

Lesson 19: Extremophiles

Summary

This learning module and related laboratory exercise exposes students to extremophiles, their habitats, and the potential to find habitable environments on Mars.

Learning Goals

Students will be able to:

- Understand the environment in which the *Tardigrade* can survive.
- Explore hydrothermal environments on Earth and Mars.

Context for Use

This learning module is meant for adaptation in an introductory earth science course and/or planetary science course.

Description and Teaching Materials

In-Class Activity

In-Class Activity 1: *Tardigrades:
Living extremely*

Homework

Homework 1: *Sea Monkey
Experiment*
Homework 2: *The Color of
Temperature*

Teaching Notes and Tips

1. Students must be familiar with Mars environments of deposition, surface processes and climate.
2. To be successful in Homework 2 students need to have exposure and instruction in making contour maps.

Assessment

Each *In-Class Activity* and *Homework* has its own measure of Assessment.

Mars for Earthlings

References and Resources

1. Image File: [Extremophiles](#)
2. Gale Crater Habitability via Curiosity:
<http://www.youtube.com/watch?v=oHLbXT0aw7w&feature=relmfu>
3. Tardigrades video from SciShow on YouTube:
http://www.youtube.com/watch?v=6H0E77TdYnY&continue_action=r7OE3bLJMH
[T8fAwevwnX90h_0zzl6Ajt2P3129QN588gcYR6MkEN_obkOAtaq5MUvFV4Yiq09ljbjDp8wedzPE1U417RionrJuPdT2CAALc=](http://www.youtube.com/watch?v=T8fAwevwnX90h_0zzl6Ajt2P3129QN588gcYR6MkEN_obkOAtaq5MUvFV4Yiq09ljbjDp8wedzPE1U417RionrJuPdT2CAALc=)
4. Additional Tardigrade link:
<http://serc.carleton.edu/microbelife/topics/tardigrade/index.html>



Mars for Earthlings

Homework 1

Extremophiles 1_MFE

Sea Monkey Experiment (courtesy of Brain Hynek, University of Colorado-Boulder)

Starting thinking: What is an extremophile?

Resources:

On brine shrimp (see materials needed on these sites)

- <http://wildlife.utah.gov/gsl/>
- <http://www.youtube.com/watch?v=kUN61qJtp6s> (tutorial on raising brine shrimp)

On extremophiles

- <http://www.spiritus-temporis.com/extremophile/types-of-extremophiles.html>
- <http://www.daviddarling.info/encyclopedia/E/extremophile.html>
- Example: *Deinococcus radiodurans* can withstand 1,500,000 “rads”. 500 rads can kill humans!

Introduction:

Sea monkey eggs (like Great Salt Lake brine shrimp) reportedly can survive dormant for > 20,000 years without water. They breathe through their feet and are born with 1 eye but develop 2 more. They are ideal for testing life's response to extreme conditions since they can survive (or remain dormant) in a wide variety of conditions (pH of 2-10, high salinity, various radiation environs, range of temperatures, etc.).

Experiment - Project Assignment:

1. Design a scientific experiment to examine some kind of extreme conditions (without destruction) on the revival and/or survival of dormant life forms (the brine shrimp eggs). The students might bake the eggs, drown them in their favorite soda, soak them in acidic lemon juice, or subject them to other extreme conditions or combinations!
2. Carry out a scientific experiment following the scientific method. Record all condition information of time, methods, amounts, solutions etc.
3. After this we will do a “blind test” and your sea monkey eggs will be given to someone else to raise (so the students are not tempted to bias the experiment).
4. Have students meet with the group that attempted to hatch their eggs. Discuss the results in terms of their hypothesis.
5. In a clear and concise write up of their experiment, discuss the results in the broader terms of astrobiology.

In-Class Discussion

Discuss the design of the students' experiment and outcomes with the class following the submission of their assignment.

Limits of the Brine Shrimp

Were there any conditions too extreme for the brine shrimp?

