Journey to Mars: Exploring the Red Planet with NASA

Grade(s): 7th Grade Science
Lesson Duration: Class 2+ Days
Course Name(s): Science
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BIG IDEAS

Students will explore the science and technology needed for space exploration, looking at NASA's efforts to send humans to Mars. They will learn about the challenges of living on Mars and the technologies necessary to overcome those challenges.

EDUCATION STANDARDS

Science Performance Expectations (or state Science standard):
MS-ESS1-3:
Analyze and interpret data to determine scale properties of objects in the solar system.
In this lesson, students will analyze NASA's data on Mars to understand the planet's size, distance from Earth, and environmental properties.

MS-ETS1-1:
Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.
Students will apply these concepts when planning a mission to Mars, designing habitats, and addressing the challenges of sustaining human life on Mars.

Science and Engineering Practices:	Disciplinary Core Ideas:	Crosscutting Concepts:
Analyzing and Interpreting Data: Students will explore and analyze Mars data using NASA's interactive tools and websites to better	**ESS1.B**: Earth and the Solar System: The solar system consists of the sun and a collection of objects, including planets, their	**Scale, Proportion, and Quantity**: Students will explore the vast distances between Earth and Mars, as well as the

understand the Martian surface and environment. **Developing and Using Models**: Students will use models to design a Mars habitat and mission, considering elements such as food, water, shelter, and power systems needed for human survival. **Planning and Carrying Out Investigations**: In group activities, students will plan a human mission to Mars, investigating how to address environmental challenges using the data provided by NASA.	moons, and asteroids that are held in orbit around the sun by its gravitational pull. This idea will be addressed as students learn about Mars's position in the solar system and the conditions on its surface. **ETS1.A:** Defining and Delimiting Engineering Problems: The more precisely a design task's criteria and constraints are defined, the more likely it is that the solution will be successful. Students will encounter this concept when designing a Mars mission and ensuring it meets the constraints of Mars's environment. **ETS1.B**: Developing Possible Solutions: A solution needs to be tested, and then modified based on test results, to improve it. Students will address this when they design, test, and modify their Mars habitats and life support systems.	proportions of habitats needed to sustain human life in such a harsh environment. **Cause and Effect**: The lesson will explore how certain conditions on Mars (e.g., lack of breathable atmosphere, radiation) cause specific engineering problems that NASA needs to address for a successful mission. **Systems and System Models**: Students will model the systems required for survival on Mars, including life support, communication, and resource management systems.

Common Core State Standards
Math:
While this lesson is focused primarily on science, there are opportunities to incorporate math standards, particularly when students are planning their Mars mission and calculating distances, supplies, or resources.
CCSS.MATH.CONTENT.7.RP.A.3:
Use proportional relationships to solve multistep ratio and percent problems.
Students could use proportional relationships to calculate the amount of resources (e.g., food, water) needed to sustain human life on Mars based on population and mission duration.

CCSS.MATH.CONTENT.7.G.B.6:
Solve real-world and mathematical problems involving area, volume, and surface area of two- and three-dimensional objects.
When students design habitats, they can calculate the surface area and volume of structures needed to accommodate human life on Mars.

ELA:
This lesson presents different chances for students to connect with ELA standards through research, discussion, and writing activities.
CCSS.ELA-LITERACY.RI.7.1:
Cite several pieces of textual evidence to support analysis of what the text says explicitly as well as inferences drawn from the text.
Students will be required to analyze NASA resources and cite evidence in discussions and writing about Mars exploration.

CCSS.ELA-LITERACY.W.7.2:
Write informative/explanatory texts to examine a topic and convey ideas, concepts, and information through the selection, organization, and analysis of relevant content.
The homework reflection on living on Mars ties into this standard, where students explain their understanding based on the information they've researched.

CCSS.ELA-LITERACY.SL.7.1:
Engage effectively in a range of collaborative discussions with diverse partners, building on others' ideas and expressing their own clearly.
The group activity of designing a Mars mission encourages collaborative discussions, where students contribute and respond to peer feedback

ITEEA Standard 3:
Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.
The lesson connects the technologies used in space exploration (e.g., rovers, habitats) to scientific principles and problem-solving.

ITEEA Standard 10:
Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem-solving.
In their mission planning, students will experiment with ideas and solutions for

overcoming Mars’s environmental challenges, using NASA's research as a foundation.
Other Standards:

MEASURABLE STUDENT LEARNING OBJECTIVES

- Students will be able to analyze data from NASA's Mars missions and describe key features of the Martian environment.
- Students will plan a mission to Mars, considering necessary life support systems, shelter, and exploration tools.
- Students will understand the challenges and technologies required for human settlement on Mars.

MATERIALS NEEDED

NASA website access
    Mars Exploration Program: https://mars.nasa.gov
    Mars Rover Mission: https://mars.nasa.gov/mars2020
Large touch screen TV for visual aids
    Use this for displaying NASA’s videos, simulations, and live data feeds.
Digital devices for activities
NASA’s Mars Interactive Tools
    3D Models: https://mars.nasa.gov/resources/25042
    Mars Trek: https://trek.nasa.gov/mars

ENGAGING CONTEXT/PHENOMENON

Hook students by asking: "What do we need to survive on Earth and what would we need to survive on Mars? How can we bring human life to Mars?" This can spark curiosity and questions that drive the lesson forward.

Show students images of Mars’s landscape (e.g., craters, canyons, dust storms), and ask them to imagine what it would be like to live and work on this barren planet.

Use NASA’s Mars overview (Mars Facts) to introduce how far Mars is from Earth, its extreme temperatures, and lack of breathable air.

DATA INTEGRATION

Mars Environmental Data:
    Atmospheric composition, surface temperatures, and radiation levels from NASA’s Mars missions.
    Students will use this information to understand the challenges of living on Mars and designing appropriate habitats and life support systems.
Mars Rover Data:
    Students will analyze rover mission data, including images and discoveries made by Curiosity and Perseverance.
    NASA’s Mars Rover Mission data provides a rich source of real-world exploration data, allowing students to explore Martian geography and geology.
How Students Will Use Data:

Students will interpret the data to identify challenges (e.g., lack of oxygen, extreme cold) and devise solutions in their Mars mission planning.
They will also use interactive tools like Mars Trek to explore the surface of Mars and propose landing sites for human missions based on real-world data.

TEACHER BACKGROUND KNOWLEDGE

To teach this lesson, I will have an understanding of the following:
Basic Mars Information:

Familiarize yourself with Mars's climate, geography, and the challenges associated with sending humans there.
NASA's Mars Exploration Program : https://mars.nasa.gov

NASA's Current Mars Missions:

Understand the goals of the Perseverance rover and how its discoveries are contributing to planning human missions.
Perseverance Rover: https://mars.nasa.gov/mars2020

Human Space Exploration Technologies:

Review NASA's plans for developing technologies that would allow humans to live and work on Mars (e.g., habitats, water recycling, growing food).
Mars Mission Concepts : https://mars.nasa.gov

DIFFERENTIATION OF INSTRUCTION

Pair students with tech-savvy peers or guide them through one-on-one support.
Allow more time for activities and assessments.
Provide clear, step-by-step instructions.

REAL-WORLD CONNECTIONS FOR STUDENTS

Many technologies developed for space exploration, such as water recycling and solar power, are now used on Earth.

Thinking about the importance of renewable resources and sustainable living—concepts directly applicable to life on Earth.

Human drive to explore the unknown

POSSIBLE PRIOR or MISCONCEPTIONS

Students might assume Mars has a similar atmosphere and conditions as Earth.

Some students might think space travel is instantaneous, so it's important to go over the long journey and the logistical challenges of reaching Mars.

LESSON PROCEDURE

5E	Details of 5E Lesson Implementation

Engage Hook students by asking: "What do we need to survive on Earth and what would we need to survive on Mars? How can we bring human life to Mars?" Learn about what students already know and want to know.	**Lesson Objective** Introduce students to the concept of Mars exploration **Standards Addressed** NGSS: MS-ESS1-3 (Analyze and interpret data to determine scale properties of objects in the solar system). CCSS ELA: CCSS.ELA-LITERACY.SL.7.1 (Engage effectively in a range of collaborative discussions). **Materials & Resources** NASA website access Mars Exploration Program : https://mars.nasa.gov Mars Rover Mission : https://mars.nasa.gov/mars2020 Large touch screen TV for visual aids Digital devices for activities NASA's Mars Interactive Tools 3D Models: https://mars.nasa.gov/resources/25042 Mars Trek : https://trek.nasa.gov/mars **Procedure:** Begin with a brief introduction using images and videos from the Perseverance rover, showcasing Mars's rocky and desolate landscape. Ask students what they already know about Mars and what they would need to survive there. Use the Mars Facts page from NASA to discuss how far Mars is from Earth and some key features (e.g., atmosphere, gravity). Facilitate a class discussion where students pose questions they have about Mars. **Formative/Summative Assessments** Use a KWL (Know, Want to know, Learned) chart to assess prior knowledge and student interest. **Modifications** Allow more time for activities and assessments.
Explore Plan for students to engage in hands-on activities that are designed to facilitate conceptual change.	**Lesson Objective** Students will explore NASA's Mars information and interactive tools to understand the Martian environment and the challenges of landing on Mars. **Standards Addressed** NGSS: MS-ETS1-1 (Define criteria and constraints of a design problem with precision). CCSS Math: CCSS.MATH.CONTENT.7.RP.A.3 (Use proportional relationships to solve multistep problems). **Materials & Resources** NASA's Mars Interactive Tools :

	Mars Trek 3D Models: https://mars.nasa.gov/resources/25042 **Procedure:** Students use the Mars Trek tool to explore Mars's terrain, zooming in on different areas. Identify interesting features (e.g., craters, valleys, mountains) and take notes on what they observe. Discuss the significance of these features for future Mars missions, where would they want to land, and why? **Formative/Summative Assessments** Have students upload online notes on Mars's surface features. Assess understanding by asking students to explain their landing site choices based on the data they observed **Modifications** Pair students in mixed-ability groups for support. Provide a guided worksheet
Explain Facilitate opportunities for students to explain their understanding of the concepts and processes and make sense of new concepts.	**Lesson Objective** Students will explain the challenges of living on Mars and analyze the necessary technologies for a successful mission. **Standards Addressed** NGSS: MS-ETS1-1 (Define criteria and constraints of a design problem with precision). CCSS ELA: CCSS.ELA-LITERACY.W.7.2 (Write informative/explanatory texts to examine a topic). **Materials & Resources** NASA's resources on Mars habitats and mission challenges (e.g., radiation, food, water recycling). **Procedure:** Review NASA's technologies for supporting human life on Mars (shelters, water recycling, food production). Facilitate a group discussion where students explain their understanding of the key challenges of living on Mars. Ask students to explain the importance of certain technologies (e.g., spacesuits, solar power) and how they would use them in their Mars mission design. **Formative/Summative Assessments** Have students upload online notes on Mars's surface features. Assess understanding by asking students to explain their landing site choices based on the data they observed **Modifications**

	Allow students to use visual aids (drawings, models) to support their explanations if writing is difficult.
Elaborate Provide applications of concepts and opportunities to challenge and deep ideas; build on or extend understanding and skills.	**Lesson Objective** Students will apply their understanding by designing a complete mission to Mars, considering the necessary systems (life support, shelter, power). **Standards Addressed** NGSS: MS-ETS1-1 (Define the criteria and constraints of a design problem). CCSS ELA: CCSS.ELA-LITERACY.SL.7.1 (Engage in collaborative discussions). **Materials & Resources** NASA resources: Mars habitats, life support systems, and mission planning materials. Digital devices for students to create models of their Mars missions. **Procedure:** In groups, students will use the data they've gathered to design a human mission to Mars, focusing on key systems (food, water, shelter, power). Students create models (physical or digital) of their mission plans and prepare to present them to the class. Facilitate discussions where students critique each other's designs and propose improvements based on what they've learned. **Formative/Summative Assessments** Assess group notes/presentations of their Mars missions for accuracy, creativity, and practicality. Provide a rubric assessing how well students addressed the challenges and used data to support their decisions. **Modifications** Allow students to create digital presentations (PowerPoint, video) if public speaking is a challenge. Use checklists or rubrics to guide students in developing their mission designs.
Evaluate Students are encouraged to assess their understanding and abilities. It also provides opportunities for teachers to evaluate their	**Lesson Objective** Students will assess their understanding by reflecting on the challenges of living on Mars and the potential solutions they've proposed. **Standards Addressed** NGSS: MS-ESS1-3 (Analyze and interpret data to determine scale properties of objects in the solar system). CCSS ELA: CCSS.ELA-LITERACY.W.7.2 (Write informative/explanatory texts).

progress toward achieving the educational objectives of the lesson.	**Materials & Resources** Students' mission designs, NASA resources, reflection prompt for writing activity. **Procedure:** Groups will work a presentation on reflection answering the question: “What would it be like to live on Mars for a year?” They should use evidence from their research and mission design to support their reflections, citing specific technologies and solutions. **Formative/Summative Assessments** Assess group presentations of their Mars missions for accuracy, creativity, and practicality. Provide a rubric assessing how well students addressed the challenges and used data to support their decisions **Modifications** Offer alternative formats for reflection (notes)

REFERENCES

1. NASA. (n.d.). **Mars Exploration Program**. NASA. Retrieved from https://mars.nasa.gov

2. NASA. (n.d.). **Mars 2020 Perseverance Rover**. NASA. Retrieved from https://mars.nasa.gov/mars2020

3. NASA. (n.d.). **Mars 3D Models**. NASA. Retrieved from https://mars.nasa.gov/resources/25042

4. NASA. (n.d.). **Mars Trek: Solar System Treks Project**. NASA. Retrieved from https://trek.nasa.gov/mars