

ASTROBIOLOGY AND EXTREME LIFE



Lesson 2: Creating an Extreme World

OVERVIEW	<p>This lesson builds upon students' understanding of astrobiology and extreme life by having them design their own extreme environments and the life forms that could survive there. By applying scientific reasoning and creativity, students will explore how adaptations enable organisms to survive in harsh conditions, both on Earth and beyond. Duration: 60-90 minutes.</p>
LEARNING OBJECTIVES	<ul style="list-style-type: none"> • Understand the concept of extreme life and their adaptations to extreme environments. • Recognize how extreme life forms inform the search for alien life. • Combine previous knowledge with creativity to design hypothetical extreme environments and life forms.
ARIZONA SCIENCE STANDARDS	<p>3rd Grade</p> <ul style="list-style-type: none"> • 3.L1U1.5 Develop and use models to explain that plants and animals (including humans) have internal and external structures that serve various functions that aid in growth, survival, behavior, and reproduction. • 3.L2U1.7 Develop and use system models to describe the flow of energy from the Sun to and among living organisms...Organisms can survive only in environments in which their particular needs are met. <p>4th Grade</p> <ul style="list-style-type: none"> • 4.L4U1.11 Analyze and interpret environmental data to demonstrate that species either adapt and survive or go extinct over time....When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die...For any particular environment, some kinds of organisms survive well, some survive less well, and some cannot survive at all. <p>5th Grade</p> <ul style="list-style-type: none"> • 5.L3U1.10 Construct an explanation based on evidence that the changes in an environment can affect the development of the traits in a population of organisms....The environment also affects the traits that an organism develops. Differences in where they grow or in the food they consume may cause organisms that are related to end up looking or behaving differently.
NEXT GENERATION SCIENCE STANDARDS	<p>3rd Grade</p> <ul style="list-style-type: none"> • 4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. <p>4th Grade</p> <ul style="list-style-type: none"> • 3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all. <p>5th Grade</p> <ul style="list-style-type: none"> • 3-LS3-2 Use evidence to support the explanation that traits can be influenced by the environment.

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MATERIALS	<ul style="list-style-type: none"> • Worksheets: “Create an Extreme World” and “Create an Extreme Life Form” (optional) • Art supplies (optional, for coloring in drawings) • Optional: air dry clay for the “Create an Extreme Life Form” activity.
VOCABULARY	<ul style="list-style-type: none"> • Astrobiology: The study of life in the universe, including its origins, evolution, and potential existence beyond Earth. • Extreme Life: A living organism that thrives in extreme environments, such as high heat, extreme cold, high radiation, or high salinity. • Adaptation: A physical or behavioral trait that helps an organism survive in its environment. • Analog: In astrobiology, an analogue refers to an Earth-based environment, organism, or system that serves as a model for understanding conditions on other planets.
SET UP	<ul style="list-style-type: none"> • Ensure booklets and art supplies are distributed.
LESSON PROCEDURE	<p>Warm Up:</p> <ol style="list-style-type: none"> 1. Ask students to define astrobiology and discuss what they’ve learned about astrobiologists so far. 2. Have students reflect on which real-life environments and adaptations (from lesson 1) they found most fascinating. They might highlight or write down their favorites for Activity 1. 3. If time allows, students can share their selections in small groups or with the class, explaining why they found certain adaptations interesting. <p>Activity 1: Imagining Extreme Worlds</p> <ol style="list-style-type: none"> 4. Pass out the “Create an Extreme World” worksheet, or blank pieces of paper. You could also choose to instead pass out poster paper or chart paper if you’d like to make it a group activity. 5. Explain that they will design a planet or moon with an extreme environment. At this time, they should ONLY draw the environment, not any organisms that might live on their world. <ul style="list-style-type: none"> ◦ First, have each student write at least three key descriptive words about their world’s conditions, using inspiration from their favorite environments as discussed in the Warm Up. ◦ Next, they should draw a picture of the surface of the world, making sure it matches the words they wrote at the top of the page. ◦ If time, have students gather small groups to describe their worlds and explore the following questions: <ul style="list-style-type: none"> ▪ What is the closest Earth Analog to my fictional world? ▪ What types of adaptations would an organism need to survive on this world?

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LESSON PROCEDURE

Activity 2: Imagining Extreme Life

6. Pass out the "Create an Extreme Life Form" worksheet (or blank paper, or air dry clay if you choose to use this instead)

7. Explain that they will design at least one organism that can survive in their extreme environment.

- First, have each student write at least three key adaptation words about their organism, using inspiration from their favorite organisms as discussed in the Warm Up.
- Next, they should draw an illustration of their organism (or create it from clay), ensuring that their adaptations are represented in their drawing where applicable.
- If time, have students gather small groups to describe their organisms, and possibly brainstorm other organisms that might also live on that world.

Reflection

8. Explore the following questions with the students as time and interest levels allow. You might also choose one of these questions as an "exit ticket" type of activity.

- What was the most surprising or creative adaptation you saw?
- How do real-life extreme life forms compare to the ones we designed?
- What can studying Earth's extreme life tell us about the possibility of life on other planets?
- Reinforce the connection between astrobiology and real-world science, emphasizing how NASA and other organizations use extreme life as models for studying alien life.

EXTENSIONS AND TAKE HOME ACTIVITIES

Here are some additional activities you might consider to extend the lesson or expand learning beyond the classroom.

- Storytelling: Write a short sci-fi story featuring their extreme life form, describing a "day in the life" of their creature.
- Astrobiology Research: Assign students to research a real-life extreme life form that is similar to the fictional organism they designed.
- Ask students to recall their favorite animal, then alter that animal to survive on the extreme world they designed. What characteristics of that animal did they have to change? What stayed the same?