The Moon
ASTR 1010

NAME: Taaruni Ananya

Overview:
In this activity you will study how light and shadow produces the phases of the Moon. Next, you will learn why we have eclipses. Finally, this lab explores reasons to return to the Moon, and why the original 1969 Moon landing could not have been faked.

Objectives:
After completing this activity, students will be able to:
• Explain why there are different phases of the Moon.
• Explain why we have eclipses and how often they occur.
• Understand why people wish to return to the Moon.
• Explain why the original Moon landing could not have been faked.

Definitions
Here are some terms from lecture that we will be using today in lab:

• **Moon**: Earth's only natural satellite. It is the fifth largest moon (lower case) in the Solar System and is about ¼ the size of Earth. The Moon has a significant impact on Earth, influencing both biological and environmental processes.

• **Heat**: a form of energy that is transferred between objects due to a temperature difference. It flows from a hotter object to a cooler one until thermal equilibrium is reached.

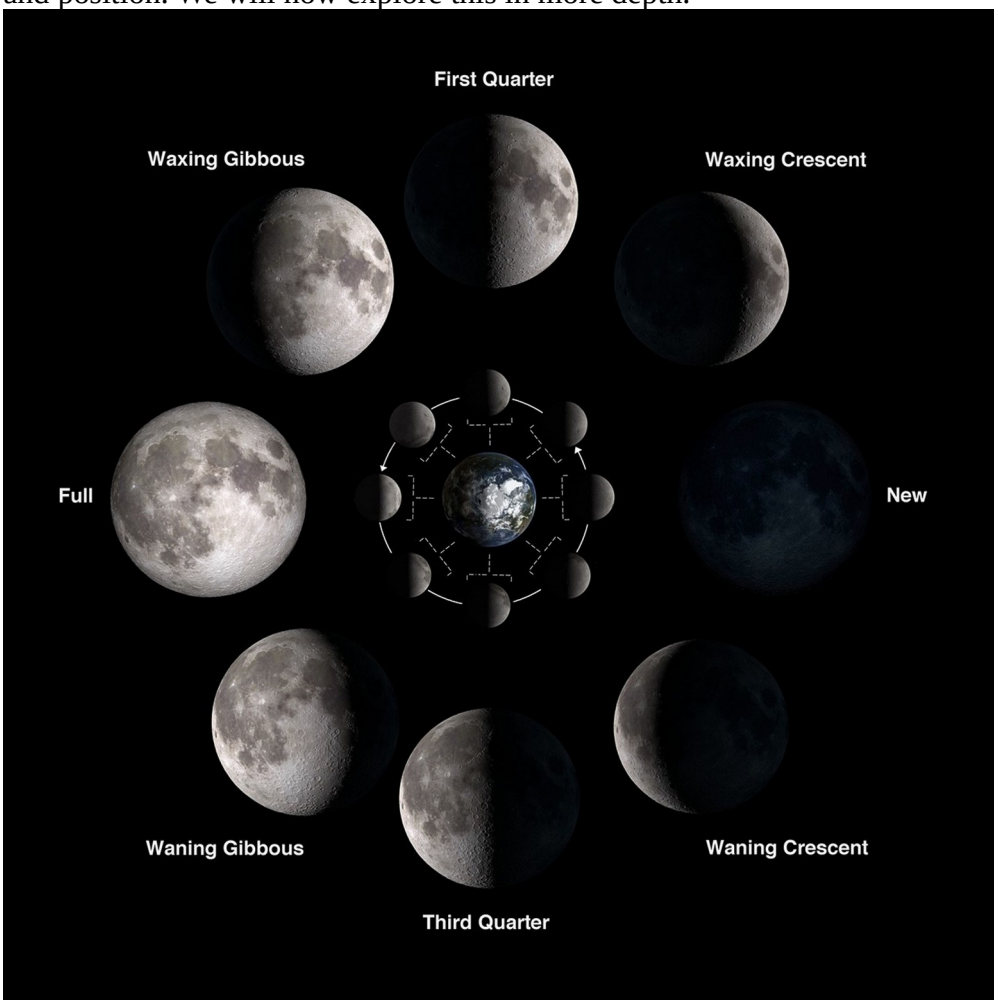
• **Phases of the Moon**: the various stages of illumination that the Moon undergoes as it orbits the Earth.

• **Eclipse:** when one celestial body (Earth, Moon, etc) moves into the shadow of another celestial body or when one body is obscured by another.

• **Conspiracy Theory:** belief or explanation that suggests that events or situations are secretly manipulated or orchestrated by a group of people, typically with some malicious intent. These theories suggest that that significant events are the result of covert actions by powerful organizations or individuals rather than being the result of more accepted or straightforward explanations. Conspiracy theories are almost always universally wrong, and they thrive in environments where there is uncertainty, fear, or distrust. Conspiracy theories also lack credible evidence and rely on speculation, anecdotal evidence, or misinterpretations of information – as is the case for the Moon landing conspiracies.

Part 1: Phases of the Moon

Why does the Moon have different phases? The figure below (credit: NASA/Bill Dunford) shows what you learned in lecture -- the phases are a celestial phenomenon resulting from the interplay of sunlight and position. We will now explore this in more depth.



Go to the simulation here:

https://astro.unl.edu/classaction/animations/lunarcycles/positionsdemonstrator.html

You should see the Sun, Moon, and "you". There are three things we can change, the **latitude**, **Sun's position**, and the **Moon's position**. Start with the Sun's position at "1" (6:00 am) and then go through a complete cycle, roughly until 4:00 am or so (position "8").

1)List the phases of the Moon you observed in order.

Waning Crescent,New,Waxing Crescent,First Quarter,Waxing Gibbous,Full,Waning Gibbous, Third Quarter

Now return the Sun to position 4 (3:00 pm) and cycle the Moon from position 1 to position 8.

2)List the phases of the Moon you observed in order.

First Quarter,Waxing Gibbous,Full,Waning Gibbous,Third Quarter,Waning Crescent,New,Waxing Gibbous

3)Consider this – another student who saw the same thing says “Well, the Sun rises in the east, and sets in the west each day. Since it does this, clearly the Moon goes through different phases in 24 hours.” Explain why this is wrong.

This is wrong because the moon takes days to change phases, not just 24 hours.

4)Recall that **latitude** is a geographic coordinate that specifies the north-south position of a point on the Earth's surface. The Equator is 0 degrees latitude. If you were in the North Pole your latitude would be 90 degrees. All that said, how does latitude affect the phases of the Moon that you observe?

The latitude changes the way the Moon looks as we observe it.

Let us continue exploring the phases by going to the simulation here:

https://astro.unl.edu/naap/lps/animations/lps.html

You will notice that the simulation begins with a New Moon. You may want to click on the “show angle” and “show time tick marks” options.

5)One day after the New Moon, by how many degrees has the Moon orbited around the Earth, and how much of the Moon’s surface is now illuminated to observers on Earth?

12.2 degrees and 1.1% illuminated

6)Seven days after the New Moon, what percentage of the Moon’s surface is now illuminated (to observers on Earth)? Does the illumination of the Moon increase in a strictly incremental manner?

56.6% is illuminated, no it doesn’t increase in a strictly incrementail manner.

7)Start the animation and watch the Moon complete a rotation or two. Strictly speaking, what percentage of the Moon is illuminated by the Sun at any given time as it rotates around the Earth?

At least 0.01% of the Moon is illuminated by the Sun at any given time other than the start at

8)In your own words, explain what produces the phases of the Moon. Be sure to explain why we see a “New Moon” and “Full Moon”. Also, be sure to explain whether everyone on the Earth sees the same phases of the Moon at any given time, or does it depend on where on the Earth you are?

The Moon’s orbit around the Eart is what produces the different phases of the Moon. We see a “New Moon” and “Full Moon” because depending on the Moon’s position relative to the Earth and Sun, we have nights with a full moon’s light and some with little. Yes, the Moon’s phase is the same for everyone as the cycles are the same throughout Earth.

Part 2: Eclipses

In class you learned about **eclipses**. There are two types, solar and lunar. Complete the sentence --
9)A solar eclipse is when the Moon blocks at least some sunlight from reaching Earth. Whereas a lunar eclipse is where the Earth blocks at some least some sunlight from reaching the Moon.

10) Consider this -- if the Earth and Moon were perfectly aligned in a straight line with no inclination (meaning the Moon's orbit was directly in the same plane as the Earth's orbit around the Sun), about how many lunar eclipses would you observe in a year? Likewise, about how many solar eclipses would you observe?

There would be an equal number of both eclipses since they are in a straight line, so about

In reality, there were two solar eclipses and three lunar eclipses in 2024. This is fairly typical. Let us explore the reason why we see fewer eclipses than you might expect. Go here:

https://astro.unl.edu/classaction/animations/lunarcycles/mooninc.html

Watch the simulation.

11) In a typical year, about how many “eclipse seasons” are there?

There are three “eclipse seasons” in a typical year.

12) In your own words explain why are there are only a few eclipses per year?

There are only a few amount of times when the Sun and Moon align or are aligned with the Earth to cause eclipses.

Part 3: Moon Landings

Our civilization is at the dawn of a new era of space exploration. For decades, the only entity that could launch mission into space, let alone the Moon, were governments. About one year ago, in February of 2024, the first commercial landing on the Moon occurred by Intuitive Machines' Odysseus lander. Consequently, this was also the first time an American spacecraft landed on the Moon since 1972! Here is a beautiful video showing the lander’s journey – https://www.youtube.com/watch?v=PxfgLuALTRk

13) That said, why should humanity return to the Moon? Read this article –
https://press.princeton.edu/ideas/why-going-to-the-moon-still-matters
The article is a few years old (written before the success of the Odysseus lander), but still very prevalent. In your own words, explain the scientific and commercial reasons the author believes we should return to the Moon. What are your thoughts about investing and sending people to the Moon?

The author explains that using our current and evolving technology, we can more easily view and study the Moon, use it to search for line, and set a precedent for exploration. For commerica reasons, the author states that there are elements on Moon that are rarely found on Earth, has potential for tourism, and can create a new economy. My thoughts are that the Moon has lots of potential that needs to be explored.

Lastly, but not least, if we are going to talk about the Moon, we should also address the widespread conspiracy theories that the 1969 Moon landing was faked. Spoiler: the Moon landing was NOT faked! Neil Armstrong and Edwin “Buzz” Aldrin became the first people to walk on the Moon in July 20, 1969. Watch these three short videos --
A)Adam Ruins Everything - Why the Moon Landing Couldn't Have Been Faked
https://www.youtube.com/watch?v=dWBYAxhH3u4

B)5 famous moon landing conspiracy theories debunked
https://www.youtube.com/watch?v=ultbR7D7W5k

C)The Moon landing at 50: Debunking the conspiracy theories
https://www.youtube.com/watch?v=ewV3dBgTa5w

14) Now answer the following: Before you watched the videos did you any “doubts” concerning the Moon landing? What are the conspiracy theories discussed, and how were they debunked? What are your thoughts on the Moon landing? Lastly, it’s quite possible that soonish, Moon tourism will be a reality! Given the opportunity, would you be interested in visiting the Moon?

No, I did not have any doubts concerning the Moon landing. The theories are largely based on the motives and presented findings, they are debunked with facts and observations. My thoughts are that it is very real but I understand how and why people got confused—my understanding and sympathy increased after watching the Fly Me to the Moon movie. No, as exciting as it sounds, I ’ d rather stick to Earth for tourism.