National Aeronautics and Space Administration

Mars Rover Celebration

Curriculum Module

Week 4: Understanding Rovers

Lesson 9: Spacecraft Structure and Design

Educational Product	
Educators & Students	Grades 3-5

www.marsrover.org

Week 4: Understanding Rovers

LESSON 9: SPACECRAFT STRUCTURE AND DESIGN
GRADE LEVEL: 3-5
LENGTH: 3 DAYS

VOCABULARY: aerodynamic
attribute

MATERIALS:

- Chart Paper
- Chart Paper Markers- one per team
- Science Notebooks
- Station #1- Research and Investigation
  - *Research and Investigation* handout- one per student
  - Computers with Internet access
- Station #2- Spacecraft Design
  - *Spacecraft Design* handout – one per student
  - *The NASA Engineers' Design* article- one per student
  - Index cards or card stock
  - Notebook paper
  - Tape
  - Paper clips
  - Scissors
  - Ruler
- Station #3- Rover Communication
  - *Rover Communication* handout- one per student
  - Balloon (one per team)
  - Flashlight
  - Mirrors (4)
  - Roll of Aluminum Foil (25 sq. ft.)
  - Scissors
  - Ruler

ESSENTIAL QUESTION:

What attributes will my Mars Rover need to: get to Mars, carry out its mission, and send the data back to Earth?

LESSON OBJECTIVE(S):

Students will be able to:
- Investigate probes and rovers to learn how they are built.
- Learn about the propulsion, navigation, controls and daily handling of spacecraft
- Gather, and analyze data from multiple sources on the internet
- Understand how rovers communicate with Earth
- Integrate new research into spacecraft/ rover designs

ENGAGEMENT

1. At the beginning of this lesson, and using the attached documents, present the Essential Question and Key Vocabulary for students to consider during the lesson.
2. On their pieces of chart paper, each team will write three facts they have learned so far, two questions that they still have, and one opinion about something they have learned thus far.
3. Once students have had time to complete this activity, teams will share with the class. While students are sharing, the teacher should be paying particular attention to the chart paper responses answering their questions when possible and clarifying any misunderstandings.

EXPLORATION

1. During this lesson, teams will rotate to three different stations to learn how spacecraft are built, how rovers communicate with Earth, and how aspects of spacecraft work.
2. Teams will work at each station for one class period. Before station work begins, the teacher should introduce the "Learning New Vocabulary" mini-lesson. Then, post the Vocabulary Toolbox or provide a copy to each student to assist in trying to figure out the meaning of new vocabulary words before asking for teacher assistance.
3. Next, the teacher should introduce each station, review the handout(s) and procedure for each station and identify the data that will need to be recorded in student Science Notebooks during station work.
4. As students are working through the stations, the teacher should circulate the room helping teams and guiding students as necessary. Students may need specific assistance reading the article at the conclusion of the *Spacecraft Design* station and possibly reading the *Research and Investigate* station web sites.

EXPLANATION

Note: The teacher may choose whether to address the Explanation at the end of each class period or once at the end of the three day lesson. If the teacher decides to address this section at the end of each class period, answers should not be revealed until the last day.

1. Either at the end of each class period or at the end of the three-day lesson, the teacher will bring students together to discuss a series of statements and decide whether they are true or false:
   - Astrology and astronomy are basically the same thing. *(False)*
   - Rovers communicate with Earth using radio waves. *(True)*
   - Since we already went to the moon, it is easy to send people to Mars. *(False)*
   - Because Mars has a thinner atmosphere than Earth, the shape of a space probe is critical for landing on Mars. *(True)*
   - Although spacecraft are constructed for specific missions and purposes, they are all designed and built in the same way. *(True)*
2. The teacher may elect to write these statements on the board or on chart paper, making a clear indication that these are true/false statements for the class to consider, not facts they will learn.

ELABORATION

1. If time allows, students should write a summary of what they have learned at their designated station each day of the lesson. The writing may also be assessed for a grade.
2. Students may also continue designing and building their space probes, focusing on their impact. Specifically, students should ask questions and predict outcomes about the changes in energy that occur when their space probe impacts upon Mars' terrain.

EVALUATION

1. During this lesson, the teacher is encouraged to use formative assessments to determine and deepen student understanding. Teachers may wish to assess student team posters and/or grade students' science notebooks to establish student understanding. Students will also be informally assessed when discussing the statements in the Explanation section of the lesson.
2. Teachers are encouraged to create their own grade-level and ability-level assessments so as to best meet the needs of their students.

SUPPLEMENTAL RESOURCES

European Space Agency for Kids
http://www.esa.int/esaKIDSen/Spacecraft.html

Mars Science Laboratory: Mission
http://mars.jpl.nasa.gov/msl/mission/spacecraft/

Jet Propulsion Laboratory
http://saturn.jpl.nasa.gov/kids/fun-facts-spacecraft.cfm
Solving a Spacecraft Design Problem- Article
http://mars.jpl.nasa.gov/msp98/ds2/kids/probe_design.pdf

Landing a Space Probe or Rover
http://education.nationalgeographic.com/education/activity/landing-a-space-probe-or-rover/?ar_a=1

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