

Topic: Sustaining Life on Mars

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Genre: Science & Math

Grade Level: 6th -8th grade

Unit: Earth Science and Pythagorean Theorem

Estimated Duration: 1-2 single period

Essential Question

(Domain 1: Planning and Preparation-Component 1c: Designing Coherent Instruction)

- **How do scientists use models to draw inferences, find evidence, and analyze data supporting the claim that life is sustainable on Mars?**

Background Knowledge

Background Summary:

This lesson studies the relationship between the Earth and various planets. Students will better understand the concepts of patterns, cause and effect, and energy, when they construct models that will best represent a rover to drive into a cave on Mars to collect samples. Students should be familiar with the different layers of the Earth as well as various common elements necessary for life. Earth is the only planet known to sustain life. Mars is the 4th planet from the Sun and called the Red Planet. Students should recognize that air is one of the most important substances for life and that water is actually even more important. Students should understand why smaller planets have no atmosphere and large planets have very thick atmospheres. “Gravity determines whether a planet can hold onto molecules of atmosphere. Smaller planets do not have enough gravity to hold onto the atmosphere.” Students should also understand that planet size matters. If a planet is too small, it doesn’t have enough gravity to hold an atmosphere. If it’s too large, it holds too much atmosphere. A larger planet can also hold more inhabitants.

Lesson Objective:

- Students will learn the steps involved in the engineering design process by designing a EV3 Lego Rover mission to Mars to collect Element samples.
- Students will understand what is necessary to sustain life.
- Students will understand what makes a planet habitable.
- Students will gain knowledge of how robots are used in real world situations.
- Students will be able to apply the Pythagorean Theorem to find the distance between two points in a coordinate system.

Standards

(Domain 1: Planning and Preparation- Component 1a: Demonstrating Knowledge of Content and Pedagogy)

MST Standards: Standard 7: Interdisciplinary Problem Solving Key Idea 1:

The knowledge and skills of mathematics, science, and technology are used together to make informed decisions and solve problems, especially those relating to issues of science/technology/society, consumer decision making, design, and inquiry into phenomena.

NGSS Standards

Scale, Proportion, and Quantity: In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different

quantities as scales change.

NYS Science Standards

5.2a: Every object exerts gravitational force on every other object. Gravitational force depends on how much mass the objects have and how far apart they are. Gravity is on the forces acting on orbiting objects and projectiles.

7.1e: The environment may contain dangerous levels of substances (pollutants) that are harmful to organisms. Therefore, the good health of environments and individuals requires the monitoring of soil, air, and water, and taking steps to keep them safe.

Standard 6: Interconnectedness:

Key Idea 1: Through systems thinking, people can recognize the commonalities that exist among all systems and how parts of a system interrelate and combine to perform specific functions.

Key Idea 2: Models are simplified representations of objects, structures, or systems used in the analysis, explanation, interpretation, or design.

Common Core State Standards for Mathematics

Geometry - Understand and apply the Pythagorean Theorem:

8.G. Apply the Pythagorean Theorem to find the distance between two points in a coordinate plane.

Vocabulary (Domain I: Planning and Preparation - Component 1e: Demonstrating Knowledge of Students.)	Prep Work/Materials (Domain 1 Planning and Instruction-Component 1e: Designing Coherent Instruction, Domain 3 Instruction-Component 3c: Instruction Engaging Students in Learning)	Cross Curricular Connection (Domain I: Planning and Preparation - Component 1a: Demonstrating Knowledge of Content and Pedagogy, Component 1b: Demonstrating Knowledge of Students.)
Nitrogen Carbon Uranium Kryptonite Water Rover Periodic Table Life Sustain Mars Earth Pythagorean Theorem Coordinates Distance Gravity Habitable	EV3 robot with ultrasonic and color sensor Laptop/iPad with Mindstorms Education version Different color tape/stickers Graph paper or White poster board (chart paper or poster size.) Markers Ruler Measuring tape Science fair board	Science Mathematics Technology Engineering ELA
Differentiation (Domain I Planning and Preparation-Component 1e: Designing Coherent Instruction, Domain 3: Instruction - Component 3b: Using Question and Discussion techniques Domain 3: Instruction - Component 3c: Engaging Students in Learning)		

- Bodily kinesthetic learners - EV3 rover and Element colored dot activity.
- Audio and Visual learners – Visual representation of activity in the Do Now. The observations collected throughout the activity. Virtual field trip - Procedure step #3.
- ELL/Low reader - Guided notes printed for those who require them
- Technology- Utilizing Lego Mindstorms robot kit and digital program. See additional resources
- Enrichment: Research Elements and identify which planets contains the most of these elements, explain how it is most like Earth and why you think it can sustain life.
- Extended time for those who require it
- Small groups
- Individual attention from ICT teachers and paraprofessionals
- Resource room remediation for those who require

Procedure (Domain I Planning and Preparation-Component 1e: Designing Coherent Instruction, Domain 3: Instruction - Component 3b: Using Question and Discussion techniques Domain 3: Instruction - Component 3c: Engaging Students in Learning)	Student Engagement (Teacher Assessment)
<p>1) Introduce the problem of the day making a real scenario using the EV3 Rover. -Astronauts travel to Mars for a routine expedition. Upon release of the EV3 rover, they discovered a cave. Hesitant to enter, the astronauts sent in the rover to collect samples of what was in the cave. The robot returned with evidence of various elements found in the cave. Could this be the answer the astronauts were looking for? Can this evidence prove that life can exist on Mars? Make your predictions and share out in your respected groups.</p> <p>2) Do Now: <i>Worksheet 1</i> - Complete the scenario questions and discuss with your group. Share out answers.</p> <p>3) Class Discussion - Have students find connections between today's problem of the day and a real world article about Venus, Mars, and Earth. (NOTE: Previous homework assignment- read article and answer questions attached about Goldilocks and the Three Planets. http://lasp.colorado.edu/home/education/k-12/project-spectra/goldilocks-interactive/ http://www.nytimes.com/2015/01/07/science/space/as-ranks-of-goldilocks-planets-grow-astronomers-consider-whats-next.html</p> <p>4) Mini Lesson/Review - Teacher will review what is necessary to sustain life on any planet. Discuss the elements necessary in Earth's atmosphere to sustain life. What is the Goldilocks Principle? Explain. Provide students with knowledge on the effect of greenhouse gases by comparing Earth with Venus and Mars. Explain that these planets either have too much greenhouse effect or too little to be able to sustain life as we know it. The differences between the three planets have been termed the "Goldilocks Principle" (Venus is too hot, Mars is too cold, but Earth is just</p>	

right.) Math- calculate distances between element locations using Pythagorean's Theorem.

5) Prior to student arrival create the Mars cave map on a poster sized board. (See attached schematics in DRK12 Materials) The teacher will go over the schematics of the Mars cave map.

6) Provide students with **Student Data Collection Directions** listed below. In small groups, direct students to the correct program to sync their brick; *EV3 Rover Program*. Have students complete **EV3 Rover Data Collection Worksheet**.

7) Circulate and motivate students to complete the worksheets, record responses and use the **Rover Data Collection Worksheet** activity to verify answers. Ask students key questions as well as to describe what they are observing, and documenting on both worksheets.

9) Extensions:

-Students will make text to world connection, demonstrating how populations decline or grow in a certain ecosystem. Students will have the color markers resemble different animals that pertain to one ecosystem and measure the data. Students will write a reflection based on their data.

-Create a web page to get people to move and colonize Mars. Include information such as elements found, cost effectiveness, reasons to move, etc..

-Substitute full name on the brick for the symbol and have students use the periodic table to find the corresponding element name.

Student Data Collection Directions:

1. Collect EV3 Lego Kit.
2. Build EV3 Rover.
3. Attach your EV3 brick to the computer and sync the EV3 Rover Program.
4. Place your Rover at the start points your teacher has pre labeled for you.
5. Run EV3 Rover Program by pressing the center button
6. Record Element name, Element Symbol and Element. coordinate location on your Data Collection Worksheet.
7. Repeat steps 4-6 for each of the five elements found in

<p>the cave.</p> <p>8. On your Worksheet, answer all questions.</p>	
<p>Assessment (<i>Formative or Summative</i>) (Domain 1 Planning and Instruction- Component 1e: Designing Coherent Instruction, Domain 3 Instruction- Component 3c: Engaging Students in Learning, Domain 3 Instruction- Component 3d: Using Assessment in Instruction)</p>	<p>Student Engagement (Teacher Assessment)</p>
<p>Pre-assessment:</p> <p>Do Now Worksheet on colonizing Mars.</p> <p>Assessment will occur during lesson and after the lesson, by gauging understanding and mastery through student responses to lesson discussion as well as their answers to the in class activity worksheets. We will wrap up by answering the objectives; reviewing in class worksheets, and having the students summarize the lesson activity.</p> <p>KEY Questions:</p> <p>What are the three basic needs of all life?</p> <p>What has caused the destruction of our Earth?</p> <p>Why are robots helpful? (Especially in places that are dangerous for humans to go search.)</p> <p>What is the Goldilock Planet Principle?</p> <p>How do we use the Pythagorean Theorem to find the shortest distances between two points?</p>	

Additional Resources

<http://lasp.colorado.edu/home/education/k-12/project-spectra/goldilocks-interactive/>

<http://www.exploremarsnow.org/>

<http://www.nytimes.com/2015/01/07/science/space/as-ranks-of-goldilocks-planets-grow-astronomers-consider-whats-next.html>