

Phases of the Moon Lab

 HTML Content

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This is a detailed outline of the moon phase lab. The text in italics represents audio clips that will be recorded as WAV files. The [] text indicates the name of the audio, image, video resource, or other notes to the developers.

Educational objectives of this lab

At the end of this lab, students will be able to:

- Describe how the appearance of the moon changes over the month for everyone on Earth.
- Explain how lunar phases and the sequence they follow are created.
- Match the names of the phases of the moon with their appearance
- Identify the orbital configurations that are associated with specific phases
- Explain the times when someone can view each moon phase based on its visibility from different locations on earth

The lab begins below ...

Introduction

This section will likely be done in a slightly different format - but it will just be the students viewing a video presentation.

- Video *On behalf of the CyberAR development team at Middle Tennessee State University, I'd like to welcome you to the Magic Classroom. In today's lab, we will be exploring moon phases. At the end of this lab, students will be able to: -Describe how the appearance of the moon changes during its monthly cycle. - Name lunar phases by their appearance. - Place lunar phases in order based on their appearance and their names. - Understand the relative sizes and scales of the Earth-Moon system. - Identify the orbital configurations that are associated with specific phases. - Explain when we can view each moon phase based on its location in its orbit and where this phase is visible from Earth.*

Let's get started!

- Video *When you look up at the moon, you are seeing a celestial body that is about 2000 miles in diameter and located about 240,000 miles away. Both the moon and the Earth are basically spherically shaped objects. At first, moon phases might seem confusing. However, there is a predictable sequence for moon*

phases that is caused by its orbit around the earth.

Exercise 1 - Names of Moon phases

- Media presentation with multiple choice questions
 - We will show a picture of the phase, go through a audio description, and then ask the student to identify the phase from a list of multiple choice options. [e1-c1] *We will now do a short exercise to help you learn the names of the lunar phases that we observe from earth. I will show you a picture of some lunar phases and ask you to identify them. Don't worry if you get them wrong! You will get another chance to identify them later in the lab.*
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- **Full Moon**

[e1-c2] *In this picture, the visible disk of the moon appears to be completely illuminated by sunlight. What is the name of this phase?*

[e1-c3] *Good job! This is a picture of the full moon. Sunlight covers the visible surface of the moon. The visible surface is the part of the moon that can be seen from Earth.*

[e1-c4] *Good try! However, this is a picture of the full moon. Sunlight covers the visible surface of the moon.*

- **Waxing Gibbous**

[e1-c5] *This picture was taken about 3 days after the full moon. You can see a dark crescent appearing on the right side of the disk. What is the name of this phase of the moon?*

[e1-c6] *Excellent! This picture shows the moon in its "Waning Gibbous" phase. The word "Waning" refers to the moon shrinking. Portion of the moon that is illuminated by sunlight has decreased since the moon was full. Gibbous refers to the phase of the moon that is closest to full. Notice there is a dividing line between the light and dark parts of the moon. This line is known as "the terminator."*

[e1-c7] *Sorry - that's not right answer. This was a tough one. This picture shows the moon in its "Waning Gibbous" phase. The word "Waning" refers to the moon shrinking. Portion of the moon that is illuminated by sunlight has decreased since the moon was full. Gibbous refers to the phase of the moon that is closest to full. Notice there is a dividing line between the light and dark parts of the moon. This line is known as "the terminator."*

- **3rd Quarter**

[e1-c8] *This picture shows how the moon appears about 7 days after the full moon. Notice that the left half of the moon is illuminated, and the right half is dark. What's the name of this lunar phase?*

[e1-c9] *Nice job! Even though half the moon is appears to be illuminated, this phase is known as the "Third Quarter." The name refers to the moon having completed 3/4 of its orbit since the New Moon. Notice that going from full moon to 3rd quarter took about a week. This is about 1/4 of the length of the moon's orbit. The terminator cuts right through the center of the moon's disk during a quarter moon phase.*

[e1-c10] *You got this one wrong, but it is tricky. This is a picture of a Third Quarter Moon. This name of this phase is confusing because it refers to the moon having completed 3/4 of its orbit since the New Moon. Notice that going from full moon to 3rd quarter took about a week. This is about 1/4 of the length of the moon's orbit. The terminator cuts right through the center of the moon's disk during a quarter*

moon phase.

- **Waning Crescent**

[e1-c11] *This picture shows the moon about 10 days after the full moon. A tiny sliver of light on the left side is illuminated. Most of the visible surface of the moon is dark - although you might be able to see dimly light craters and mountains beyond the shadow. What's the name of this phase of the moon?*

[e1-c12] *Fantastic! This is the waning crescent phase. The phase is waning because the fraction of the moon lit by the sun has decreased since the third quarter phase. We call it a crescent because it is crescent shaped. After the full moon, the amount of the surface that we observe being lit by the sun decreases for about two weeks.*

[e1-c13] *Good try! However, this phase is known as the waning crescent phase. The phase is waning because the part of the moon lit by the sun has decreased since the third quarter phase. We call it a crescent because it is crescent shaped. After the full moon, the amount of the surface that we observe being lit by the sun decreases for about two weeks.*

- **New Moon**

[e1-c14] *In this picture, you can barely see the moon. The image was taken about two weeks after full moon and about one week after the 3rd quarter. There is only a faint bit of light on the visible surface of the moon. What's the name of this moon phase?*

[e1-c15] *Correct! This is the new moon. The entire visible surface of the moon is dark. The only reason we can see anything is because of something we call "earth glow." Light from the Sun is reflected off the earth and then illuminates the moon. Notice that we have gone from visible surface of the moon being completely illuminated to completely dark in two weeks. After the new moon phase, the portion of the moon that is lit grows larger over the next two weeks. We call the phases when the moon's surface is getting brighter the "waxing phases."*

[e1-c16] *This is the new moon. The entire visible surface of the moon is dark. The only reason we can see anything is because of something we call "earth glow." Light from the Sun is reflected off the earth and then illuminates the moon. Notice that we have gone from visible surface of the moon being completely illuminated to completely dark in two weeks. After the new moon phase, the portion of the moon that is lit grows larger over the next two weeks. We call the phases when the moon's surface is getting brighter the "waxing phases."*

- **Waxing Crescent**

[e1-c17] *In this picture, you can see a sliver of light on the right side of the moon. The picture was taken about 3 days after the new moon or about 17 days after the full moon. What's the name of this lunar phase?*

[e1-c18] *Good job! This is the waxing crescent phase. Notice again the right side of the moon is illuminated. This is the crescent phase right after the new moon. All the waxing phases are after the new moon and before the full moon.*

[e1-c19] *This is the waxing crescent phase. Notice again the right side of the moon is illuminated. This is the crescent phase right after the new moon. All the waxing phases are after the new moon and before the full moon.*

- **First Quarter**

In this image, you can see that the right half of the moon is illuminated. This picture was taken seven

in this image, you can see that the right half of the moon is illuminated. This picture was taken seven days after the new moon or about 21 days after the full moon. What is the name of this lunar phase? Correct. This is the first quarter moon. Even though half of the moon is illuminated, the moon has just completed the first quarter of its orbit as measured from the new moon. Notice the right hand side of the moon is illuminated. During the third quarter moon, the left hand side was illuminated. This is the first quarter moon. Even though half of the moon is illuminated, the moon has just completed the first quarter of its orbit as measured from the new moon. Notice the right hand side of the moon is illuminated. During the third quarter moon, the left hand side was illuminated.

- **Waxing Gibbous**

This image shows the moon is almost full. The picture was taken about 23 days after the full moon or about 11 days after the new moon. The shadow is on the left hand side of the disk. What is the name of this moon phase?

Good! This picture shows the moon in its “Waxing Gibbous” phase. This is the phase right after the first quarter moon. Portion of the moon that is illuminated by sunlight is increasing and the moon is almost full. Notice the terminator and the shadow are on the left hand side of the disk. This is backwards from the waning gibbous moon.

Sorry, but this picture shows the moon in its “Waxing Gibbous” phase. This is the phase right after the first quarter moon. Portion of the moon that is illuminated by sunlight is increasing and the moon is almost full. Notice the terminator and the shadow are on the left hand side of the disk. This is backwards from the waning gibbous moon. ...

Exercise 2 - matching moon phase pictures and their names + sequences

- A 2d sorting and matching exercise - place the picture and the label in the right box. This could be done on a table or on a virtual whiteboard. *Let’s try an exercise to see if you can remember the sequence of lunar phases. Put the pictures and names into the correct sequence on the board. The far left side will be the Full moon, and the far right side will be the next full moon. Put the pictures and names into the correct order. **Some instructions in how this is mechanically done is needed. Will students use their controller or their hands to move things around?***

Nice job! You got everything correct!

The words and images marked with a red border aren’t in the correct location.

Try moving them around until you get the right answer!

Exercise 3 - The scale of the Earth moon system - users determine how big the moon is relative to a scale earth and place it at the correct scaled orbital distance - multiple choice questions about likelihood of eclipses

- This exercise involves two interactions. 1) Pick the correct size for the moon relative to the earth. 2) Place the moon at the correct relative orbital distance.

Before we explore why moon phases occur, let’s explore the size and scale of the Earth-Moon system.

Hovering over your table is a model of the planet Earth (rotating textured sphere about 3 inches in diameter perhaps 12 inches above the table). Above the Earth, there are several different sized models of the moon. Select the correct model for the moon. Some of the examples might be too big or too small -

the moon. Select the correct model for the moon. Some of the examples might be too big or too small. *That's too big! - That's too small! - That's the correct size! The moon is about 1/4 the size of the Earth, - so it is pretty small in this model. Many of the diagrams of moon phases - you see in your book make it seem like the moon is a lot bigger!*

Ok - now move the moon about the right distance from the Sun. The green markers floating in a line should help you place the moon in the right location. - That's a too far from the Earth! - That's looking better, but move it a bit closer! - That's too close to the Earth. Move the moon further away. - That's still too close to the Earth! Try again. - This is the actual location of the moon in this model. [move the model]

As you can see, the moon is both tiny and far away from the earth. In many models to explain moon phases, it helps to make the moon larger and move it a lot closer to the Earth. We will be doing that in this lab, so remember this is what the Earth moon system would actually look like.

Exercise 4 - Understanding moon phases

This is audio + 3d sphere demo to help students understand lighting on a sphere. [A virtual beach ball is about 2 ft above the table and directional light is setup to the side of the room. The lighting source is marked with a Sun textured spherical shape.] *To understand moon phases a bit better, let's examine something that is a little simpler - this beach ball. The beach ball in front of you is lit by light coming from a single direction - specifically from the Sun. Move yourself so you are on the side of the beach ball by the Sun. The green cube will help you find the correct location. [A green cube appears in the location where the students need to move. The system waits until the students move to that area.] Notice that you are seeing the side of the beach ball that is fully illuminated. It is similar to the full moon. Now move your position so that you that the Sun, beachball and you make a 90 degree angle. The green cube will help you find the correct location. [A green cube moves or appears at 90 degrees about 5 ft way. The system waits for the students to move to the right location.] When you look at the beach ball, you can see that half of it appears illuminated. It looks like the third quarter moon. Notice that the light and the ball haven't changed. You have changed your perspective so you see the beach ball from a different perspective. [pause] Moon phases occur because we are observing a spherical object that is illuminated by sunlight. As the moon orbits around the earth, we see it from different angles.*

Exercise 5 - associate phases with specific geometries.

[The Sun, Earth, Moon system appears on the table. The moon and Earth are not to scale. There may be snap-to points for the moon, and the orbit of the moon might be shown. Pictures of the phases will be shown somewhere to help the students do the matches.] *Let's put this all together. You can now see the Sun, Earth, and Moon system. The orbit of the moon is also visible. Along the orbit, you can see eight point that indicate the positions of each of the main lunar phases. Your job is to place the moon in the right location based on the phase. You can move the moon with your hand or with the controller. Right now, the moon is in the location of the New Moon.*

- [Waxing Crescent image] *Move the moon so it is the correct location for the Waxing Crescent. You can see the shadow of the moon to help you find the right location*
[PING!] *Good job! Notice angle between the Moon and the Sun is small - about 45 degrees.*
Audio feedback for right and wrong positions.
- [First Quarter image] *Move the moon so it is in its First Quarter phase. Use the image and the shadow on the Moon to help guide you to the correct location.*
[PING!] *Good job! Notice angle between the Moon and the Sun is about 90 degrees. This is why half of the Moon is illuminated.*
Audio feedback for right and wrong positions.
- [Waxing Gibbous image] *Move the moon so it is in its Waxing Gibbous phase. Use the image and the shadow on the Moon to help guide you to the correct location.*
[PING!] *Good job! Notice angle between the Moon and the Sun is about 135 degrees.*
Audio feedback for right and wrong positions.
- [Full Moon image] *Move the moon so it is in the location of the Full Moon. Use the image and the shadow on the Moon to help guide you to the correct location.*
[PING!] *Good job! Notice the alignment between the Sun, Earth and Moon. Remember - the actual sizes and distances of the Earth and Moon are much different than in this representation. The Moon rarely passes through the Earth's shadow.*
Audio feedback for right and wrong positions.
- [Waning Gibbous image] *Move the moon so it is in its Waning Gibbous phase. Use the image and the shadow on the Moon to help guide you to the correct location.*
[PING!] *Good job! Notice angle between the Moon and the Sun is about 135 degrees. It is the same angle as the Waxing Gibbous phase, but on the opposite side of the orbit.*
Audio feedback for right and wrong positions.
- [Third Quarter image] *Move the moon so it is in its Third Quarter phase. Use the image and the shadow on the Moon to help guide you to the correct location.*
[PING!] *Good job! Notice angle between the Moon and the Sun is about 90 degrees. Just like with the First Quarter, the Sun, Earth and Moon form a 90 degree angle. The shadow is on the opposite side of the moon because it is on the opposite side of its orbit.*
Audio feedback for right and wrong positions.
- [Waning Crescent image] *Move the moon so it is the correct location for the Waning Crescent. You can see the shadow of the moon to help you find the right location*
[PING!] *Good job! Notice angle between the Moon and the Sun is small - about 45 degrees. It is very close to the New Moon phase.*
Audio feedback for right and wrong positions.

Exercise 6

[At this point, we will repeat this exercise in random order to re-help students remember these phases.] *Ok -*