

## Signs of Life

Scientists don't always agree on how to define life, but in general, something that is alive can:

- Eat, metabolize, and produce waste
- Maintain homeostasis (internal equilibrium)
- Take in energy from the environment for growth and development
- Respond to outside stimuli
- Reproduce and evolve
- Adapt to changes

Life is sometimes tricky to detect. In our experiment, the yeast and the antacid tablet both bubble and move. However, the antacid is not alive. As we observe the reaction, we see that the antacid produces a chemical reaction and not a biological reaction, which ends once the tablet dissolves in water. Yeast organisms, on the other hand, continue to bubble as long as they have food and water!

Astrobiologists studying life on other planets and moons face similar challenges. How do you think astrobiologists tell the difference between something that is alive, and something that is simply acting alive?

### Materials needed:

- 3 clear cups
- 3 tablespoons baking soda
- 1/2 packet of active dry yeast
- 1 fizzing antacid tablet, crushed
- A teaspoon
- 3 teaspoons of sugar
- Warm water

### Step-by-step instructions:

1. Place the baking soda, yeast, and crushed antacid tablet each in their own cup.
2. Add a teaspoon of sugar (food) to each sample. Do you observe life in any of the samples?
3. Add just enough warm water to cover each sample.
4. Observe for about 5 minutes. What do you see?
5. Add more sugar to each cup. What happens?



### Discussion questions:

- Are any of the substances alive? If so, which one?
- What observations did you make that prove the substance is alive?
- What are some signs of life astrobiologists can look for on other planets?
- How do you think astrobiologists tell the difference between reactions that involve life, and reactions that don't?
- How do you think rain shadows affect where wildlife and plants can live?



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### Conclusions:

1. The baking soda is not alive: it did not display any reaction to the water or sugar.
2. The antacid is not alive: You may have guessed it was alive because the antacid reacts strongly to water with a lot of fizzing! However, this reaction is chemical, not biological. Once the chemical reaction is done, the tablet is gone and it won't react anymore.
3. The yeast is alive: Yeast are tiny living organisms that remain dormant until they are given food and water. When yeast eats the sugar, it gives off carbon dioxide gas, which are the bubbles you observed. Unlike the antacid tablet, the yeast will continue to give off bubbles of carbon dioxide as long as it has sugar to munch on.