THE FRANKLIN INSTITUTE

Be a **Space Scientist!**

Be an Astrobiologist

Educator Guide

Big Question: How can we discover if a sample contains something alive?

GSK Science in the Summer™

In collaboration with GSK

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Be a Space Scientist! Big Ideas

These are the themes you'll find running through all five *Be a Space Scientist!* activities.

- ***Space science is about exploring and traveling outside our planet.*** *Space scientists study questions like:*
  - *What kinds of things are in the universe?*
  - *How can we learn more about them?*
  - *How might people (and other living things) travel or live in space?*
- ***Space is really big! Almost everything in space is too far away and hard to reach for space scientists to visit and study.*** *Instead they:*
  - *Use tools and machines to* ***gather information*** *and send it back to Earth*
  - ***Compare*** *what they see in space to things they know about on Earth*
  - ***Use models*** *to represent things that are too big, too small, or too far away to study directly*

Core Four Strategies

Use the Core Four Strategies as you guide your learners through this activity.

- **Ask questions** to spark curiosity and encourage new ideas
- **Encourage scientific thinking** with chances to observe, make predictions, and test ideas
- **Cultivate rich dialogue** with chances to talk together, share ideas, and use science words
- **Make connections** between learners' experiences, science careers, and this activity

Ask Questions

Encourage Scientific Thinking

Cultivate Rich Dialogue

Make Connections

Be an Astrobiologist

Big Question: ***How can we discover if a sample contains something alive?***

MATERIALS:

Per class:

- Astrobiologist career card
- Instant or rapid-rise yeast (4 oz)
- Sand (5 cups)
- Cornstarch (2 heaping spoonfuls, or about 2 tbsp)
- Sugar (1 cup)
- 1-pint containers with lids (7)
- Large Styrofoam cups (5–6)
- Aluminum foil (enough to cover the top of each Styrofoam cup)
- Pipettes (5–6)
- Permanent marker
- Pitcher (optional)
- Electric kettle (optional)
- Lab notebooks
- Pencils
- Science skills stickers

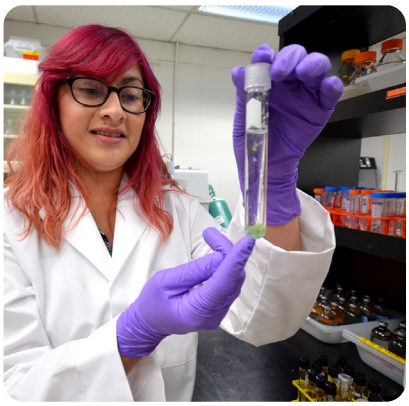
Per group of 2–3 learners:

- Small plastic condiment cups (5)
- Magnifying lenses (2-3)
- Small spoons (2)

Prepare

1. Make the "soil samples." Fill and label five of the pint containers as follows:
   - Test 1 – Sand
   - Test 2 – Mix 1 cup sand with 4 heaping spoonfuls of yeast
   - Sample A – Mix 1 cup sand with 2 heaping spoonfuls of yeast
   - Sample B – Mix 1 cup sand with 1 spoonful of yeast and 1 spoonful of cornstarch
   - Sample C – Mix 1 cup sand with 1 spoonful of cornstarch
2. Split the 1 cup of sugar between remaining 2 containers and label them “Food.”
3. Fill Styrofoam cups with hot water. Cover securely with aluminum foil and insert a pipette by poking a hole in the center of the aluminum foil. **The water should be hot enough to feel quite hot to the touch but not burning** (about 120° F). You can reach this temperature by
   - Using hot tap water, if available and hot enough
   - Mix two parts room-temperature water with one part boiling water (heat in the electric kettle).
4. Place all “soil sample” pint containers, “food” containers, and hot water cups in one centralized location in your space. This will serve as the sample station learners will visit throughout the activity.

Engage



1. Introduce the astrobiologist career by showing the group the career card and asking questions to encourage students to think about what an astrobiologist might do:
   - *What do you notice about this picture? What do you think this person is doing?*
   - *Have you ever heard the words "astro" or "biologist" before?*
   - *What do you think an astrobiologist might do or study?*
2. Explain that "astro" means space or stars, and "biologists" study living things. Astrobiologists study whether there might be living things outside of Earth.
   - *If there are living things somewhere outside of Earth, where might we find them?*
   - *How can we look for them? How will we know if we find them?*
   - *What if they were too small to see?*
3. Point out that one way to answer these questions is to study living things on Earth and think about how they could happen on other planets.
   - *What living things can you think of on Earth that are too tiny to see?*
   - *How do we find out about things that are too tiny to see?*

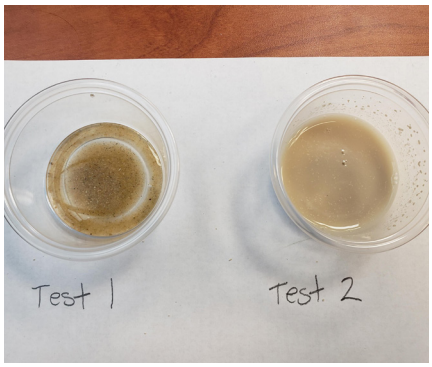
4. Introduce the storyline like this:
   - Imagine we are a team of astrobiologists studying whether tiny microbes could live in the soil on other planets.
   - A spacecraft is going to bring back some samples of soil from another planet, and we want to find out if any of them might have tiny living things in them.
   - What could we do? How can we tell if something is alive?

Explore

Part 1: Research

1. Explain that you'll start with some research about two samples: one that doesn't have anything alive, and one that has tiny living things called yeast in it.
   - *Have you heard of yeast before? Where have you heard about it?*
2. Divide the class into groups of 2–3 and give each group two empty condiment cups, two sample spoons, and magnifying lenses. Tell them to visit the sample station and put a spoonful from the Test 1 container in one cup and a spoonful from the Test 2 container in the second cup.
   - *What do you observe about the two samples?*
   - *Which one do you think might have the living yeast in it? Why?*

3. Invite groups to add a spoonful from the "Food" container and a full pipette of hot water to each sample cup. Tell them to swirl each cup gently to mix it and observe any changes.
   - *What do you notice now?*
   - *How are the two samples the same or different?*



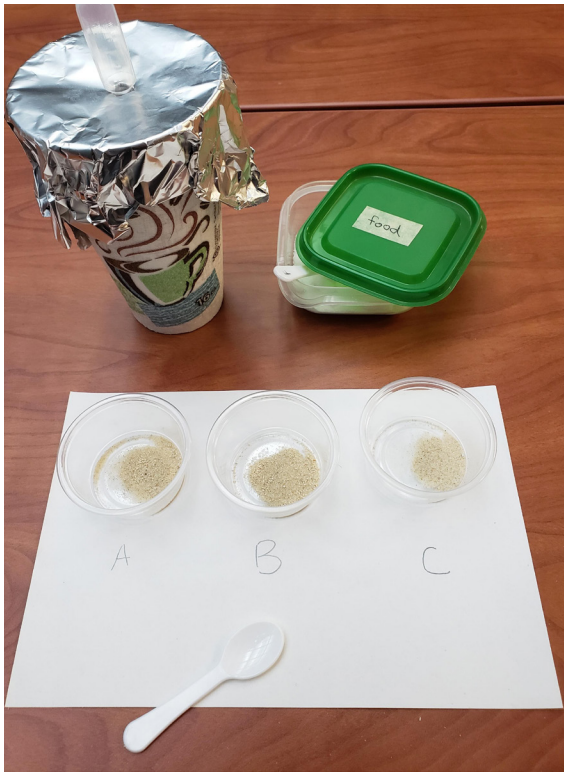
For younger groups you may need to demonstrate how to fully fill and empty the pipette.

4. Give groups 5–10 minutes to make observations. They may want to write or draw them on page 5 of their notebooks. Then have a brief discussion with the whole class:
   - *Which one do you think has the living yeast in it?*
   - *What clues did you use to make your decision?*
   - *Sometimes different scientists find clues that point to different answers—it's OK if we did, too! If we had more research time, what could we do to get more information?*
5. Explain that the Test 2 sample contained the yeast. When it digests its food, it gives off bubbles of gas that made the foam in the sample cup (and also help make bread fluffy!)

For younger groups, you may want to skip Part 2, or save it for a later session, and move straight to the Reflection.

Part 2: Unknown Samples

6. Ask the group to imagine that your team has just received some samples of dirt brought back from another planet.
   - *How could we find out if any of these samples had a living thing like yeast in it?*
7. Ask groups to make a plan for how they will test the unknown samples.
8. Pass out three empty condiment cups and invite groups to put a spoonful of each of the unknown samples from the sample station (A, B, and C) into separate cups. Encourage groups to test each sample the same way and decide if they think it has a yeast-like microbe in it. They may write or draw their observations on page 6 of their notebooks.
   - *What do you notice about each of the samples?*
   - *How do they compare to our test samples (1 and 2)?*



Reflect

1. Bring the whole group together to discuss their results:
   - *What did you do to test your samples?*
   - *Which one(s) do you think had microbes in them? Why?*
   - *Would you recommend your testing process to other astrobiologists looking for microbes in samples from space? What else would you add or do instead?*
2. Encourage the group to reflect on how they were like astrobiologists during the activity. Refer to the career card and the science skills stickers:
   - *What are some of the things we did today as astrobiologists?*
   - *How did we think like scientists? What science skills did we use?*
   - *What did you do today that made you feel like a scientist?*
3. Allow time for students to draw or write their reflections on page 7 of their lab notebooks. Invite them to choose a science skills sticker that reflects a skill they used and add it to their notebooks.

Background

- Astrobiologists study **whether and how there might be other living things in space** beyond Earth. They try to find out how life originates and what kinds of environments different organisms can live in. One way they do this is by investigating extreme environments on Earth, like the deep ocean or active volcanoes, and the organisms that live there.
- **So far no one has discovered any evidence of life on other planets**—certainly not the kinds of aliens we see in movies! But **there's a chance that smaller forms of life, like bacteria or yeast, might live (or have lived long ago) on some planets and moons** in our solar system where there was liquid water. Mars likely had water on it millions of years ago, and if any tiny organisms lived in it, there might possibly be traces of them left in the Martian soil.
- **Yeasts are a group of tiny microbes** that live all over Earth and are generally harmless to humans. They consume sugars for energy and give off carbon dioxide gas as a waste product. We take advantage of those bubbles of gas in making bread, where they help the dough rise and make the bread fluffy.
- Yeast is a common test subject for scientists who study the effects of different environments on living things. **In 2022, NASA launched a small satellite into orbit around the Moon with live samples of baker's yeast aboard**, to study the effects of space radiation and low gravity on living organisms.

Acknowledgments

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Astrobiologist Quick Guide

EDUCATORS DO:	EDUCATORS ASK:	LEARNERS DO:
ENGAGE		
Introduce Career • Use career card • Ask discussion question • Explain what astrobiologists do	*What do you notice about this picture?* *Have you heard "astro" or "biologist" before?* *What do you think an astrobiologist does in their job?*	• Make observations about the image • Make connections to their own experience • Share their ideas
Introduce Story • We're astrobiologists studying soil from another planet • We want to find out if there are tiny living things in it!	*If there are living things somewhere outside of Earth, how will we know if we find them?* *What living things can you think of on Earth that are too tiny to see?* *How can we tell if something is alive?*	• Imagine being astrobiologists • Share examples of living things • Discuss their ideas about clues that signal life
EXPLORE		
Part 1: Research • Give groups cups, spoons, & test samples (1 & 2) • Distribute "food" containers and hot water cups • Demonstrate pipette use	*What do you observe about the two samples?* *Which one do you think might have the living yeast in it? Why?* *What clues did you use to make your decision?*	• Observe test samples (1 & 2) • Add warm water & food • Observe changes
Part 2: Unknown Samples • Give groups unknown samples (A,B,C) • Guide groups in planning & testing samples • Encourage observations & predictions	*How could we find out if any of these samples had a microbe like yeast in it?* *What do you notice about each of the samples?* *How do they compare to our test samples?*	• Make a plan for testing samples • Test 3 unknown samples (A, B, C) • Decide which ones have a living microbe

***Quick Guide continues on the following page.*

Astrobiologist Quick Guide

EDUCATORS DO:	EDUCATORS ASK:	LEARNERS DO:
REFLECT		
Share Group Results	*Which one(s) do you think had microbes in them? Why?* *What should we tell other astrobiologists looking for microbes in samples from space?*	• Draw conclusions • Make recommendations
Make Career Connections	*What did you do today that made you feel like an astrobiologist?* *How did we think like scientists? What science skills did we use?*	• Use skill stickers • Draw/write reflections

Notes

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