Establishing Mars Research Station

Duration
Five 45-minute class periods

Lesson Overview
In this activity, students will form a mission organization to create and execute a plan for establishing Mars Research Stations (MRS). The mission will be to place MRS in scientific and logistically strategic locations.

Lesson Objective
Students will:

- Work collaboratively within teams to make decisions by conducting research;
- Collaborate between teams by engaging in discussions, creating and sharing information in the form of charts, maps, and reports; and
- Take responsibility for the success of the project by working effectively together.

Next Generation Science Standards Addressed

Science and Engineering Practices

Asking Questions and Defining Problems
Analyzing and Interpreting Data
Developing and Using Models

Disciplinary Core Ideas

ESS1.A The Universe and Its Stars
ESS1.B: Earth and the Solar System

Crosscutting Concepts

Patterns
Scale, Proportion, and Quantity
Systems and System

Texas Essential Knowledge and Skills for Science

Scientific Processes

A.2G: Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to organize, analyze, evaluate, make inferences, and predict trends from data, including making new revised hypotheses when appropriate.
A.2H: Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to communicate valid conclusions in writing, oral presentations, and through collaborative projects.
A.2I: Scientific processes. The student uses scientific methods during laboratory and field investigations. The student is expected to use astronomical technology such as telescopes, binoculars, sextants, computers, and software.
A.3A: Scientific processes. The student uses critical thinking, scientific reasoning, and problem solving to make informed decisions within and outside the classroom. The student is expected to in all fields of science, analyze, evaluate, and critique scientific explanations by using

empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student.

Science Concepts

A.9A: Science concepts. The student knows that planets of different size, composition, and surface features orbit around the Sun. The student is expected to compare and contrast the factors essential to life on Earth such as temperature, water, mass, and gases to conditions on other planets.

A.9B: Science concepts. The student knows that planets of different size, composition, and surface features orbit around the Sun. The student is expected to compare the planets in terms of orbit, size, composition, rotation, atmosphere, natural satellites, and geological activity.

A.14A: Science concepts. The student recognizes the benefits and challenges of space exploration to the study of the universe. The student is expected to identify and explain the contributions of human space flight and future plans and challenges.

A.14B: Science concepts. The student recognizes the benefits and challenges of space exploration to the study of the universe. The student is expected to recognize the advancement of knowledge in astronomy through robotic space flight.

Materials

- *Giant Mars Map*
- *Meter sticks*
- *Protractors*
- *String*
- *MyBot robot*
- *Materials for construction of MRS units*

Teacher Preparation Instructions

This set of activities depends upon the members of the class working together on separate tasks to inform decisions by the whole class and to accomplish the mission. The teacher will take on the role of a supervisor and advisor, but the students will direct the activity. The parameters for what the students create is dependent both upon the creativity of the group and the requirements of each team. The classroom can be set up to allow each team to maintain an office with the four executives (MMD, PAO, DPAO, and MSO) in a central location.

Engagement

Part One – Building a Team

Some projects are bigger than what can be accomplished by individuals. This project is designed to require members of the class to work as a team on interrelated tasks in order to reach the goal. In this mission you will be establishing Mars Research Stations (MRS, *pronounced MERS*) across the surface of Mars.

As a class,

- Discuss the characteristics of effective teams of which you have been a part.
- Discuss the responsibilities of each executive and team.
    - Each executive is responsible for supervision, reporting, and decision-making.
    - Each team must create the parameters in which they work in collaboration with the other teams. No individual or team is an island.
    - Everyone needs to understand that no single right answer exists, rather the best solution is the one that can be developed to meet the needs of all groups.
- Select people to serve in each of the following roles:

    - Mars Mission Director, (MMD) one per class:
        - Serves as chief executive in charge of the operations of the mission,
        - Assigns staffing to meet needs,
        - Calls and leads meetings of teams,
        - Assures that teams are working together, and
        - Acts as the final decision-maker.

    - Mars Safety Officer (MSO) one per class:
        - Assures safe operations of the project,
        - Reviews MRS specifications to determine if people will be able to safely live at the MRS,
        - Reviews delivery routes and plans to assure their safety and that hazards have been avoided, and
        - Serves as an assistant to MMD.

    - Public Affairs Officer (PAO) one per class:
        - Reports to MMD,
        - Maintains a written log of the activities of each group from reports filed by each group,
        - Is prepared to make verbal comments as to the progress of the mission at any time,
        - Makes a daily statement of progress from the previous day at the beginning of each class period, and
        - Publishes a daily press release of activities related to the mission.

- Deputy Public Affairs Officer (DPAO, *pronounced dee paw*) one per class:
  - Reports to PAO, and
  - Serves as an assistant to PAO.

- Robot Programming and Operations Team (RoOps, *pronounced ROW-ops*):
  - Writes and tests code for the operation of the robot,
  - Works with BDCon to assure that the MRS can be carried by the robot,
  - Provides robot performance statistics to MCart,
  - Operates the robot to deliver MRS, and
  - Submits a daily report to PAO.

- Base Design & Construction Team (BDCon, *pronounced BeeDeeCon*)
  - Designs and constructs the Mars Research Stations (MRS) that will be placed at their locations by the RoOps team using their robot,
  - Determines the design and materials that will represent the operation of each MRS,
  - Collaborates with SciOps to assure that the MRS adequately represent the both thefunctions that are both common to all locations and any features that unique due to the research being conducted at each location
  - Collaborates with RoOps to assure that the physical MRS can be delivered to the location by RoOps, and
  - Submits a daily report to PAO.

- Mars Cartography Team (MCart, *pronounced M cart*)
  - Determines the delivery routes for each Mars Research Station,
  - Reviews delivery routes with MSO to assure adequate clearance of hazards, and
  - Defines delivery routes by distance and turn angles,
  - Communicates delivery route information to RoOps, and
  - Submits a daily report to PAO.

- Mars Science Operations (MSO *referred to as MSO or sci-ops*)
  - Determines why a MRS should be established at each location by clearly defining the scientific and/or logistical purpose for each MRS location,
  - Defines the features that must be included in the MRS for both habitability to accomplish the unique science and/or logistic goals,
  - Provides precise location for each MRS in latitude and longitude to MCart,
  - Communicates MRS purpose and specifications for each MRS to BDCon and collaborates with BDCon to assure that MRS design fully represents the function of each MRS, and

- Submits a daily report to PAO.

Exploration

Part Two – Operating as a Team

The class is now ready to begin operations. The goal of the class is to efficiently work together to accomplish all the tasks required to locate MRS across the Giant Mars Map.

- Establish office spaces for each executive and functional team.
- Adjust staffing levels of functional teams as work load requires.
- Conduct meetings of functional teams to guide work.
- Maintain communications throughout the organization.
- Conduct end-of-day status report sessions at the conclusion of each class period.

Explanation

Part Three – Meeting the Challenge

The team is now ready to view the delivery of MRS units on the Giant Mars Map. While the delivery is taking place,

- RoOps will operate the robot to deliver each MRS,
- SciOps will describe the function of each MRS,
- MCart will describe the considerations for creating each delivery route, and
- BDCon will describe how the actual MRS was designed to reflect its function.

Evaluation

- Student teams will be evaluated through formative assessment methods throughout the activity.
- Teacher questioning of groups and gathering evidence of learning such as their generated notes will provide evidence of learning.
- The teacher will evaluate the quality of the reasoning as exhibited in the presentation by each group as each MRS is installed.

Extension

Activity – Logistics and MRS Supply Missions

Work together as a team in the current roles to establish a schedule of resupply for each MRS to include:

- Routes of travel,
- Schedule of arrival and departure times,
- Needs of each MRS,
- Items to be picked up from each MRS, and
- Sources of supplies.