



Science Unit: *Biodiversity & Extreme Environments*

Lesson 1: *Extreme Environments*

School Year: 2009/2010
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Grade level: Presented to grade 5/6/7; appropriate for grades 4 – 8 with age appropriate modifications
Duration of lesson: 1 hour and 30 minutes

Objectives

1. Explore extreme environments, discussing obvious examples like the Polar Regions and deserts and the characteristics that make them extreme.
2. Discover how animals have adapted to live in extreme environments.
3. Learn about habitats with steep environmental gradients in space and time (e.g. intertidal zones) and discover how these habitats are “extreme” in their own unique ways.

Background Information

Most people have a sense of what an “extreme environment” is. Responses to the question “what are examples of extreme environments on earth?” typically include the Arctic, Antarctic, deserts, volcanoes, caves and mountain tops. Sometimes people think of the ocean and might also include the deep sea as an extreme place to live. These examples are usually united by the fact that one or more of the physical characteristics of the environment (e.g. temperature, rainfall/moisture, pressure) occurs in the upper or lower limits of the range that is known to support life. For example, few species can tolerate the freezing Antarctic winter or the dry relentless heat of the Sahara desert. Animals that do live in these extreme places are adapted to survive under conditions that other species would find intolerable. To survive, all animals need to breathe, eat, drink, find shelter, and regulate their body temperature within a tolerable range. For example, some fish in the Antarctic have “antifreeze” in their blood so it doesn’t freeze at very low temperatures, while camels can segregate their body fat into a hump on their backs so that their internal organs don’t overheat in the hot desert sun.

Another way to think about extreme environments, however, is to consider those habitats which are very variable in space and time. The intertidal zone is such a place. The animals and plants that live on this thin band of coastline where the tides wash in and out two times a day must tolerate a wide range of temperatures, salinities, wave and wind action and varying amounts of time exposed to air. A barnacle attached to the shore in the middle intertidal zone will be exposed to air about half the time. During this time the barnacle may have to cope with fresh water if it rains, tolerate high temperatures if the sun is shining, and prevent itself from drying out. When the tide comes in, the barnacle is submerged in cold seawater – a completely different environment. Intertidal animals are thus adapted to thrive under a wide range of abiotic conditions that vary dramatically over the course of the day and also depend on the specific location within the intertidal zone.



Vocabulary

<u>Word:</u>	Brief definition.
Adaptation	An alteration or adjustment in structure or habits by which a species or individual improves its condition in relationship to its environment
Desert	A landscape or region that receives an extremely low amount of precipitation (<250 mm per year), less than enough to support growth of most plants
Polar region	Earth's polar regions are the areas of the globe surrounding the poles (the Arctic and Antarctica)
Deep sea	Typically considered the area of the ocean below 2km. No sunlight penetrates and average temperature is about 2 degrees C
Intertidal zone	The intertidal zone is the area that is exposed to the air at low tide and underwater at high tide (e.g. the area between tide marks)
Abiotic conditions	All physical and non-living attributes of an environment, such as climate, temperature, geology etc.

Materials

- Large sheets of paper
- 5 colours of plasticine (play-doh)
- Computer with projector (to show tidal animation)
- Coloured pencils
- Small piece of wooden board for each student

In the Classroom

Introductory Discussion

1. Extreme environments on Earth. On the blackboard, draw the following matrix:

Extreme Environment	Why is it extreme?	Example Animals	Adaptations
Eg. 1 (Desert)			
Eg, 2 (Arctic)			
Eg. 3			
Etc.			

Fill in the above table by asking the students the following questions. Prepare your own table before the lesson so you can help the students if they get stuck.

- What are some extreme environments on Earth? Fill in at least 3 in the first column.
- What makes these environments extreme? Fill in column 2.
- What are some examples of animals that live in these environments? Fill in column 3.
- How are these animals adapted to their environment?



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2. Review the “classic” definition of an extreme environment, and break the students into groups of 4 for activity #1 (see below).
3. After students complete activity #1, bring the class together again to introduce the intertidal zone. Explain the three intertidal zones: low, middle and upper intertidal and how abiotic conditions vary over time and space. A good tide animation helps students to visualize the temporal variability of the intertidal zone (see: http://oceanservice.noaa.gov/education/kits/tides/media/supp_tide01.html) Explain that the area below the low tide mark is called the “subtidal zone” and the area above the high tide mark the “spray zone”.
 - Ask students how the abiotic conditions in these 3 major zones (subtidal, intertidal, spray zone) are different.
 - Ask students if they think the abiotic conditions are different between the low, middle and upper intertidal zones.
4. Ask students to each choose one of the intertidal zones (low, mid, high) and briefly describe Activity #2 (see below).

Science Activity #1

Activity Title: Extreme Environments & Animal Adaptations

Purpose of Activity: To challenge students to think about how physical adaptations allow animals to survive in extreme environments.

Methods and Instructions:

Set-up prior to activity: Prepare large sheets of paper & coloured pencils. Divide students into groups of 4.

1. In groups, students choose a “classic” extreme environment and write their choice on the sheet.
2. Students discuss what type of animal they want to create (encourage them to think outside the box, can be a totally imaginary animal), and collectively they must decide how their animal breathes, finds food and water, obtains shelter/protects itself, and maintains a good body temperature in their chosen extreme environment.
3. Students draw their animals and write or explain to the teacher how the physical adaptations of their animal allow it to survive in their chosen extreme environment.
4. Encourage students to name their animal!

Science Activity #2

Activity Title: Intertidal Zone & Animal Adaptations

Purpose of Activity: To challenge students to think about how physical adaptations allow animals to survive in the intertidal zone.

Methods and Instructions:

Set-up prior to activity: Prepare a small wooden board for each student to build their plasticine animal on.

1. Each student chooses a habitat within the intertidal zone (low, mid or high intertidal).
2. Each student creates an imaginary animal that is adapted to living in that zone.
3. Students use playdoh to create the animal, knowing that it has to have physical adaptations that allow it to thrive in its habitat.



Closure Discussion

1. What are extreme environments?
2. Has your idea of extreme environments changed from the beginning of this lesson? If yes, how?
3. What was the most interesting thing you learned?

References (examples of the format to use for different types of references are below)

1. http://www.windows2universe.org/earth/extreme_environments.html. Windows to the Universe: Extreme Environments. Accessed Feb 2010.
2. http://www.oddee.com/item_96770.aspx 10 Most Extreme Environments on Earth. Accessed Feb 2010.
3. <http://soldierontgether.blogspot.com/2008/07/adaptations-of-animals-living-in.html> Adaptations of Animals Living in Extreme Environments. Accessed March 2010.
4. <http://www.vanaqua.org/education/documents/Part4IMBPPOSTVISITACTIVITIES.pdf> Design your own invertebrate. [Lesson plan from the Vancouver Aquarium that includes good ideas for Activities #1 and 2]. Accessed March 2010.
5. Sheldon, Ian. 1998. Seahorse of British Columbia. Lone Pine Publishing. [good background on the intertidal zone]

Extension of Lesson Plan

1. Plan for students to need additional time to finish their intertidal animals. Once the animals are done, have the students create a “fact sheet” for their animal, including its name, its habitat (low, mid, high intertidal) and a description of all its adaptations. Display the animals in a mock intertidal habitat (ideally for the whole school to see) and post the fact sheets for each animal.