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[SOLUTIONS]

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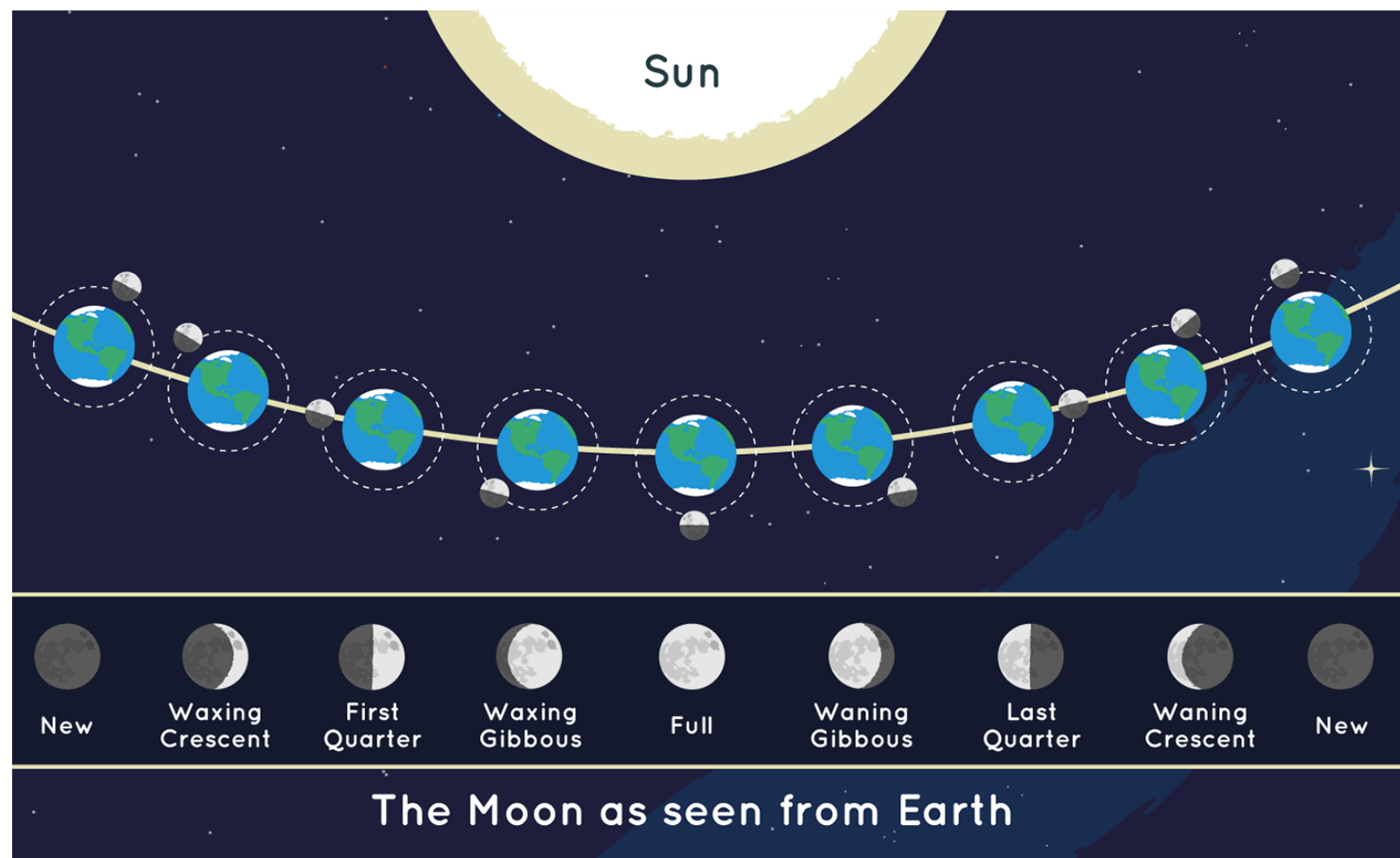
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Module 3: Our Moon Part 1

The Moon is Earth's only natural satellite and plays a crucial role in our planet's tides, climate, and even the way we measure time. It orbits Earth at an average distance of 384,400 km, reflecting sunlight to create the familiar phases we see each month. Unlike the Sun, the Moon doesn't produce its own light—it simply reflects sunlight. As it orbits Earth, we see different portions of its illuminated surface, creating the phases of the Moon. These phases change in a predictable cycle due to the Moon's position relative to Earth and the Sun. In this module, we will explore the different phases of the Moon, what causes them, and how they impact our world. For this worksheet, make sure to watch our recommended video at: <https://youtu.be/AQ5vty8f9Xc?si=DAUZxl3mAzagpyiJ>
See below for Earth, Moon and Sun at various positions for 1 orbit of the Moon around Earth.

[Figure 1: This graphic shows the position of the Moon and the Sun during each of the Moon's phases and the Moon as it appears from Earth during each phase. Not to scale.]

Image Credit: NASA/JPL-Caltech]



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The Phases of the Moon

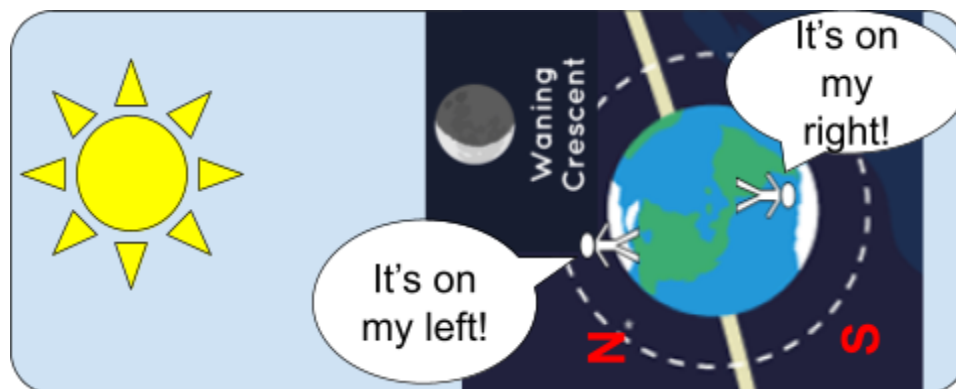
The phases of the Moon are the different shapes we see as the Moon orbits Earth. As seen in the figure, this happens because sunlight shines on the Moon, but we only see the part that is lit up from our point of view on Earth. There are eight main phases of the Moon:

1. **New Moon** – The Moon is completely dark because it's between the Earth and the Sun. It rises near sunrise and we cannot see the illuminated side!
2. **Waxing Crescent** – Seen in the west after sunset, in the Northern Hemisphere the **right** of the Moon (left from Southern Hemisphere) is illuminated, beginning as a slender crescent and growing fatter on its way to First Quarter.
3. **First Quarter** – Half of the Moon is lit up on the right in the Northern Hemisphere (left side in the Southern Hemisphere). The moon appears to increase in size to Waxing Gibbous.
4. **Waxing Gibbous** – More than half of the moon is illuminated, growing on its way to Full.
5. **Full Moon** – The entire Moon is bright and fully visible. The moon rises as the sun sets. From here the moon appears to get slightly smaller again going into the Waning Gibbous phase.
6. **Waning Gibbous** – The Moon gets darker on the right if you are in the Northern Hemisphere (left in the South). Each night the dark side grows larger on its way to Last Quarter.
7. **Last Quarter** – Half of the Moon is lit up on the left if you are in the Northern Hemisphere (right side in the Southern hemisphere). From here the moon gets darker, becoming crescent.
8. **Waning Crescent** – Only a small part on the **left side** of the Moon is still bright in the Northern Hemisphere (right side from the Southern Hemisphere). The crescent becomes thinner and thinner each night on its way to another New (and dark) Moon.

The cycle repeats about once a month, but not exactly! The full cycle takes about **29.5 days or about a week to go from New Moon to the First Quarter**. Old calendars in history would sometimes line up exactly with the phases of our Moon, but our modern calendar does not, which is why we need to specify month and day to tell the time.

Why is the **Waning Crescent** on the left to people in the Northern Hemisphere and on the right to people in the Southern Hemisphere of Earth? It is because people in opposite Hemispheres of Earth are standing upside down (with respect to the Moon)!

[Figure 2: The waning crescent moon viewed by 2 humans, one in the Northern Hemisphere and one in the Southern Hemisphere. Image credit: E.A. Hyde, AICO, NASA/JPL Caltech]



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Short Answer Questions

1. Why does the Moon have phases?

The Moon has phases because of its position relative to Earth and the Sun. As the Moon orbits Earth, different portions of its sunlit side become visible from our perspective, creating the cycle of lunar phases

2. What is the difference between waxing and waning?

Waxing means the Moon appears to be growing larger, as more of its surface becomes illuminated from our perspective. Waning means the Moon appears to be shrinking, as less of its illuminated surface is visible

3. What is the terminator, and why is it important in understanding the Moon's phases?

The terminator is the dividing line between the lit and dark portions of the Moon. It is important because it highlights surface details and helps astronomers study the Moon's topography due to the shadows cast along this line.

4. How does the Moon rotate when it orbits around Earth?

One side of the Moon is always facing Earth due to synchronous rotation, meaning the Moon rotates on its axis at the same rate that it orbits Earth. However, half of the Moon is always illuminated by the Sun, though we only see different portions depending on its phase.

5. If today is a Full Moon, what phase will the Moon be in one week from now?

One week after a Full Moon, the Moon will be in the Last Quarter phase.

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Multiple Choice

1. What causes the different phases of the Moon?

- A) The Moon's shadow covering parts of itself
- B) The Earth's shadow blocking the Moon
- C) The Moon's position relative to the Earth and Sun**
- D) The Moon changing its shape over time

2. How long does it take for the Moon to go through all its phases (one lunar cycle)?

- A) 29.5 days**
- B) 7 days
- C) 14 days
- D) 365 days

3. During which phase do we see the entire Moon fully lit?

- A) First Quarter
- B) Waxing Gibbous
- C) Waning Crescent
- D) Full Moon**

4. Which Moon phase would be best for stargazing because the sky is darkest?

- A) Full Moon
- B) First Quarter
- C) New Moon**
- D) Waxing Gibbous

5. How much of the Moon is always lit by the Sun, even though we see different phases?

- A) 50%**
- B) 25%
- C) 100%
- D) Only the part we see from Earth

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True or False

Answer the following True and False questions. If you answer False explain your reasoning and correct the False statement.

1. True or False: The Moon produces its own light, which is why it appears bright in the night sky

False – The Moon does not produce its own light; it reflects sunlight.

2. True or False: Half of the Moon is always illuminated by the Sun, no matter what phase we see from Earth.

True - The phases are caused by our angle to the illuminated portion of the Moon

3. True or False: The phases of the Moon are caused by Earth's shadow covering parts of the Moon.

False – The phases are caused by the Moon's position relative to Earth and the Sun, not by Earth's shadow.

4. True or False: A full Moon occurs when the Moon is on the opposite side of Earth from the Sun.

True - The New Moon is between Earth and the Sun, the full Moon is on the opposite side of Earth from the Sun

5. True or False: The term “Earthshine” refers to sunlight reflected off Earth that illuminates the dark side of the Moon.

True - This explains why we can faintly see the Moon during the daytime

[Figure 3: Credit, AICO, Mani Mehdipoor 2021]

Bonus Question:

What phase of the Moon is shown in the AICO image at the bottom right of this page?

- A. Full Moon
- B. First Quarter
- C. New Moon

D. Waxing or Waning Crescent

