

Tammi Deines 5E Lesson Plan

Topic: Mars Spirit Rover

Grade: 4th grade

Time: 4 days

Background:

One of two rovers launched in 2003 to explore Mars and search for signs of past life, Spirit far outlasted her planned 90-day mission. Among her myriad discoveries, Spirit found evidence that Mars was once much wetter than it is today and helped scientists better understand the Martian wind.

In May 2009, the rover became embedded in soft soil at a site called "Troy" with only five working wheels to aid in the rescue effort. After months of testing and carefully planned maneuvers, NASA ended efforts to free the rover and eventually ended the mission on May 25, 2011.

Standards:

NGSS:

#### **4-ESS2-2 Earth's Systems**

Analyze and interpret data from maps to describe patterns of Earth's features.

#### **4-ESS1-1 Earth's Place in the Universe**

Identify evidence from patterns in rock formations and fossils in rock layers to support an explanation for changes in a landscape over time

Objectives:

The students will to learn about the challenges faced while trying to operate a planetary rover. ·

The students will learn to work within a mission team setting, working together to problem solve and accomplish a common goal.  
The students will learn to operate a robotic vehicle while it is not directly in view of the driver or operations team.

Materials:

- Remote control car for each 4 to 6 member team (borrow from students)
- Measuring devices (meter stick or tape measure - Can change units to yards) 2 per team
- Rocks or other marking devices to- set up 'way points' in which to drive car
- Background information on planetary rover teleoperation
- Student calibration and mission planning sheets
- Stopwatches
- Compasses
- Popsicle sticks
- Pencils
- Masking tape for marking starting lines
- Calculators (optional)
- Video camera and monitor (optional)

5E Lesson Plan	
<b>Engage (Day 1)</b> The purpose for the ENGAGE stage is to pique	At the beginning of class I will show this picture of the Mars Rover Spirit. I will have the students quietly observe the picture and write one I notice and I wonder statement for the picture.

5E Lesson Plan	
<p>student interest and get them personally involved in the lesson, while pre-assessing prior understanding.</p>	<p><a href="https://cdn.britannica.com/93/93293-050-92D12F74/Artist-conception-Mars-Exploration-Rover.jpg">https://cdn.britannica.com/93/93293-050-92D12F74/Artist-conception-Mars-Exploration-Rover.jpg</a>  After 5-7 minutes of observation I will then have the students share with a partner what they noticed and what they wondered. I will then explain that we will be looking at the Mars Exploration Rover Spirit. We will also be trying to operate a planetary rover without being able to directly see the rover in person.</p>
<p><b>Explore (Day 2)</b>  The purpose for the EXPLORE stage is to get students involved in the topic; providing them with a chance to build their own understanding.</p>	<p>Other rovers are calibrated and tested in much the same manner, with the “drivers” operating out of a small mobile trailer, away from actually watching the rover drive during the field testing. While these tests were taking place, there were scientists, engineers, and students in the field to measure the actual results of the commands for the rover to move. In doing so, the rover software and responses to the commands could be tested while still here on Earth to see if they were indeed accurate. That way, when the commands are given to the particular rover on Mars, the scientists and engineers can have a better idea of what movement they might expect. The students will research what rovers have been to Mars and what their success was or was not. If there were problems they can then try to determine what went wrong and what could possible be changed to make it more successful.</p>
<p><b>Explain (Day 3-4)</b>  The purpose for the EXPLAIN stage is to provide students with an opportunity to communicate what they have learned so far and figure out what it means.</p>	<ol style="list-style-type: none"> <li>1) Divide the class into teams of 4 students (smaller groups better if you have enough robotic vehicles).</li> <li>2) Choose two designated drivers (test driver and calibration driver) for each team. The drivers need to be sequestered away from seeing the vehicle course being set up. (Note: Be aware of making sure that some of the drivers are female. Most likely, the people volunteering vehicles will be male. Maybe selecting male and female as a team of drivers would be the answer).</li> <li>3) During the time away from the course, the calibration driver (with the test driver helping) will calibrate the remote vehicle as to: <ul style="list-style-type: none"> <li>· Distance traveled in 5 seconds (3 distance trials)</li> <li>· Time needed to turn in 45° increments.</li> <li>· The rest of the team (course calibrators) will work on setting up a symmetrical course that the vehicle will drive through (the same course design for each team - multiple courses could be set up all at once to speed up the team testing) using the rocks or other items to serve as waypoints (or targets) that each vehicle will try to navigate to. There will need to be an area that will or could cause the vehicles to get stuck. The can avoid the area or if they get</li> </ul> </li> </ol>

5E Lesson Plan	
	<p>stuck see if they can figure out how to get out of the dilemma.</p> <p>4) Have the course calibrating team members measure the distance to each object and record the distance on the course sheet (make sure all the teams are following the same path so that the times and accuracy can be compared).</p> <p>5) Have the course calibrating team measure the angle of turn needed to point the remote vehicle toward the next waypoint. (Note: The turns should be made in 45° intervals for easier measurement.)</p> <p>6) Once the drivers and course calibrating team members have finished their tasks and recorded all necessary data, all the team members can merge their data sets to create a mission plan scenario. Neither driver should still be allowed to actually see the course that the remote vehicle will be driving. This is to be a "blind" test. The measured distance to each waypoint can be calculated with the speed and time necessary to achieve each waypoint destination. This should give the driving time necessary for the remote vehicle to travel to each waypoint destination. Time and coordinates should be given for each waypoint direction (i.e. 12 seconds straight; stop; left 45°; 17 seconds straight; stop; right 90°, etc.) 7) Once the data is calculated, the test driver will have the course calibration team members place the remote vehicle at the designated course starting line. The test driver (who is not in direct eye-contact with the vehicle) will drive the team vehicle according to the mission plan calculations taken from the calibration speed tests and course measurements. A team member can read out the commands and another member can time the remote vehicle's travel.</p> <p>8) The calibration team members watching the test will measure the resulting movement of the remote vehicle and record the actual distance traveled by the remote vehicle next to the pre-measured data.</p> <p>9) After the actual driving results are compared with the precalculated results, determine the adjustments needed to drive the remote vehicle more accurately and repeat the test to see if the changes helped.</p>
<p><b>Elaborate/Extend</b> The purpose for the</p>	<p>To extend the activity I would then have the students switch roles and have them run through another course to see if they can develop a more difficult one for them to go through.</p>

5E Lesson Plan	
EXTEND stage is to allow students to use their new knowledge and continue to explore its implications.	
<p><b>Evaluate</b>  The purpose for the EVALUATION stage is for both students and teachers to determine how much learning and understanding has taken place.</p>	Assessment can be based on completion of student work sheets and team participation.

Worksheets are in my attachments for my lesson plan.

Resources:

<https://www.jpl.nasa.gov/missions/mars-exploration-rover-spirit-mer-spirit/>

<https://mars.nasa.gov/files/mepjpl/MSIP-MarsActivities.pdf>



