

Looking for Life

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.

Goals:

- Learn about the five criteria for life.

Time Required: 1 hour

Materials:

- A pair of objects, one living (such as an insect or plant) and one non-living (any inanimate object, preferably one not made from once-living material such as wood or leather)
- An outdoor area to investigate, or images of a variety of living and nonliving things
- Hand lenses
- 3 small containers per group of 3-4 students (clear beakers or cups, or 3-oz. paper dixie cups)
- Clean play sand, 150 ml per group of 3 students (50 ml for each of 3 containers)
- 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 the warm tap water (1 per group of 3 students)
- Paper towels in case of spills
- Looking for Life Student Worksheet

Procedure:

Set-up:

1. Prior to teaching the lesson, locate an outdoor area that contains a variety of living and nonliving things for students to investigate. If an outdoor area is not available, gather images of a variety of living and nonliving things.
2. Just before class, prepare jars of soil samples for student groups of three to four students.
 - Place 50 ml of sand in each jar. (You will need 3 jars per team.)
 - Add 5 ml of sugar to the first jar in each set of 3. Label these jars "A".



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- 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.”

**If making ahead of time, store in airtight containers. Humidity will inactivate the yeast and cause the effervescent tablets to lose their fizz.*

Part 1

1. Ask students, "How do you know if something is alive?" and discuss the criteria students come up with. Provide counterexamples as appropriate.
**Example: Consider a bear and a chair— they both have legs, but one can move on its own and the other can't; 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 cannot 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 or metabolic processes.*
2. Take a look at the Criteria for Life Chart on the student worksheet. Tell students they are to go outdoors and locate five living organisms and log them on their chart.
**If an outside space is not available, have students sort through pictures to find examples of living organisms to log on their chart.*
3. Return to the classroom and make a large chart that includes all of the students' findings.
4. Ask students to explain why they deemed each object to be alive.
5. Guide students in summarizing their findings into criteria that can be used to determine the presence of life. List criteria across the top of the class chart. Students might not list all the fundamental criteria for life. They might state the more obvious signs, like methods of locomotion, but guide them toward including the five criteria for life.

**Five 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*
- *Reaction to stimuli*



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6. Have students check off on their charts which of the 5 signs of life their living things exhibit. Discuss that it may be difficult to observe some of these in a short period of time, but inference from experience and prior knowledge can be made.

Part 2

1. Give each group a set of three jars (A, B, C, that you prepared beforehand) and a hand lens.
2. 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.
3. Ask students to observe all three samples for signs of life. They can smell and touch the samples, but not taste them. Encourage students to put a few grains on the circles on Data Chart 1 and observe them with a hand lens. Students should then record their observations on Data Chart 1.
4. Give each group a cup of water. (Use hot tap water, about 50°C, for the best results. Do not kill the yeast.) Ask students to pour the water so that each sample is covered with water.
5. Repeat observations and record them on Data Chart 2. Students should look for and record differences caused by adding water. After recording the first observations, have students go back and observe again.
**Note: After about 10 minutes, Sample B will show even more activity. Leave it for several hours or overnight and reproduction will be obvious.*
6. Discuss which samples showed indications of activity (Samples B and C). 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.*
7. Determine which sample(s) contain life by applying the fundamental criteria for life.
8. 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.
9. Discuss which of the criteria for life would identify yeast as living and fizzy antacid as nonliving.



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Reflection:

- 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?
- How do scientists look for life when they can't visit another world themselves?
**Evidence of respiration, amino acids, etc.*

Adapted from the following lesson:

- NASA JPL Looking for Life (includes background and extension ideas):
<https://www.jpl.nasa.gov/edu/teach/activity/looking-for-life/>

