

Christine Cote
5E Lesson Plan

Topic -

Epic Challenge - Creating a sustainable human habitat on Mars

Title -

Introduction to Mars' Surface

Grade Levels -

10 - 12

NGSS and Massachusetts State Standards

HS-ETS1-2. Break a complex real-world problem into smaller, more manageable problems that each can be solved using scientific and engineering principles.*

HS-ETS1-3. Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, aesthetics, and maintenance, as well as social, cultural, and environmental impacts.*

NGSS -

ESS1.C: The History of Planet Earth Practices

PRACTICES: 1. Asking Questions and Defining Problems 2. Developing and Using Models 3. Constructing Explanations and Designing Solutions 4. Engaging in Argument from Evidence 5. Obtaining, Evaluating, and Communicating Information
Scientific Knowledge is Based on Empirical Evidence

Set Up - Time and Place:

The lesson will take place in the classroom using the desktop computers. It will take approximately 6 class periods.

Background -

Each year the students in the Epic Challenge program are presented with a challenge that NASA is currently working to solve. This year, the challenge is to create something that could be utilized in the creation of a sustainable human habitat on Mars. After the students study basic facts on the planet Mars, they can form comparisons between Earth's geological developments and potential similarities on Mars. They will also study developments in space exploration. The students will work in teams and will choose a topic of research that will be the focus for their research for the remainder of the school year. The students will then communicate with experts in their field of interest to inquire about mentoring possibilities and/or opinions on their research proposals. Their research will culminate with the design and creation of a prototype and a final presentation at a student symposium at the Kennedy Space Center in June 2019.

Justification -

The students will first need to understand why Mars is a viable option for a space colony. By studying the satellite imagery and using the data in the JMARS system, the students will be able to classify, measure, and calculate the size of craters and other geological formations. This exercise also helps students make connections to Earth's geological transformation. Further, students will use critical thinking skills as they analyze the Martian surface to determine if there are areas more suitable for supporting a habitat. Each group will select a THEMIS image provided by Arizona State University and taken by the Odyssey satellite. The images depict a section of the surface of Mars with great detail and resolution. The teams will begin to analyze the types of land formations and terrain visible in the regions they are studying. The landscape will factor into their designs for the habitat and JMARS will be invaluable in providing them this essential data.

Objectives -

- Students will study the surface of Mars using the JMARS database.
- Students will log into JMARS and learn the different layer features (surface temperature, thermal imagery of the landscape, MOLA, day and night observations, etc) in the software program which will provide detailed information from satellite observations.
- Students will be able to identify landforms and geological features and formulate scientific theories as to how they were formed.
- Students will form comparisons between Mars and Earth's geological history and formations.
- Students will complete the study packet identifying the different types of geological formations and craters.
- Students will create a scale to demonstrate size and proportion of the formations they have studied.
- Students will use the data learned to create a proposal for a Martian habitat.

Materials -

Student Packet

Pencil

Ruler

Calculator

Computer with Internet Access

[JMARS](#) software program

[THEMIS](#) images (provided by Arizona State University - these can be accessed online at the JMARS/ASU website)

Engage -

To spark the students' curiosity, the class will watch a video on the proposal of a Mars Mission that has been submitted to NASA and the government.

https://www.youtube.com/watch?time_continue=2&v=Zw2fycH-Avc

Following the video, there will be a class discussion on why we should investigate Mars.

Using the guiding questions, the students will reflect on their knowledge of historical events and political climate during the time period of the 1960s and 1970s. Students will also critique the consequences and benefits of space travel and exploration

- Following the lunar landing in 1969, the video states that the US had the technology to go to Mars in the early 1970s. Why do you think the mission to Mars had not been widely accepted?
- What are the challenges facing the astronauts travelling in space for long periods of time?
- Do you feel there is any benefit in creating a colony on Mars?

The class will read through two scientific articles providing more details to the Mars exploration mission. Students will conduct a literary analysis and create an essay citing reasons for their stance on space exploration and colonization.

<https://docs.google.com/document/d/1VRkrGWztAZF8wV-uXwz8ek1I5H89NJO7YJlphpsl8Ec/edit?usp=sharing>

https://docs.google.com/document/d/1CKVQc-_VJYEg_SkoTmfC32ATF17k2bASdjl0P-Tzvtc/edit?usp=sharing

Assessment 1. The students will write a brief persuasive essay entitled "Why Mars" and will elaborate on their viewpoint whether humans should inhabit Mars based on the information they obtained in the film and articles.

Explore -

The students will be introduced to the [THEMIS](#) images which depict various regions on the surface of Mars and display various land types and formations. As a class, we will review the software and I will demonstrate the different layers that can be added to the satellite images which will provide detailed information on specific regions. These layers add information on topography, temperature, and provide a time stamp so students can compare images from various dates and times and look for changes in the area.

The students will then be able to log onto the program and begin exploring the surface of Mars and locate the areas shown in the THEMIS images.

Explain -

The students will work in teams (3-4 students) to complete a student packet which prompts them to choose an area on the surface of Mars and identify all the features visible in the satellite image of that particular area. This packet prompts students to critically view their THEMIS image and categorize the elements visible in the region.

http://marsed.mars.asu.edu/sites/default/files/stem_resources/SM_MARS_IMAGE_ANALYSIS_2_16.pdf

Elaborate/Extend -

The students will be able to explore the surface area using the JMARS software and compare the data collected in the stamp collection. The snapshots provide a timestamp with valuable information and may show any changes in landforms or regions over an extended time period. The students will be able to demonstrate measurements of various geological elements visible on the surface using the tools in the JMARS program. Their objective is to find an area that warrants additional research and exploration. This study will also help them in the selection of a location for a settlement and/or future rover landing.

Evaluate -

The students will create a slide presentation sharing their discoveries and observations from their studies. The presentation should explain why certain geological features may be beneficial in the creation of a human colony. They will also provide a theory as to how these features may have been created. If there are areas that may be a hindrance to a successful landing or habitation then the students should address these as well.

Final Assessment - Students will create a slide presentation to share with the class providing detailed information on a specific region on Mars' surface.

References -

<https://jmars.asu.edu/>

<http://www.pas.rochester.edu/~blackman/ast104/msurface.html>

<https://docs.google.com/document/d/1VRkrGWztAZF8wV-uXwz8ek1I5H89NJO7YJlphpsl8Ec/edit?usp=sharing>

https://docs.google.com/document/d/1CKVQc-_VJYEq_SkoTmfC32ATF17k2bASdjl0P-Tzvtc/edit?usp=sharing

https://www.youtube.com/watch?time_continue=2&v=Zw2fycH-Avc

<https://www.astronomytrek.com/10-interesting-features-on-mars/>

Rubrics -

School issued rubrics will be used for the assessments.

