

# EXPLORING SPACE TRAVEL, LUNAR LANDING, & ROVER IMPACT

## Teachers Guide

The Exploring Space Travel, Lunar Landing, & Rover Impact 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.

Canada participates in Space exploration to advance knowledge of space through science and ensure that space science and technology provide social and economic benefits for Canadians. Canada has been involved in Moon exploration since the 1960s.

<https://www.asc-csa.gc.ca/eng/youth-educators/objective-moon/quick-history-canada-on-the-moon.asp>

[https://www.asc-csa.gc.ca/videos/recherche/1\\_mx7pigjh/1\\_2r38i4vq.webm](https://www.asc-csa.gc.ca/videos/recherche/1_mx7pigjh/1_2r38i4vq.webm)



MISSION CONTROL

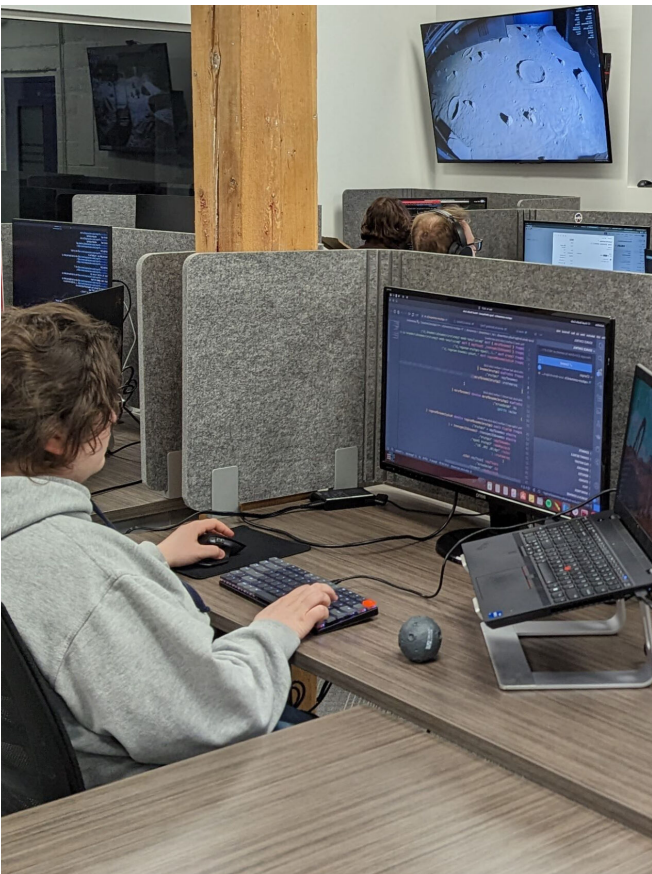


Credit: NASA / JHUAPL / SwRI



## 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 - EXPLORING SPACE TRAVEL, LUNAR LANDING, & ROVER IMPACT**

Grades 6-9

Approximately 1 hour

Embark on an hour-long exploration of space travel's intricacies, lunar landing challenges, and rover impacts. Tailored for grades 6-9, engage in hands-on activities and discussions that unveil the science and engineering behind space exploration.

### **LEARNING OUTCOMES**

- Comprehend the fundamentals of space travel and lunar landing.
- Analyze the challenges and forces involved in landing a rover on the Moon.
- Understand the significance of space missions for scientific exploration.

### **INTRODUCTION – 5 MINS**

- Introduce the theme of space travel, lunar landing, and rover missions.

### **GETTING OFF EARTH – 10 MINS**

- Explain how rockets are launched into space.
- Discuss the forces, propulsion, and challenges involved in getting a rover to the Moon's surface.

### **LANDING ON THE MOON – 10 MINS**

- Discuss how understanding the lack of atmosphere, precise calculations, and precise manoeuvres is crucial for lunar landing.

### **GROUP ACTIVITY – 20 MINS**

- Have students brainstorm, design, and present lunar landers that would safely deliver a lunar rover to the lunar surface.

### **IMPORTANCE OF LUNAR MISSIONS – 5 MINS**

- Discuss how lunar missions are crucial for Earth's benefit as they contribute to scientific advancement, providing unique data that enhances our understanding of lunar geology.

### **DISCUSSION – 5 MINS**

### **WRAP UP – 5 MINS**



## EXPLORING SPACE TRAVEL, LUNAR LANDING, & ROVER IMPACT



### LEARNING OBJECTIVES

- Comprehend space travel and lunar landing.
- Analyze rover landing challenges.
- Understand mission significance.

## INTRODUCTION – 5 MINS

**Emphasize Advancements:** Space exploration has driven significant advancements in science and technology.

**Expanding Boundaries:** Space exploration allows us to explore new frontiers and discover things that were once thought impossible.

**Innovations:** Tangible innovations like GPS technology, medical advancements, and environmental monitoring have roots in space exploration.

**Expanding Understanding:** Each mission contributes to our understanding of the vast cosmos, like reading an exciting book where every chapter reveals a thrilling story.

**Inspiration:** Space exploration inspires new generations of scientists, engineers, and dreamers to dream big and reach for the stars.

**Earth's Health:** Space missions help us better understand and care for our own planet, contributing to climate monitoring and disaster prediction and response.

**Global Collaboration:** Space exploration requires international collaboration, bringing countries and cultures together in pursuit of common goals.





## GETTING OFF EARTH

### GETTING OFF EARTH

The interplay of gravity, thrust, orbital mechanics, and rocket design significantly influences the launch of rockets carrying rovers to the Moon. Understanding and effectively managing these factors are crucial for a successful lunar mission, impacting the trajectory, stability, and overall success of the launch.



### ROCKET DESIGN (Balancing Forces)

Rocket design, focusing on balancing forces, is vital for a successful lunar mission. Achieving equilibrium in thrust, aerodynamics, and structural integrity ensures stability during launch and travel, optimizing the rocket's performance and increasing the likelihood of safely delivering rovers to the Moon.



### GRAVITY (The Pull of the Earth)

Gravity, the force of attraction between masses, significantly influences the launch of rockets carrying rovers into space, necessitating powerful propulsion systems to overcome Earth's gravitational pull. Understanding and managing gravity are crucial aspects of planning and executing successful space missions.



### THRUST (Overcoming Gravity)

Thrust is the force generated by rocket engines to overcome Earth's gravity during a launch, providing the upward acceleration needed to propel rockets carrying rovers into space. It plays a critical role in achieving the necessary velocity to enter orbit and continue the journey toward the Moon. It also means there is a lot of shaking during liftoff, something all space-bound instruments need to be able to withstand.



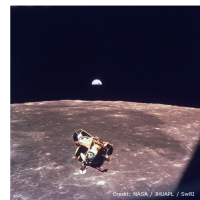
### ORBITAL MECHANICS (Going Around the Earth)

The interplay of gravity, thrust, orbital mechanics, and rocket design significantly influences the launch of rockets carrying rovers to the Moon. Understanding and effectively managing these factors are crucial for a successful lunar mission, impacting the trajectory, stability, and overall success of the launch.



### APOLLO 11

Apollo 11 utilized a combination of gravity, thrust, orbital mechanics, and carefully designed rockets to navigate the journey to the Moon. These factors were orchestrated to achieve a precise trajectory, overcome gravitational forces, and ensure the successful landing of the spacecraft on the lunar surface.



## GETTING OFF EARTH – 10 MINS

### Gravity

Definition: Gravity is a force that pulls objects with mass toward each other. On Earth, it is what gives weight to physical objects and is responsible for holding everything on the planet.

Significance in Rocket Launch: Rockets need to overcome Earth's gravity to reach space. During launch, they must generate sufficient thrust to counteract gravity, allowing them to break free from the gravitational pull.

## LUNAR PHASES – 10 MINS

### Thrust

Definition: Thrust is the force exerted by a rocket engine to propel the rocket forward. It is generated by expelling mass at high velocities through the rocket's nozzles.

Significance in Rocket Launch: To escape Earth's gravity and enter space, a rocket must produce thrust greater than the force of gravity pulling it downward. Adequate thrust is essential for reaching the required velocity for orbital insertion or traveling to the Moon.

### Orbital Mechanics

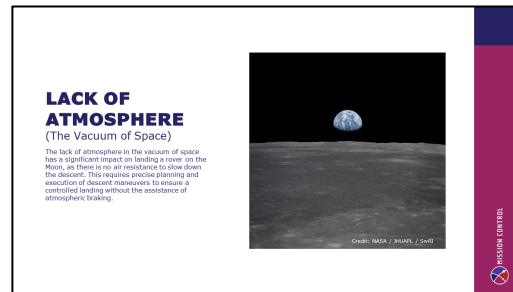
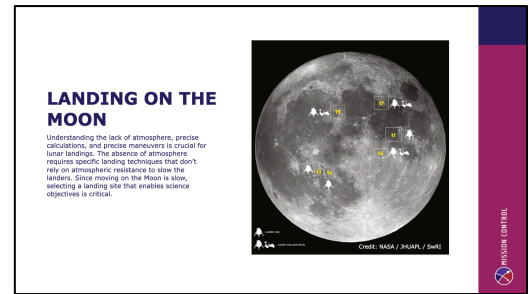
Definition: Orbital mechanics is the study of the motion of objects in space under the influence of gravitational forces. It involves understanding orbits, trajectories, and the interaction of celestial bodies.

Significance in Rocket Launch: To reach the Moon, rockets follow precise trajectories influenced by orbital mechanics. Achieving the right orbital insertion is critical for a spacecraft to rendezvous with the Moon, and calculations must consider the gravitational forces of both Earth and the Moon.

### Rocket Design Impacts Launching Rockets to the Moon Carrying Rovers

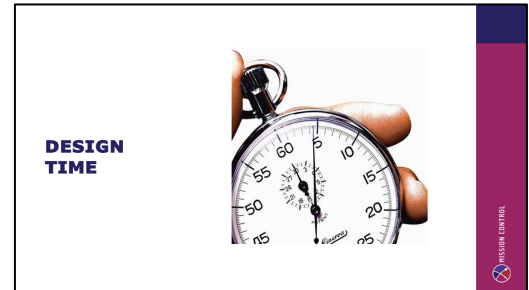
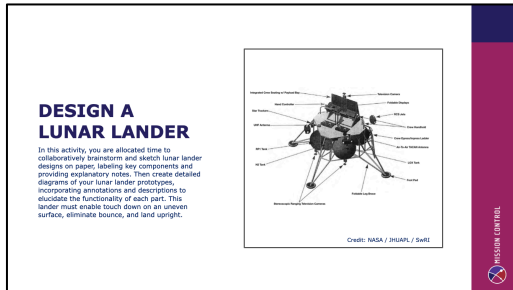
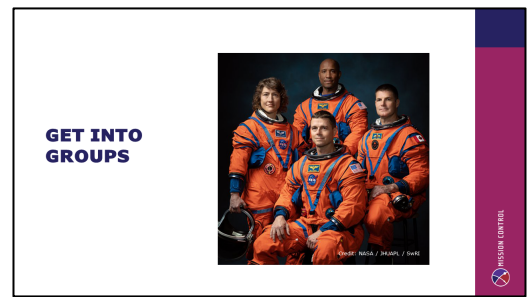
Definition: Rocket design involves the configuration and engineering of a rocket, considering factors like payload capacity, fuel efficiency, and structural integrity.

Significance in Rocket Launch: The design of a rocket impacts its ability to carry payloads, such as lunar rovers. Efficient design allows rockets to carry more weight while consuming less fuel. For Moon missions, the design must also consider the lunar environment, including the challenges of landing and deploying rovers on the lunar surface.



## LANDING ON THE MOON – 10 MINS

Lack of Atmosphere on the Moon: Unlike Earth, the Moon has no atmosphere. This means there's no air to slow down a descending spacecraft. Precise control is necessary to ensure a safe landing.



## GROUP ACTIVITY – 30 MINS

### Designing and Drawing Lunar Lander Prototypes

#### Group Formation:

Divide the students into small groups, with ideally 3-4 students per group. This fosters collaboration and shared thinking.

#### Materials:

Provide each group with drawing materials like paper, markers, coloured pencils, and rulers.

#### Instructions:

Explain to the students that their task is to collaboratively design and draw a lunar lander prototype that can safely transport a rover to the Moon's surface.

Emphasize that the lander must protect the rover during descent and landing, similar to real lunar landers.



## GROUP ACTIVITY – 30 MINS

Encourage students to think creatively and critically while designing their prototypes. They should consider factors like stability, impact absorption, and simplicity of design.

### Design Phase:

Give each group a designated amount of time to brainstorm and sketch their lunar lander designs collaboratively on paper. Encourage them to label key components and include explanatory notes.

### Drawing and Annotation:

Instruct students to draw detailed diagrams of their lunar lander prototypes. They should include annotations and descriptions explaining how each part of the lander functions.

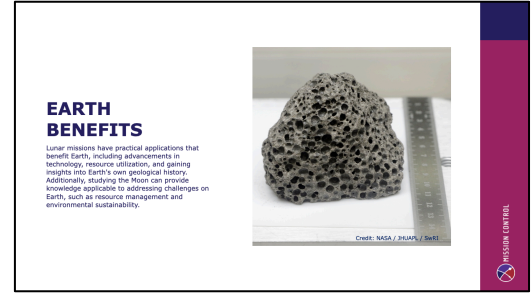
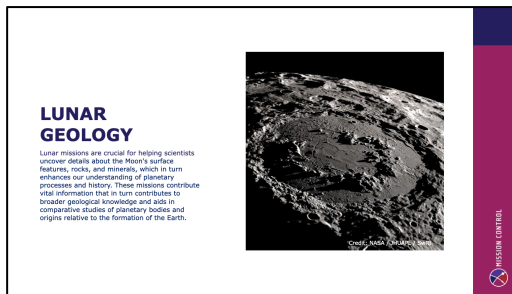
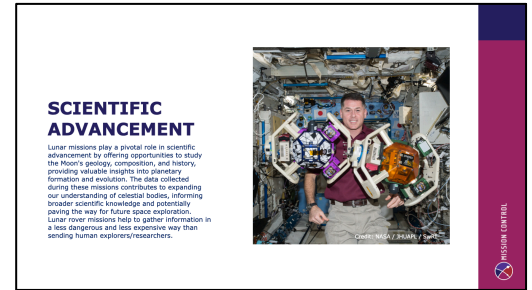
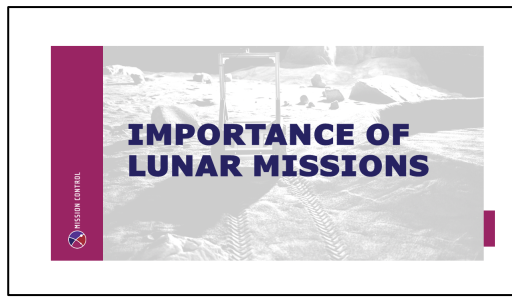
### Presentation:

After the drawing session, have each group present their lunar lander designs to the class. During these presentations, students can describe the design principles they applied and how their prototypes protect the rover during landing.

### Analysis and Discussion:

Facilitate a class discussion following the presentations. Encourage students to analyze the presented designs, pointing out strengths and potential areas for improvement.

Relate their experiences to real lunar landings, discussing the importance of precision and careful engineering in space exploration.



## IMPORTANCE OF LUNAR MISSIONS – 10 mins

### Importance of Space Missions:

Start by explaining that space missions are not mere adventures but essential scientific endeavours. These missions involve sending spacecraft, rovers, or astronauts to explore distant celestial bodies like the Moon, Mars, or even other galaxies.

### Gathering Unique Data:

Emphasize that these missions enable scientists to collect unique and invaluable data that can't be obtained from Earth. For example, discuss how lunar missions have provided us with insights into the Moon's geology, composition, and history.

### Expanding Scientific Knowledge:

Stress the idea that every mission contributes to expanding our knowledge of the universe. Whether it's studying the Moon's surface or examining distant stars and galaxies, space missions help us uncover the secrets of the cosmos.

## IMPORTANCE OF LUNAR MISSIONS – 10 mins

### Fundamental Processes:

Explain that the data and discoveries made during lunar missions contribute directly to our understanding of fundamental processes in the universe. For instance, lunar rocks can reveal information about the formation of planets and the evolution of our solar system.



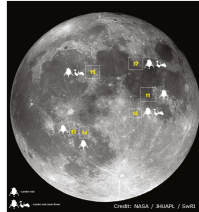
## GETTING OFF EARTH

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## LANDING ON THE MOON

Understanding the lack of atmosphere, precise calculations, and precise maneuvers are crucial for lunar landings as the absence of atmosphere requires specific landing techniques, precise calculations ensure accurate trajectories, and precise maneuvers are essential to navigate the spacecraft safely to the Moon's surface, overcoming the unique challenges of space exploration.



## LUNAR MISSIONS

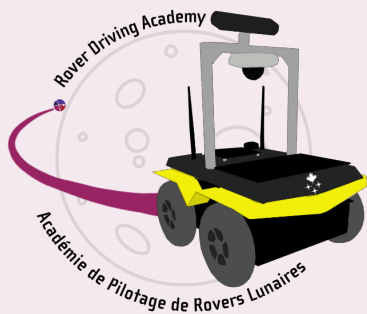
Lunar missions are crucial for Earth's benefit as they contribute to scientific advancement, providing unique data that enhances our understanding of lunar geology. This knowledge, in turn, has broader applications, benefiting both Earth and future space exploration endeavors.



**DISCUSSION – 5 MINS**

**WRAP UP – 5 MINS**





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