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FACULTY OF EDUCATION

Department of  
Curriculum and Pedagogy

# **Earth & Space Science Exploration of Extreme Environments: General**

Science and Mathematics  
Education Research Group

# Extreme Environments



# Extreme Environments I

Which of the following statements best describes extreme environments?

They are places:

- A. Exhibiting extreme conditions that are challenging to most life forms
- B. That humans may explore
- C. Requiring special equipment and technology to explore
- D. Including space, high mountains, polar ice caps, high salinity waters, and deserts
- E. All of the above

# Solution

**Answer:** E

**Justification:** While extreme environments are places that people can explore, they are places in which it is very difficult and/or impossible for human survival.

For example, the extreme environment of space does not allow humans to breathe (on their own) nor does it have its own supply of water. Humans may not survive in space without the appropriate technology that would enable them to do so, such as the International Space Station.

# Extreme Environments II

From the list below, which of the following is NOT considered an extreme environment?

- A. Antarctica
- B. The Amazon Rainforest
- C. The Sahara Desert
- D. The Mariana Trench
- E. The Dead Sea

# Solution

**Answer:** B

**Justification:** An extreme environment is one where it is very difficult or impossible for humans to live.

The Amazon Rainforest is a habitable place for humans, as it has air, water, shelter and food readily available.





# Solution Cont'd

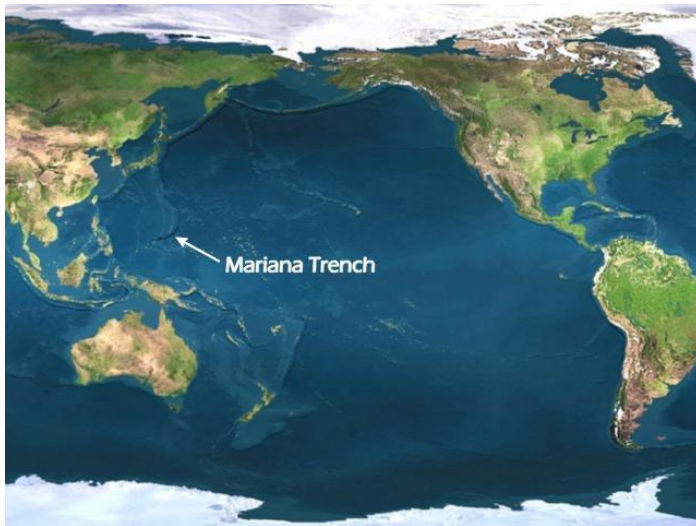
**Antarctica** is Earth's southernmost continent and typically has the coldest, driest, and windiest conditions. Surprisingly, Antarctica is considered a desert because of these conditions.



The **Sahara Desert** is located in the Middle East, across the Northern countries of Africa. It is the world's hottest and third largest desert.



# Solution Cont'd



The **Mariana Trench** is the deepest part of the earth's oceans and runs just over 2500 km long. At this depth, the pressure is over 1000 times that of sea level pressure.



The **Dead Sea**, also located in the Middle East, is one of the world's saltiest bodies, with 33.7% salinity. Due to this high salinity level, organisms are not able to flourish.



# Extreme Environments III

What are the four basic needs for human survival?

- A. Fire, water, air, soil
- B. Shelter, fire, water, air
- C. Food, water, fire, shelter
- D. Water, shelter, air, food



# Solution

**Answer:** D

**Justification:** An extreme environment is a place where human survival is difficult or impossible. In order for human survival in an environment, the four basic needs (water, shelter, air and food) must be available.

For example, in a polar region it is difficult for human survival because it lacks shelter and has extremely cold temperatures.

Similarly, space doesn't have any of the four needs of human survival occurring naturally in it. Technology such as space suits and the International Space Station (ISS) are requirements for human survival in space.

# Extreme Environments IV

Which of the four basic needs for human survival is not present in the extreme environment of a volcano?

- A. Water
- B. Shelter
- C. Food
- D. Breathable air
- E. All of the above



# Solution

**Answer:** E

**Justification:** Often, volcanoes spew lava and poisonous gases from a crater at its summit; this is called a volcanic cone. While there are different types of volcanoes (see Slide 14), no volcano is able to consistently provide any of the basic needs for human survival.

The table in the next slide describes each of the basic needs for human survival and why a volcano does not satisfy them.

# Solution Cont'd

Breathable air	Volcanoes emit (give off) carbon dioxide in large amounts. Humans are unable to breathe in large amounts of carbon dioxide.
Water	Water is not present in a volcano because the extreme heat would boil and evaporate any water present.
Food	In and around volcanoes, only microbes are able to live, thus not providing humans with adequate food sources.
Shelter	While there is often a crater on top of a volcano, the extreme heat and poisonous gasses do not allow for humans to find shelter.



# Extend Your Learning: Points of Interest

When we think of volcanoes, people often think of a conical mountain. However, there are many other different types of volcanoes as seen in the pictures below.



Volcanic Cones



Fissure Vents



Lava Domes



Submarine Volcanoes



Subglacial Volcanoes



Mud Volcanoes

# Extreme Environments V

What do all of Earth's extreme environments have in common?

- A. They are all located within the boundaries of our atmosphere
- B. They lack the four basic needs for survival
- C. They are all places in which human survival is possible
- D. They are all either a type of desert or an ocean
- E. None of the above



# Solution

**Answer:** A

**Justification:** All of these extreme environments are located in places on earth, therefore, they are contained by the boundaries of our atmosphere.

All extreme environments lack **at least** one of the four basic needs for human survival, but of Earth's extreme environments, the ocean and volcanoes lack all four (food, water, air, shelter).

# Solution Cont'd

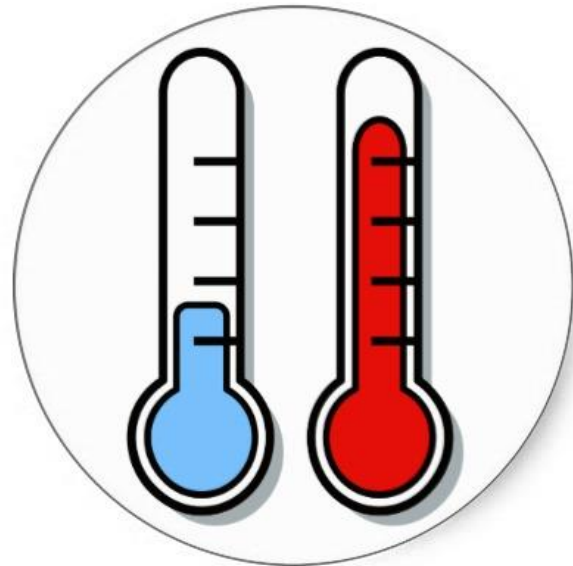
**The Ocean:** Since humans can't breathe in the ocean, its water and food sources are not useful to us. In addition, shelter and protection from the elements is not present in the ocean environment.

**Volcanoes:** The air spewing from volcanoes often contains gases that are extremely harmful and poisonous to humans, thus not safe to breathe in. These gases often include large concentrations of carbon dioxide, sulfur and nitrogen. Volcanoes lack shelter, any water will evaporate due to the extremely high temperatures and the only living organisms in and around volcanoes include heat-loving bacteria.

# Extreme Environments VI

Which of the following environments is considered extreme because of its extreme temperature differences, and limited water and vegetation?

- A. Polar region
- B. Desert
- C. Ocean
- D. Space
- E. Caves





# Solution

**Answer: B**

**Justification:** The desert is one of Earth's extreme environments. Deserts have very little precipitation, thus limited plant life. Plants and animals that live in the desert have adaptations that enable them to survive with limited water. Many people think deserts are only hot places; however, the Arctic and Antarctica are also deserts.



# Extreme Environments VII

What makes an animal an extremophile?

- A. It has tried to live in an extreme environment, but didn't survive
- B. It is genetically related to an animal that lives in an extreme environment
- C. It is an animal that has a protective outer layer, allowing it to live in extreme environments
- D. It is an animal that has special adaptations to an extreme environment

# Solution

**Answer:** D

**Justification:** An extremophile (extremo + phile = extreme + lover) is an organism that thrives in challenging environments. Different organisms have adapted to survive in various extreme environments such as volcanoes, the deep sea, space and the desert.



# Solution Cont'd

Be careful not to generalize your answers in this question.

For example, polar bears and grizzly bears are genetically related and share many common features such as a thick fur coat and large paws. Polar bears have additional adaptations to the cold arctic environment such as hollow chambers in their fur to trap heat. On the other hand, all grizzly bears hibernate whereas only female polar bears “den” during reproduction.

Another generalization to be careful of is that not all animals with a protective outer layer are extremophiles. For example, an armadillo and a turtle both have protective outer layer, but only an armadillo can survive in an extreme environment; the desert.

# Extend Your Learning: Video

Title: World's Deepest Living Fish





# Extreme Environments VIII

The cataglyphis ant is an extremophile that lives in the desert. It moves forward and then rotates 360 degrees in order to locate the position of the sun, then continues on to locate its prey. This is so that it may find the most direct route back to its nest (see first video on Slide 24).

What is this type of adaptation called?

- A. A physiological adaptation
- B. A structural adaptation
- C. A behavioural adaptation
- D. Both A & B
- E. None of the above



# Solution

**Answer:** C

**Justification:** This is an example of a behavioural adaptation because there is no change to the ant's physical appearance or physiological features. Turning around to locate the position of the sun is something that the ant does to survive the intense heat in the desert.

Other behavioural adaptation include bird calls to find a mate or sense danger and the caribou migration ([video link](#)) to the Canadian arctic.

# Extend Your Learning: Video

**Title:** The Amazing Cataglyphis Ant



**Title:** BBC Finding the Way: Ants, Moths & Bees

