

Lesson 18: Origin of Life

Summary

This module explores various hypotheses concerning the origins of life on planet Earth and their plausibility when applied to Mars.

Learning Goals

Students will be able to:

- Explain the conditions of the Miller-Urey Experiment.
- Define “life” and the requirements for life.
- Determine if the Miller-Urey Experiment has applicability on Mars.

Context for Use

This module is meant for adaptation in an Earth science course, particularly a segment discussing Pre-Cambrian/Hadean environmental conditions on Earth. Biology instructors are also encouraged to adapt this material.

Description and Teaching Materials

In-Class Activity 1: Miller-Urey Experiment

In-Class Activity 2: Mars Life through the Lens of MSL Curiosity

Teaching Notes and Tips

1. Encourage a discussion about the requirements for life and what “life” means in the In-Class Activity
2. Have students determine the viability of the Miller-Urey Experiment as a theory for the origin of life.

Assessment

Methods of assessment are within each individual *In-Class Activity* and *Homework*.

Mars for Earthlings

References and Resources

Miller-Urey Experiment YouTube Video: <http://www.youtube.com/watch?v=iahBQolXQH8>



Mars for Earthlings

In-Class Activity 1

The Origin of Life

Miller-Urey Experiment

Preparation

Have an Internet connection to view the associated video

Engage

Questions for students:

1. Have the students in their own words, define “life”:
2. List some requirements for life?

Explain

1. Students can debate the different definitions of life. A general definition of life is as follows: an organismic state characterized by capacity for metabolism, growth, reaction to stimuli, and reproduction.
2. Requirements for life are: chemical building blocks, energy, and a liquid medium.
3. Most researchers would general agree that life requires water; hence NASA’s campaign “Follow the Water”.
4. Energy does not need to be sourced from photosynthesis (e.g. chemosynthesis).

Explore

View the following YouTube animation of the Miller-Urey Experiment:

<http://www.youtube.com/watch?v=iahBQolXQH8>

1. Describe at least 4 conditions of the experiment.
2. What was “applied” after the gases travelled through the horizontal tube?
3. Was O₂ gas an important component of the experiment? Why or why not?
4. Did the experiment accurately represent a scale model of early Earth? Did they set up the conditions of early Earth properly?



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Elaborate

1. Would this experiment be applicable to early Mars?
2. How would the students modify the experiment to represent what might have occurred on Mars?
3. Visit NASA's NAI-Astrobiology website and explore the various "headlines." <https://astrobiology.nasa.gov/nai/> List at least 2 ongoing investigations that have applicability to researching the "origin of life."
4. Read "About NAI" on the website. Are investigations into the origin of life a NAI focus? Why or why not?

Students could also consider exploring a planet in a habitable zone and compare it to Earth and Mars using data from the Kepler mission. See upcoming news featuring NASA's Kepler Mission.

Evaluate

1. When students consider the present and/or past environment of Mars, could they find all the requirements for life?

