



NASA's Mars Rover

Grade(s): *8th*
 Lesson Duration: *Class 50 minutes*
 Course Name(s): *Eyes on Earth Course*
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Directions for using this template: The red text provides guidance on what to include in the sections with the blue or gray headers. Remove this set of directions as well as the red text and replace the red text with your own text.

BIG IDEAS

- Space exploration involves cutting-edge technology and collaboration.
- NASA's Mars Rover mission provides insights into the challenges of space missions.

EDUCATION STANDARDS

NGSS MS-ETS1-1: Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, considering relevant scientific principles and potential impacts on people and the natural environment.

NGSS MS-ETS1-2: Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.

Science Performance Expectations (or state Science standard): <i>(List the PEs here, and then list the associated NGSS elements in the table below.)</i>		
Science and Engineering Practices: <i>(SEP elements connected to the PEs or standards)</i>	Disciplinary Core Ideas: <i>(DCI elements connected to the PEs or standards)</i>	Crosscutting Concepts: <i>(CC elements connected to the PEs or standards)</i>
Asking questions and defining problems. Developing and using models. Constructing explanations and designing solutions. .	ETS1.A: Defining and Delimiting Engineering Problems. ETS1.B: Developing Possible Solutions. PS3.A: Definitions of	Systems and system models. Structure and function.

	Energy.	
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Common Core State Standards: *You are required to connect your lesson to either the CCSS for Math or for ELA. Use your state Math or ELA standards if Common Core is not applicable in your state. However, you are encouraged to list both the CCSS and your state standards.*

Math: *If applicable*

and/or

ELA CCSS.ELA-LITERACY.W.8.7: Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions for further research and investigation.

- Students research various space destinations and related NASA missions to design their own space exploration mission, answering specific questions about their objectives and challenges.

State Math or ELA Standards: *If applicable*

ITEEA Standards: *If applicable*

Other Standards: *(as needed)*

MEASURABLE STUDENT LEARNING OBJECTIVES

- Students will describe the challenges and importance of space missions by evaluating NASA's Mars Rover.
- Students will collaboratively design a space mission, selecting a destination and outlining mission objectives and technology.
 - Students will present their mission, demonstrating an understanding of engineering, science, and technology constraints.

MATERIALS NEEDED

- Computers with internet access.
- NASA resources on Mars Rover missions ([NASA Mars Rover Overview](#)).
- NASA Mars Rover Videos ([NASA Mars Mission Videos](#)).

- Large paper or poster board for mission design.
- Markers and other art supplies for creating posters.
- Printed mission design worksheet for planning (with prompts for destination, objectives, and technology).

ENGAGING CONTEXT/PHENOMENON

The Mars Rover mission has been one of NASA’s most successful endeavors, unlocking critical information about the Red Planet’s potential to support life and the future of human space exploration. Understanding the technology behind these missions, students will work collaboratively to design their own space exploration mission.

DATA INTEGRATION

Students will use data from NASA’s Mars Rover mission, including its objectives, technology, and findings, to inform their own mission designs. By comparing their mission designs to real NASA missions, students will integrate scientific data and technological constraints

TEACHER BACKGROUND KNOWLEDGE

Teachers should be familiar with NASA’s Mars Rover mission and other space exploration endeavors. Teachers should understand the basics of mission planning, including technology requirements, energy needs, and potential challenges in space exploration. Resources to explore:

- [NASA Mars Exploration Program](#)
- [Curiosity Rover Overview](#)
- [Perseverance Rover Overview](#)

DIFFERENTIATION OF INSTRUCTION

For advanced learners: Encourage students to consider more complex technology, mission durations, and potential scientific experiments on their mission.

For struggling learners: Provide a simplified mission template with guiding questions and allow students to work in mixed-ability groups to support peer collaboration.

For English Language Learners (ELLs): Offer visual aids, simplified language, and key vocabulary lists for technical terms related to space missions.

REAL-WORLD CONNECTIONS FOR STUDENTS

Space exploration is directly connected to technological advancements that impact everyday life, from satellite communications to medical technologies. By understanding NASA missions, students can relate these innovations to real-world applications, inspiring future careers in STEM fields.

POSSIBLE PRIOR or MISCONCEPTIONS

Space missions can happen without significant technological or financial constraints.

All space missions are manned.

There is little difference between missions to planets, moons, and other celestial bodies.

LESSON PROCEDURE

This is where you include each phase of the 5E. They should be extremely clear, well organized, and ready to be used by another educator. Be sure that each learning experience meets the guidelines for each “E”. The template below will help you.

5E	Details of 5E Lesson Implementation <i>(Visit BSCS to learn more about the 5E instructional model)</i>
<p>Engage <i>Show a video about NASA's Mars Rover mission https://mars.nasa.gov/</i></p> <p><i>Discuss key questions: Why is space exploration important? What challenges do engineers and scientists face during these missions?</i></p> <p><i>Explain the lesson's objective: to design a space mission similar to NASA's Mars Rover:</i></p>	<p>Lesson Objective Students will describe the challenges and importance of space missions by evaluating NASA's Mars Rover.</p> <p>Standards Addressed 8.ETS1.1: Define a design problem that can be solved through the development of an object, tool, process, or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions.</p> <p>Materials & Resources □ NASA Mars Rover Overview Video: NASA Mars Rover Overview</p> <p>□ Computers with internet access to view the video and engage in follow-up discussion.</p> <p>□ Projector to show the video to the whole class.</p> <p>□ Whiteboard and markers for the teacher to note student responses during the discussion.</p> <p>Procedure: Teacher Action:</p> <ul style="list-style-type: none"> • The teacher introduces the lesson by showing a short video about NASA's Mars Rover mission, which highlights the mission's goals, technological innovations, and challenges faced during space exploration. • After watching the video, the teacher will pose open-ended questions, such as: <ul style="list-style-type: none"> ○ Why is space exploration, like the Mars Rover mission, important for scientific knowledge? ○ What challenges do you think NASA faced when designing the Mars Rover? ○ How might technology evolve to help overcome these challenges in future missions? • The teacher will write key points from the discussion on the whiteboard, helping to guide students in identifying the constraints and challenges involved in space exploration. <p>Student Learning:</p> <ul style="list-style-type: none"> • Students will engage with the content through active listening during the video and participate in a class discussion. This discussion will focus on evaluating the Mars Rover's design, the scientific challenges it addresses, and how technology is used to overcome constraints in space exploration.

	<p>Formative/Summative Assessments During the class discussion, the teacher will use an informal checklist to monitor student participation and assess understanding. The teacher will prompt students with questions about the technological constraints and solutions presented in the video, tracking whether students are able to identify and articulate challenges related to space missions.</p> <p>Modifications For English Language Learners (ELLs):</p> <ul style="list-style-type: none"> • Introduce key vocabulary and concepts before watching the video (e.g., constraints, mission, exploration) with simplified definitions and visual aids. • Encourage peer discussions in small groups where ELLs can share their thoughts in their native language or with the support of a peer, then contribute to the whole class.
<p>Explore Each group will research a potential space destination (e.g., Mars, Jupiter’s moons, asteroids). Students will brainstorm possible mission objectives (e.g., searching for life, collecting geological samples, studying the atmosphere).</p>	<p>Lesson Objective Students will work collaboratively to apply the engineering design process to plan their own space mission.</p> <p>Standards Addressed 8.ETS1.1: Define a design problem that can be solved through the development of an object, tool, process, or system, including scientific knowledge that may limit possible solutions.</p> <p>Materials & Resources □ Computers with internet access for research on potential space destinations.</p> <p>□ NASA Mars Rover Overview: NASA Mars Rover Overview</p> <p>□ Mission planning worksheet for groups to outline their space mission design.</p> <p>□ Whiteboard/markers for brainstorming ideas.</p> <p>Procedure: Teacher Action: The teacher assigns students to small groups. Each group is tasked with researching space destinations (Mars, moons of Jupiter, asteroids) and brainstorming mission objectives. The teacher circulates the room, prompting students with questions about their design and guiding them to think about constraints and challenges.</p> <p> Student Learning: Students work in groups to explore and research potential mission destinations, focusing on selecting a location and beginning to outline their mission objectives.</p>

	<p>Formative/Summative Assessments Formative Assessment: The teacher monitors group discussions and collects the mission planning worksheets to assess student progress. The focus is on evaluating their understanding of the destination, objectives, and initial thoughts on technology constraints.</p> <p>Modifications For English Language Learners (ELLs): Offer a list of vocabulary terms with translations, and allow students to use visual aids like images of planets to help them understand the destinations.</p>
<p>Explain Discuss with students the key components of a space mission:</p> <ul style="list-style-type: none"> • Destination: Why is this location chosen? • Objectives: What do you hope to achieve or discover? • Technology: What tools or rovers will you need? <p>Introduce the mission planning worksheet for students to outline their ideas.</p>	<p>Lesson Objective Students will describe the key components of a space mission, including destination, objectives, and technology requirements.</p> <p>Standards Addressed 8.ETS1.1: Define a design problem that includes scientific knowledge and constraints.</p> <p>Materials & Resources Mission planning worksheet (completed from the Explore phase). Teacher's presentation on key components of a space mission (destination, objectives, technology). Whiteboard/markers for outlining mission components.</p> <p>Procedure: Teacher Action: The teacher presents the key components of a space mission, explaining how each one (destination, objectives, technology) plays a crucial role. The teacher asks each group to share their preliminary mission ideas and provide feedback to refine their designs.</p> <p>Student Learning: Students take notes and refine their mission plans based on the teacher's explanations. They discuss their design choices and adjust their plans according to the outlined constraints and criteria.</p> <p>Formative/Summative Assessments Formative Assessment: Students' mission plans are checked for understanding of the mission components. The teacher gives immediate feedback on how well they define their destination, objectives, and technology.</p> <p>Modifications For ELLs: Provide visual aids for each key mission component (images of rovers, planets, etc.) and pair them with bilingual peers for support.</p>
<p>Elaborate Students will design their space mission using the</p>	<p>Lesson Objective Students will collaboratively design a space mission, choosing a destination and outlining mission objectives and necessary technology.</p> <p>Standards Addressed .ETS1.1: Define and delimit engineering</p>

<p>worksheet and large poster boards.</p> <p>Groups will outline their mission’s objectives, technology needs, and the potential challenges they might face (e.g., lack of oxygen, extreme temperatures).</p> <p>They will create visual representations of their mission.</p>	<p>problems by developing a solution using scientific knowledge.</p> <p>Materials & Resources □ Large poster boards or digital tools for students to design their space mission posters.</p> <p>□ Art supplies (markers, etc.) for visual representations of their missions.</p> <p>□ NASA resources for additional mission research: NASA Mars Exploration.</p> <p>Procedure: Teacher Action: The teacher provides groups with materials to create posters that showcase their space missions, including their destination, objectives, and the technology needed. The teacher circulates, offering guidance and prompting deeper thinking about potential challenges.</p> <p>Student Learning: Students work collaboratively in their groups to elaborate on their mission designs, visually representing their destination, mission goals, and technology. They present their ideas on posters or digitally</p> <p>Formative/Summative Assessments Summative Assessment: The completed posters are assessed based on a rubric that evaluates creativity, understanding of mission components, and consideration of scientific constraints.</p> <p>Modifications For ELLs: Offer sentence starters and key vocabulary lists to help them explain their mission components clearly on their posters.</p> <p>For Advanced Learners: Encourage them to integrate advanced technological solutions or experiment with digital design tools for their posters.</p>
<p>Evaluate</p> <p>Each group presents its mission to the class.</p> <p>As a class, evaluate each mission’s feasibility by discussing its strengths and potential challenges.</p>	<p>Lesson Objective Students will present their mission, demonstrating an understanding of engineering, science, and technology constraint</p> <p>Standards Addressed 8.ETS1.1: Define engineering problems and consider scientific knowledge for solutions.</p> <p>Materials & Resources Completed mission posters or digital presentations.</p> <p>Procedure: Teacher Action: The teacher facilitates group</p>

presentations, asking each team to present their space mission poster. After each presentation, the teacher and peers provide constructive feedback, asking probing questions about the feasibility and constraints of the missions.

Student Learning: Students present their mission to the class and answer questions from their peers and the teacher, demonstrating their understanding of the space mission design process.

Formative/Summative Assessments Summative Assessment: The teacher uses a rubric to evaluate the final presentations based on creativity, collaboration, understanding of mission components, and the consideration of scientific and technological constraints.

Modifications For ELLs: Provide opportunities for practice presentations with bilingual peers or teachers before presenting to the whole class.

REFERENCES

- *List all references using APA formatting.*
- *Highlight in yellow to identify content in your lesson that was borrowed from elsewhere and provide the citation below. In the lesson, describe how what you borrowed was modified for your audience.*
- NASA. (n.d.). *Mars Rover Overview*. NASA. Retrieved from <https://mars.nasa.gov/>
- Tennessee Department of Education. (2017). *Tennessee English Language Arts Standards (Grade 8)*. Tennessee State Government. Retrieved from https://www.tn.gov/content/dam/tn/education/standards/ela/stds_ela_gr_8.pdf
- OpenAI. (2024). *ChatGPT (4o)* [Large language model]. <https://chatgpt.com/c/66e32a91-195c-8001-9cf6-a8b1910b951c> (learning objectives, procedure, and modifications).