

## **5E Integrated STEM Lesson Plan**

**Lesson Title:** The Road to Mars

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**Topic:** This lesson engages students in a discussion and activities surrounding the Mars “Perseverance” Rover. By bringing the rover to life in lessons designed to spark students' creativity and engineering prowess, we will engage students in the STEM side of space travel. Creation of a robotic arm, and activities that have students leading peers through an obstacle course demonstrate how each part of the rover works.

**Targeted Grade Level:** 6th grade

**Time Needed:** 8 (40 minute) classes

**Subject Integration:** Engineering, Science, Visual Arts, History, and Robotics

### **Justification:**

*Engineering-* Creating and using a robotic arm with regular household items in the classroom. Creating a coded game for the exploration of the martian surface.

*Science-* Students will learn and share with their teammates facts about the Martian surface through discussion and creating of a code based game in the Scratch coding platform.

*History-* Students will explore the history of mars rover missions and how they have impacted the study and exploration of space since their inception.

*Arts-* Students will create a computer program that uses different visual techniques .

*Robotics-* Creating and using a robotic arm with regular household items in the classroom.

### **Standards:**

K-2-ETS1-2

MS-ETS1-3

MS-PS4-2

K-2-ETS1-3

3-5-ETS1-2

MS-PS4-3

MS-ETS1-2

CCSS.ELA-LITERACY.SL.6.2

PE 6th grade standard 1.9

6.NS.C.5

5.G.A.1

6.NS.C.6.C

<b><u>NGSS Performance Expectations</u></b>		
<b>Science and Engineering Practices</b>	<b>Disciplinary Core Ideas</b>	<b>Crosscutting Concepts:</b>
<p><b><u>Developing and Using Models</u></b> Modeling in 6–8 builds on K–5 and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.</p> <ul style="list-style-type: none"><li>• Develop and use a model to describe phenomena.</li></ul>	<p><b><u>PS4.A: Wave Properties</u></b></p> <ul style="list-style-type: none"><li>• A sound wave needs a medium through which it is transmitted.</li></ul> <p><b><u>PS4.B: Electromagnetic Radiation</u></b></p> <ul style="list-style-type: none"><li>• When light shines on an object, it is reflected, absorbed, or transmitted through the object, depending on the object's material and the frequency (color) of the light.</li><li>• The path that light travels can be traced as straight lines, except at surfaces between different transparent materials (e.g., air and water, air and glass) where the light path bends.</li><li>• A wave model of light is useful for explaining brightness, color, and the frequency-dependent bending of light at a surface between media.</li><li>• However, because light can travel through space, it cannot be a matter wave, like sound or water waves.</li></ul>	<p><b><u>Structure and Function</u></b></p> <ul style="list-style-type: none"><li>• <i>Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.</i></li></ul>

**Measurable Student Learning Objectives:**

- Students will be able explain how the Mars rover is able to navigate the surface of the planet. (DOK 2)
- Students will be able to explain the impact the robotic arm has on the exploration of Mars. (DOK 4)
- Students will be able to explain technological advances in robotics to help us understand life on Mars. (DOK 4)
- Students will be able to create an initial and final design of their robotic arm.(DOK 2)
- Students will be able explain their process for their communication system. (DOK 2)
- Students will be able to code a program using Scratch coding language to demonstrate movement of the rover on the Martian surface. (DOK 4)

**Nature of STEM:** This assignment addresses the Nature of Engineering through the observation, implementation, and active nature of researching designing and building the robotic arm and hand. This assignment also covers the nature of science as it embraces the scientific method in order to find the best solution for building the robotic arm and hand.

**Engaging Context/Phenomena:**

- NASA's Perseverance rover Launching, travelling to,landing, and exploring Mars

**Data Integration:** Students will review the launch, landing, and exploration by the Perseverance Rover on the Martian surface and the data it has begun to collect. Students will also review the data and experiments completed by the curiosity rover. Taking that data, and analyzing how the rover works, students will be required to design and redesign their robotic arm to improve its overall performance. Assessment questions and the rubric help to guide the progress of the students. To best monitor progress, students will record the changes made to their projects and any observations of how it performed each time they redesigned in their journals.

**Differentiation of Instruction:** In order to differentiate the project, I will allow this to be done individually or with a partner. I will also allow students to design and test their robotic arms in an online or cloud based software, such as a CAD program. Students will also be provided additional research assistance should they need it from the school library media teacher. Students will be provided printed transcripts of any videos shown in the process of this lesson.

**Real-life Connection:**The Mars Rover is using robotic arms in order to collect data from beneath the surface of the Red Planet. It also uses complex coding and communication technologies in order for the human controllers on earth to direct its movements on Mars. Both robotics and coding are visible in prosthetics that are now using small motors and neural connectors in order to change a simple prosthetic arm into fully functioning robotic limbs. Students will be able to witness this technology through the viewing of multiple videos showcasing the advancement of prosthesis technologies.

**Possible Misconceptions:** Students may feel that the exploration of another planet's surface is not necessary to their education or their everyday life, even though we are looking for possible inhabitable planets. Students may be unaware of their need to know how or where they would need the use of a robotic arm? Unless they choose to go into skilled robotics or manufacturing, will they ever need this technology. I will link them to the simple use of a claw in an arcade claw game to draw them back should this happen. Students may not understand the need to know how the rover communicates, but they will need to be effective communicators in their future careers. The activity in directions with their peers will help dissuade this idea.

**Lesson Procedure:**

5E Model	5E Objectives
<p><b><u>Engage</u></b></p>	<p><b>Procedure:</b> Students will watch a video on” Sending Humans to Mars: How Will We Do it?” Students will document their “KWL’s” (Know, Wanna Know, Learned) in their science journals. On the board, I will provide questions for the students to answer about the video.</p> <p><b>Modifications:</b> The instructor will provide a transcript of the videos used in the classroom.</p> <p><b>Standards Addressed</b> CCSS.ELA-LITERACY.SL.6.2-Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.</p>

	<p><b>Formative/Summative Assessments</b> Students will be recording their answers as well as their KWL chart in their journal. The instructor will review the journals to decide the level of understanding by the students.</p> <p><b>Resources</b></p> <ul style="list-style-type: none"><li>• <a href="https://www.youtube.com/watch?v=zZVAP2P_N2E&amp;t=55s">https://www.youtube.com/watch?v=zZVAP2P_N2E&amp;t=55s</a></li></ul> <p><b>Materials:</b> Science Journal</p>
<p><u>Explore</u></p>	<p><b>Procedure:</b> Students will listen to a guest speaker, Leslie Thompson. Leslie worked on all three steps of the Perseverance Rover (build, launch, monitor). She will explain how they created the different parts of the rover, especially the most important part: the robotic arm. Students will then create a robotic arm that can pick up a pencil box off of a table. They will be creating and designing their arms to perform the task and will create a journal documenting any changes they make to their designs. The teacher will be walking around giving limited guidance and supporting students with critical thinking answers and questions</p> <p><b>Modifications</b> Additional one-on-one support will be provided during the practical, or project based, side of the lesson. The instructor will be walking around the room and the workstations to assess the level of interaction needed by students.</p> <p><b>Standards Addressed:</b> <a href="#">K-2-ETS1-2</a> , <a href="#">K-2-ETS1-3</a>, <a href="#">MS-ETS1-2</a>, <a href="#">MS-ETS1-3</a> , <a href="#">3-5-ETS1-2</a></p> <p><b>Formative/Summative Assessments:</b> Students will document in their science journal documenting any changes they make to their designs and observations of how it performed each time they redesigned in their journals.</p> <p><b>Resources:</b></p> <ul style="list-style-type: none"><li>• <a href="https://www.jpl.nasa.gov/edu/teach/activity/robotic-arm-challenge/">https://www.jpl.nasa.gov/edu/teach/activity/robotic-arm-challenge/</a></li><li>• Project worksheet “See Appendix A”</li></ul>

	<p><b>Materials:</b> Duct tape, masking tape, bowls, object for grabbing, paper clips, string, rubberbands, binder clips, dowels, skewers, brass fasteners, index cards, craft sticks</p>
<p><u>Explain</u></p>	<p><b>Procedure:</b> Students will be placed into teams of 2 and each will have a walkie talkie. One of the students will be blindfolded and will be completing the obstacle course while the other will be giving the directions for the other to follow to successfully complete it.</p> <p><b>Standards Addressed:</b> <a href="#">MS-PS4-2</a>, <a href="#">MS-PS4-3</a></p> <p><b>Formative/Summative Assessments:</b> Students will need to complete the obstacle course using the walkie talkies and without knocking over any of the obstacles.</p> <p><b>Materials:</b> blindfolds, Walkie talkies, obstacles</p>
<p><u>Elaborate</u></p>	<p><b>Procedure:</b> Students will use mirrors ,light, and optics to model the technique that NASA is using to communicate with spacecraft. Students will build a relay using microcontrollers along with a laser and mirrors to build a relay that can send information to a LEGO EV3 light detector and program their detector to indicate when data is being received.</p> <p><b>Standards Addressed:</b> <a href="#">MS-PS4-2</a>, <a href="#">MS-PS4-3</a>, PE 6th grade standard 1.9</p> <p><b>Formative/Summative Assessments:</b> Students will be graded based on a rubric. Appendix “B”</p> <p><b>Resources:</b> <a href="https://www.jpl.nasa.gov/edu/teach/activity/build-a-relay-inspired-by-space-communications/">https://www.jpl.nasa.gov/edu/teach/activity/build-a-relay-inspired-by-space-communications/</a></p>
<p><u>Evaluate</u></p>	<p><b>Procedure:</b> Students create a Mars exploration game using the Scratch programming platform. They will engage in computational thinking, use math and include elements of real rover-mission planning to design their game. The goal will be for them to create a game that incorporates a driveable rover that will obtain artifacts as it drives. Students will add 3 or more science targets in their program to obtain these points.</p> <p><b>Standards Addressed:</b> <a href="#">6.NS.C.5</a>, <a href="#">5.G.A.1</a>, <a href="#">6.NS.C.6.C</a></p>

	<p><b>Formative/Summative Assessments:</b> Students will play and critique another students game and answer the following questions:</p> <ul style="list-style-type: none"><li>• Does the game do what it's supposed to as described by the game creator?</li><li>• Is the game winnable (i.e., can players complete the tasks, or was the game designed to frustrate players or be unbeatable)?</li><li>• Have ways that players can "cheat" the game been eliminated through code?</li><li>• Did the game creators go beyond the basics and explore the addition of creative or more in-depth scripts?</li></ul> <p><b>Resources:</b> <a href="https://www.jpl.nasa.gov/edu/teach/activity/explore-mars-with-scratch/">https://www.jpl.nasa.gov/edu/teach/activity/explore-mars-with-scratch/</a></p>
<p><b><u>Post Assessment</u></b></p>	<p>Students will complete the KWL chart from the beginning of the Unit by filling in what they have learned.</p>

### **References**

Educator guide: Build a relay inspired by space communications. (2021, February 26). Retrieved from <https://www.jpl.nasa.gov/edu/teach/activity/build-a-relay-inspired-by-space-communications/>

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