Mission 11
Mission to Planet Earth Life Trap!

Can You Detect Life in the Atmosphere?

Overview

In mission 11.1, students construct two Life Traps-nutrient gelatin dishes-and attempt to detect life in Earth's atmosphere. They prepare experimental dish and a control dish of the nutrient gelatin medium. In mission 11.2, students observe both dishes for a few days to watch any collected microbes multiply enough to be seen as colonies. This experiment shows students that life may be detected by growth and by changes in form. In mission 11.3, students observe further microbial growth in their own Life Traps and analyze the results of each other's Life Traps.

Notes

In Mission 40, students tested for life in the solid of an alien planet. But what about life in the atmosphere? If extraterrestrial scientist sent a robotic spaceship to earth to search for life in the air, would they be able to detect life or would they conclude that Earth's atmosphere has no life.

Mission 11.1
Materials

For a Glass of 30

- 200 ml of Sterigel Instant Medium (for an alternative recipe, see "Making Your Own Medium," in appendix)
- Masking tape
- Overhead projector
- "Experiment and Control" transparencies (2 pages)

For Each Team

- 2 sterile 60-mm by 15-mm Petri dishes (see "Sterile Dishes," in appendix)
- *2* stick-on labels or a grease pen "Making a Life Trap!" directions

For Each Student

- "Life in Strange Locations" worksheet
- Pencil

Getting Ready

1. If you are sterilizing your own Petri dishes (instead of buying sterilized Petri dishes, which require no preparation), do so the day before class. Follow the instructions in the appendix (see "Sterile Dishes," in appendix).

2. If you are preparing your own medium (instead of using the Sterigel Instant Medium), do so the day before class. Follow the instructions in the appendix (see "Making Your Own Medium," in appendix).

3. Copy the "Making a Life Trap!" directions for each team and the "Life in Strange Locations" worksheet for each student.

4. Prepare the "Experiment and Control" transparencies (2 pages). Set up the overhead projector.

Classroom Action

1. **Discussion**. Divide the class into teams of two students each. Tell students that they will be playing the role of extraterrestrial scientists who are investigating whether or not there is life in the atmosphere of planet Earth. The extraterrestrial scientists have sent another probe to Earth. This one will not take soil samples; instead, it will be a Life Trap designed to capture any microscopic, airborne life-forms and take them home for observation, or send home the data about them. In this experiment, students will simulate sending a life detection device to some strange location to see if it actually finds life there.

   Each team will prepare two identical Life Traps, dishes with a nutrient gelatin food supply for microbes. The experimental dish will be opened at a strange location for 20 minutes. The control dish will never be opened. Students will observe both dishes each day for a few days to see if any life appears.

   If any microbes settle into the experimental dish while it is open, and if they can use the nutrients in the dish, they will grow. They may be too small to see at first, but if they have enough time to multiply, they will grow numerous enough so that students can see their colonies. Nonliving things that settle into the experimental dish will not grow at all. Therefore, this is a way of finding life-forms that are originally too small to see.

2. **Activity.** Hand out the "Making a Life Trap!" directions to each team. Each team should now make a pair of Life Traps. Students should wash their hands and their

work areas with soap and water. Give teams their sterile Petri dishes and four pieces of masking tape. Ask students to tape shut their Petri dishes without opening them; this makes a “hinge” on one side of each dish and a rebreakable seal on the other.

While students are taping their Petri dishes prepare the Sterigel at a central area in the classroom: Close any windows to pre drafts. Open an alcohol swab and place it on the table. Open the two jars in the Sterigel kit. Place their lids on the alcohol swab. Pour the Sterigel liquid into the bottle of Sterigel powder and shake the bottle for 30 seconds. Sterigel must be used quickly after it is made; it cannot be melted for later use.

Each team should now obtain nutrient gelatin medium for its sterile Petri dishes by bringing them to the Sterigel area. Make sure students remove only one piece of tape from each dish. The teacher should pour the Sterigel, enough to halfway cover the bottom of each Petri dish. Students should then quickly close and retape their dishes, swirling them gently to evenly distribute the Sterigel. Work quickly and swirl the Sterigel bottle frequently to keep the nutrient suspension even. The Sterigel in the Petri dishes will set quickly, and students can write “Control” on one dish and “Experimental” on the other.

3. **Activity.** Hand out the “Life in Strange Locations” worksheet to each student. (This worksheet must be kept for several days.) Each team should agree on a strange location to which one member, or more preferably the whole team, will take the dishes, and where they will leave one open for 20 minutes, after school. These strange locations may include Billy's attic, Abduhl’s doghouse, Juanita's backyard, or wherever. They represent random samples of Earth's atmosphere taken by the extraterrestrial scientists! (Note that there is no teacher's key for this worksheet because student answers will vary. Students should attempt on their maps to be accurate in terms of number of colonies growing, location of colonies, and the general appearance of colonies.)

4. **Discussion.** End this class, or begin the next one, with a discussion of the control dish. Ask students why they are bothering with a dish that they aren't going to open. (A *control is necessary to see if any life accidentally entered the gelatin when the dishes were made.)*

5. **Transparency.** Show the “Experiment and Control” transparencies (2 pages). Explain that each dot represents the presence of life because each dot is actually a colony of bacteria or fungi that has formed from a single bacterium or fungus that happened to land on the dish while it was open. Note that one bacterium is invisible to the naked eye, but one bacterial colony is easily seen.

Ask students how they would interpret the results for the following four possible cases:

- Life appears in the experimental dish but not in the control dish.

- Life appears in neither the experimental dish nor the control dish.
- Life appears in both the experimental dish and the control dish.
- Life appears in the control dish but not in the experimental dish.

6. **Activity.** Students should take their two dishes to the strange location and set them down side by side. The experimental dish should be opened and left open for 20 minutes. Then it should be closed and retaped. Both dishes should be left at room temperature overnight and brought to school the next day. Both should be examined by the team and then set aside to incubate for a few days.

Mission 11.2
Materials

For Each Team

- Plastic metric ruler
- 2 hand lenses
- Grease pen
- "Mapping Microscopic Life" directions

For Each Student

- "Life in Strange Locations" worksheet
- Pencil

Getting Ready

1. Copy the "Mapping Microscopic Life" directions for each team

Classroom Action

1. **Activity.** Reassemble the class into mission 11.1's teams.

   Hand out the "Mapping Microscopic Life" directions to each team. Students should use their "Life in Strange Locations" worksheet to continue making and recording observations. When students return to class with their dishes, they should examine them carefully and make a map of each dish without removing the covers. This is a precaution: certain molds could produce irritating or infectious spores, although most common molds are harmless. Students should mark a line or arrow on the top of the Petri dish with a grease pencil. This will allow students to orient their dishes for observations after they have had a few days to incubate. Have students calculate the minimum time that the Life Trap would have to remain open to catch one microbe at their test location.

After teams have mapped and interpreted their own Petri dishes, have them visit other teams' Petri dishes. A good procedure is for half of a team to remain at their station to explain their findings to visitors while the other half circulates; then switch halves and duties.

2. Storage**.** Have teams put away their pairs of dishes (somewhere at room temperature) for safekeeping.

Mission 11.3
Materials

For Each Student

- "Analyzing Life Traps" worksheet
- Pencil

Getting Ready

- Prepare worksheet.

Classroom Action

1. **Activity.** Have students examine their dishes each day for several days and make new maps of the objects they see growing on the surface of the gelatin.

2. **Activity.** After students have finished all their observations, hand out "Analyzing Life Traps." Have them work on this in class alone, in their teams, or as homework.

3. **Wrap-Up Discussion.** Have a student volunteer list on the chalkboard the locations at which the teams opened their Life Traps. The volunteer should also list whether each team found microorganisms in its experimental dish or in its control dish.

   For cases in which life appeared in the control dish, ask the following questions:

   - When did it get there? *(Probably when gelatin was prepared by the teacher, or when it was poured by the team.)* Can we conclude that the experimental dish really caught life at the test location? *(No, because the life in the experimental dish may not be from the test site; it could be life that was picked up in the classroom before the experiment started in the same way that the control dish picked up life.)*

   - Is there any way that we can use the experimental results, if the control shows life? *(Vies; if there are kinds of microbes in the experimental dish that didn't appear in the control dish, we can guess that they got in at the test location, but*

we can't be as sure as we could if there was nothing *in the control dish-remember that the perimentaldish was open for 20 minutes.)* For cases in which life did not appear in any control dishes, proceed as follows: Assuming that each visible colony started from one and only one microorganism, list the total number of colonizing microorganisms caught in the experimental dish at each location and the number of minutes that a Life Trap would need to remain open there in order to catch at least one microorganism. Which location was richest in life?

- List the most common kind of organisms (e.g., bacteria or fungus) caught at each location and in the control dishes. Were there any differences between locations?

Finally, ask the following thought-provoking questions: 'Would you have recognized the objects in the Petri dishes as life if you didn't know that they had been growing?" "Is there any nonliving entity that could grow and fool you into thinking that it is alive?" Crystals grow! "Suppose that the Life Traps had been opened on a planet or satellite where there are organisms and the Life Traps cannot use the nutrients in Earth-based gelatin, or they find that Earth-based gelatin is poison to them. What would you have to do then to recognize life?" "Have we seen anything during the course of this experiment that kills life? Could a test for life be based on the use of this procedure?"

4. **Disposal.** After all observations of the Petri dishes have been made, dispose of the cultures.

   Teacher *Note: A teacher should disposeof the cultures because they may contain harmful, even pathogenic, microbes. Your school may require certain disposal procedures. Disposal bags can be ordered from biological supply houses listed in. the appendix. Ideally, the cultures should be sterilized(autoclaved or microwaved on high for a few minutes) before disposal. Avoid touching or inhaling spores from the microbial colonies; you may wish to wear a dust mask.*

Going Further

Activity: Picky Eaters

Make extra Life Traps and order special media that lack certain nutrients from biological supply houses. Have students preform the experiment and compare the number of microbes that grow on each plate. Ask students if it is important to provide certain nutrients in a Life Trap. What would happen if even one crucial ingredient was left out?

Activity: Hands-on Microbiology

Make extra Life Traps. Have students make handprints, or fingerprints, on the gelatin. Have some students wash their hands first. Ask students which of these will probably grow more microbes. Why? Students may not realize it, but everybody has harmless

microbes living on their skin all of the time. In most cases, the washed hands will produce more microbes on the culture dish because the washing will have brought microbes nearer to the surface of the skin! Show students some pictures of this normal bacterial life. There are many microbes that are specialized to live on the human body. Variation: Have students write short "secret messages" by brushing the surface of the gelatin with their fingers. See if these messages can be read a few days later.

Activity: Is It Too Hot in Here?

Make extra Life Traps. Have students expose all of them in the same way, at the same time, at the same place. Incubate one-third of them at room temperature, one-third of them in a warmer place, and one-third of them in a cool place such as a refrigerator. Have students predict how this will affect the growth of microbes and then compare their predictions to the results.

Research: A "Micro" Safari

Give each student the name of one specific microbe (e.g., Paramecium, yeast, a green alga) to research and draw. Have each student report to the class what the microbe likes to eat, where it lives, and what enemies it has. Have the class decide if each microbe would be caught by a Life Trap. For those microbes that would not be caught, ask students how they could make a better Life Trap.

Activity: "Moldy Michelangelo"

Make extra Life Traps. Have students use toothpicks to transfer tiny bits of colorful colonies from a thriving Petri dish onto a new one. Have them arrange different colors into patterns to "grow" pieces of art!

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Analyzing Life Traps--Teacher's Key

1, 2, 3**,** 4. Student answers will vary. Accept all reasonable attempts.

5. If you leave the experimental dish open for too short a time, you may not "trap" any life, even if life is present.

6. No. This is only an average calculation. It is till possible that no organisms would land in the dish.

7. If no, then the control was adequately sterilized and tightly sealed. If yes, then the control was either not adequately sterilized or not tightly sealed. Microbes may have gotten in when the gelatin was prepared by the teacher, when it was poured into the

team's Petri dish, or whenever the dish might not have been air-tight. This may have happened right in your classroom, or at the strange location. If a control dish on Mars or Venus showed contamination by life-forms, then we could not determine whether or not there was life there because the life in the experimental dish may not have been from Mars or Venus. It could be the same Earth life that was picked up in the control dish before the experiment started.

If the control from Mars does show “life,” there is a way that we could use the experimental results: if there are kinds of microbes in the experimental dish that didn't appear in the control dish, we can guess that they got in on Mars, but we can't be as sure as we could if there was nothing in the control dish.

8. Some organisms may not be able to live on the nutrients that are provided in the nutrient medium in the Petri dish

9. You could provide many Life Traps, each with different nutrients, or attempt to put all possible nutrients into one nutrient medium. But you could never be sure!

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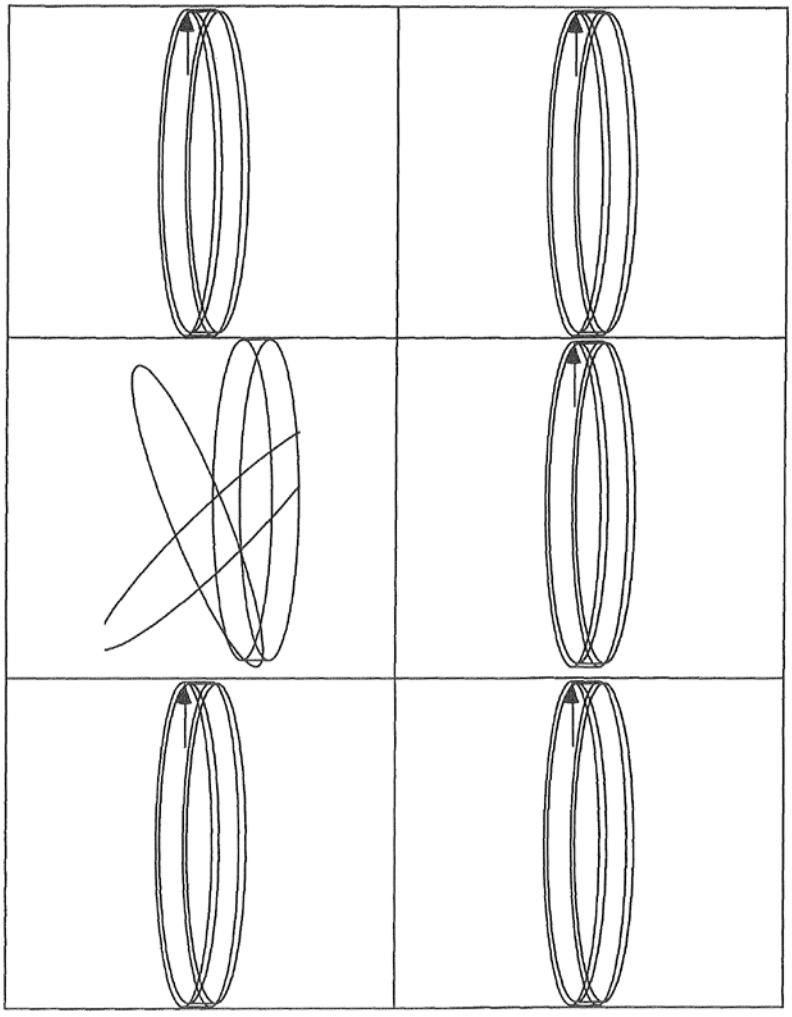
Experiment and Control Transparency

Figure 11.1-Experiment and Control.



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Experiment and Control II---Transparency

Figure 11.2-Experiment and Control Maps.