



## ***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 similarly formed
- 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**

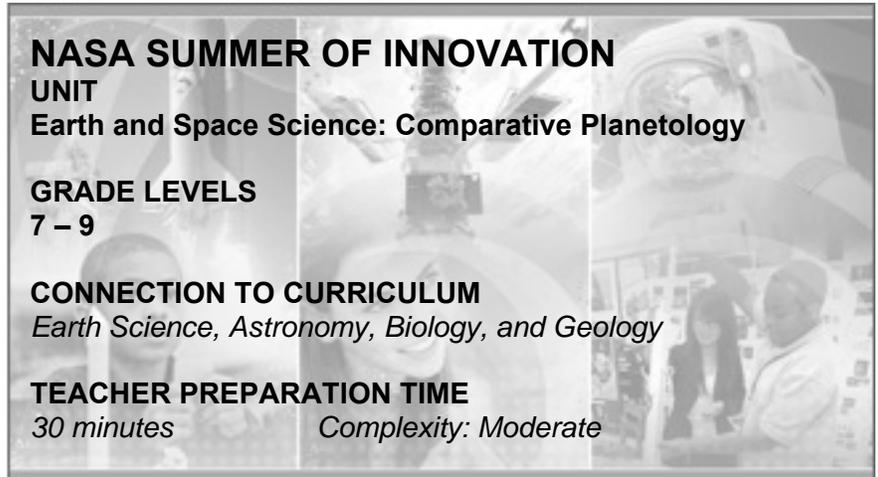
### **CONNECTION TO CURRICULUM**

*Earth Science, Astronomy, Biology, and 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**

##### *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 (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**—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 using artificial intelligence.

## MATERIALS

- Module 2, Investigation 3: Briefing: What similar physical processes occur on both Earth and Mars? [Module 2](#)
- Copies of the activities at [Life on Earth](#)
- 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 Web site allows students to determine what makes a planet habitable and 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 life needs to live, what makes a world habitable, what can life tolerate, and 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 our Earth from a digital camera onboard 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/](http://www.nasa.gov/mission_pages/mars-pathfinder/)

## **Solar System Lithograph Set**

This lithograph set featured 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.

[Lithograph Set](#)

## **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. Instruct students to 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 would likely be rare within our galaxy and in the universe.*

What is a key factor for the presence of life? *Water*

## **ASSESSMENT ACTIVITIES**

Use Activity 3, "Assessing Planets as Candidates for Life" 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 how well they are understanding 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 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 Astronomer Carl Sagan's Cosmos television series as he explains his views on extraterrestrial civilizations.