EXTREMOVERSE: LIFE IN EXTREME ENVIRONMENTS

ARIZONA ASTRO BIOLOGY CENTER
aabc.arizona.edu

OVERVIEW

Students will explore how life can survive in extreme environments on Earth, and imagine what life might look like on other worlds. Using images, movement, and creativity, students identify environmental conditions, compare survival challenges, and apply their understanding while playing and expanding the Exremoverse card game.
Duration: 60-75 minutes

LEARNING OBJECTIVES

Students will:

- Identify environmental conditions that affect where life can survive.
- Recognize examples of Earth's extreme environments and the types of organisms that live there.
- Understand that life adapts to its environment through physical and behavioral traits.
- Connect ideas about Earth's extreme life to the possibility of life beyond Earth.
- Apply understanding creatively while designing and playing in the *Exremoverse* card game.

ARIZONA STANDARDS

3rd Grade: 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.

4th Grade: 4.L4U1.11 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.

5th Grade: 5.L3U1.10 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.

6th Grade: 6.L2U1.13 Develop and use models to demonstrate the interdependence of organisms and their environment, including biotic and abiotic factors.

7th Grade: 7.L1U1.11 Construct an explanation for how organisms maintain internal stability and evaluate the effect of the external factors on organisms' internal stability.

8th Grade: 8.L4U1.12 Adaptation by natural selection acting over generations is one important process by which species change over time in response to changes in environmental conditions.

EXREMOVERSE: LIFE IN EXTREME ENVIRONMENTS

ARIZONA ASTRO BIOLOGY CENTER
aabc.arizona.edu

NEXT GENERATION SCIENCE STANDARDS	**3rd Grade:** 3-LS3-2 Use evidence to support the explanation that traits can be influenced by the environment. 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. **4th Grade: 4-LS1-1** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. **Middle School: MS-LS2-1** Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. MS-LS2-4 Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
MATERIALS	• YES/NO signs or floor tape for the movement game (optional) • Writing utensils • Blank paper and colored pencils (optional extension activity) From the AABC website: • PowerPoint: Extremoverse Life Forms • PowerPoint: Extremoverse Environments (consider printing and placing each slide at a station around the classroom) • PowerPoint: Yes or No Movement Game (optional) • Exremoverse gameplay video • Extreme Environments Worksheets • *Extremoverse* card game decks (1 deck per group of 3), printed and cut
BACKGROUND KNOWLEDGE	Students should know: • Living things need water, energy, and appropriate temperatures to survive. • Some organisms (extreme lifeforms) can survive where humans cannot. • Earth has many types of environments—hot, cold, wet, dry, dark, salty—and each supports different kinds of life. • Adaptations are special body parts/behaviors that help organisms survive.
VOCABULARY	• **Environment**: The surroundings or conditions in which an organism lives. • **Adaptation**: A feature that helps a living thing survive in its environment. • **Astrobiology**: The study of life in the universe, including how life might survive beyond Earth. • **Condition**: A feature of an environment (temperature, water type, light level, etc.) that affects survival.

EXREMOVERSE: LIFE IN EXTREME ENVIRONMENTS

ARIZONA ASTRO BIOLOGY CENTER
aabc.arizona.edu

SET UP

- Load and test the Extremoverse Game: Life Forms PowerPoint, Extremoverse Game: Environments PowerPoint, and the Exremoverse game instructional video.
- Select a 3-6 of your favorites from the Life Forms PowerPoint to discuss as a class.
- If doing a gallery walk, print the images of extreme environments and place them around the room to create learning stations.
- Label two classroom sides as YES and NO for the (optional) movement game.
- Prepare and organize all *Exremoverse* card game materials, and print one copy of the Extreme Environments Worksheet for each student.
- Have blank paper for each student if doing the extension activity.

LESSON PROCEDURE

Warm Up(10-20 minutes)

- Ask:
  - What kinds of places might be too hard for humans to live in?
  - Can you think of any organisms that live in places where humans can't live?
- Show some of the Extremoverse Lifeforms PowerPoint, as time allows. Ask:
  - What type of environment does this life form survive in?
  - Can humans live there? Can [organism from previous slide] live there?
- Is our local environment an extreme environment? Why or why not? What adaptations (if any) are needed to survive in our local environment?

Activity 1: Environment Stations Gallery Walk (15-20 minutes)

1. Students rotate through different environments placed around the room (using printed slides from the Environments PowerPoint). Alternatively, you can view the slideshow as a class or in small groups.
2. For each environment, students answer questions on their worksheet about the environment's conditions.
3. After reviewing all environments, guide a short discussion as a class using questions like:
   a. Have you ever visited extreme environments like this, or seen them in a show?
   b. Which place looks the hardest to live in?
   c. Which place might have living things we don't expect?
   d. What type of adaptations would a living thing need to have to survive here?
   e. How might humans use technology to survive in a place like this?
   f. Would you like to visit/study this place? Why or why not?
   g. Why might a scientist want to study this place?
   h. How could we study life in these extreme environments without harming the environment or the living things?

Activity 2 (Optional): "Yes or No" Movement Game (10 minutes)

- Inform students that they are allowed to use their worksheet from Activity 1 as a "cheat sheet."
- Bring up the "Yes or No" slideshow.
- For each question, ask students to move to the YES or NO side of the room based on what they think.
- After all students have guessed, reveal the answer on the next slide.

EXREMOVERSE: LIFE IN EXTREME ENVIRONMENTS

ARIZONA ASTRO BIOLOGY CENTER
aabc.arizona.edu

LESSON PROCEDURE

Activity 3: Play the Extremoverse Card Game (25–30 minutes)

- Watch the Extremoverse introduction and instructional video to review how to play.
- Divide students into groups of 2-3 to play the Extremoverse card game.
- During play, encourage them to explain their reasoning:
  - Why would this creature survive here?
  - What features help it live in this place?
  - What makes your lifeform more or less likely to survive than your opponent's?

Reflection (10 minutes)

Use the following questions to lead a short discussion and/or as an exit ticket:

- What's one new thing you learned about how life survives extreme places?
- How can/do humans adapt to living in these environments? (Arctic & desert cultures, submarines to study the deep ocean, spacecraft for studying outer space, etc.)
- Are there any environments or life forms from the game that you'd like to know more about? If you could talk to a scientist studying this topic, what would you ask them?
- As astrobiologist is a scientist that studies the possibility of life beyond Earth. Why might an astrobiologist want to study the extreme environments and extreme organisms we just learned about?

EXTENSIONS AND TAKE HOME ACTIVITIES

EXTENSION ACTIVITY: Build-a-Place Game (30–45 minutes)

- Tell the students that they will be creating a new environment, meant to represent an alien world with different conditions than any of the extreme environments discussed in class. They can use the condition symbols from the game and combine them (such as making a high pressure, high radiation environment), or they can create new conditions not included in the game (such as darkness vs. sunlight).
- Students will then draw their own "environment cards" on blank paper and sketch symbols to represent conditions.
- Each student or group shares their card(s) and explains what kinds of creatures might live there.
- For an even longer project, you can have students also create a card for a lifeform(s) that would thrive in their newly created alien environment.

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

- Assign one of the organisms from the card game to a group of students to do further research and report back to the class.
- Research one of the following locations in our Solar System where astrobiologists are searching for life: Mars, Europa, Enceladus, Venus' clouds, Titan. Compare the conditions of this environment to extreme environments on Earth.