



Earth: A One-Of-A-Kind Planet?

LESSON THEME

Students analyze physical processes that occur on Earth and Mars and compare differences on how particular similar physical features occur. Students will use planetary comparisons in understanding why Earth is conducive to supporting life. What is life, and is life a rarity in the solar system and galaxy?

OBJECTIVES

Students will

- Compare and contrast the physical features on Earth and Mars to determine if these features were formed similarly.
- Organize Earth and Mars images into pairs that show evidence of similar physical processes.
- Determine what physical processes on Earth led to an environment suitable for life and investigate if similar physical processes may have provided an opportunity for life to have developed on Mars or on other planetary bodies in the solar system.
- Research the characteristics of what makes a planet inhabitable.

NASA SUMMER OF INNOVATION

UNIT

Earth and Space Science: Comparative Planetology

GRADE LEVELS

7-9

CONNECTION TO CURRICULUM

Earth Science, Astronomy, Biology, Geology

TEACHER PREPARATION TIME

30 Minutes

Complexity: Moderate

NATIONAL STANDARDS

National Science Education Standards, NSTA

Earth and Space Science

- Earth in the solar system.
- Origin and evolution of the Earth system.
- Origin and evolution of the universe.

Life Science

- Populations and ecosystems.
- Diversity and adaptations of organisms.
- Biological evolution.
- Behavior of organism.

National Geography Standards, NCGE

The Uses of Geography

- How to apply geography to interpret the past.
- How to apply geography to interpret the present and plan for the future.

ISTE NETS and Performance Indicators for Students, ISTE

Technology Operations and Concepts

- Understand and use technology systems.
- Select and use applications effectively and productively.
- Transfer current knowledge to learning of new technologies.

MANAGEMENT

The investigations in these lessons are best adapted for engaging students in groups of two. Ensure that sufficient printed copies of the lessons are provided for students working in pairs.

CONTENT RESEARCH

The planets in our solar system are being explored by robots either in orbit around the planet or, as in the case of Mars, by surface-roving robots. Planetary scientists using these robots are beginning to discover the characteristics that may allow a planet to be hospitable for life. The activities will allow students to investigate why life is found on Earth and investigate the chances of life being discovered on other planets and bodies in the solar system.

VOCABULARY:

Artificial intelligence or AI -- uses onboard computers to interpret the environment and terrain as the robot moves

Drake Equation -- an equation intended to help calculate the odds of finding other habitable planets in the universe

Life -- Living organisms undergo metabolism, maintain homeostasis, possess a capacity to grow, respond to stimuli, reproduce, and, through natural selection, adapt to their environment in successive generations.

Habitable -- capable of sustaining life

Hospitable -- offering an environment for life

Mars Pathfinder Mission -- mission of a NASA planetary spacecraft made to travel to the surface of Mars. Pathfinder was designed to be a demonstration of the technology necessary to deliver a lander and a free-ranging robotic rover to the surface of Mars in a cost-effective and efficient manner.

Rover robot -- robot built to maneuver on a planet with wheels by using artificial intelligence

MATERIALS

- Module 2, Investigation 3: Briefing: What similar physical processes occur on both Earth and Mars? <http://www.missiongeography.org/58mod2inv3.htm>
- Copies of the activities at: <http://nai.arc.nasa.gov/library/downloads/ERG.pdf>
- Scissors
- Computers with Internet Access

LESSON ACTIVITIES

Mars and Earth Physical Comparison

Students investigate common physical features appearing on Earth and Mars and determine if these features have common origins.

<http://www.missiongeography.org/58mod2inv3.htm>

Astro-Venture: Search for and Design a Habitable Planet!

This interactive website allows students to determine what makes a planet hospitable for life.

<http://astroventure.arc.nasa.gov/>

Assessing Planets as Candidates for Life

Students engage in a thorough investigation of what life is. What does life need to live? What makes a world habitable? What can life tolerate? Is there life on other worlds?

<http://nai.arc.nasa.gov/library/downloads/ERG.pdf>

ADDITIONAL RESOURCES

EarthKam

Sponsored by NASA, EarthKAM (Earth Knowledge Acquired by Middle School Students) is an educational outreach program allowing middle school students to take pictures of Earth from a digital camera aboard the International Space Station.

<https://earthkam.ucsd.edu/>

Mars Pathfinder

Mars Pathfinder was designed to be a demonstration of the technology necessary to deliver a lander and a free-ranging robotic rover to the surface of Mars in a cost-effective and efficient manner. Pathfinder not only accomplished this goal but also returned an unprecedented amount of data and outlived its primary design life.

http://www.nasa.gov/mission_pages/mars-pathfinder/

Solar System Lithograph Set

This lithograph set features images of the planets, the sun, asteroids, comets, meteors and meteorites, the Kuiper Belt and Oort cloud, and moons of the solar system. General information, significant dates, interesting facts and brief descriptions of the images are included

http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Our_Solar_System_Lithograph_Set.html

YouTube Video. Carl Sagan on Drake Equation

<http://www.youtube.com/watch?v=0Ztl8CG3Sys>

SETI

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

DISCUSSION QUESTIONS

Could a mathematical equation be formulated to calculate the chances of life in the solar system or civilizations in the Milky Way galaxy?

--Frank Drake, an astronomer formulated an equation in 1961 to estimate the possibility of extraterrestrial civilizations in the Milky Way galaxy. Have students review the Drake equation by watching the YouTube video excerpt of Carl Sagan's **Cosmos** television series explaining the equation.

After being introduced to the Drake equation, allow students to discuss their views whether civilizations in our galaxy would be common or rare?

--The Drake equation implies that Earth-like civilizations likely would be rare within our galaxy and in the universe.

What is a key factor for the presence of life?

--Water

ASSESSMENT ACTIVITIES

You can use **Assessing Planets as Candidates** as an assessment by allowing students to work on the activities included in the lesson. Observe how students are able to complete the exercises in a concise and logical manner and see how well they understand the multiple requirements to find a planet suitable for life.

<http://nai.arc.nasa.gov/library/downloads/ERG.pdf>

ENRICHMENT

Invite a guest astronomer from a local college or university or speakers from a local astronomy group to come and speak to students about what they believe are the chances of finding life in the galaxy and universe. Assign students the task of finding short videos on YouTube taken from the astronomer Carl Sagan's **Cosmos** television series where he explains his views on extraterrestrial civilizations.