Activity 2—

Looking for Life

About This Activity

This is the second in a sequence of activities borrowed from Destination: Mars. In Part A students will use research to develop their criteria for life. The class will combine their ideas in a teacher-guided discussion. In Part B they will then use their definition of life to determine whether there is anything alive in three different soil samples. They will make observations and draw pictures as they collect data from the samples and experiment.

Objectives

Students will:

- form an operational definition of life.
- conduct a simulated experiment with soil samples similar to the experiments on the Mars Viking Lander.
- state relationships between the soil samples using their operational definition of life.
- make an inference about the possibility of life on Mars based on data obtained.

Background

We usually recognize something as being alive or not alive. But when scientists study very small samples or very old fossilized materials, the signs of life or previous life are not easy to determine. Scientists must establish criteria to work with in their research. The tests for life used by the Viking Mars missions were based on the idea that life would cause changes in the air or soil in the same way that Earth life does. The Viking tests did not detect the presence of life on Mars. The Viking tests would not have detected fossil evidence of past Mars life or a life form that is very different from Earth life.

Vocabulary

criteria, characteristics, organism, replication, metabolic

Part A:

An Operational Definition of Life

About This Part

Students will conduct research to identify characteristics of living and non-living organisms. They will record their observations on a chart that will help the class to come to a consensus about how to identify living things.

Materials

- ❑ Student Sheet *Fundamental Criteria for Life Chart* (pg. 4)
- ❑ dictionaries and encyclopedias
- ❑ examples of living and non-living things (should include plants, animals, and microorganisms—pictures can be substituted for the real thing)

Procedure

Advanced Preparation

1. Gather materials.
2. Review Background and Procedure.

Classroom Procedure

1. Explain to students that their job is to come up with a definition of how living things can be detected.
2. Ask students to state (or write) what characteristics make an individual item alive or not alive. Encourage them to find pictures and definitions of living and non-living things. Allow the students use of dictionaries and encyclopedias. Use the examples on the following page to encourage the students but not to limit them.

Example: Consider a bear and a chair—they both have legs, but one can move on its own and the other would need a motor made by humans; therefore, independent movement might be one characteristic that indicates life. Not every living organism needs legs or roots. But they do need a mode of locomotion or a way to get nutrients. Also, the bear breathes and the chair does not, another indication of life. Or consider a tree and a light pole. We know that a light pole can not reproduce— it is made by humans—and we know that the tree makes seeds that may produce more trees. The tree also takes in nutrients and gives off gasses and grows. The light uses electricity and gives off light, but it is strictly an energy exchange and there is no growth and there are no metabolic processes.

However, students might not list the fundamental criteria for life. They might go for the more obvious signs like methods of locomotion. The more subtle but fundamental signs of life are:

- 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.
- reaction to stimuli.

3. As a class, discuss the indications of life, asking for examples from a diverse sampling of living things. The teacher will paraphrase and group criteria on the blank chart, then guide the students to summarize the groupings to reflect the fundamental criteria for life.

4. Students will use these criteria for the following activities.

Part B: It's Alive!

About This Part

Students will take three different soil samples and look for signs of life based on the criteria from Part A.

Materials

- ❑ sand or sandy soil sample
- ❑ three glass vials, baby food jars, or beakers for soil per group
- ❑ sugar- 5 ml (sugar will be added to all soil samples)
- ❑ instant active dry yeast- 5 ml added to 50 ml of soil
- ❑ Alka-Seltzer tablets crushed- 1 tablet added to 50 ml of soil
- ❑ hot water - enough to cover the top of the soil in all jars (not hot enough to kill the yeast!)
- ❑ cups for distributing the water
- ❑ magnifying lens- 1 per group or individual
- ❑ Student Sheets *Data Chart I* and *Data Chart II* (pgs. 5-6)

Procedure

Advanced Preparation

1. Fill all jars 1/4th full of soil. (You will need 3 jars per team.)
2. Add just sugar to 1/3rd of the jars. Label these jars "A."
3. Add instant active dry yeast and sugar to 1/3rd of the jars. Label these jars "B."
4. Add the powdered Alka-seltzer and sugar to the remaining jars. Label these jars "C."
5. Give each group a set of three jars, magnifying lens, and the chart from previous activity.

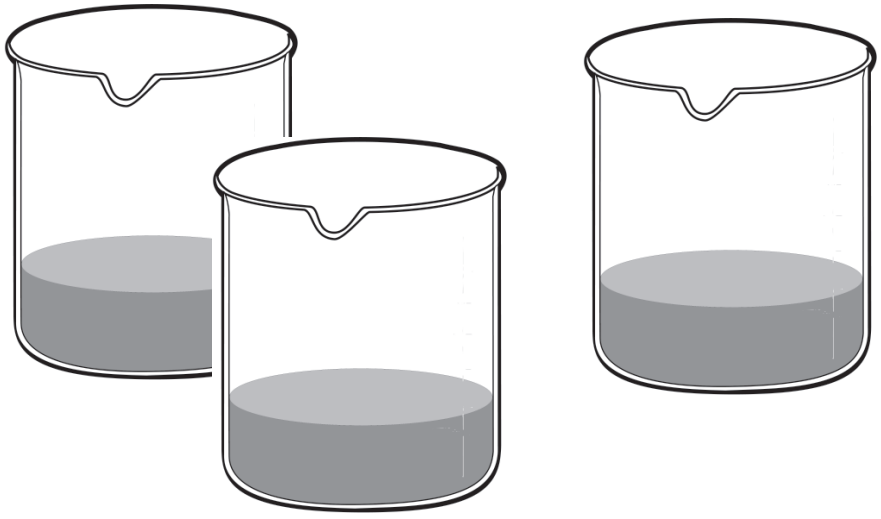
Classroom Procedure

(Information for teacher only— do not share all the information with students!)

1. 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 them — based on their criteria.
2. Ask students to observe all three samples. They can smell and touch the samples but not taste them. Encourage students to put a few grains on a flat white surface and observe them with a hand lens. Students should then record their data.
3. Give each group a cup of water. (Use hot tap water (~50ºC) for the best results, do not kill the yeast.) Ask students to pour the water so that each sample is covered with the water.
4. Repeat step 2 and record data on a second sheet or in a separate area of the first sheet. 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 ten minutes Sample B will show even more activity.)
5. Discuss which samples showed indication of activity (B and C). Does that activity mean there is life in both B and C and no life in Sample A? Are there other explanations for the activity in either B or C?

   - Both B and C are chemical reactions
   - Sample C reaction stops
   - Sample B sustains long term activity
   - Sample A is a simple physical change where sugar dissolves

   Students should realize that there could be other tests that would detect life in Sample B. There might be microbes in the soil that would grow on a culture medium.
6. Determine which sample(s) contain life by applying the fundamental criteria for indicating life developed in Activity 2.
7. Tell students that Sample B contained yeast and Sample C contained Alka Seltzer. Discuss how scientists could tell the difference between a non-living chemical change (Alka Seltzer) and a life process (yeast) which is also a chemical change.
8. Discuss which of their criteria would identify yeast as living and Alka Seltzer as non-living.



Student Sheet

Fundamental Criteria for Life Chart

Fill in Criteria after the class has made observations and the teacher has grouped the observations.

Living Organism	Criteria	Criteria	Criteria	Criteria	Criteria

It's Alive! Data Chart I

Initial Descriptions (no water added):

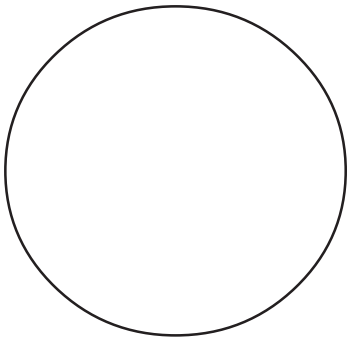
Sample A:

Sample B:

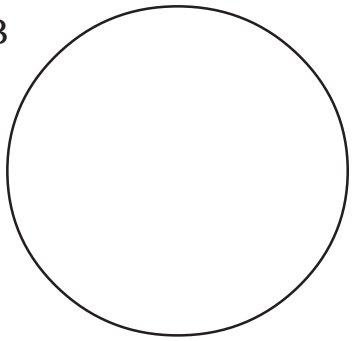
Sample C:

Initial Drawings (no water added):

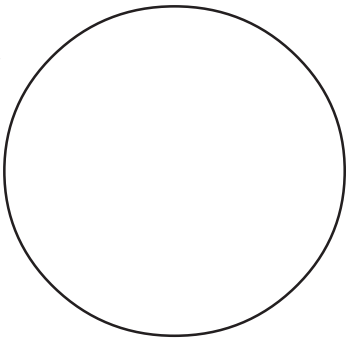
Sample A



Sample B



Sample C



It's Alive! Data Chart II

Initial Descriptions (after water is added):

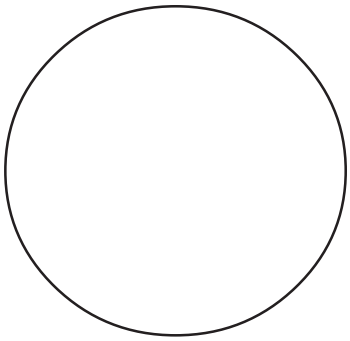
Sample A:

Sample B:

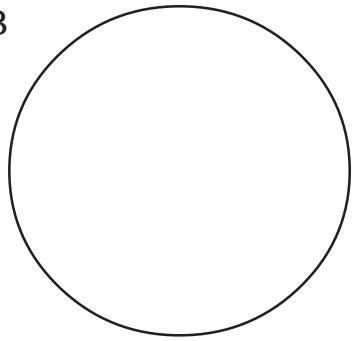
Sample C:

Initial Drawings (after water is added):

Sample A



Sample B



Sample C