



## ***Astrobiology: Life Here and Out There***

### **DESCRIPTION**

Students explore life here on Earth and utilize that understanding to determine what life is and how to look for it on other planets.

### **OBJECTIVES**

Students will

- Survey their opinions on the possible existence of alien life and then go on to develop a working definition of what it means to be alive
- Apply their definitions by taking a field trip to search for living things
- Determine life by focusing on the observable characteristics of living things
- Theorize places in the universe that meet the requirements for life
- Match recently discovered microscopic life forms with the extreme environments in which they thrive
- Utilize an inquiry-based learning approach that fosters team building and introduces students to careers in astrobiology

### **NASA SUMMER OF INNOVATION UNIT**

*Life Science—Search for Life*

### **GRADE LEVELS**

4 – 6

### **CONNECTION TO CURRICULUM**

*Science*

### **TEACHER PREPARATION TIME**

1 hour

### **LESSON TIME NEEDED**

3.5 hours

*Complexity: Moderate*

## **NATIONAL STANDARDS**

### **National Science Education Standards**

#### *Science as Inquiry*

- Understanding of scientific concepts
- Abilities necessary to do scientific inquiry
- Skills necessary to become independent inquirers about the natural world
- The dispositions to use the skills, abilities, and attitudes associated with science

#### *Life Science*

- Characteristics of organisms
- Organisms and environments
- Structure and function in living systems
- Populations and ecosystems
- Diversity and adaptations of organisms

#### *Earth and Space Science*

- Structure of the earth system

#### *Science in Personal and Social Perspectives*

- Personal health
- Types of resources
- Changes in environments
- Populations, resources, and environments
- Natural hazards
- Science and technology in society

## MANAGEMENT

The *Astrobiology: Science Learning Activities for Afterschool* curriculum guide consists of eight activities, each of which may be completed in about 1 hour. The activities are targeted for 5 to 12 year olds, with separate instructions for the different age groups when appropriate. *Navigating Through the Activities* uses a format that is geared towards helping the instructor navigate efficiently through each hour-long activity. The headings contain brief but pertinent information.

The *Overview* gives you a quick summary of the Activity and the estimated time for each part.

*Connections* help you make sense of the flow of the unit by relating the topic of the activity to those that come before or after it. You may use this section to introduce an activity and to help participants connect to what they have already done or will be doing in subsequent activities.

The *Big Ideas* present the background content information and the concepts that are addressed in the activity.

The *Materials* section lists everything you will need to use that day. In many cases, the materials are commonly available supplies. Most images listed are provided either as handouts or online. There are some items you will need to gather yourself, and these are clearly outlined. Be sure to preview the *Materials* section in advance. Please see the complete materials list for the entire unit on page 6.

The *Preparation* section lets you know what you need to get ready ahead of time.

The *Activity* is presented in a step-by-step style. The main objective in each step comes first, in bold print as a visual cue. A brief paragraph explains the step in more detail and also provides questions and prompts to use with participants.

## CONTENT RESEARCH

The science of astrobiology is concerned with the question of whether or not life exists on other planets. A common misconception many students have is that our planet has been visited by other “alien” life. To date, however, there is no definitive proof that life does or has in past times existed beyond Earth much less visited our planet, but it is important to realize that this is still an open question about life beyond Earth. Everything we know about life comes from studying our own planet, so the current strategy is to study the life that exists here to find out more about where and how to look for life beyond our own system. Recent discoveries about life forms in extreme environments and about our solar system have renewed scientists' interest in looking for life elsewhere. *Astrobiology* presents young thinkers with some intriguing questions about the universe and gives them the opportunity to explore topics related to the search for life beyond their own planet using some of the same strategies that astrobiologists use. They will also explore the biology related careers needed to study and examine the possibility of life on other worlds.

### Key Concepts:

- The only life we have ever been able to detect exists here on Earth.
- Everything we know about life and living things comes from what we know about our own planet.
- Scientists define life in different ways, but agree that certain characteristics are common to living things. These are the ability to use energy, to grow, and to reproduce.
- Life as we know it on Earth requires water, a source of energy and a stable environment to exist.
- Sometimes we cannot see living things, but we can observe evidence of their presence.
- At the present time, there is no positive evidence that life exists beyond Earth.

## MATERIALS

(Basic materials are listed. Complete list can be found on page 6 in the *Astrobiology: Science Learning Activities for Afterschool* guide)

- White board, chalkboard, or pad of chart paper and chalk or markers
- Crayons or colored pencils
- An outdoor area
- 3 clear containers
- 1 container of hot tap water
- 3 tablespoons of sand
- 3 teaspoons of sugar
- 1/2 packet of active dry yeast
- 1 fizzing antacid tablet, crushed
- 3 small sheets of paper
- 1 spoon
- 1 large sheet of paper
- 1/4 inch slice of raw potato
- 1 re-sealable plastic sandwich bag

**Key Terms:**

- **Astrobiology:** the science that studies the question of whether or not life exists on other planets
- **Alien:** extraterrestrial (not from Earth) life form
- **Biology:** the science of living things

**LESSON ACTIVITIES**

The *Astrobiology: Science Learning Activities for Afterschool* curriculum guide is divided into eight activities that are described below. Following those activities, *Astro-Venture's Biology Training Module* will guide students through biology careers needed to study life here on Earth and possible life on other worlds. The complete guide can be accessed at:

[http://www.nasa.gov/pdf/145916main\\_Astrobiology.Guide.pdf](http://www.nasa.gov/pdf/145916main_Astrobiology.Guide.pdf)

**Do You Think Aliens Exist?**

Students discuss the possible existence of alien life and then survey the group to record and graph opinions. They use their science journals to write about and illustrate their ideas.

**Is It Living?**

Students compare a living and a nonliving object to begin defining life. They go outdoors to search for living things.

**Do the Mystery Samples Contain Life?**

Students explore the properties of three mystery samples and try to find out which one contains life. Then they review what they have learned so far about the characteristics of living things.

**What Does Life Need?**

Working in small groups, students determine, write about, and/or draw what a particular living organism needs to survive.

**Are Microbes Alive?**

Students observe mold growing on potatoes and then look at magnified images of several different microbes.

**Where Does Life Live?**

Students use cards and/or computer images to look at some extreme environments and then match the environments with life forms they support. On large sheets of paper, students summarize what they have learned about where life can exist.

**Could Life Exist in Other Places in the Solar System?**

In their science journals, students record what they already know about our solar system. Then they examine NASA images of moons, planets, and the Sun to evaluate them as possible places for life to exist.

**Now What Do You Think About the Possibility of Life in the Universe?**

Students reexamine their own thinking process, they then take a new survey to find out if they have changed their opinions because of new information.

**ADDITIONAL RESOURCES****Astro-Venture's Biology Training Module**

This module guides you, as a Junior Biologist, through your job to change the biologic features of Earth and observe the effects. You will also explore how these features work together to help make a planet habitable to humans.

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

**NASA Astrobiology Web site**

<http://astrobiology.nasa.gov/>

## NASA Welcome to the Planets

<http://pds.jpl.nasa.gov/planets/>

## NASA Our Solar System Lithograph Set

[http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Our Solar System Lithograph Set.html](http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Our_Solar_System_Lithograph_Set.html)

### DISCUSSION QUESTIONS

Begin the lesson by encouraging an open discussion in which each student contributes ideas and gives reasons. (Answers will vary based on students' prelesson knowledge and should not be considered correct or incorrect, but only to motivate discussion. Some sample answers are listed below.)

- Have you ever seen or read anything about aliens, or creatures such, as people or animals from other planets? *Answers will vary*
- Do you think that there is life in places beyond Earth? Why or why not? *Answers will vary*
- What characteristics do living things have? *Breathe, eat, reproduce, mobile, and communicate*

### ASSESSMENT ACTIVITIES

- Students will keep journals throughout their investigations. They may record their discoveries, thoughts, and ideas in writing and drawings, the way that working scientists do. Have the students share these journals with the class.
- Observe and assess student performance throughout the activities.

### ENRICHMENT

- Have students determine which careers would be necessary to study the possibility of life beyond Earth. They can research NASA careers at <http://www.nasa.gov/audience/forstudents/9-12/career/index.html>
- Let the students choose a planet that they think life can exist. Have them research that planet and then design an "alien life form" that could exist on that planet. They can draw an image or construct a model of that life form.