LUNAR PHASES, TIDAL LOCKING, & ROVER IMPACTS

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Credit: NASA / JHUAPL / SwRI

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LEARNING OBJECTIVES

- Lunar Phases - Understanding the Moon's Changing Face
- Tidal Locking - The Moon's Synchronous Dance
- Rover Impacts - Exploring the Lunar Terrain

LUNAR PHASES

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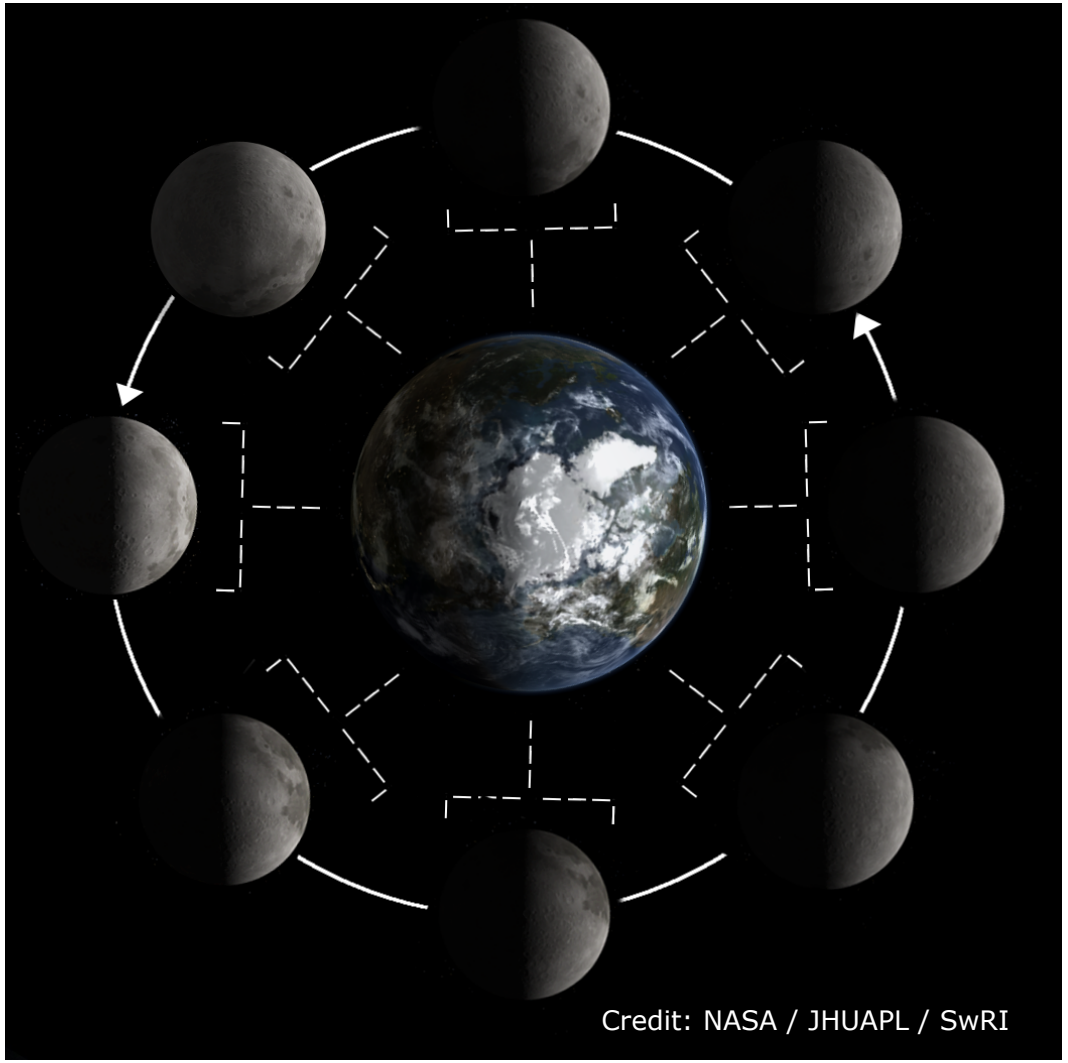
LUNAR PHASES

Lunar phases refer to the changing appearance of the Moon as viewed from Earth due to its orbit around our planet. This cycle includes phases characterized by the amount of illuminated Moon that is visible.



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NEW MOON

The Moon is positioned between the Earth and the Sun, and the side of the Moon illuminated by the Sun faces away from Earth. The Moon appears dark, and this marks the beginning of a new lunar cycle.

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WAXING CRESCENT

A small, crescent-shaped sliver of the Moon becomes visible from Earth. This phase occurs as the Moon starts to move away from its alignment with the Sun.

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FIRST QUARTER

Exactly half of the Moon is illuminated and visible from Earth. This is the phase where the Moon has completed one-quarter of its orbit around the Earth.

Credit: NASA / JHUAPL / SwRI

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WAXING GIBBOUS

More than half of the Moon is illuminated, but it's not yet full. This phase continues the waxing or growing process.

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FULL MOON

The entire face of the Moon is illuminated and visible from Earth. It occurs when the Moon is on the opposite side of the Earth from the Sun.

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WANING GIBBOUS

Like the waxing gibbous phase, more than half of the Moon is still illuminated, but it's decreasing.

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LAST (THIRD) QUARTER

Again, exactly half of the Moon is illuminated, but it's the opposite half from the First Quarter. The Moon is now moving towards its new moon phase.

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WANING CRESCENT

A small, crescent-shaped sliver of the Moon is visible again, but now on the left side. The illuminated portion is decreasing as the Moon approaches the New Moon phase.

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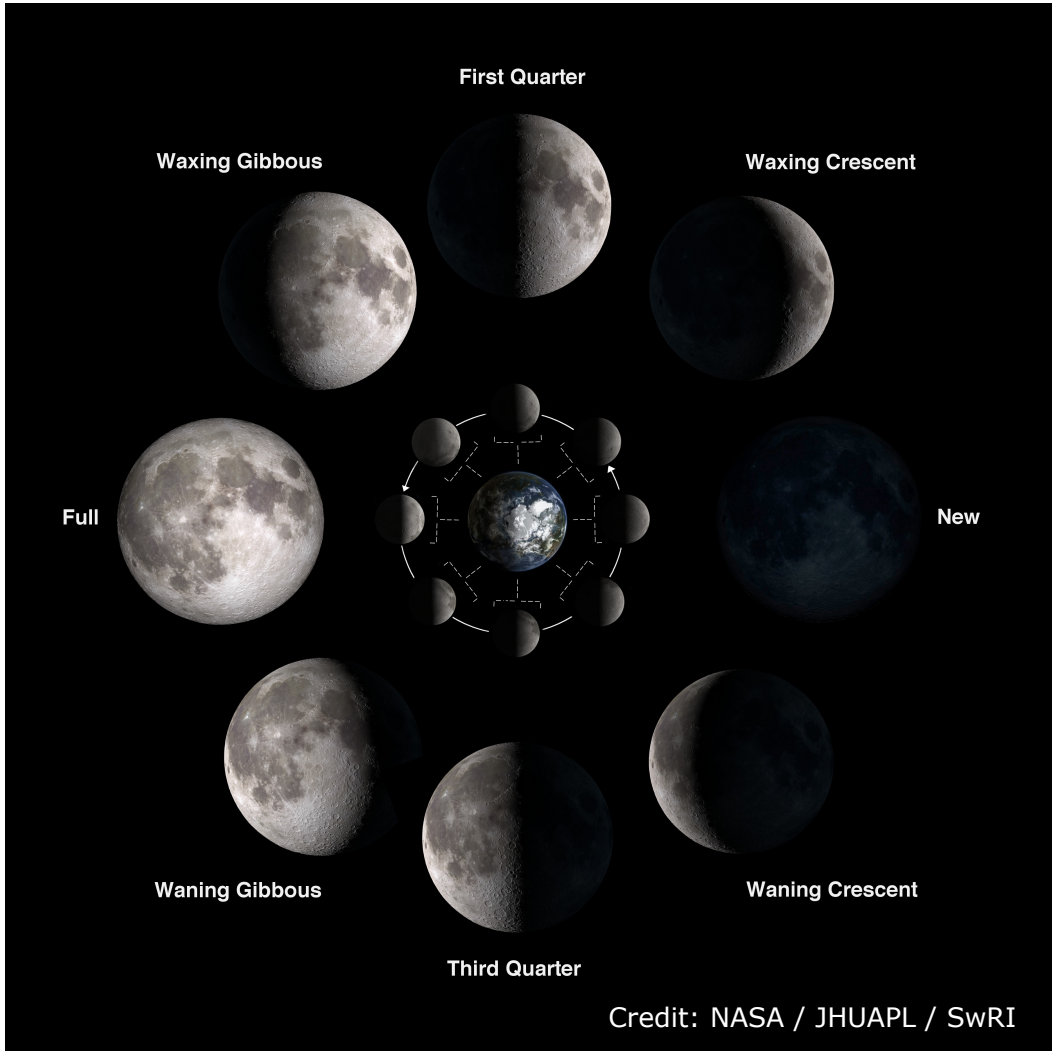
LUNAR PHASES

Lunar phases represent the changing appearance of the Moon throughout its orbit around Earth, transitioning from New Moon to Full Moon and back. Understanding these phases helps explain the varying amounts of illuminated Moon visible from Earth during different points in its orbit.



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TIDAL LOCK

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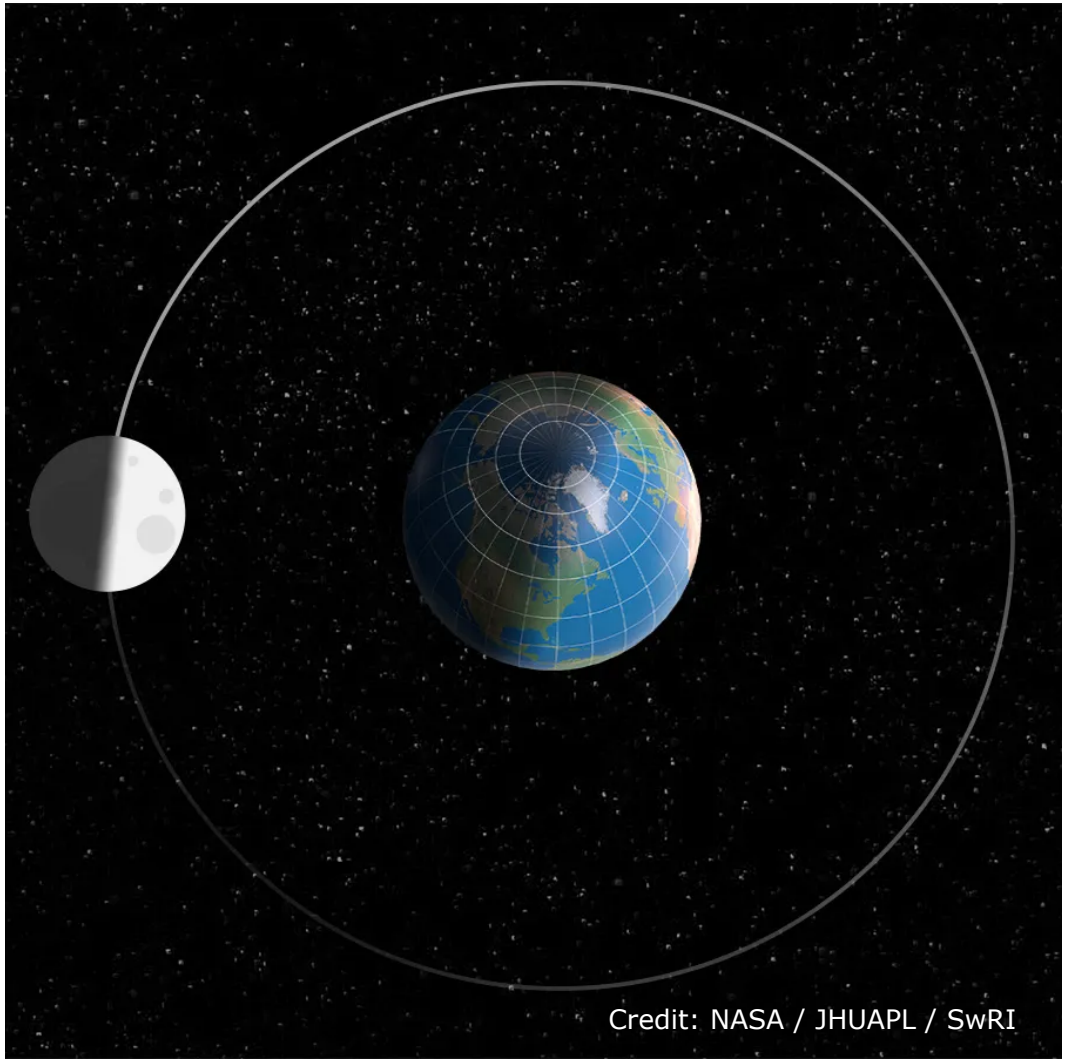
TIDAL LOCK

The Moon rotates, but its rotation period matches its orbital period around Earth, ensuring that the same side always faces us. This creates a dance-like scenario where the Moon, like a partner in a dance, never turns away from Earth. This is tidal lock.



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NEAR SIDE

Tidal lock causes the same side to always face Earth called the near side of the Moon. This gravitational interaction results in a permanent alignment, with the near side of the Moon consistently visible from Earth.

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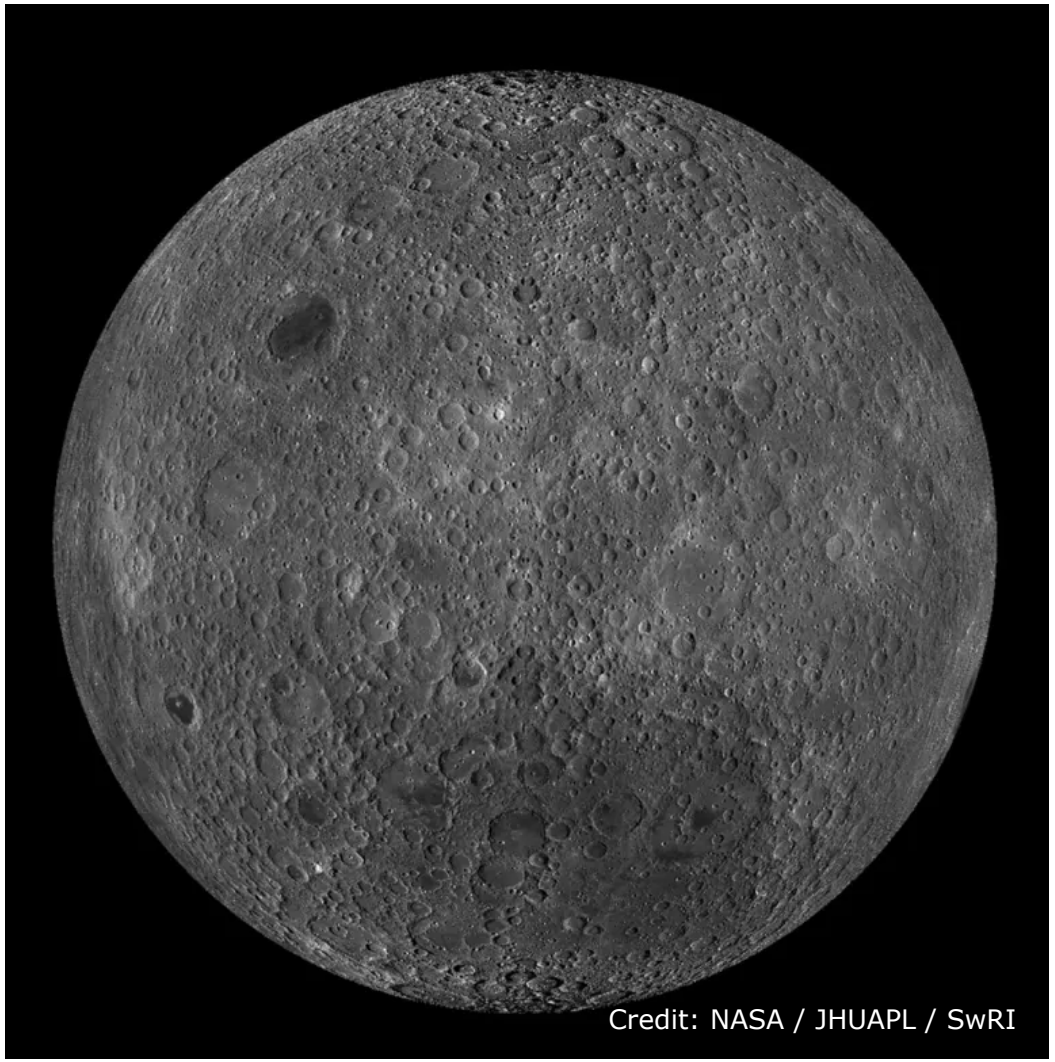
FAR SIDE

Tidal lock also causes the same side to always face away from Earth called the far side of the Moon.



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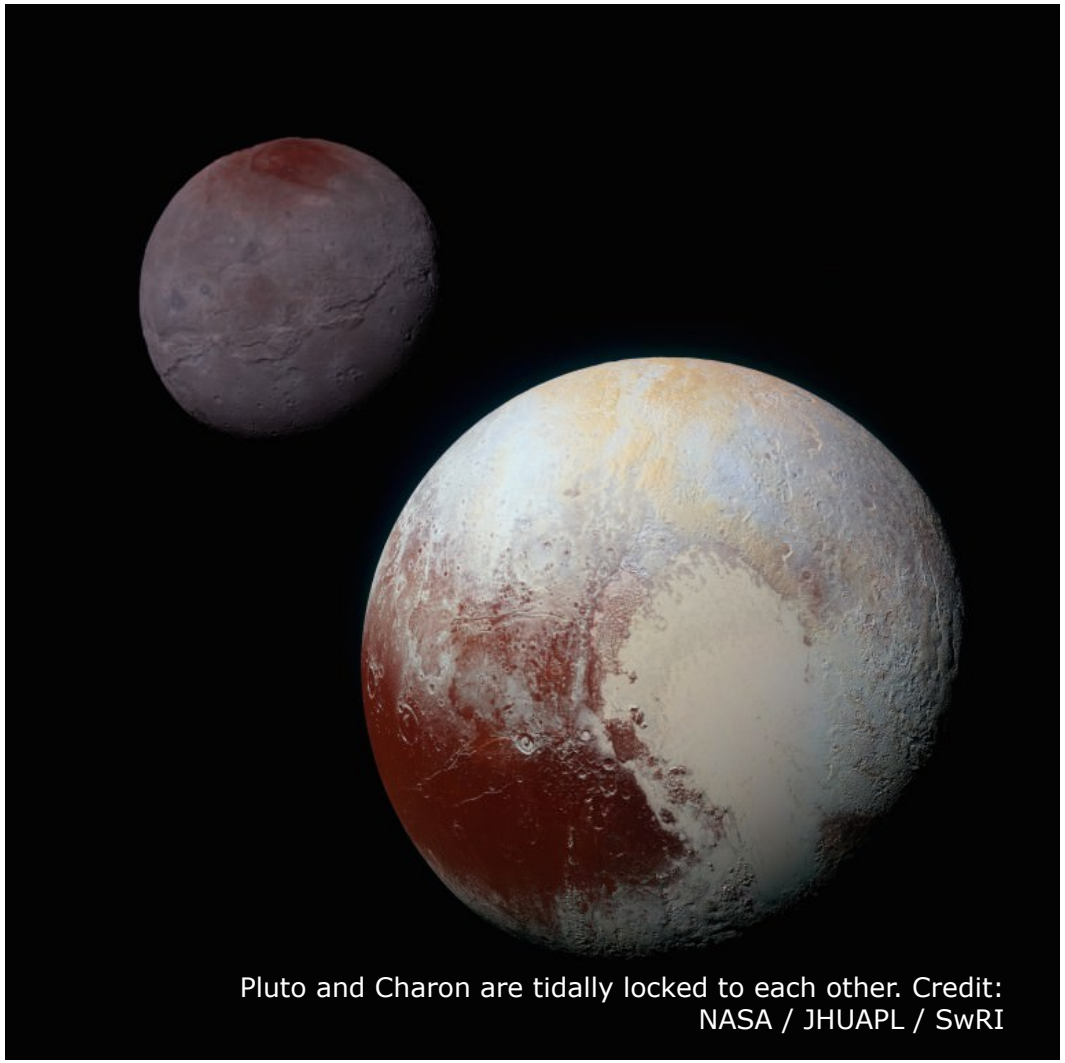
SOLAR SYSTEM

The major moons in the solar system, as well as some binary stars, experience tidal locking, where their rotation becomes synchronized with their orbit. Larger moons achieve this state early in their existence, typically within hundreds of thousands of orbits, and there's emerging evidence that numerous exoplanets are tidally locked with their host stars.



Pluto and Charon are tidally locked to each other. Credit: NASA / JHUAPL / SwRI

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CULTURAL IMPACT OF THE MOON

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INDIGENOUS MOON

Cultures globally view the Moon uniquely, with diverse stories about its phases. In the Americas, the Moon and Sun held central roles, marking time through lunar cycles, and Indigenous Peoples, like the Ininew, utilized a lunar calendar symbolized by patterns on a turtle's shell.

Read through the following article and discuss:

Tipiskawi Pisim (Moon)
By Wilfred Buck, Researcher and Knowledge Keeper, Opaskwayak Cree Nation, Manitoba

https://www.asc-csa.gc.ca/eng/youth-educators/objective-moon/indigenous-moon.asp

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Cakapis (Little Spirit or Little Boy on the Moon)

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Cakapis, by artist Mistawasis Buck, Opaskwayak Cree Nation
(Credit: Mistawasis Buck)

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Cakapiw (Spirit Man or Man on the Moon)

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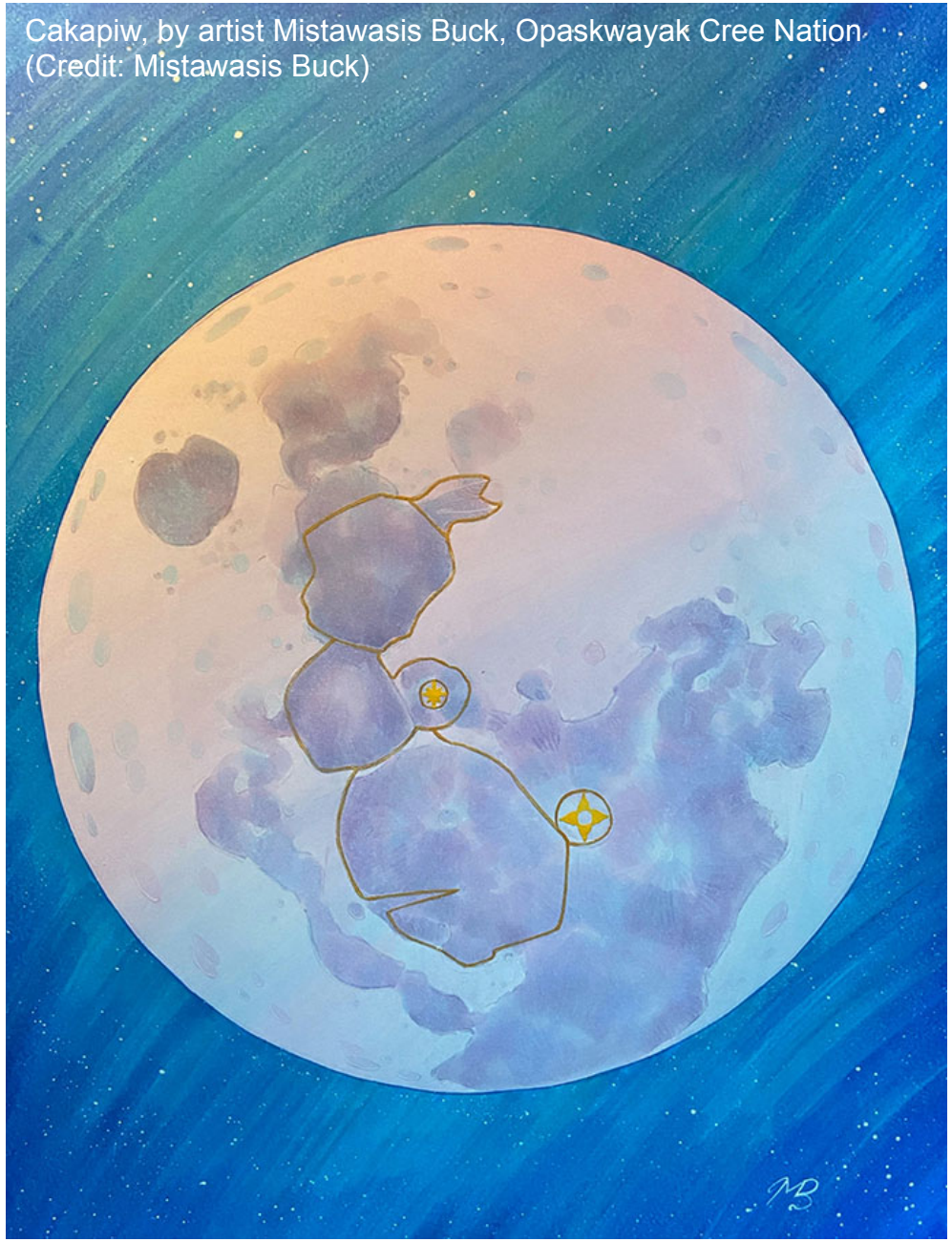

Cakapiw, by artist Mistawasis Buck, Opaskwayak Cree Nation (Credit: Mistawasis Buck)

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DISCUSSION

Operating a rover on the Moon is significantly shaped by the Moon's tidal locking, extreme temperature variations, and the challenges posed by the absence of a continuous power source. Adaptations in design, operational planning, and energy management are crucial for successful lunar rover missions.

How do you think the lunar phases and tidal lock impact the operation of a lunar rover on the Moon?

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TIDAL LOCK

On the Moon: The Moon is tidally locked to the Earth, meaning the same side always faces Earth. Lunar phases (Full Moon, New Moon, etc.) are a result of the changing positions of the Earth and the Moon relative to the Sun over the course of an Earth year.

Impact on Rovers: Tidal locking means that lunar days and nights are about 14 Earth days long each. Rovers must contend with prolonged periods of extreme heat during the lunar day and extreme cold during the lunar night.

**A day is the length of time between two Noons or sunsets. That's 24 hours on Earth, 708.7 hours (29.53 Earth days) on the Moon.*

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TEMPERATURE

On the Moon: The Moon experiences extreme temperature variations. Daytime temperatures can reach up to 127 degrees Celsius (260 degrees Fahrenheit), while nighttime temperatures can drop to -173 degrees Celsius (-280 degrees Fahrenheit).

Impact on Rovers: Rovers must be equipped to handle these extreme temperature swings. Thermal control systems are crucial for protecting sensitive instruments and ensuring the rover's functionality.

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SOLAR POWER

On the Moon: The lunar day lasts about 14 Earth days, providing an extended period of sunlight.

Impact on Rovers: Solar-powered rovers have an opportunity to generate energy for an extended duration during the lunar day. However, the challenge arises during the long lunar night when there is no sunlight for power generation.

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ENERGY CONSERVATION

On the Moon: Energy conservation is paramount, especially during the lunar night.

Impact on Rovers: Rovers need efficient energy management systems, including the ability to enter a low-power or hibernation mode during the lunar night. This ensures that critical systems can be powered while conserving energy for essential functions.

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OPERATIONAL TIME

On the Moon: Rovers have a limited operational window during the lunar day.

Impact on Rovers: Operators must plan activities strategically within the available sunlight hours. Energy-consuming activities, including data transmission, may need to be prioritized, and periods of inactivity are necessary during the lunar night.

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WRAP UP

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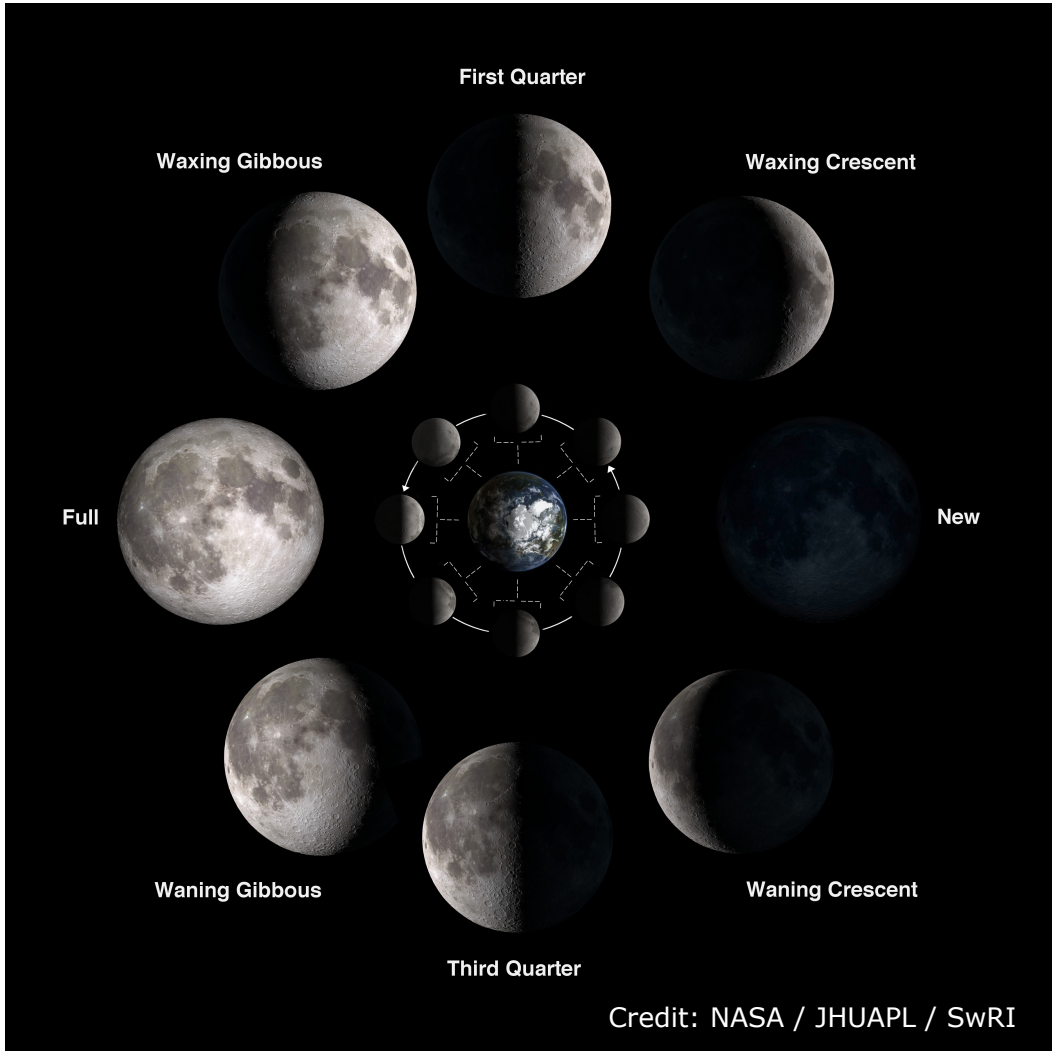

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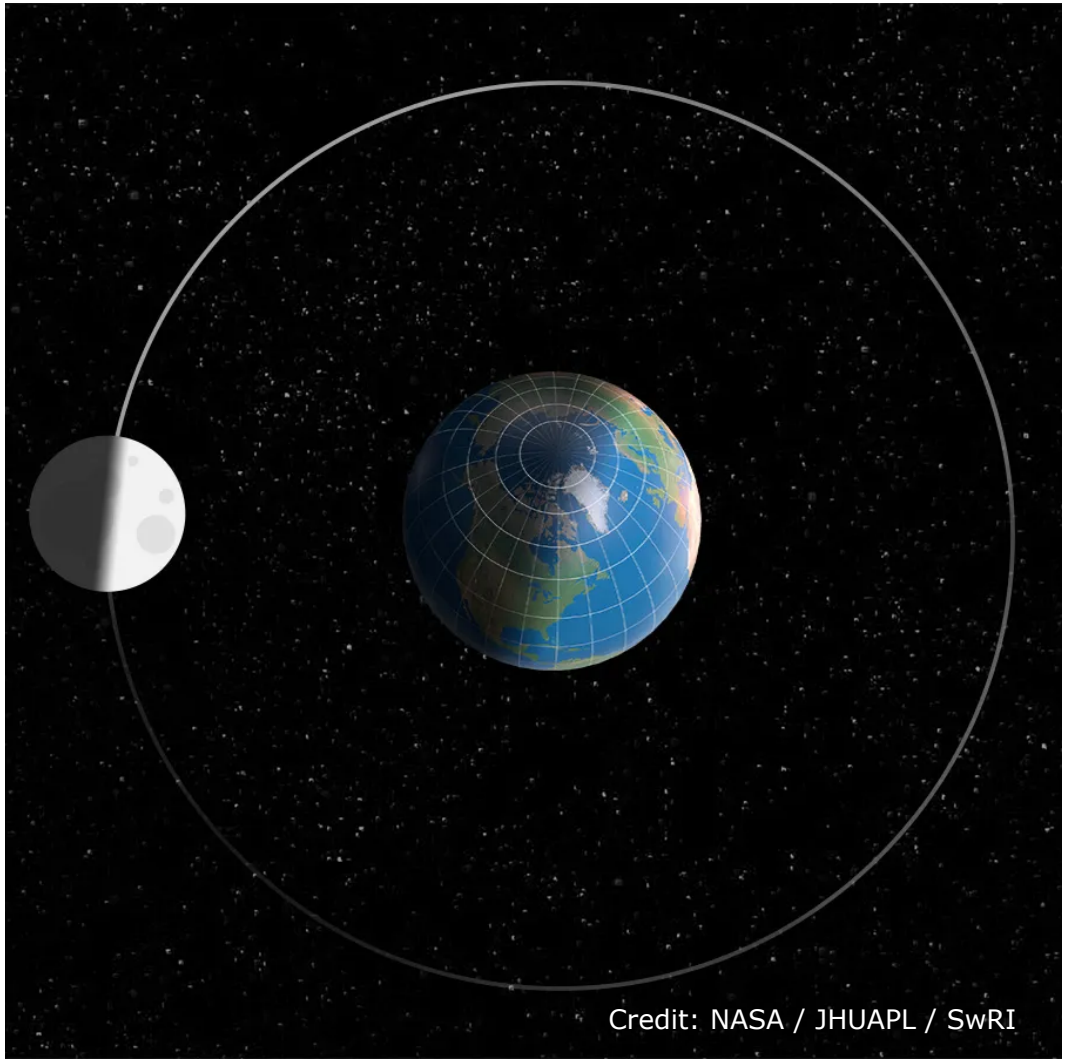

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