FUTURE U.

Boeing 360 Experience | Rover Exploration

Objectives

Students wil be able to:

- **Assess** the challenges that Mars presents and hypothesize what engineers need to consider when constructing a rover.
- **Synthesize** what they have learned to develop an updated rover design that considers the goals of Mars rovers and the challenges they face.
- **Develop** new research questions for Martian exploration and collaborate to compose instructions that will guide the rover through this data collection.

Overview

Our 360 experience transports students to Mars through the navigation of a deep space rover. Students will investigate the main features of the rover as they explore the planet and collect samples for research. During the experience, students will learn about the challenges of the Martian environment and develop their own modified rover designed to function optimally amidst these challenges. Students will then take on the roles of two different space careers as they collaborate and plan for the rover's next mission!

Grade level

6–8

Materials

- Devices with internet access, at least one per every 2–3 students
- Boot Up handout, one per student
- Experience handout, one per student
- Reorient #1 handout, one per student
- Reorient #2 handout, one per student

Boot Up

Tell students that they will soon be participating in a simulation in which they navigate a Mars rover. Explain that rovers are vehicles especially designed for space exploration. Without astronauts nearby, rovers are programmed and controlled remotely to accomplish their missions in order to help us understand more about outer space from afar.

Explain that rovers on Mars face their own unique set of difficulties. For this reason, rovers must be prepared specifically for a Martian mission. Divide students into pairs and distribute a Boot Up handout to each partnership. Instruct students to read through the challenges that are presented and brainstorm what engineers may need to consider when building a rover that will not only survive on Mars but also be able to collect important data.

Experience

Distribute an Experience handout to every student and review the instructions. Explain that each student will be responsible for taking notes on this sheet as they move through the 360 experience.

Reorient

Two activity options are available for students to summarize, apply and synthesize their learning:

Reorient #1:

Challenge students to design their own updated Mars rover! Students should use mars.nasa.gov/mer/mission/ overview to learn more about the features of current Mars rovers. They will then combine what they have learned to design a new and improved rover that continues to take Mars' challenges into account. Remind students of the importance of justifying their design decisions.

Reorient #2

In the 360 exploration, students used the rover to explore a section of Mars. It's now up to the class to continue this exploration! Student pairs will first think like planetary scientists as they access mars.nasa.gov/mer/multimedia/images, choose a Mars location to investigate further, and develop research questions to guide this exploration. They will then swap handouts with another pair and take on the role of rover drivers as they develop instructions for the rover's course of action!

Note: Students may complete this Reorient #2 handout with either the original Mars rover *or* their updated rover in mind.

National Standards

Next Generation Science Standards

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.

Standards for Technological Literacy

17.H. Information and Communication systems allow information to be transferred from human to human, human to machine, and machine to human.

17.I. Communication systems are made up of a course, encoder, transmitter, receiver, decoder and destination.

Common Core English Language Arts Standards

CCSS.ELA-LITERACY.CCRA.W.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

CCSS.ELA-LITERACY.CCRA.SL.1 Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.

Boot Up

Directions: Mars is not an easy planet to navigate…even for a machine! Below are just some of the challenges that a Mars rover faces. With your partner, read each challenge and then brainstorm what aerospace engineers may have to consider as they design a rover that can explore this planet.

Challenges	**Think like an aerospace engineer!** **How may this impact a rover's design?**
Landing: Before rovers can explore Mars and collect data, they must first successfully land on this faraway planet!	
Temperature: The average temperature on Mars is about -81°F. Temperatures range from about -284°F to 86°F, and can change as much as 235° in a single day!	
Dust: Mars is covered with a very fine dust that sticks to surfaces easily. Occasional strong dust storms occur.	
Martian Exploration: Mars' surface is difficult to navigate. Its surface is rocky and rugged, and it is filled with crater canyons and inactive volcanos.	
Other:	

Experience Handout

Directions: As you learn more about the Mars rover throughout the 360 experience, use the space below to take notes on the rover's important features as well as any challenges that it faces. Complete sentences are not needed, but notes must be taken!

Part 1: Label the rover's key parts below, as well as why each part is important. Be as specific as possible.

Part:_____

Function_____

_____

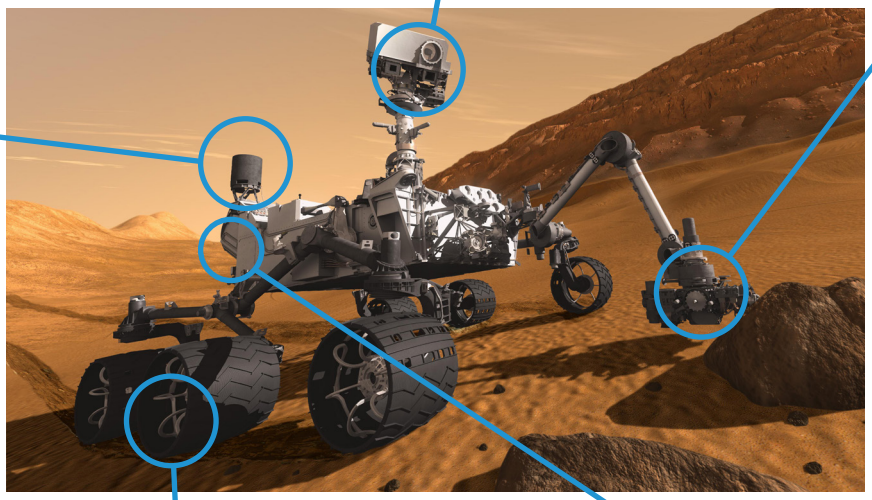
_____

Part:_____

Function_____

_____

_____



Part:_____

Function_____

_____

_____

Part:_____

Function_____

_____

_____

Part:_____

Function_____

_____

_____

Part 2: As you navigate the rover, jot down any challenges you face, as well as new or improved rover elements that may help make its mission more successful. Sketch or explain your ideas in the space below.

Reorient #1

Directions: Pretend that you now work in the field of Aerospace Engineering, and you have been selected to submit a design proposal for an updated Mars rover! Follow the steps below to complete this proposal.

Step 1: As you read NASA's Overview on Mars rovers, take notes on the rovers' most important features. This will help you consider what you want your updated rover to include.

Step 2: Review the challenges you learned about during the Boot Up Activity, the notes you took during the 360 experience, *and* the notes you jotted above. Then combine what you have learned to create a labeled sketch of an updated rover that you think will be able to explore Mars even more successfully!

Step 3: Choose three features or design elements of your new rover and explain why you included this part or designed your rover this way:

1. _____

   _____

2. _____

   _____

3. _____

   _____

Reorient #2

Directions: You already explored a section of Mars, but there's a lot more ground to cover. Follow the directions below to investigate further!

Part 1

1. With a partner, use the website provided by your teacher to review the images that the Curiosity Rover captured. Then think like a planetary geologist (e.g. a scientist who studies all aspects of planets) and choose one image that you would like to learn more about.
2. Record three research questions to guide your investigation of this area in the chart below. For instance: Are you curious about the color of the soil, the size of the craters, or _____?
3. Then use the chart's right column to explain how the rover could be used to answer these questions. For instance: Could it take pictures, collect samples, provide measurements, etc.?

Research Questions	How will the rover help you?
1.	
2.	
3.	

Part 2:

Background: Every day, rover drivers located on Earth review rover activity and develop instructions for the following day. They can communicate to rovers through a computer software system that NASA developed especially for rovers. In this computer system, commands are written in a specific code language that the rovers understand. This code is then transmitted to Mars from the Deep Space Network, which are antennas located around the world.

Your job: Think like a rover driver! Swap handouts with another pair of students, review the image they selected, and read the research questions that they recorded. Then on a separate piece of paper, write instructions for the Mars rover that will help these planetary geologists collect their data.

Tips:

- ***Do*** be as detailed as possible…The rover will only do exactly what you say. You may make up some information, so your instructions are more specific. Instead of *Go straight,* for example, you may say *Move forward 200 feet until you reach the crater edge.*
- ***Don't*** worry about writing in code…The software will translate your instructions!