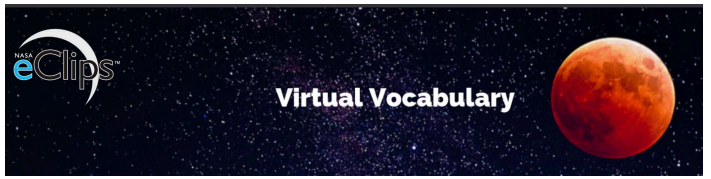
You will review key vocabulary. Pay attention to how your definitions compare to standard definitions.

Explain

Vocabulary Words

Word	Definition	Word	Definition
MOON PHASE 	The phase of the Moon is how much of the sunlit side of the Moon that we see from our perspective on Earth.	**PATTERN** 	A pattern is a repeated design or recurring sequence.
WANING 	Waning is an adjective that means "decreasing," as in a "waning crescent moon."	**WAXING** 	Waxing is an adjective that means "increasing," as in a "waxing crescent moon."
REVOLVE 	To revolve is to circle around something or move in an orbit.	**REFLECTION** 	Reflection is the bouncing of light waves (or sound -- echo) off a surface.

Visit the NASA eClips™ Virtual Vocabulary for more definitions.



Elaborate/Extend

Elaborate/Extend Activity

What is causing the moon phase shown in this picture?

This picture shows the Moon rising over a ridge in the Wasatch Mountains, Utah.

Image credit: Solarsystem.NASA.gov

Evaluate

Post-Assessment

Check students' understanding with these activities.

Identify Misconception

What is a common misconception people have about moon phases and how can you correct this misconception?

Discussion Questions

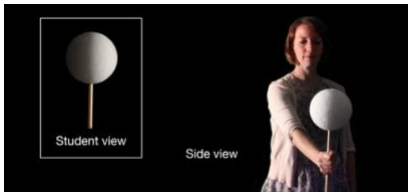
1. What causes the Moon to shine?
2. Why does the Moon look like it is changing its shape?
3. What causes the phases of the Moon?

Carefully re-watch the NASA Spotlite video about the Moon to assess your understanding of moon phases.

Video Links - NASA Spotlite: Moon Phases and Shadows
NASA eClips™ Website - https://nasaeclips.arc.nasa.gov
NASA eClips™ YouTube - https://youtu.be/_5AG2dFxe4s

Vocabulary Review

Look at each picture. Name each moon phase.



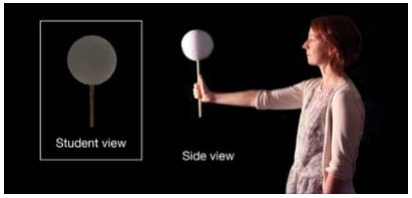
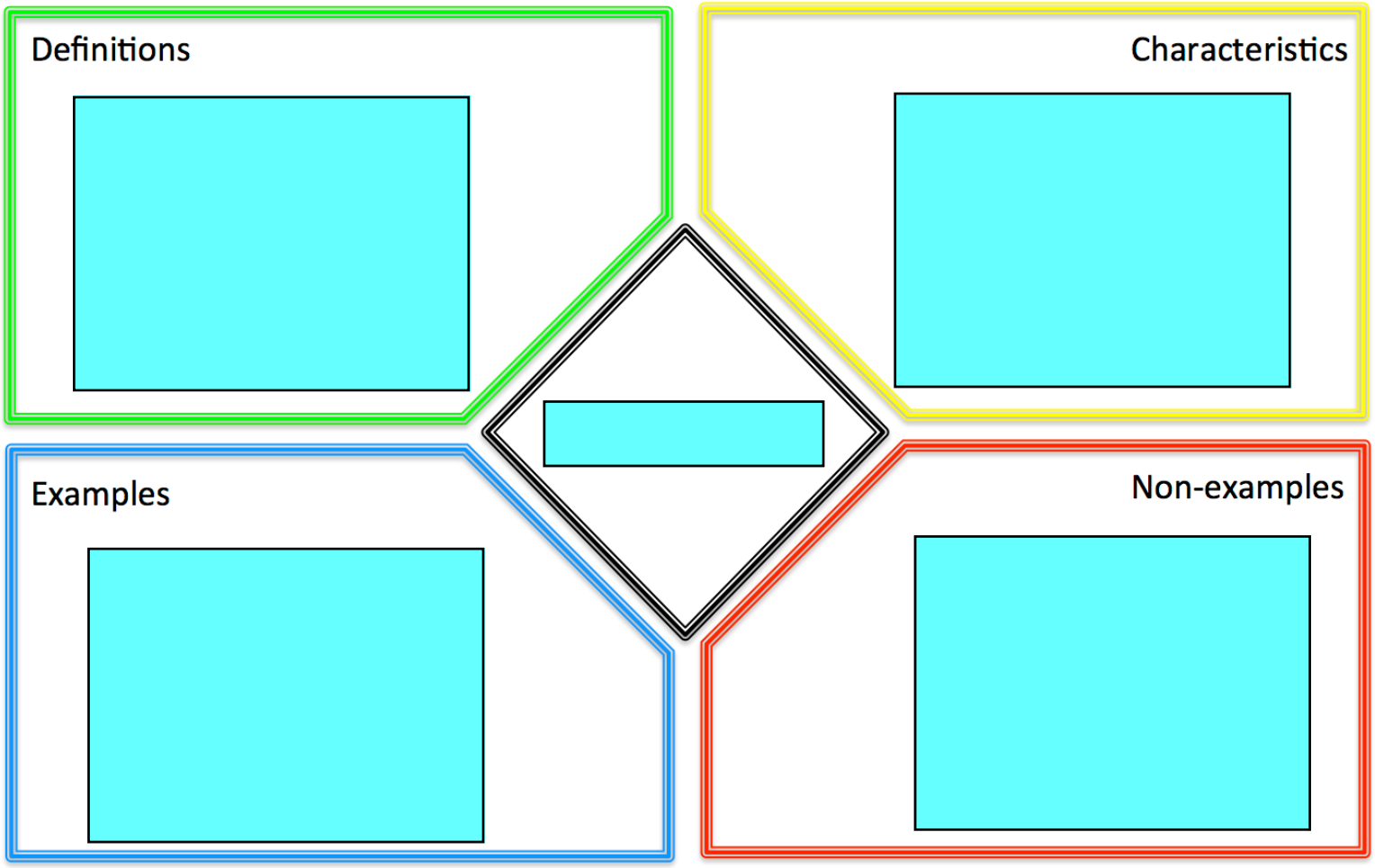


Image credit: JPL.NASA.gov

Resources

Frayer Model for Vocabulary Development

Use the graphic organizer to write definitions, characteristics, examples and non-examples for a vocabulary word. You can include drawings, graphics, and diagrams.



Resources

Moon Phases and Shadows Grades 4-8 Pretest / Posttest NASA Spotlite Interactive Lesson

Read each question and select the best choice.

1. Which of the following does NOT play a part in creating moon phases?

Select the best answer.

A. Looking at the Moon from Earth.
B. The revolution of the Moon around Earth.
C. Shadows cast on the Moon's surface by objects in the solar system.
D. Sunlight reflecting off the surface of the Moon.

Image credit: SVS.GSFC.NASA.gov

2. A new moon occurs when

Select the best answer.

A. the portion of the Moon seen from Earth is completely illuminated.
B. the portion of the Moon seen from Earth is not illuminated.
C. one half of the Moon seen from Earth is illuminated.
D. the portion of Earth seen from the Moon is completely illuminated.

3.When the illuminated portion of the Moon seen from Earth is getting larger, the Moon is said to be

Select the best answer.

A. waxing
B. a first quarter
C. a new moon
D. waning

4. The eight distinct stages in the Moon's cycle are called.

Select the best answer.

A. waxing crescents
B. full moons
C. illuminations
D. phases

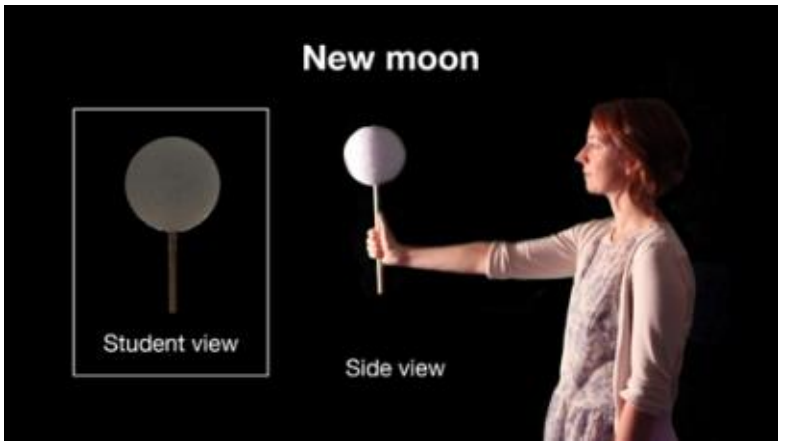
5. Which of the following is a correct statement describing moon phases?

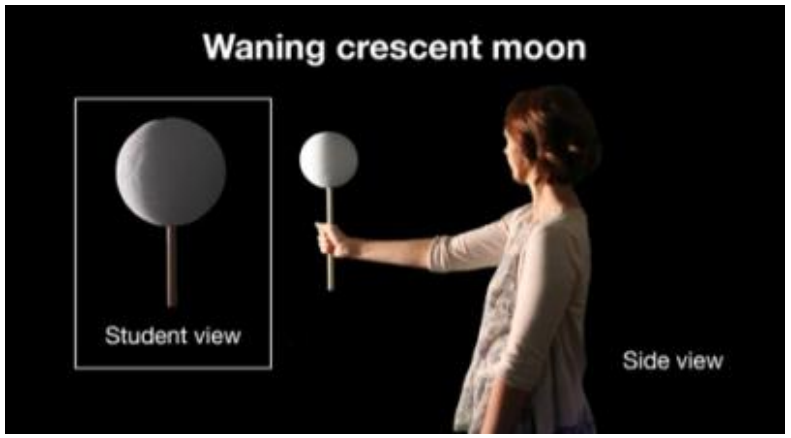
Select the best answer.

A. Moon's cycle of phases takes about 27.32 days.
B. There are 12 distinct moon phases.
C. Less than half the Moon is visible in a gibbous phase.
D. Moon's complete phase cycle takes 8 days.

Answer Key


First quarter moon
Student view
Side view


New moon
Student view
Side view


Waning crescent moon
Student view
Side view


Waxing gibbous moon
Student view
Side view

Answer Key

Moon Phases Grades 4-8 Pretest / Posttest

NASA Spotlite Interactive Lesson

Read each question and select the best choice.

1. Which of the following does NOT play a part in creating moon phases?

A. Looking at the Moon from Earth.
B. The revolution of the Moon around Earth.
C. **Shadows cast on the Moon's surface by objects in the solar system. ****
D. Sunlight reflecting off the surface of the Moon.

2. A new moon occurs when

A. the portion of the Moon seen from Earth is completely illuminated.
B. **the portion of the Moon seen from Earth is not illuminated.****
C. one half of the Moon seen from Earth is illuminated.
D. the portion of Earth seen from the Moon is completely illuminated.

3. When the illuminated portion of the Moon seen from Earth is getting larger, the Moon is said to be

A. **waxing.****
B. a first quarter.
C. a new moon.
D. waning.

Image credit: SVS.GSFC.NASA.gov

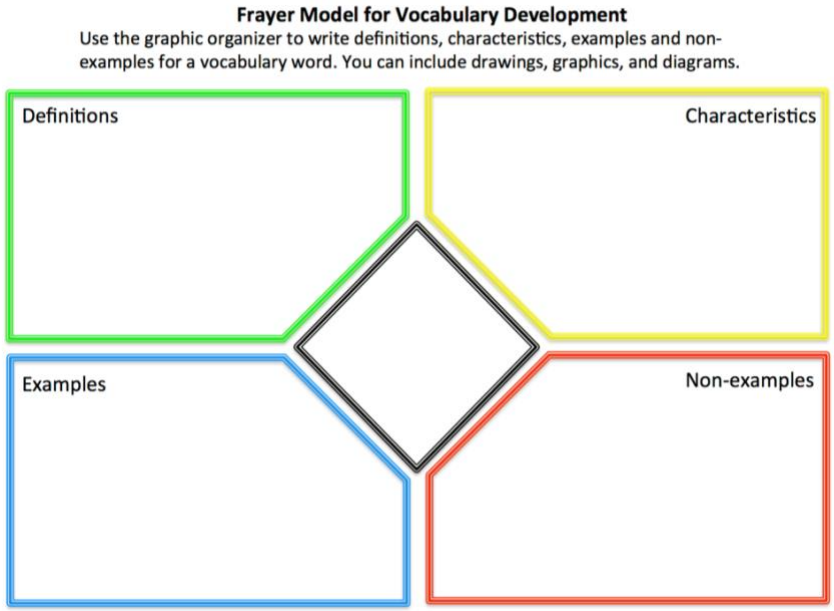
4. The eight distinct stages in the Moon's cycle are called.

A. waxing crescents.
B. full moons.
C. illuminations.
D. **phases.****

5. Which of the following is a correct statement describing moon phases?

A. **Moon's cycle of phases takes about 27.32 days. ****
B. There are 12 distinct moon phases.
C. A gibbous moon phase occurs when less than half of the Moon visible from Earth is illuminated.
D. The Moon moves through its complete cycle of phases in 8 days

Answer Key



Vocabulary Word
Orbit

Characteristics
circular or elliptical, path

Examples
Earth travels around the Sun
planets travel a path around the Sun

Non-examples
Rotation
Spinning
Parallel
straight path

Definition
The circular or elliptical, path an object takes around another object.

Product Information

Image Credit

Female teacher - https://www.careerindia.com/img/2018/06/education-3420037-1920-1528192194.png
Male teacher - https://i.graphicmama.com/blog/wp-content/uploads/2017/01/27100054/afro-american-teacher.jpg
moon phase - NASA SVS https://svs.gsfc.nasa.gov/4118
waning - NASA SVS https://svs.gsfc.nasa.gov/4118
revolve - NASA Space Place https://spaceplace.nasa.gov/seasons/en/ pattern - NASA Space Place https://spaceplace.nasa.gov/seasons/en/ waxing - www.wikihow.com
reflection - NASA https://science.nasa.gov/ems/03_behaviors

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