Life Science

Looking for Life

5E Lesson Plan

Source Material: Looking for Life
Mission Focused Area: Solar System and Beyond

Lesson Overview

In this activity, students will use research to develop an operational definition of life and then use the fundamental criteria for life to examine simulated extraterrestrial soil samples for signs of life.

NASA Connection

During the Viking Mars missions, tests for life off Earth were based on the idea that life would cause changes in the air or soil in the same way it does on Earth. The Viking tests did not detect the presence of life on Mars, nor would they have detected fossil evidence of past life on Mars or life that is different from that on Earth. Recent Mars missions yielded a number of findings that shape the way we search for evidence of past life on the Red Planet. The Curiosity rover determined that Mars was once potentially hospitable for life and had liquid water flowing on its surface. The Mars Reconnaissance Orbiter obtained evidence that liquid water still flows seasonally on Mars. And the Mars 2020 mission is conducting further investigation regarding the Red Planet's habitability and astrobiology, the study of life on other planets.

Objectives

- Develop a list of criteria for life using observations of local wildlife
- Summarize findings from a scientific organization using graphic organizers and charts
- Explain which samples in an experiment displayed characteristics of life using the fundamental criteria for life

Guiding Questions

- How can you tell if something is alive?
- Are there characteristics of living things that also appear in non-living things?
- What specific things do you think scientists are looking for when they search for life on other planets?
- Besides Mars, where else might there be life in our solar system? Is it possible that there is life on a planet orbiting another star?
- What tools do scientists use to look for life when they can't visit another world themselves?

National STEM Standards

NGSS

- **4-LS1-1** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction
- **MS-LS1-5** Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms
- **MS-LS1-1** Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells
- **MS-LS1-3** Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions

5E Instructional Model



Materials

- A pair of objects, one living (insect or plant, for example) and one non-living (any inanimate object, preferably one not made of once living material like wood or leather)
- An outdoor area to investigate, or images of a variety of living things
- Hand lenses
- Criteria for Life Log Charts (one per student)
- 3 small containers per student group (clear beakers or cups, or 3-oz paper dixie cups)
- Clean play sand, 150 ml per group of 3 students (50 ml per container)
- Sugar, 15 ml per group of 3 students (5 ml will be added to each container)
- Instant active dry yeast, 5 ml per group of 3 students (added to container B)
- 1 fizzing antacid tablet crushed to a fine powder per group of 3 students (added to container C)
- Warm tap water (enough to cover each soil sample)
- Cup for holding warm tap water (1 per group of 3 students)
- Student work sheets – Data chart I, Data chart II
- Paper towels in case of spills

Teacher Action

Engage - Is it Living: Formative assessment Probe

- Instruct students to complete the activity on the “Is It Living” handout; provide enough time for them to fully explain their choices
- Ask students to share responses; select a variety of responses to highlight anticipated misconceptions (e.g., a seed is not alive because it does not move)
- Allow students to discuss and debate their answers, but do not come to a consensus yet; that will come during “explain”

Scripted CFU questions

- Do some living and non-living things share characteristics?
- What characteristics do living things share that non-living things do not?

Explore - Observations of life outdoors

- Distribute criteria for life log charts to students (see materials)
- Take students to a pre-selected outside location and monitor while they make observations

Explain - Criteria for life log charts

- Produce a large chart with all of the student findings from the observation
- Guide students towards the five fundamental criteria listed below. Use examples from the observations and opening of class.
- Allow students to discuss and debate; use their responses to build off one another

Fundamental criteria for life:

- Locomotion
- Metabolic processes that show chemical exchanges, which may be detected in some sort of respiration, or exchange of gases or solid materials
- Some type of reproduction, replication, or cell division
- Growth and development
- Reaction to stimuli

Elaborate - Part 2: Soil Samples and Signs of Activity (from part 2 of source material page)

Prep instructions:

- Place 50 ml of sand in each jar. (You will need 3 jars per team.)
- Add 5 ml of sugar to each jar. Label one jar in each set of 3 “A” and set aside.
- Add instant active dry yeast to the second jar in each set of 3 and label these jars “B”
- Add a powdered fizzing antacid tablet to the remaining jars. Label these jars “C”.
- Give each group a set of three jars, a hand lens and Data Chart I
- Explain to the students that each team has been given a set of soil samples. No one knows if there is anything alive in them. The assignment is to make careful observations and check for indications of living material in the samples based on the fundamental criteria for life.

- Give each group a cup of warm water (approximately 50 C, too warm will kill yeast). Have students pour water to cover the soil in each sample.
- Tell students that Sample B contained yeast and Sample C contained an effervescent antacid tablet. Discuss how scientists could tell the difference between a nonliving chemical change (fizzy antacid) and a life process (yeast) which is also a chemical change.

Scripted CFU questions

- Does that activity mean there is life in Samples B and C and no life in Sample A?
- Are there other explanations for the activity in either B or C? (Note: Samples B and C exhibit a chemical reaction; Sample C activity stops; Sample B sustains long term activity; Sample A is a simple physical change in which sugar dissolves.)

Evaluate - Match criteria for life with results of Activity

- This activity may be assessed by examining student documentation of living things in the school yard and samples. Students should be able to state the fundamental criteria for life and describe how each is observable.

Student Action

Engage - Is it Living: Formative assessment Probe

- Fill out “Is It Living” probe, explain choices in complete sentences
- Share responses, discuss with classmates
- Provide reasoning for each point made, rather than simply stating choices

Explore - Observations of life outdoors

- Use the criteria for life log charts and the information discussed in the opening of the lesson to make observations of living things
- Record the name of the organism and as many criteria as can be observed

Explain - Criteria for life log charts

- Summarize findings from the observations to create a consensus list on the class chart
- Explain choices and why each object they selected should be considered alive

Elaborate - Part 2: Soil Samples and Signs of Activity (from part 2 of source material page)

- Observe all three samples for signs of life. Smell and touch the samples, but not taste them. Put a few grains on the circles on Data Chart 1 and observe them with a hand lens. Record their data.
- Pour warm water into samples enough to cover the soil
- Repeat Step 2 and record the data on Data Chart II. Students should look for and record differences caused by adding water. After recording the first observations, have students go back and observe again. (After about 10 minutes, Sample B will show even more activity. Leave it for several hours or overnight and reproduction will be obvious).
- Discuss which samples showed indications of activity
- Discuss which of the criteria for life would identify yeast as living and fizzy antacid as nonliving

Evaluate - Match criteria for life with results of Activity

- Students state, either verbally or in writing, the fundamental criteria for life
- Provide a specific description of how each criterion was observable during the activity

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