

University of Wyoming
AstroCamp
Mars Rover

Purpose:

To introduce students to the concepts of robotic missions to other planets.

To allow students to work with technology to achieve mission goals and build technology skills.

To give students the opportunity to work with maps and decipher obstacles before they are even seen.

To give students the opportunity to work with coordinate systems and relay messages to their lander to achieve mission goals.

To give students the opportunity to value the concepts of teamwork and communication.

Wyoming State Science Standards Addressed:

Standard 2:

Students demonstrate knowledge, skills, and habits of mind necessary to safely perform scientific inquiry. Inquiry is the foundation for the development of content, teaching students the use of processes of science that enable them to construct and develop their own knowledge. Inquiry requires appropriate field, classroom, and laboratory experiences with suitable facilities and equipment.

Benchmark 2:

Students use inquiry to conduct scientific investigations.

Ask questions that lead to conducting an investigation.

Collect, organize, and analyze and appropriately represent data.

Draw conclusions based on evidence and make connections to applied scientific concepts.

Benchmark 4:

Students recognize the relationship between science and technology in meeting human needs.

Standard 3:

Students recognize the nature of science, its history, and its connections to personal, social, economic, and political decisions. Historically, scientific events have had significant impacts on our cultural heritage.

Benchmark 1:

Students explore the history and nature of science.

1a. Students explore how scientific knowledge changes and grows over time, and impacts personal and social decisions.

Benchmark 2:

Students explore how scientific information is used to make decisions.

2a. The role of science in solving personal, local, and national problems.

2b. Interdisciplinary connections of the sciences and connections to other subject areas are careers in science or technical fields.

Goals:

Students will work in groups to develop teamwork skills to successfully complete an assigned mission.
Students will use their listening skills to follow directions.
Students will use their computer skills to direct the Remote Vehicle to do assigned tasks.
Students will learn to read a map, decipher what is there and determine an appropriate landing site.
Students will use their map skills to determine what the rover's orientation is upon first contact.
Students will understand the relationship between science and technology.
Students will understand the cooperation required between scientists and technicians in order for successful missions to happen.

Entry Level:

Students will need an introduction to robotic missions to other planets.
Students will need information about how science has changed over time and how we approach space exploration has changed as well.
Students will need an understanding of how different scientific and technical skills are required to successfully explore space.
Students will need instruction on how to read a map and how to navigate using only a map and a visual.
Students will need instruction on how to determine necessary angles and meters needed to direct the rover properly.
Students will need to be placed in small groups and determine roles to be played.

Premise:

Students will be learning about planetary exploration and the many factors required to successfully travel to other planets. Specifically, the students will be looking at a map of a planet, determining the appropriate area to land, landing their rover, reading a map with a visual from the rover to determine what their telemetry is, and direct their rover to perform certain tasks and successfully complete the mission. Students will plot their progress and movements on a given map or on graph paper. This will allow students to graph their results as a record of where they came from. Students will be given the opportunity to fill certain niches in order to complete the mission. Time required for this activity varies depending on the size of the area, the skill level of the students, and the quality of the equipment. Estimated time to do activity is 1-2 hours.

Supplies:

Laptop Computers Wireless Internet Access Open Area
Computer Lab w/Internet Access Web Cameras & Software
Remote Controlled Cars (Rovers) Map of area to be explored
Objectives to photograph (i.e. rocks, water, geologic items, action figures)

Activities:

Mars Rover

Introduce: Begin the activities by asking the students about planetary exploration and what they know about the science behind it. Allow time for questions and discussion.

Instruct: Planetary Exploration has been on scientists' minds since we discovered that different planets exist. To date this planet has landed manned missions on one other body, and landed unmanned missions on several others. Being able to go to other planets or moons is very important to scientists, governments, and humans in general for a variety of reasons. At current population growth rates, Earth will have 10 billion inhabitants by 2050. (Source: U.S. Census Bureau)

As Earth's population grows the need for natural resources increases. The Earth has a limited amount of natural resources and can only support so much pressure until the entire ecosystem fails. One possibility is to start terraforming other planets to inhabit them, or use the abundant resources that are available there.

Other implications of planetary exploration are that we are ever curious about our own planet's evolution. Going to other planet/moons allows us to solve puzzles that exist here on Earth. One example of this is the recent exploration of Titan, a moon of Saturn. We went there because of its primitive atmosphere that resembles what atmospheric scientists believe Earth's atmosphere looked like billions of years ago. The information found there will help scientists to find better explanations to the problems found here on Earth.

Another implication to being on other less massive bodies is the implication to space travel. A less massive body has less gravity and therefore it is cheaper to get off of that body because it requires less fuel. Further out, bodies such as the moons of Jupiter, Saturn, Uranus or Neptune could be used as stations for refueling or jump off points for deep space exploration. The importance of robotic exploration is essential to the success of these possible future missions. Learning to safely and efficiently explore space with the use of robots will decrease the cost of human life and allow humans to go places that are today, thought to be impossible.

Questions:

Why is it important to use robots in space exploration?

What different careers could you pursue in space exploration?

Why is it important to have a team approach when doing science?

What benefits do you, the community, the nation and the world receive as a result of space exploration?

Why is it important for humans to explore space, or is it important?

Additions/Modifications to instruction:

Activity: AstroCamp Staff has done the reconnaissance for the students. The landing site has been determined and there is no need for discussion about where to land the rover and why.

Separate the students into two groups.

Have the students decide who will take each of the following roles:

Commander- Responsible for the overall success of the mission. Roles include overseeing other team members, aiding the decision-making process, problem solving, general organizational duties.

Communications- Responsible for all computer communications between the rover. Report to commander any communication issues. Report on progress of each communication to and from the rover.

Cartography(2)- Responsible for mapping each movement of the rover on a map to ensure accuracy of movements over the terrain.

Record Keeper - Responsible for recording each command typed by communications. It is important for the team to match commands with pictures, in case unknown/wanted images arise, and to keep team organized as they complete their mission. Use the attached chart to record commands.

Telemetry- Responsible for determination of orientation of rover upon initial contact. It will be important to know which direction the rover is facing when the first pictures are sent back. Telemetry will be evaluating the pictures and discussing the results with the team. Aid Cartography upon completion of initial duties.

Once the students have determined who will be in what leadership position, give them a map of the area that was taken on a previous mission. (The map is an areal view of the courtyard between Physical and Biological Sciences buildings. An electronic copy can be found in Matt Bryant's directory. The scale on the map is 1cm=10m)

Give the groups a mission to complete with various components. This could be as simple as find a green rock, to as complicated as find evidence of flowing water by locating and identifying specific rocks, geologic signifiers, etc. Successful missions were those in which students were shown the object (figurines from "Hitch Hiker's Guide") and then had to find the object somewhere in the exploration area.

Once the groups understand their missions, rovers can be set out in the exploration area. Some ways to make this easy is to set it away from the planters or walls of the buildings, so that students can easily turn the rover and see all of the surroundings clearly. To make it harder, set the rover in an area that may be hard to determine based on the digital pictures they will receive.

(Optional)

While the rovers are being placed, play a video of the Mars Odyssey Launch taken from (<http://faculty.rmwc.edu/tmichalik/astmovie.htm>). This will get students' creativity and imaginations flowing.

The rovers should be placed and the electronics, web connections, and mission objectives prepared. Communication from the rovers can be received by taking a picture to determine telemetry. At this point the student responsible for telemetry should be at the computer determining what the orientation of the rover is. Communication with the cartography student(s) is vital to ensuring proper mapping later in the mission. Communication should be relaying all commands typed into the computer to the record keeper. Overall, each team member should be playing their part to ensure a successful mission.

At this point the mission objectives should be addressed and supervisors should be prepared to help with any technology questions that may arise. Minimal guidance should be given in accomplishing mission objectives, but any aid in map reading, angles, direction, or math issues can be given if mission success is threatened. Redirection is critical during this time period as all team members are needed to successfully accomplish the mission in the given time.

The objective is to complete the mission in the given time. It is not a race, but a finish that is important.

Additions/Modifications to Activity:

This activity can not be successful without understanding angles and map scaling. Be sure to review with students how to measure meters on the map. Run students through measurement exercises. e.g. Predict how wide or long the computer lab is. Write students' estimates on the board, then have two students help you measure the lab. How close were the estimates? How wide is the hallway? Are predictions correct?

The second activity needs to center on angles. Stand at the front of the classroom facing students. Explain that you can only see the computers and people in the room. Now ask students to direct you to look at the chalkboard by commanding you to move a certain direction so many angles. Did students ask you to turn right/left 180 degrees? What would the instructor face is he/she turned 45 degrees to the right/left?

Guide students through these easy exercises as this will prepare them for directing the rover.

Teaching Strategy: Collaborative Learning Model (Constructivism)

Strengths: The teaching strategy used here is collaborative learning. This strategy

allows students to act as experts within a given area, teach their peers what is required to perform the mission, cooperate in an atmosphere of learning, contribute positively to the success of the mission, and act as a team member within the construct. This gives each student a sense of belonging, a sense of usefulness, a sense of influence and a sense of competence. Ultimately, each student should feel a sense of responsibility to each other member of the group to achieve mission parameters. This is constructivist so of course it is hands on minds on, student driven and student centered.

Weaknesses:

It is very important to monitor the progress of each group during the initial stages as some personalities tend to dominate while others tend to be dominated. It is not in the best interest of any group to allow one student to make all of the decisions. Each team member is responsible for the job title given to them. Ensuring that the Commander is aware of this is essential to the success of the mission and the learning experience of the other team members. It would be ideal for teams to have no more than 3 students.

