

Explore Life on Mars

SEARCHING FOR LIFE

www.lpi.usra.edu/education/explore/LifeOnMars/activities/searchingForLife/

Adapted from "It's Alive!" from *Destination: Mars*, NASA Johnson Space Center, 2002.

OVERVIEW —

Children discuss how life is defined and conduct a simple experiment, looking for signs of life in three different "soil" samples. The experiment introduces the children to the difficulty that scientists face in defining life. By observing the soil samples, the children try to determine if any contain signs of life and work to identify, refine, and create a set of characteristics that may be used to identify living versus nonliving things. The activity concludes with the development of a group definition of life.

Ages: 8 to 13 years

Duration: 45-60 minutes

WHAT'S THE POINT?

- There is no firm scientific definition of life, and no single characteristic that applies to all living things.
- Natural chemical reactions could be confused with evidence for life.
- Scientists need to use multiple tests to determine if life is present.
- There are characteristics that almost all living things share.

MATERIALS —

For each pair of children:

- 3 (clean) plastic cups (5–8 oz.), (clear if available)
- 1 cup of sand, enough to fill each cup $\frac{1}{4}$ full
- 3 teaspoons (tsp.) sugar
- 1 teaspoon (tsp.) instant active dry yeast
- 1 tablet of crushed (as finely as possible) Alka-Seltzer® or comparable fizzing tablets
- hot water, enough to cover the sand in each cup (not hot enough to kill the yeast)
- 1 pitcher, carafe, or other appropriate container for the hot water
- optional: a variety of colorful Post-It® notes

For each child:

- 1 pencil/pen
- 1 copy of the [Extreme-O-File: Searching for Life](#) activity pages

For the facilitator:

- [background information](#)
- flip chart, white board, or blackboard and appropriate writing utensils
- permanent marker for writing on the cups
- thermometer
- 3 craft sticks or spoons (for mixing cups A, B, and C)
- container (large mug, cup, or pitcher) of water to fill all the cups to cover the sand (use water that is between 105° and 115°F; check the temperature with the thermometer).

PREPARATION —

~ LPI EDUCATION/PUBLIC ENGAGEMENT SCIENCE ACTIVITIES ~

- Review the activity procedures and corresponding resources.
- Make copies of *Extreme-O-File: Searching for Life* activity pages
- Prepare 1 set of 3 cups for each pair of children before the event/program: Each cup will contain sand and should be approximately $\frac{1}{4}$ full of sand. Each cup should also contain 1 tsp. of sugar.
 - Mark one cup "A." This cup should contain only the sand and sugar. Mix well using a craft stick or spoon.
 - Mark the second cup "B." Add 1 finely crushed tablet of Alka-Seltzer® or other comparable fizzing tablet to the sand and sugar. Mix well using a craft stick or spoon.
 - Mark the last cup "C." Add 1 tsp. instant active dry yeast to the sand and sugar. Mix well using a craft stick or spoon.

ACTIVITY —

Divide the children into small groups of 2–3 children each.

1. Welcome and introduce the topic/module. Explain to the children that in this activity, they are going to discuss how we define life and conduct an experiment to test for the signs of life (much like a rover on Mars may do) – creating a group definition of life to use in later activities. Having a clear definition is important for scientists, too. In order for a rover, like the Curiosity rover on Mars, to find signs of life, scientists need to have a clear understanding of what to look for — how to identify living versus non-living!

2. Ask the children what the characteristics of life are. Invite the children to work in their small groups and then to share their answers and examples. Write their responses on the White Board/Poster/Chalk Board. *Optional: You may write their responses on colorful Post-It® notes and post them on a poster or wall.*

As a group, you should work to create an initial definition for life together that they will use as they move on to complete more of the *Explore: Life on Mars?* activities. *Optional: Have the children record their definition (set of characteristics) on their Extreme-O-File activity page. Note: If you have previously conducted the Ice Breaker activity, you should incorporate the characteristics compiled during that activity here and add to them/refine them.*

- What are some examples of living things? *Cat, dog, tree, flowers, grass, many possible answers here*
- What are some examples of non-living things? *Car, TV, table, many possible answers here*
- What tells you that something is alive (i.e., characteristics of living things)? How can you tell that it is alive? *It moves, breathes, eats, reproduces, it responds to changes in its environment, many possible answers here.*
 - Living example: A cat needs to be fed and watered, provided shelter. It can breathe, move on its own, reproduce, and respond to its environment (make choices).
 - Non-living example: A car "eats" or consumes a fuel (gas), and its engine need to "breathe" (i.e., take in fresh air and release used air — exhaust), but it is not alive. It cannot reproduce, move on its own (needs an operator), or respond to its environment (make decisions).
 - One (single) characteristic cannot be used to distinguish between living and nonliving. We need to develop more tests (questions) that we can use together to determine the presence of life. Scientists also have to do this!

3. Invite the children to conduct an experiment searching for signs of life in three different "alien" samples, based on the characteristics they defined. Pass each small group the 3 prepared cups A, B, and C, and a copy of the *Extreme-O-File: Searching for Life* activity page.

- Examine your samples — look and even smell the samples (do not taste them). Fill in the first observation on your observation page.
- Do you detect any visible evidence of life? *No — Unless they recognize the yeast, there won't be any true evidence of life yet.*

4. Invite the children to add hot water to their samples. Pass around the hot water to the children and ask them to add the water to each cup, filling it up halfway (to completely cover the sand and leave some water on top). Alternatively, fill the cups to the appropriate level for them. *Note: Caution them to be careful while handling the hot water.*

- What do you notice? *Invite them to make observations and record their observations (optional).*

After a few minutes...

- Ask the children what they see, smell, and feel. *Invite them to share what they've seen. They should comment that the second cup, B, is showing a reaction with bubbling.*

5. Discuss the definition of life with the children, while the water continues to react with the materials in the cups. Discuss the scientific perspective on life, and consider how life might be different on other planets. Encourage all ideas, and write their responses on the flip chart/white board.

- How can you tell living things apart from nonliving things (recall the Ice Breaker Activity if applicable)? *If it moves, breathes, eats, reproduces, learns, uses energy, is made of cells, grows, evolves, respond to changes in the environment, produces waste, etc.*

Facilitator's Note: Share that scientists do not agree on exactly how to define life; it is a difficult subject. Machines can be built to make other machines, computers can be programmed to learn, and cars also need fuel and use energy and move. **One of the most basic definitions that may be applied is that life does something and keeps on doing it (while living).**

6. Observe any further changes in the “alien” samples. Ask the children to observe their three cups again and record their last observations.

- What do you see, smell, and feel? *Invite them to share the changes that they've observed. (Cup B should no longer be reacting. Cup C may be warmer to the touch than the other cups, and should have a layer of foam on top, and a yeast/dough smell.)*
- What is the evidence of life? Are any of the cups showing something happening and continuing to happen? *(The quick reaction in cup B is a chemical reaction, not an indication of life. Cup C is demonstrating a sustained reaction.)*

7. Describe the ingredients for each cup, and for each cup, ask whether the sample contained life.

Describe the yeast sample last. Let the children know that yeast is a fungus that was growing, using the sugar and giving off carbon dioxide, which created the foam. While they could not see the yeast itself (it is microscopic), they were able to observe signs of life, such as the foam and gas bubbles. They may have also noticed that the cup was getting warmer — another sign of life from the yeast. Scientists suspect that any life present on Mars would have been (or is) microscopic (i.e., too small to see with the human eye). Thus, scientists need to observe for signs of life much like the children have just done!

8. Revisit the group definition/set of the characteristics of life. Do you have any changes or additions to make to your definition? If so, add/change as needed. Have the children record it their findings in their *Extreme-O-File* activity pages.

Facilitator's Note:

Studying (unicellular) yeast cells, such as those in the experimental cup C, has provided many scientific advances in biology over the years. Yeast has even made it into space to study the effects of microgravity. In fact, researchers today are using yeast to help understand the development of multicellular life forms that exist on Earth today, alongside the unicellular forms. By understanding how life developed on Earth, they hope to understand how life may have developed beyond our planet.

For more information about how yeast is being used to study the origin of life, please visit astrobio.net/components/com_news/newsPrintDetail.php?id=4477.

IN CONCLUSION —

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Ask the children whether it was difficult to identify the soil sample with life. If so, why? Which of their senses were most useful as they were observing? Note that scientists use instruments to make observations. For example, they can use instruments that measure the chemical composition of air as a remote form of “smell” on another planet (like Mars). Did the children use their noses and notice any differences between the “soil” samples during the activity?

Summarize the experiment and its results. How did this experiment affect and help you to create your group definition of life?

Share that, while at first it might seem like determining if something is alive or not is easy, defining life is actually much more difficult than many people realize. Optional: Have the children record the group definition in their activity pages.

Revisit your refined group definition. Explain how an experiment may be used in missions (such as their rovers) to search for signs of life in other places, such as Mars. By refining our understanding of life, we are better able to look for it elsewhere. This is what astrobiology strives to do!

Defining life is not a simple task and even scientists do not completely agree on all the characteristics that should be used to do so. Tell the children that they will refine their group definition as they continue to explore the possibilities of life on Mars in the later activities.

CORRELATION TO STANDARDS

Next Generation Science Standards

Disciplinary Core Ideas

- ESS3A Natural Resources: K-2. Living things need water, air, and resources from the land, and they live in places that have the things they need. Humans use natural resources for everything they do.

Science and Engineering Practices

- Planning and Carrying Out Investigations: Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon or test a design solution.
- Analyzing and Interpreting Data: Use and share pictures, drawings, and/or writings of observations.
- Analyzing and Interpreting Data: Use observations (firsthand or from media) to describe patterns and/or relationships in the natural and designed world(s) in order to answer scientific questions and solve problems.
- Analyzing and Interpreting Data: Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
- Constructing Explanations and Designing Solutions: Make observations (firsthand or from media) to construct an evidence-based account for natural phenomena.
- Engaging in Argument from Evidence: Construct an argument with evidence to support a claim.

Crosscutting Concepts

- Cause and Effect: students routinely identify and test causal relationships and use these relationships to explain change.

Searching for Life

Extreme-O-File Activity Pages

Name: _____



Searching for Life

Group Definition of Life (Characteristics of living things):

1. Compare the three cups of material before adding the hot water. Observe without touching or tasting any of the samples (smelling is okay, as is touching the outside of the cup). Circle the words you would use to describe each cup and draw each in the cup-shaped space below. Do any show any signs of life?

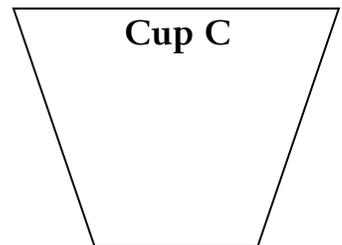
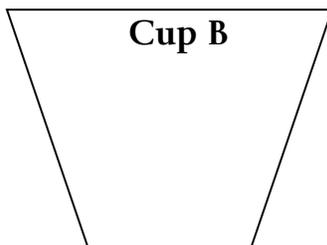
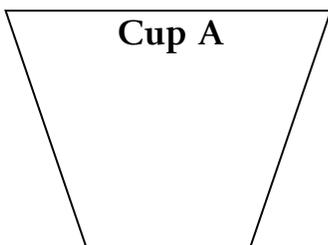
Cup A

growing	slushy	foamy	warm	cold	moving
shrinking	bubbly	smelly	(add your own description)		

Cup B

growing	slushy	foamy	warm	cold	moving
shrinking	bubbly	smelly	(add your own description)		

growing	slushy	foamy	warm	cold	moving
shrinking	bubbly	smelly	(add your own description)		



2. After hot water is added:

Observe without touching or tasting any of the samples (CAUTION: the water may be very hot). Write down and draw your observations for each cup below. Do any show any signs of life?

Cup A

Cup B

Cup C

3. Final analysis: Wait at least 5 minutes after adding the hot water. Observe without touching or tasting any of the samples (smelling is okay, as is touching the outside of the cup). Write down and draw your observations for each cup. Do any show any signs of life? **Circle the cup with the evidence for life.**

Cup A

Cup B

Cup C

Group Definition of Life (Refined from this activity):

