LUNAR PHASES, TIDAL LOCKING, & ROVER IMPACTS

Teachers Guide

The Lunar Phases, Tidal Locking, & Rover Impacts Lesson is part of the Rover Driving Academy Program which provides students with the ability to become part of a lunar research team, operating a remote rover to explore a simulated lunar landscape, investigate areas of interest, and identify lunar features.

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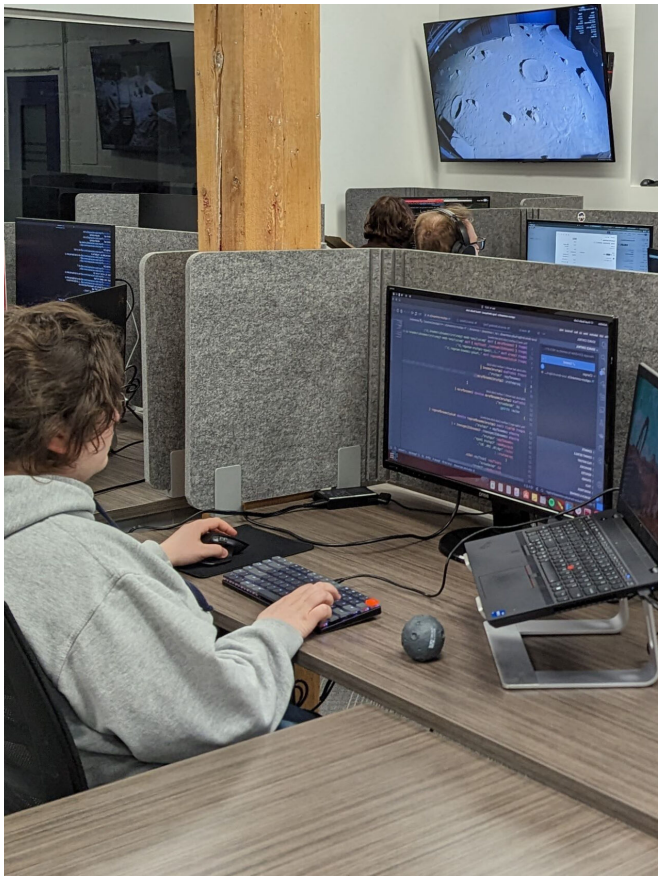
Credit: NASA / JHUAPL / SwRI



ABOUT THE PROGRAM

The Rover Driving Academy Program is a captivating educational program specifically designed for students in grades 6-9. It offers an in-depth exploration of lunar science and space missions, covering a variety of exciting topics such as lunar geology, crater formation, lunar phases, tidal locking, space travel, lunar landings, and rover operations. The program consists of multiple lessons, each with a distinct theme, allowing students to gain a comprehensive understanding of these subjects. The highlight of the Rover Driving Academy is the opportunity for students to actively participate in a learning experience where they become part of a team that operates a real lunar rover in a simulated lunar environment.

LESSON PLAN - LUNAR PHASES, TIDAL LOCKING, AND ROVER IMPACTS

Grades 6-9
Approximately 1 hour

Unveil the Moon's phases, explore tidal locking, and grasp rover implications. Engage with STEM and diverse perspectives through captivating activities.

LEARNING OUTCOMES

- Understand the lunar phases and the concept of tidal locking.
- Explore the influence of lunar phases and tidal locking on lunar rover operations.
- Recognize the cultural significance of the Moon in Indigenous communities.

INTRODUCTION – 5 MINS

- Introduce the topic of lunar phases, tidal locking, and their relevance to lunar rovers.

LUNAR PHASES – 10 MINS

- Explain the lunar phases.
- Discuss the influence of the Earth, Moon, and Sun on the different phases of the Moon.

TIDAL LOCK – 10 MINS

- Explain the Moon and tidal lock.
- Highlight the significance of tidal locking and its effects on the Moon’s rotation and orbit.

CULTURAL IMPACT OF THE MOON – 20 MINS

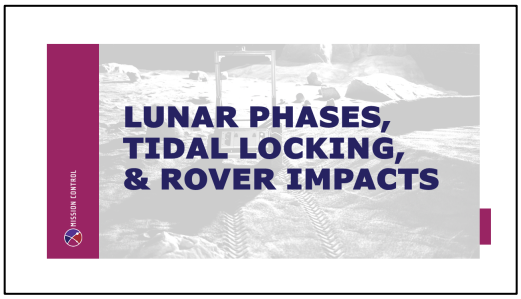
- Have students read through 3 articles and discuss as a group.

ROVER IMPACT – 5 MINS

- Discuss – How do the lunar phases and tidal lock impact operating a lunar rover on the Moon?

DISCUSSION – 5 MINS

WRAP UP – 5 MINS



INTRODUCTION – 5 MINS

- Lunar Phases
    - Objective - Understanding the Cosmic Ballet:
    - Clearly state the objective: demystifying lunar phases.
    - Relate lunar phases to a cosmic light show, emphasizing their visual and historical significance.
    - Connect lunar phases to a celestial calendar used for navigation and timekeeping.
- Tidal Locking
    - Objective - Unraveling the Earth-Moon Connection:
    - Clearly state the objective: exploring tidal locking.
    - Explain tidal locking as a gravitational dance and its impact on the Moon's rotation and Earth's tides.
    - Emphasize the real-world implications of understanding this cosmic connection.
- Rover Impact
    - Objective - Bridging Science and Exploration:
    - Clearly state the objective: delving into rover impacts.
    - Relate lunar phases and tidal locking to challenges faced by lunar rovers.
    - Frame the understanding of these impacts as preparation for the future of space exploration.

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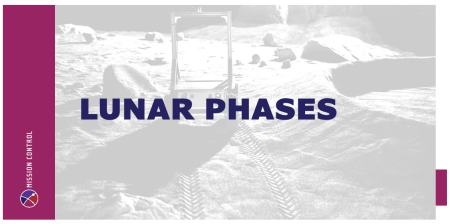

LUNAR PHASES

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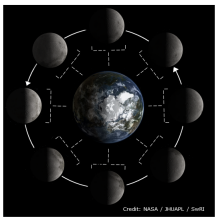
LUNAR PHASES

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 visible.



Credit: NASA / JHUAPL / SwRI

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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.

Credit: NASA / JHUAPL / SwRI

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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.

Credit: NASA / JHUAPL / SwRI

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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.

Credit: NASA / JHUAPL / SwRI

MISSION CONTROL

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.

Credit: NASA / JHUAPL / SwRI

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WANING GIBBOUS

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

Credit: NASA / JHUAPL / SwRI

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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.

Credit: NASA / JHUAPL / SwRI

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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.

Credit: NASA / JHUAPL / SwRI

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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.

Credit: NASA / JHUAPL / SwRI

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LUNAR PHASES – 10 MINS

Definition:

Lunar phases refer to the changing appearance of the Moon as observed from Earth due to the varying angles of sunlight falling on its surface.

Phases Sequence:

1. New Moon: The side of the Moon facing Earth is not illuminated, making it appear completely dark.
2. Waxing Crescent: A small, illuminated crescent shape becomes visible as the Moon begins to move away from the New Moon phase.
3. First Quarter: Half of the Moon is illuminated, resembling a half-moon shape.
4. Waxing Gibbous: More than half but not fully illuminated, leading to a rounded shape.
5. Full Moon: The entire side of the Moon facing Earth is fully illuminated, appearing as a complete circle.
6. Waning Gibbous: The illuminated portion decreases from a Full Moon towards a rounded shape.
7. Last Quarter: Half of the Moon is illuminated, but the opposite side from the First Quarter.
8. Waning Crescent: A small, illuminated crescent shape, similar to the Waxing Crescent but on the opposite side.

Cycle Duration:

The complete lunar phase cycle, from New Moon to New Moon, lasts about 29.5 days, known as a lunar month or synodic month.

Causes:

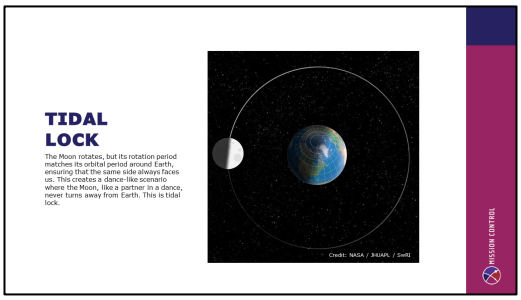
Lunar phases are a result of the relative positions of the Sun, Earth, and Moon. The changing angles create different amounts of illuminated surface visible from Earth.

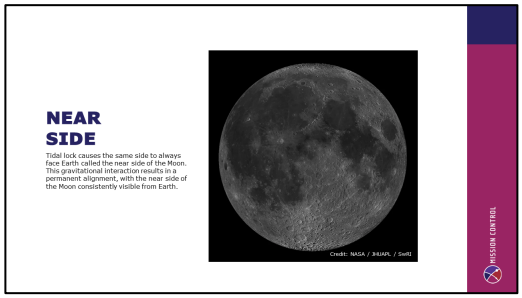
Cultural Significance:

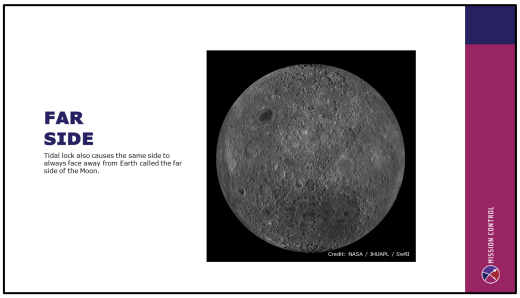
Lunar phases are culturally significant, with various cultures using them for timekeeping, religious observances, and agricultural practices.

Application:

Understanding lunar phases is crucial for planning lunar missions, as different phases impact the amount of sunlight available on the Moon's surface.







TIDAL LOCK – 10 MINS

Tidal Locking:

Tidal locking is a gravitational interaction between a celestial body and its natural satellite that results in the same side of the satellite always facing the larger body. This means the satellite rotates on its axis in the same time it takes to orbit the larger body.

Earth-Moon Tidal Locking:

The Moon is tidally locked to Earth, meaning it consistently presents the same face towards our planet.

Near Side and Far Side:

- The "near side" refers to the side of the Moon that constantly faces Earth.
- The "far side" (or "dark side," although it receives sunlight) is the side that remains hidden from Earth.

TIDAL LOCK – 10 MINS

Causes:

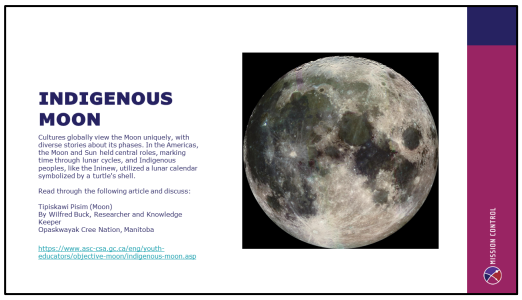
Tidal locking is a result of gravitational forces. The gravitational pull of the larger body (Earth) causes deformations on the smaller body (Moon). Over time, these deformations lead to the alignment of rotation and orbital periods.

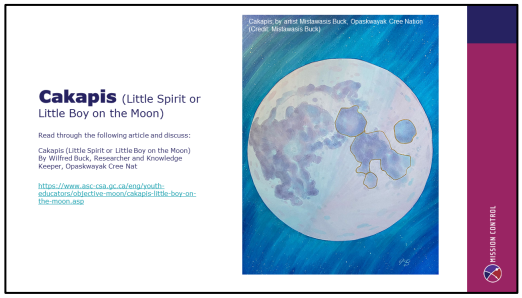
Impact on Observation:

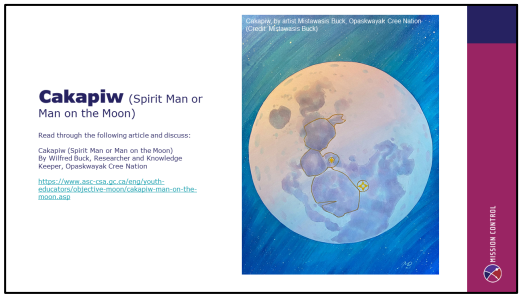
Because of tidal locking, we always see the same features on the Moon's surface from Earth, and one hemisphere is hidden from direct observation.

Practical Implications:

Tidal locking has practical implications for lunar exploration. Certain areas, due to this lockstep rotation, experience continuous daylight or remain in perpetual shadow. Understanding these conditions is crucial for planning lunar missions.







CULTURAL IMPACT OF THE MOON – 20 MINS

Indigenous Moon - Summary Notes

General Overview:

Every culture has unique perspectives and stories about the Moon. The Moon and the Sun are central to the lives, beliefs, ceremonies, and understandings of Indigenous Peoples in the Americas.
The passage of time is often marked by lunar cycles, and the Moon holds significance in observing environmental changes.

Lunar Calendar and Turtle Symbolism:

Indigenous Peoples, such as the Cree, follow a lunar calendar depicted on a turtle's shell. The turtle's shell has 28 smaller outer edge scutes, representing the days from one full Moon to the next, and 13 larger central scutes, representing the 13 moon cycles. The turtle has cultural importance and is linked to origin stories, including its role in creating Turtle Island.

Cakapis (Little Spirit or Little Boy on the Moon) - Summary Notes

Story Overview:

A family faced a winter blizzard, and only one little boy survived after days of struggling in the storm. The boy, named Cakapis, was taken in by a family with no sons but was treated with cruelty and indifference. As the winter progressed, he became weaker and was given difficult tasks and little care.

CULTURAL IMPACT OF THE MOON – 20 MINS

Lunar Connection:

One winter night, he was sent to fetch water during a storm, and as he stood by the water hole, he cried and shared his pain with Grandmother Moon (Nokoom Tipiskawi Pisim). Touched by his sincerity, Grandmother Moon lifted him into the sky and set him on the Moon. Cakapis became a reminder to be kind to the less fortunate, symbolizing compassion and care for the weak and helpless.

Cakapiw (Spirit Man or Man on the Moon) - Summary Notes

Spiritual Helper and Responsibilities:

Cakapiw, or Oskapiwis, is a spiritual helper residing on the Moon and represents the responsibilities of men in Indigenous communities. Men are entrusted with various duties related to community well-being, ceremonies, and familial roles.

Sacred Fire and Energy:

Cakapiw is depicted kneeling in front of a fire on the Moon, holding a burning ember symbolizing a star. The sacred fire, Iskatiw, is a direct connection to kisikookuk (beings of light/energy/spirit). The concept of everything being Misiwa (energy) is emphasized, transcending physical and spiritual realities.

Sacred Duty and Origins:

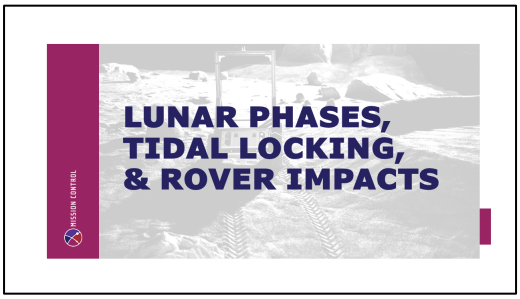
Iskatiw is a sacred duty given by Acakos Iskwew (Star Woman) and represents the energy/light/spirit connection. Cakapiw's representation on the Moon serves as a reminder of life, the sacred duty of men, and the origins traced back to the umbilical cord (matisi) connecting to Acakos Iskwew.

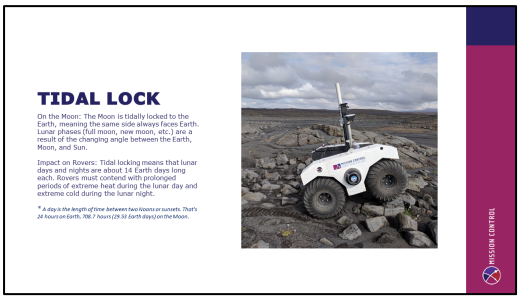
Symbolic Elements:

Cakapiw's features correspond to lunar geography, with specific Moon features representing aspects of his form. The sacred duty ties back to the concept of Paymatisiwin, symbolizing a confident forward journey with memories of female relatives.

Creation Myth and Star Woman:

Acakos Iskwew, the first grandmother, descended to Earth through a hole in the sky and is connected to the creation myth. The umbilical cord symbolizes the connection of all beings to Earth.





ROVER IMPACT - 8 MINS

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

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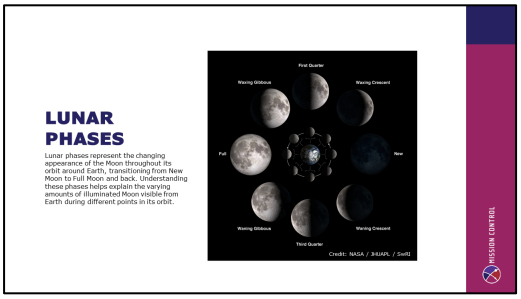

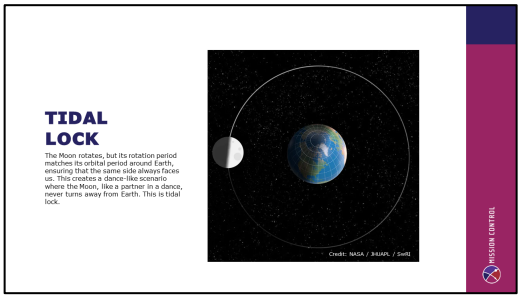

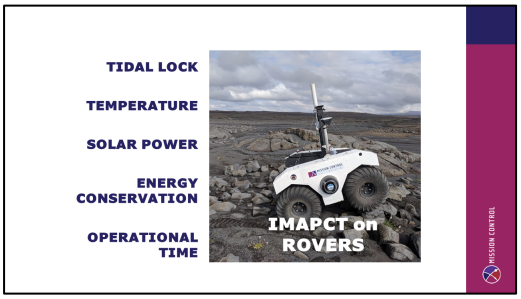

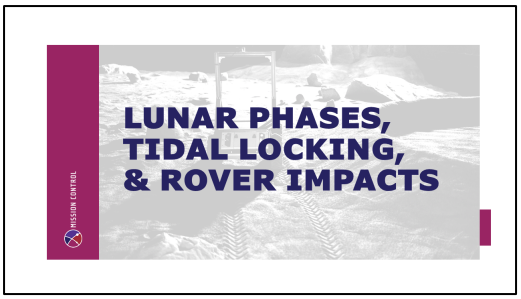

DISCUSSION – 5 MINS

WRAP UP – 5 MINS

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