Lesson 1: Overview of the Solar System

Engagement Questions:

How is the motion of Venus and Uranus different than the motion of the other planets?
________________________________________________________________________

Describe the difference between planetary spin and orbital motion. _______________________
________________________________________________________________________________

Is it possible for a planet to have both planetary spin and orbital motion? Explain. __________
________________________________________________________________________________

What is an Astronomical Unit? Why is it important? _____________________________________
________________________________________________________________________________

What is the value of an Astronomical Unit in kilometers? _______________________________ km

Convert an Astronomical Unit into miles __________________________________________________mi

Convert an Astronomical Unit into light years ___________________________________________ ly

Exploration Activity:

After determining the scale factor of _______________________ complete the table below.

<table>
<thead>
<tr>
<th>Planet</th>
<th>Actual Diameter (in km)</th>
<th>Scaled Diameter (in mm)</th>
<th>Corresponding Sphere</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mercury</td>
<td>4879.4 km</td>
<td>2.1 mm</td>
<td>bb shot</td>
</tr>
<tr>
<td>Venus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earth</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mars</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jupiter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uranus</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Neptune</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Exploration:

How does the distance between the planets compare to the size of the individual planets or even the sun? Explain.

What observations can you make about the astronomical size of our solar system?

Explanation:

Explain how you and your team calculated the correct scaled diameters of the planets. You may use words, pictures or equations to explain your answer.

Evaluation:

How might you describe the solar system to a friend who knows nothing about the relative sizes of the sun and planets or the distances among them?
Lesson 2: Introduction to Mars

Engagement Question:

<table>
<thead>
<tr>
<th>Mars</th>
</tr>
</thead>
<tbody>
<tr>
<td>What I KNOW about Mars</td>
</tr>
<tr>
<td>What I WONDER about Mars</td>
</tr>
<tr>
<td>What I LEARNED about Mars</td>
</tr>
</tbody>
</table>

Exploration Activity:

Examine your unknown foreign object. What observations can you make about its surface?
_________________________________________________________________________________
_________________________________________________________________________________

Based on what you have read about the surface of Mars, how does the surface of your unknown foreign object compare? ____________________________________________________________
_________________________________________________________________________________
_________________________________________________________________________________

Draw a picture of the surface of your unknown foreign object.
Exploration Activity:

Next, cut your sample in half. Describe what you see. __________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

Using your straw, take a core sample of your unknown foreign object. What observations can you make? __________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

Using the reading selection of Mars as a guide, how does the core sample of your unknown foreign object compare? __________________________________________
____________________________________________________________________________________
____________________________________________________________________________________

Draw a picture of the core sample of your unknown foreign object.

As you have observed both the outside and inside of your foreign object, how have you altered your sample? What effect might this have on your conclusions? __________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
Exploration Activity Cont.:

Make a prediction of what would happen if your sample came into contact with water. ______

____________________________________________________________________________________

Now, take an interior slice of your sample that measures no more than 3mm (about 1/8”) thick and submerge it in water. Record your observations:

<table>
<thead>
<tr>
<th>Minutes Elapsed</th>
<th>Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 minute</td>
<td></td>
</tr>
<tr>
<td>2 minutes</td>
<td></td>
</tr>
<tr>
<td>5 minutes</td>
<td></td>
</tr>
</tbody>
</table>

Through your research and based on the data you have collected, could this unknown foreign object have come from Mars? Explain your conclusion. ________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

Evaluation:

How do you think the activities you completed on making observations and on researching Mars will help you design a successful mission for your Mars Rover? ________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________________________________
**Lesson 3: Research Tools and Skills**

**Engagement Questions:**

What kind of fly-by photographs were the Mariner IV, VI, and VII able to take of Mars? __________

_________________________________________________________________________________

What evidence did Viking 1 discover that makes us think there might have been water on Mars? __

_________________________________________________________________________________

What are the names of the twin Mars Exploration Rovers (MER) that landed on Mars in 2004?

_________________________________________________________________________________

According to the tour, what is Opportunity’s next big destination? _________________________

_________________________________________________________________________________

Why did the scientists know that the Phoenix Lander wouldn’t last very long? ________________

_________________________________________________________________________________

**Exploration Activity:**

<table>
<thead>
<tr>
<th>Mars Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Meaning of the Name</strong></td>
</tr>
<tr>
<td><strong>Diameter of Mars in mi/km</strong></td>
</tr>
<tr>
<td><strong>Length of a Day</strong></td>
</tr>
<tr>
<td><strong>Length of a Year</strong></td>
</tr>
<tr>
<td><strong>Maximum Distance from Earth in mi/km</strong></td>
</tr>
<tr>
<td><strong>Minimum Distance from Earth in mi/km</strong></td>
</tr>
<tr>
<td><strong>Gases in the Atmosphere</strong></td>
</tr>
<tr>
<td><strong>Average Temperature in °C/°F</strong></td>
</tr>
<tr>
<td><strong>Temperature Range in °C/°F</strong></td>
</tr>
<tr>
<td><strong>Satellites</strong></td>
</tr>
</tbody>
</table>
**Exploration Activity:**

In what year was Mars first viewed by telescope? _________________________________

What is Olympus Mons? ________________________________

Where is the largest gorge in the solar system located? _____________________________
What is it called? ________________________________

What causes Mars to have seasons? ________________________________
How does that compare to how Earth has seasons? ________________________________

How does the length of a day on Mars compare to the length of a day on Earth? __________

If you weigh 125lbs on Earth, how much would you weigh on Mars? _______________________

<table>
<thead>
<tr>
<th>Year</th>
<th>US Lander Name</th>
<th>Reason for Mission</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>Viking 1 Orbiter/Lander</td>
<td>First successful landing on Mars</td>
</tr>
<tr>
<td>1975</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1975</td>
<td>Mars Global Surveyor</td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td></td>
<td>High resolution images of Mars</td>
</tr>
<tr>
<td>2003</td>
<td>MER - Opportunity</td>
<td></td>
</tr>
<tr>
<td>2005</td>
<td></td>
<td>Returned more than 26 terabits of data (more than all other Mars missions combined)</td>
</tr>
<tr>
<td>2012</td>
<td>Phoenix Mars Lander</td>
<td></td>
</tr>
</tbody>
</table>
Evaluation:

Which of the informational text features you learned about today was the most helpful to you in researching information for your Mars Rover project?

___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

Explanation:

Based on the information you have researched about Mars, complete the Venn Diagram. If more space is needed, complete your Venn Diagram on a separate page and tape it neatly into the space below.
Engagement Questions:

What are the three most important details to help find the lost rover?

1. ______________________________________________________________
2. ______________________________________________________________
3. ______________________________________________________________

Use the information above to design a draft of your lost rover poster. Then, create your final copy on the paper from your teacher.
Exploration Activity:

Using what you have learned about identifying important details, use the resources provided to learn about different aspects of Mars.

Terrain
1. __________________________________________________________
2. __________________________________________________________
3. __________________________________________________________
4. __________________________________________________________
5. __________________________________________________________
6. __________________________________________________________

Climate
1. __________________________________________________________
2. __________________________________________________________
3. __________________________________________________________
4. __________________________________________________________
5. __________________________________________________________
6. __________________________________________________________
Exploration Activity Cont.:

Atmosphere

1. ________________________________________________________________

2. ________________________________________________________________

3. ________________________________________________________________

4. ________________________________________________________________

5. ________________________________________________________________

6. ________________________________________________________________

Choose a team category: ________________________________

1. ________________________________________________________________

2. ________________________________________________________________

3. ________________________________________________________________

4. ________________________________________________________________

5. ________________________________________________________________

6. ________________________________________________________________
Explanation:

After each team has shared their most important details with the class, record the most important details that would help you to identify and distinguish Mars from other planets or planetary bodies.

1. 

2. 

3. 

4. 

5. 

6. 

7. 

Evaluation:

How do I know when I’ve found important information in my reading? 

____________________________________________________________________________________

____________________________________________________________________________________

____________________________________________________________
Lesson 5: Selecting Team Rover Missions

Engagement Questions:

As your teacher shares and discusses your ideas with the class, write the three questions that you think would be the most interesting to investigate.

1. __________________________________________________________________________________
2. __________________________________________________________________________________
3. __________________________________________________________________________________

Exploration Activity:

Work with your team to narrow your possible questions to a total of three possible questions for your team to consider. Write them below.

1. ________________________________________________________________________________
2. ________________________________________________________________________________
3. ________________________________________________________________________________

Then, choose the one scientific question that:
- Has a scientific basis
- Is an interesting question to answer
- Addresses a specific scope
- Interests all students on your team

Once, your team has decided on the one scientific or technological question that you will answer, put a star next to it.

Teacher Checkpoint: ______
Explanation:

Now that you have determined your team’s scientific question, use the chart below and circle the mission that best matches your question. If your question does not match any of the missions, select Mission 9 and create your own using the others as a guide.

<table>
<thead>
<tr>
<th>Mission</th>
<th>Mars Rover Mission Choices</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Explore the craters on Mars</strong>. Your vehicle will try to find a crater suitable for use as a domed settlement site. It should make measurements, test the soil and take photographs.</td>
</tr>
<tr>
<td>2</td>
<td><strong>Explore the polar ice caps of Mars</strong>. Mars has carbon dioxide ice and water ice. Your vehicle should determine how much of each type of ice there is and map the distribution and depth. Samples of the ice should be analyzed for impurities, and its potential to be purified.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Explore the valleys of Mars</strong>. Rift valleys will provide information about the geologic history of the planet, while river valleys might provide clues as to the sources of past water or evidence of ancient forms of life. Devise a method to collect samples and analyze them.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Analyze the weather at several sites that have been identified as possible areas for future settlement</strong>. Instruments will need to make careful measurements of temperature, wind, and the composition of the atmosphere (gases and water vapor).</td>
</tr>
<tr>
<td>5</td>
<td><strong>Identify the elements and compounds found in the rocks and soil of Mars</strong>. Determine how much oxygen is present, and whether the soil could be used for planting or if metal ores are present for future mining.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Search for forms of water on Mars possibly found a layer of frozen soil, called permafrost</strong>. Your vehicle will be exploring the areas near the poles, drilling tens to hundreds of meters below the surface, providing data for future Mars colonies.</td>
</tr>
<tr>
<td>7</td>
<td><strong>Explore for fossils of ancient life forms in the riverbeds and the canyons of Mars</strong>. Samples that are collected will need to be mapped, analyzed and photographed.</td>
</tr>
<tr>
<td>8</td>
<td><strong>Search for present life on Mars in the Polar Regions</strong>. Microbes have been found in the permafrost and glaciers on Earth, some remain dormant until they are warmed up. Design a system to gently warm and analyze polar and permafrost samples, looking for similar occurrences on Mars.</td>
</tr>
<tr>
<td>9</td>
<td>Develop your own mission ________________________________________________</td>
</tr>
</tbody>
</table>

Evaluation:

Why is it important to form a valid (reasonable or sensible) and specific scientific question before conducting your research?

__________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

__________________________________________________________

Teacher Checkpoint: ______
Engagement Questions:

Your teacher’s scientific question has to do with Saturn:

*Can an object stay in orbit around Saturn somewhere else besides the rings?*

Brainstorm some possible solutions to this scientific question to share with your teacher and your class.

Solution #1 __________________________________________________________

____________________________________________________________

Why is this solution a good idea? ____________________________________

____________________________________________________________

Solution #2 __________________________________________________________

____________________________________________________________

Why is this solution a good idea? ____________________________________

____________________________________________________________

Solution #3 __________________________________________________________

____________________________________________________________

Why is this solution a good idea? ____________________________________

____________________________________________________________

Solution #4 __________________________________________________________

____________________________________________________________

Why is this solution a good idea? ____________________________________

____________________________________________________________
### Exploration:

Using your teacher’s example as a guide, brainstorm your team’s scientific or technological question. Narrow your solutions down to one and circle it:

<table>
<thead>
<tr>
<th>Mission Questions</th>
<th>Proposed Missions</th>
</tr>
</thead>
<tbody>
<tr>
<td>How might this happen?</td>
<td></td>
</tr>
<tr>
<td>What else could happen?</td>
<td></td>
</tr>
<tr>
<td>Have we thought this through?</td>
<td></td>
</tr>
<tr>
<td>Does this mission make sense?</td>
<td></td>
</tr>
<tr>
<td>Can this be done?</td>
<td></td>
</tr>
<tr>
<td>Is it possible and/or reasonable?</td>
<td></td>
</tr>
</tbody>
</table>

### Evaluation:

How does coming up with a plausible solution for your scientific question help you design the measurements you need for your Mars Rover mission?

____________________________________________________
____________________________________________________
____________________________________________________
Lesson 7: How Do I Measure This?

Engagement Questions:

Why is it important to have a standardized unit of measure? 
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

How can you ensure that you are making accurate measurements? 
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________
__________________________________________________________________________________

Exploration Activity:

The question that you and your team will answer during this experiment is:

How does the height of the item dropped affect the diameter of the crater?

During this experiment you will learn how craters form. To start, we will need three objects that we will pretend are meteors. With your team, decide which three objects you will use:

marble  ping pong ball  dried peas  golf ball  gumball  cinnamon imperial

Then choose two heights that you will drop your objects from:

30 centimeters  50 centimeters  70 centimeters

Now, fill in the table so that you can record your results:

<table>
<thead>
<tr>
<th>Height 1</th>
<th>Height 2</th>
<th>Height 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Height 1</th>
<th>Height 2</th>
<th>Height 3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Exploration Activity Cont.:

**Teacher Checkpoint:** Once you and your team have completed created your table, ask your teacher to check it over. Teacher’s Initials: ______________

Now that you have correctly created your table, begin the experiment by **dropping** the first item from your first drop height. Then, carefully remove the object from the pan using the tongs.

With your team, examine the crater. Use your ruler to measure the diameter of the crater (in cm).

Repeat these steps with your two other objects. When you are finished, complete the remainder of the chart by dropping your objects from your second drop height.

Now that your chart is complete, we need to draw conclusions from the information we gathered.

Which item created the biggest crater? Why? ____________________________________________

Using the diagram below, choose one of your objects and describe the crater it produced in detail.
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

![Diagram of a crater with labels for rim and ejecta](image)
Exploration Activity Cont.:

How is the crater an item produces related to the height it is dropped from? What are other factors that may affect the crater size?

Explanation:

What scientific or technological question will your team answer? (Go back through your Science Notebook and copy it from Lesson 6.)

Team Question: ____________________________________________________________

What things will you measure when conducting your own rover experiment?
1. _______________________________________________________________________
2. _______________________________________________________________________
3. _______________________________________________________________________

List three ways you and your team will take these measurements in your own experiment:
1. _______________________________________________________________________
2. _______________________________________________________________________
3. _______________________________________________________________________

Evaluation:

Why are taking accurate measurements critical to your Mars rover mission?
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
___________________________________________________________________________
Lesson 8: Where is the Best Place to Measure?

Engagement Questions:

What is your team’s scientific or technological question?____________________________________________________
_________________________________________________________________________________
_________________________________________________________________________________
_________________________________________________________________________________

Why is it important to select a good landing site for Curiosity? ___________________________________________
_________________________________________________________________________________
_________________________________________________________________________________

Exploration Activity:

Explore Gale Crater and complete the chart:

<table>
<thead>
<tr>
<th>Weather/Climate</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Terrain</td>
<td></td>
</tr>
</tbody>
</table>
Based on what you have learned about Gale Crater, name 5 reasons why it was a good place for Curiosity to land.

1. __________________________________________________________
   __________________________________________________________
2. __________________________________________________________
3. __________________________________________________________
4. __________________________________________________________
5. __________________________________________________________
**Exploration:**

Once you have completed your research and decided on a landing site for your rover, complete the following details:

Chosen Landing Site ___________________________________________________________

Exact Location on Mars _______________________________________________________

Description of terrain at this location ___________________________________________

Description of atmosphere at this location _______________________________________

**Explanation:**

Now that you have gathered the important details of your team’s landing site, record that information on a piece of chart paper.

Along with the landing site, exact location on Mars, description of terrain and atmosphere, be sure to include three reasons why your team chose this site and how this landing site will help your team answer your specific scientific question.

**Evaluation:**

How did you select the place for your Mars rover mission? Describe how your selected site meets the needs of your question. ___________________________________________________________

________________________________________________________

________________________________________________________
Lesson 9: Spacecraft Structure and Design

Engagement Questions:

<table>
<thead>
<tr>
<th>3 Facts</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Questions</td>
</tr>
<tr>
<td>1 Opinion</td>
</tr>
</tbody>
</table>

Exploration Activity:

Rover Communication

Scenario #1

<table>
<thead>
<tr>
<th>Materials</th>
<th>Number</th>
<th>Cost Each</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satellite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground Receiver/Transmitter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grand Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scenario #2

<table>
<thead>
<tr>
<th>Materials</th>
<th>Number</th>
<th>Cost Each</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satellite</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ground Receiver/Transmitter</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grand Total</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Scenario #1

<table>
<thead>
<tr>
<th>Trials</th>
<th>Total Seconds on Target in two minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1</td>
<td></td>
</tr>
<tr>
<td>Trial 2</td>
<td></td>
</tr>
<tr>
<td>Trial 3</td>
<td></td>
</tr>
<tr>
<td>Trial 4</td>
<td></td>
</tr>
<tr>
<td>Trial 5</td>
<td></td>
</tr>
</tbody>
</table>

Scenario #2

<table>
<thead>
<tr>
<th>Trials</th>
<th>Total Seconds on Target in two minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1</td>
<td></td>
</tr>
<tr>
<td>Trial 2</td>
<td></td>
</tr>
<tr>
<td>Trial 3</td>
<td></td>
</tr>
<tr>
<td>Trial 4</td>
<td></td>
</tr>
<tr>
<td>Trial 5</td>
<td></td>
</tr>
</tbody>
</table>
Exploration Activity:

Spacecraft Design

Before building:
What is the purpose of your space probe? Use your resources to help you.
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

What three things will you need to take into consideration when building your space probe?
1. __________________________________________________________________________
2. __________________________________________________________________________
3. __________________________________________________________________________

During Building:
What design elements will you put in place to ensure that your probe always lands bottom down?
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

After Building:
How does your team’s design compare with NASA’s design?
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

Testing:
Drop your probe from the following heights and record its performance.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Height</th>
<th>Scientific Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trial 1</td>
<td>12 inches</td>
<td></td>
</tr>
<tr>
<td>Trial 2</td>
<td>24 inches</td>
<td></td>
</tr>
<tr>
<td>Trial 3</td>
<td>36 inches</td>
<td></td>
</tr>
<tr>
<td>Trial 4</td>
<td>48 inches</td>
<td></td>
</tr>
</tbody>
</table>
Exploration:

Research and Investigation

Use this space to record your research and investigation on spacecraft. Remember to write your notes in your own words and always document your sources.
**Explanation:**

<table>
<thead>
<tr>
<th>Statement</th>
<th>True or False?</th>
<th>How do you know?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Astrology and astronomy are basically the same thing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rovers communicate with Earth using radio waves.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Since we already went to the Moon, it is easy to send people to Mars.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Because Mars has a thinner atmosphere than Earth, the shape of a space probe is critical for landing on Mars.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Although spacecraft are constructed for specific missions and purposes, they are all designed and built using the same process.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Evaluation:**

What attributes will my Mars Rover need to:

- Get to Mars: ________________________________
- Carry out its mission: ________________________________
- Send the data back to Earth?: ________________________________
Lesson 10: Landing, Moving and Surviving

Engagement Questions:

Different ways a rover could land on Mars:

1. ____________________________________________
2. ____________________________________________
3. ____________________________________________

<table>
<thead>
<tr>
<th>Ways to Land a Rover on Mars</th>
</tr>
</thead>
<tbody>
<tr>
<td>Landing Strategy</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

Exploration Activity:

Chosen Landing Strategy: ____________________________________________

<table>
<thead>
<tr>
<th>How My Strategy Can be Successful</th>
<th>How My Strategy Can be Problematic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Continue your notes on the next page.
After deliberating with my team, the Landing Strategy we decided to use is: ________________

We picked this landing strategy because:
1. _________________________________________________________________
2. _________________________________________________________________
3. _________________________________________________________________

Next, work with your team to decide how your rover will move around once it lands on Mars. Be specific. __________________________________________________________
______________________________________________________________
______________________________________________________________
**Exploration Cont.:**

How will your rover survive the harsh conditions on Mars? In the circles, identify the conditions your rover may encounter. In the rectangles, tell how your rover will react and what features and criteria you designed to help the rover survive.

---

**Evaluation:**

Why is the method you chose for landing your rover on Mars the best one for your mission? ________

____________________________________________________________________________________
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____________________________________________________________________________________
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____________________________________________________________________________________
____________________________________________________________________________________
____________________________________________________________________________________
Engagement Questions:

What is this process called? _______________________________________________________
______________________________________________________________________________
______________________________________________________________________________
__________________________

What is the purpose of the Engineering Design Process? __________________________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________

How will you use the Engineering Design Process to build a Mars rover? __________
______________________________________________________________________________
______________________________________________________________________________
______________________________________________________________________________
Exploration Activity:

Work with your team to draw a sketch of what your rover will look like. Tape or staple extra pages into your Science Notebook as needed.
Explanation:

Once you have completed the rough draft of your concept map on scratch paper and your teacher has approved it, copy it neatly in the space below. Use additional pages if needed.
Evaluation:

Which step of the Engineering Design Process was the most difficult for your team? What made this step so challenging for you?

________________________________

__________________________________________

__________________________________________

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Elaboration (optional):

Once you are finished building your Mars Rover, make sketches of its top, front, and side views.

How does your original sketch compare with your actual prototype? What changes did you need to make? Why?

________________________________________________________

________________________________________________________

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**Lesson 12: Final Design**

**Engagement Questions:**

<table>
<thead>
<tr>
<th>Engineering Careers</th>
<th>Examples of this Career</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace</td>
<td></td>
</tr>
<tr>
<td>Chemical</td>
<td></td>
</tr>
<tr>
<td>Civil</td>
<td></td>
</tr>
<tr>
<td>Electrical</td>
<td></td>
</tr>
<tr>
<td>Mechanical</td>
<td></td>
</tr>
</tbody>
</table>

**Exploration Activity:**

Draw a concept map of at least three careers that might contribute to the designing and building of Curiosity. Explain how each career would contribute to this project.
Exploration:

<table>
<thead>
<tr>
<th>My Team</th>
<th>My Career Assignment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

Use your Science Notebooks and additional paper to collect the following information:

- Mission (Scientific or Technological question to be answered)
- Specific Location of the Mission
- Requirements of the rover
- Features of the rover

Then work with your group to finalize your rover design. Copy it neatly onto a piece of chart paper. Be sure to include all of the information above on your drawing. When you are finished, work with your team to write a caption for your poster.

Evaluation:

Essential Question?

___________________________________________________________________________________
___________________________________________________________________________________
___________________________________________________________________________________
___________________________________________________________________________________

_______________________________

_______________________________

_______________________________

_______________________________

_______________________________
Lesson 13: Construct Mock-Up

Engagement Questions:

<table>
<thead>
<tr>
<th>Characteristics of a Successful...</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineer</td>
</tr>
<tr>
<td>Scientist</td>
</tr>
<tr>
<td>Designer</td>
</tr>
<tr>
<td>Project Manager</td>
</tr>
</tbody>
</table>

Evaluation:

How does assigning a different job to each member of your team (designer, scientist, project manager, engineer) help you to complete your Mars rover mission? 
________________________________________________________
________________________________________________________
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________________________________________________________
STEP 1:

With your team, brainstorm ideas for your skit. As you share ideas, answer the following questions:

1. What is the purpose of our skit?

2. Who is our audience?

3. Should our skit be PROFESSIONAL or INFORMAL? (Circle one)
   Explain why

Use the information in the table below as you write your skit to ensure you are writing for the correct audience.

<table>
<thead>
<tr>
<th></th>
<th>Professional</th>
<th>Informal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>short or long</td>
<td>short</td>
</tr>
<tr>
<td>Preparation</td>
<td>large amount of time</td>
<td>very little preparation time</td>
</tr>
<tr>
<td>Visual Aids</td>
<td>frequently used, polished</td>
<td>sometimes used</td>
</tr>
<tr>
<td>Rehearsals</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Refinements</td>
<td>YES</td>
<td>NO</td>
</tr>
<tr>
<td>Audience</td>
<td>large: adults, experts</td>
<td>small: family, friends, classmates</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>academic, consistent</td>
<td>language often varies from one performance to the next</td>
</tr>
</tbody>
</table>
STEP 2:

Now that you have the idea for your skit, it’s time to capture the details:

Skit Title: 
___________________________________________________________________________

Props Needed/Team member responsible:

<table>
<thead>
<tr>
<th>Prop</th>
<th>Team Member Responsible</th>
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</table>

Backdrop: YES  NO
If YES....
What will the backdrop be? ____________________________________________

Who will design backdrop? ____________________________________________

What role will each team member play in the presentation?

<table>
<thead>
<tr>
<th>Team Member</th>
<th>Character</th>
</tr>
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<tbody>
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</table>
STEP 3: Outline

Use your own paper to create your outline. Your outline doesn’t have to follow this list exactly, but be sure to include all the major categories listed below.

I. Basic Information
   a. Introduce our Team
   b. __________________________________________

II. Purpose/Goals of the Rover Mission
   a. __________________________________________
   b. __________________________________________
   c. __________________________________________

III. Important Facts/Notes to Tell Audience
   a. __________________________________________
   b. __________________________________________
   c. __________________________________________

IV. Rover Design
   a. __________________________________________
   b. __________________________________________
   c. __________________________________________
   d. __________________________________________
   e. __________________________________________

V. Other Information (OPTIONAL)
   a. __________________________________________
   b. __________________________________________

VI. Conclusion
    __________________________________________
Explanation:

To make a large project easier, share the work. Using the chart below, record the duties each person on your team will be responsible for.

<table>
<thead>
<tr>
<th>Team Member</th>
<th>Responsible For...</th>
</tr>
</thead>
<tbody>
<tr>
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Evaluation:

What are the key elements of an effective presentation that your group should keep in mind when writing your Mars Rover skit?

_______________________________________________________________________

_______________________________________________________________________

_______________________________________________________________________

_______________________________________________________________________

_______________________________________________________________________

Teacher Checkpoint: _______
Lesson 15: Present Skits and Rovers

Engagement Questions:

Great ideas I heard from other teams that I can borrow and include in our presentation:

- ________________________________________________________________
- ________________________________________________________________
- ________________________________________________________________
- ________________________________________________________________
- ________________________________________________________________
- ________________________________________________________________
- ________________________________________________________________
- ________________________________________________________________

Evaluation:

How did listening to the other teams present help you to improve your own Mars rover presentation? Be specific. ________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
____________________________________________________________________
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____________________________________________________________________