

Investigating Planetary Life

Teacher's Guide

Grade Level: 9–12

Curriculum Focus: Space Science

Lesson Duration: Two class periods

Program Description

Science has yet to prove that life exists on other planets, but it does allow us to speculate on the appearances of life forms on celestial bodies. This is the science of exobiology, the branch of biology that deals with the search for extraterrestrial life.

Lesson Summary

Students focus on the research that scientists have conducted to determine if life has ever existed – on Mars. They discuss the variables needed for life to form, why scientists are concentrating on Mars, and the tools they are using to investigate this planet. Working in small groups, students create a visual display that includes these points, as well as scientists' most recent findings.

Onscreen Questions

Part 1, "Life Beyond Earth"

- According to scientists, what elements are essential for life to thrive?
- Why are advances in computer technology important in exobiology?

Part 2, "Science Continues Its Search"

- How do the life forms found on Darwin IV compare to those on Earth?
- What might life on other planets teach scientists about the origin of life on Earth?

Lesson Plan

Student Objectives

- Identify the variables that must be in place for life to develop.
- Explain why scientists are investigating life on Mars.
- Describe the tools scientists are using in their search for life on Mars.

- Discuss the most recent scientific findings about whether life has ever existed on Mars.

Materials

- *Investigating Planetary Life* program
- Computer with Internet access
- Poster board
- Markers and colored pencils

Procedures

1. Begin the lesson by asking students to write on a piece of scrap paper their opinion about whether they think life exists elsewhere in the universe. Tell them not to show the paper to anyone and to put it away until the end of the lesson.
2. Have students watch the program *Investigating Planetary Life*. Then briefly discuss it with the class. Make sure students understand that this is a fictional account of where life might be in the universe and what it might look like. Explain that they will be learning about how scientists are searching for life elsewhere in the universe, and in particular, on Mars.
3. Divide the class into groups of four. Tell each group that their task is to research the scientific search for life on Mars and to develop a visual display describing this process. Each display should include the following items.
 - A description of Mars
 - Early scientific efforts to look for life on Mars
 - Recent efforts to look for life on Mars, with an emphasis on scientific tools
 - A discussion of the most recent findings
4. Give students time in class to work on their projects. The following Web sites have information on this topic.

Mars

<http://marsrovers.jpl.nasa.gov/gallery/press/>

<http://www.astrobio.net/news/modules.php?op=modload&name=News&file=article&sid=1785&mode=thread&order=0&thold=0>

http://www.nature.com/news/2004/040726/pf/040726-3_pf.html

<http://www.msss.com/http/ps/life/life.html>

<http://cmex.ihmc.us/CMEX/data/Marslife/NLife.htm>

http://news.nationalgeographic.com/news/2003/06/0611_030611_marslife.html

<http://news.bbc.co.uk/1/hi/sci/tech/4063181.stm>

http://www.space.com/business/technology/life_detection_040929.html

Basic Information

http://www.chem.duke.edu/~jds/cruise_chem/Exobiology/sites.html

http://www.space.com/scienceastronomy/astrobiology_nrc_040507.html

5. For your information, below is some background material on this topic.
 - To date, Mars is the only planet that has shown evidence that water may have existed on it at one time.
 - In 1976 the Viking I and II probes landed on Mars. At the time, they were the most sophisticated probes ever to land on a celestial object. The probes gathered soil samples and performed many experiments in search of signs of life; most scientists agreed that life on Mars did not exist. One scientist, Gilbert Levin, claimed that his experiments showed that some form of life was present in the soil.
 - In 2004 NASA (National Aeronautic Space Agency) sent two state-of-the-art robots, Spirit and Opportunity, to explore Mars. The images they sent to Earth confirmed the suspicion that water in some form did exist on Mars at one time. Water is essential for life.
 - Spirit has stopped sending data to Earth, but Opportunity is still functioning. Based on recent data, scientists have concluded that while water was present on Mars, other conditions may have made the development of life difficult. At this point, scientists question whether the conditions needed for a key set of chemical reactions to take place were ever present there. If these chemical reactions could not take place, the probability of life developing would be lower.
 - The search for life on Mars is ongoing. Scientists will continue to analyze new data and develop theories as information becomes available.
6. During the next class period, give students time to finish their displays. Then have each group present its findings. Discuss any themes that are evident in all the displays. Based on the data available, do students think that life has existed on Mars?
7. Conclude by asking students to look at their answer to the question about whether life exists elsewhere in the universe that they recorded at the beginning of the lesson. Have students' ideas about this topic changed? Do they think that scientists may answer this question during their lifetimes?

Assessment

Use the following three-point rubric to evaluate students' work during this lesson.

- 3 points: Students thoroughly explained the variables that need to be in place in order for life to form; demonstrated a clear understanding of why scientists are looking for life on Mars; demonstrated a clear understanding of the way research has progressed in this area.
- 2 points: Students satisfactorily explained the variables that need to be in place in order for life to form; demonstrated an adequate understanding of why scientists are looking for life

on Mars; demonstrated a satisfactory understanding of the way research has progressed in this area.

- 1 point: Students had difficulty explaining the variables that need to be in place in order for life to form; demonstrated a weak understanding of why scientists are looking for life on Mars; demonstrated a weak understanding of the way research has progressed in this area.

Vocabulary

exobiology

Definition: The branch of science that focuses on the search for life outside Earth elsewhere in the universe

Context: Many people believe that life must exist elsewhere in the universe, and a field of science called exobiology is dedicated to finding out if it does.

Mars

Definition: The fourth-closest planet to the sun, Mars has a reddish surface that can be seen from Earth.

Context: In addition to signs that water may once have been present on Mars, scientists also have found that the surface conditions on Mars are closer to those on Earth than are those of any other planet, adding further support to the idea that life may exist there.

Spirit and Opportunity

Definition: Two robots sent to Mars that have successfully sent data to Earth

Context: Spirit has stopped operating, but Opportunity continues to send important information about Mars to Earth.

Viking probes

Definition: Two spacecraft sent to study Mars in 1976; at the time, they were highly sophisticated research tools

Context: Based on an analysis of soil samples picked up by the Viking probes, most scientists concluded that it would have been impossible for life to have existed on Mars.

water

Definition: A compound of hydrogen and oxygen; thought to be a required variable for the formation of life

Context: Although there is evidence that water existed on Mars, scientists stress that this doesn't mean that the planet can support life.

Academic Standards

Mid-continent Research for Education and Learning (McREL)

McREL's Content Knowledge: A Compendium of Standards and Benchmarks for K-12 Education addresses 14 content areas. To view the standards and benchmarks, visit <http://www.mcrel.org/>.

This lesson plan addresses the following national standards:

- Space Science: Understands the composition and structure of the universe and the Earth's place in it
- Language Arts – Viewing: Uses viewing skills and strategies to understand and interpret visual media

National Academy of Sciences

The National Academy of Sciences provides guidelines for teaching science in grades K-12 to promote scientific literacy. To view the standards, visit this Web site:

<http://books.nap.edu/html/nses/html/overview.html#content>.

This lesson plan addresses the following national standards:

- Earth and Space Science: Earth in the solar system

Support Materials

Develop custom worksheets, educational puzzles, online quizzes, and more with the free teaching tools offered on the Discoveryschool.com Web site. Create and print support materials, or save them to a Custom Classroom account for future use. To learn more, visit

- <http://school.discovery.com/teachingtools/teachingtools.html>
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DVD Content

This program is available in an interactive DVD format. The following information and activities are specific to the DVD version.

How To Use the DVD

The DVD starting screen has the following options:

Play Video—This plays the video from start to finish. There are no programmed stops, except by using a remote control. With a computer, depending on the particular software player, a pause button is included with the other video controls.

Video Index—Here the video is divided into sections indicated by video thumbnail icons; brief descriptions are noted for each one. Watching all parts in sequence is similar to watching the video from start to finish. Brief descriptions and total running times are noted for each part. To play a particular segment, press Enter on the remote for TV playback; on a computer, click once to highlight a thumbnail and read the accompanying text description and click again to start the video.

Curriculum Units—These are specially edited video segments pulled from different sections of the video (see below). These nonlinear segments align with key ideas in the unit of instruction. They include onscreen pre- and post-viewing questions, reproduced below in this Teacher's Guide. Total running times for these segments are noted. To play a particular segment, press Enter on the TV remote or click once on the Curriculum Unit title on a computer.

Standards Link—Selecting this option displays a single screen that lists the national academic standards the video addresses.

Teacher Resources—This screen gives the technical support number and Web site address.

Video Index

I. Mission to Outer Space

Experts searching for intelligent life on other planets have designed a scientifically verified, simulated space mission. Watch as the spacecraft Von Braun sets its course for Darwin IV.

II. Landing on Darwin IV

Join a simulated journey and travel alongside probes as they land on Darwin IV and discover life forms not entirely unlike those found on Earth.

III. Investigating Another World

It's Day 15, and the simulated search for life on Darwin IV continues. Examine some plant and animal species the probes find on this planet.

IV. A Living Universe

What is our place in the universe? Explore that question and many more with renowned scientists and experts as the probes make contact with an intelligent alien life form.

Curriculum Units

1. Beyond Our Solar System

Pre-viewing question

Q: Do you think intelligent life exists on another planet?

A: Answers will vary.



Post-viewing question

Q: How long would it take the Von Braun spacecraft to reach the nearest star outside our solar system?

A: The star nearest to our solar system is four light-years away. Traveling at 37,000 miles a second, or 20 percent the speed of light, the Von Braun spacecraft would take 42 years to reach the star.

2. The Mission's First Phase

Pre-viewing question

Q: What exploratory space missions do you know about?

A: Answers will vary.

Post-viewing question

Q: What is expected to happen during the first phase of the Darwin mission?

A: During the first phase of the mission, the Darwin Reconnaissance Orbiter, or DRO, is deployed. The DRO will spend months monitoring the weather, geology, and topography of the planet and looking for general signs of life on the planet. The DRO will rotate around the planet to map it.

3. Launching a Probe, Landing on the Planet

Pre-viewing question

Q: How has scientific knowledge of the solar system and universe changed over time?

A: Answers will vary.

Post-viewing question

Q: How would scientists have known the density of Darwin IV prior to the mission?

A: Scientists would have known that Darwin IV the density by looking at the spectrum of the planet's oxygen signature. It would have been so broad that scientists would have known to expect much more oxygen and a higher atmospheric density on Darwin IV than on Earth.

4. The Search Team

Pre-viewing question

Q: What would you do if you saw an extraterrestrial spacecraft land?

A: Answers will vary.

Post-viewing question

Q: How are Ike and Leo different?

A: While physically identical, Ike and Leo were created with complimentary personalities. Ike is safety conscious, and Leo is inquisitive and programmed to take risks.

5. Finding Life on Darwin IV

Pre-viewing question

Q: What makes Earth suited to sustaining human life?

A: Answers will vary.

Post-viewing question

Q: Might it be possible to prepare Ike and Leo for every possible scenario they could encounter on

Darwin IV?

A: Answers will vary.

6. Night Falls on Darwin IV

Pre-viewing question

Q: How would you expect life forms on other planets to differ from those on Earth?

A: Answers will vary.

Post-viewing question

Q: What do you think the bioluminescent nighttime activity on Darwin IV was?

A: Answers will vary.

7. The First Glimpse of Death

Pre-viewing question

Q: Do you think that life can exist without death?

A: Answers will vary.

Post-viewing question

Q: Describe the forest on Darwin IV?

A: Some trees growing in the forest were stickball plants, part sponge and part virus. Giant bulbs called Darwin tomatoes sprang out of the dense soil. Trunk suckers, a type of animal, clung to black bark trees, sucking nutrients from just beneath the layer of tough outer shingles.

8. Leo Investigates a Herd

Pre-viewing question

Q: What precautions would you take when studying a new breed of animal?

A: Answers will

Post-viewing question

Q: What Earth animals do you think most closely resemble the Unths?

A: Answers will vary.

9. Predators and Prey

Pre-viewing question

Q: How do humans communicate on Earth?

A: Answers will vary.

Post-viewing question

Q: Why do predators typically have forward-facing eyes?

A: Predators typically have forward-facing eyes so they can zero in on their prey visually.

10. Meeting Darwin IV's Aggressors

Pre-viewing question

Q: Would you expect alien life forms to be aggressive?

A: Answers will vary.

Post-viewing question

Q: How would you describe a daggerwrist?

A: Answers will vary.

11. Communicating With an Alien Species

Pre-viewing question

Q: What would you expect alien life forms to look like?

A: Answers will vary.

Post-viewing question

Q: Do you think Ike should have launched the camera disc?

A: Answers will vary.

12. Our Place in the Universe

Pre-viewing question

Q: Do you think scientists should learn more about the universe? Explain your answer.

A: Answers will vary.

Post-viewing question

Q: What do you think is humanity's role in the universe?

A: Answers will vary.

Credit

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