SEARCHING FOR LIFE BEYOND EARTH

SCIENCE AND TECHNOLOGY

MISSION DESCRIPTION

This activity provides the opportunity for participants to learn about the emerging field of astrobiology and apply the scientific method to generate a testable hypothesis.

TIMELINE

Description	Duration*
Engage participants by asking discussion questions	10 minutes
Introduce the activity and the scientific method	20 minutes
Groups develop a question	5 minutes
Groups research information pertaining to the question	30 minutes
Groups complete activity worksheet	45 minutes
Total	**2 hours**

*Timing may vary. The activity can be altered to be more or less difficult to suit your needs.

BACKGROUND

Scientists are trying to better understand how life began on Earth and if lifeforms have existed or currently exist on other planets. Science, although advanced, cannot offer a complete definition of life or explain the exact time, conditions, or mechanisms when matter became living. A type of science called astrobiology addresses all these compelling mysteries by studying the origin, evolution, distribution and future of life in the universe. How did life originate? Does life exist outside Earth? What are the requirements for a planet to be habitable? Will humans explore and settle other worlds?

In order to answer these questions and conduct research, scientists must use the scientific method. The scientific method has six important steps, which are:

1. Ask a question
2. Do background research
3. Construct a hypothesis
4. Test the hypothesis with an experiment
5. Analyze your data and draw conclusions
6. Communicate your results

Difficulty: **MODERATE**

Duration: **2 HOURS**

Material: **MODERATE**

GOAL

To familiarize participants with the scientific method and to improve abstract thinking.

OBJECTIVES

By the end of the activity, participants will be able to

- Generate a strong hypothesis using the scientific method
- Describe at least three things to consider when testing a hypothesis

This activity will go through steps 1 to 3, but you can alter this activity to suit your needs. To add complexity, participants could create an experimental design (step 4).

MISSION PREPARATION

MATERIALS

- Access to a library or the Internet
- Worksheet

DISCUSSION QUESTIONS

Which conditions do you think are necessary for life?

What do various lifeforms on Earth (insects, plants, animals, humans, etc.) need in order to live?

Do you think there are lifeforms elsewhere in the universe? If so, how could we confirm it?

RESOURCES

Hypotheses

A hypothesis is defined as "a proposed explanation made on the basis of limited evidence as a starting point for further investigation." It's important to note that a hypothesis is a statement, not a question. Hypotheses often have the structure: **"If __X ___[I do this], then ___Y__[this will happen]."** The X is the cause and the Y is the effect. In other words, X is the independent variable and Y is the dependent variable.

A strong hypothesis generally has the following characteristics:

- Is formulated for a specific problem
- Is clear and simple (not vague or ambiguous)
- Contains an independent and dependent variable
- Is testable

Examples of hypotheses:

- If 100 mL of water is added to my houseplant each day and it grows, then adding 150 mL of water every day will make it grow faster.
- If there's water on another planet, then there will likely be evidence of lifeforms.
- If students eat healthy snacks while studying, they will remember more information.

ASTROBIOLOGY[1]

Astrobiology is the multidisciplinary study of the origin, distribution, and evolution (past and future) of life. Astrobiologists seek to do the following:

1. Understand how life arose on Earth
2. Determine the general principles governing the organization of matter into living systems
3. Explore how life evolves on the molecular, organismal, and ecosystem levels
4. Determine how the terrestrial biosphere has co-evolved with Earth
5. Establish limits for life in environments that provide analogues for conditions on other worlds
6. Determine what makes a planet habitable and how common those worlds are in the universe
7. Determine how to recognize the signatures of life on other worlds beyond our solar system
8. Determine whether there is (or once was) life elsewhere in our solar system, particularly on Mars, Europa, or Titan
9. Determine how ecosystems respond to environmental change on timescales relevant to human life on Earth
10. Understand the response of terrestrial life to conditions in space or on other planets

[1] Lunine, J. I. (2005). *Astrobiology: A Multidisciplinary Approach.* San Francisco: Pearson Education, Inc.

EXPLORE FURTHER

- Ecosystems on Earth
- Building blocks of life (hydrogen, oxygen, carbon, nitrogen, sulfur, phosphorus)
- Exoplanets

MISSION INSTRUCTIONS

1. Begin a discussion with the participants, using the discussion questions as a guide.
2. Introduce participants to the scientific method.
3. Put participants into groups of two or three to complete the activity.
4. Invite some groups to share their hypothesis after activity completion.

ACTIVITY WORKSHEET

ASTROBIOLOGY JUNIOR SCIENTIST: THE SEARCH FOR LIFE BEYOND EARTH

Write down a few things that were said during the discussion.

Ask a **general question** about life or evolution of life in the universe.

For example: *What are the requirements for life to exist? How could a specific animal on Earth live on a different planet? How could we identify the existence of life elsewhere in the universe?*

Conduct research about your question and write some notes below.

Generating hypotheses helps scientists design their experiment and move through all steps of the scientific method. Now that you have more information, generate a hypothesis. Identify the cause and the effect in your hypothesis.

Briefly describe how you could theoretically test your hypothesis. *Hint: What are the obstacles? What are the results you are looking for? What evidence do you need?*