ALL for Science™
Authentic Literacy and Language for Science

Baylor College of Medicine
CENTER FOR EDUCATIONAL OUTREACH

DAY 6: Can We Observe a Transfer of Energy?

MINI-LESSON

There is no organized mini-lesson for today. Learners should have additional time to work in their inquiry cirlces.

SCIENCE INQUIRY CIRCLES

Teams work on answering their Inquiry Chart questions about their food-disposal method.

GUIDED SCIENCE INVESTIGATIONS

Teams observe what happens when yeast cells are given a source of food (sugar).

ABBREVIATED STANDARDS

- ELA and Reading TEKS: 5.13(C)
- CCSS: RI.5.7
- NGSS: 5-LS2.B
- TEKS: 5.1(A)(D)(E), 5.3(B), 5.5(B)(E),(G), 5.6(D) 5.12(A)

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Day 6: Can We Observe a Transfer of Energy?

Literacy Strategy: Additional day to work in inquiry circles

Science Concept: Carbon dioxide is released as a byproduct in the decomposition of organic materials.

Science and Literacy Connection: In their work, scientists ask questions and find answers to their questions through inquiry and investigations.

Mini-Lesson (15 minutes)

OVERVIEW

There is no organized mini-lesson for today. Learners should have an additional 15 minutes to work in their inquiry circles. You might also use this time to reteach a mini-lesson for learners who have been absent.

Science Inquiry Circles (30 minutes)

OVERVIEW

Ideally, teams will finish answering the questions on their Inquiry Charts tomorrow. You many need to make adjustments for teams who are not on track to complete their Inquiry Charts tomorrow.

MATERIALS

Each team needs:

- team Inquiry Chart
- pencils
- preselected informational texts/media

Teacher needs:

- "Food Waste Resources" spreadsheet for ideas

PROCEDURE

The *italicized statements* below offer suggested wording the teacher may choose to use in the lesson.

Before Inquiry Circles (5 minutes)

1. *It is time to get into our inquiry circle teams. You will be with the same team as yesterday, but we will rotate the science roles.* (Assign roles at your discretion and have the Equipment Directors gather the Inquiry Chart for their teams).
2. *You are already familiar with the Inquiry Chart and your inquiry questions. Today we will answer more questions or add additional information to a question you've already answered.*
3. *Keep in mind that you might develop new questions as you are working today. If your team develops a new question, add it to your Inquiry Chart as a new column.*
4. *As you look for answers to your questions, you will practice your roles as scientists. As scientists, you will make sure to carefully record your findings and sources on your Inquiry Chart.*

During Inquiry Circles (20 minutes)

1. *Today you will use a different book, eBook, website, or video to find answers to the question you're investigating about your food-disposal method or add information to a question you've already answered.* (You may want to show or project a blank sample Inquiry Chart or your model Inquiry Chart. Also, you may choose to be more explicit for your class and only allow them to answer one question at a time daily. Use your judgement on the level of guidance, especially in the first few days.)
2. *We have anchor charts to help guide your thinking. Do not forget to use them while working.* (Refer to anchor charts already introduced to date. Remind learners that they can use any of the reading strategies taught so far.)
3. *The Lead Scientist will guide all inquiries for the day by picking which question(s) will be answered. The Data Scientist will record on the team Inquiry Chart all source information and the answers to your inquiry questions.*
4. *Remember, it is important to record on your Inquiry Chart where you found the information (the source). You will need to keep track of your sources carefully because you will create a list of your sources at the end of your inquiry.*
5. Point out to learners where sources are located on the Inquiry Chart and how one source may answer multiple questions. Remind learners to record the title, author, publisher, and year of publication for all sources and to include the URL for websites and videos.
6. At this point, teams might have information under multiple questions and from multiple sources. You may need to remind teams that **information in the same row is from the same source and information in the same column pertains to the same question**. One source might answer multiple questions.
7. *Everyone should help find the answers to the questions online and in texts.* (Remind learners how the Inquiry Chart will organize their progress.)
8. *My role is to help guide the inquiry circles, but I expect you to work as a science team to solve your problems together.* (While teams are working, walk around the room to facilitate as needed.)

After Inquiry Circles (5 minutes)

1. *As we conclude our inquiry circles for today, each team will have a chance to share the information they found related to their questions, what they accomplished, and what literacy strategies they used. The Lab Director will lead the discussion about today's results. What has the team learned? What problems did the team encounter? How did the team resolve those*

problems? Did the team use a reading strategy? Which one and how did it help? What new questions does the team have?

2. After you have allowed the teams to gather their thoughts, have the Data Scientists share with the class. Try to encourage teams to share a variety of things—you do not want just facts about food waste, just reading strategies, or just cooperative learning strategies.
3. After all learners have shared, thank them for their hard work, and point out any practices of scientists you observed. If you saw an outstanding example of using a reading strategy or collaborative work, explicitly point it out. If you notice any problems in the teams during the lessons, take a moment to point them out, and explain your expectations for all future inquiry circles. Collect all Inquiry Charts or have learners put them in their normal classroom place for ongoing work so they can easily access them.

Guided Science Investigation (30–45 minutes)

OVERVIEW

Learners observe what happens when yeast cells are given a source of food (sugar).

GUIDING QUESTIONS

What happens to food matter when it is consumed by an organism? Is there any evidence to indicate that microorganisms may be living in our bottles?

BACKGROUND INFORMATION FOR THE TEACHER

The matter that makes up a living thing contains stored energy. Plants and algae (producers) store energy in the form of sugars made through photosynthesis. In true plants, some energy is stored in plant matter (stems, leaves, roots, etc.) while other energy is used by the plant so it can grow and repair itself. Through this process, energy is released into the environment as heat. Plants also take matter (nutrients, water) from the soil through their roots. But only a small amount because most plant matter is created from water and air during photosynthesis. Some matter is excreted as waste (e.g., CO_2 released through leaves/stomata).

Animals (consumers) get energy from eating other animals, plants, and the sugars stored in the plants. Animals store this energy as muscles and fat. Like plants, not all energy is stored in matter; some energy is used to fuel the body so it can repair itself, move around, grow, and keep warm. Through these processes, energy is released into the environment in the form of heat, and some matter is excreted as waste (e.g., animal poop) that becomes part of the soil.

Microscopic and macroscopic decomposers consume dead organisms because they need the energy stored in them. Like plants and animals, decomposers also store energy to use for things they need to stay alive, like moving and growing. releasing some energy back to the environment as heat, and excreting waste that becomes part of the soil. In the process, decomposers recycle nutrients (mainly nitrogen and phosphorus) back to producers.

When organisms consume food, the food is broken down to release energy. During this process, oxygen is used up and some carbon is given off as carbon dioxide. In this activity, learners will observe how carbon dioxide is given off by Baker's yeast (*Saccharomyces cerevisiae*) when it is fed sugar.

Yeast is a decomposer and a member of the same kingdom as mushrooms and toadstools, which obtain their energy and nutrients by breaking down the bodies of dead organisms.

DAILY OBSERVATIONS

Each day, teams will examine their bottles and record observations in their Investigation Journals. Observations can be made at any time of the day.

SAFETY

- Remind learners not to shake the bottles or move them in a way that disturbs the layering.

MATERIALS

Each team member needs:

- Investigation Journal
- pencil
- colored pencils or crayons

Each team needs:

- 9-oz. plastic cups (two)
- 2 spoons or coffee stirrers
- measuring cup
- 1 tsp. measuring spoon
- ½–1 cup warm water
- 1 tsp. dry yeast
- 1 tsp. sugar
- 1 bag of red cabbage indicator
- black marker

Teacher needs:

- 9 oz. plastic cups
- spoons or coffee stirrers
- warm water
- packets of dry yeast
- sugar
- red cabbage
- small resealable plastic bags
- 1 teaspoon measuring spoons

SETUP

- Prepare a set of materials for each team as listed above. Include 1 packet of dry yeast per team and a small portion of sugar.
- Have a source of warm water available.
- To prepare red cabbage indicator, slice the cabbage into thin strips and place a handful in each bag. Add ½ to 1 cup of warm water. Seal the bags and gently rub the cabbage inside until water turns purple. Make enough for each team to have 1 small bag full.

PROCEDURE

The *italicized statement* below contains suggested wording the teacher may choose to use in the lesson.

Engage

1. Begin by reminding learners of the previous class. *We discussed some of the producers and consumers that make up a soil food web. We also discovered how matter is cycled through the decomposition of organisms.*
2. *Matter from dead organisms becomes food for other organisms. When this food (matter) is broken down, energy is released. During this process, oxygen is used up and carbon (matter) is released as carbon dioxide.*
3. *Today, we will use a microscopic organism to investigate this process.*

Explore

1. Announce that the microscopic organism they will investigate is yeast. *Did you know that yeast is a living thing? Yeast is a decomposer and under the right conditions, will grow and multiply.*
2. Let them know each team member will have an opportunity to do one part of the investigation. Teams can decide who does what.
3. Ask the Equipment Directors to collect one set of prepared materials for their team. Show the class where you have the source of warm water available.
4. Instruct them to label one of the clear plastic cups "food" and the other cup "no food."
5. Have them carefully open 1 package of yeast and describe what it looks like. (Dry? Powder?) Explain that what they are seeing are clusters of yeast cells. Individual yeast cells are so small, a microscope is needed to see them.
6. Next, they will measure and add ½ cup of warm water and ½ teaspoon of yeast to both plastic cups. Stir each cup gently with different spoons.
7. Remind them that the yeast is a living organism, in spite of what it looks like, and that like all living organisms, yeast needs food for energy. *What do you think the sugar is for?* (Food.) *What do you predict will happen if we add food to one cup?* Responses may vary.
8. Have Equipment Directors on each team add 1 teaspoon of sugar **only** to the cup labeled "food" and stir it gently. Place the cups side by side and observe carefully at 5–10 min intervals to see what happens. After each interval, stir both cups gently again with separate spoons.

Explain

1. Ask, *What do you notice? What is happening? What happened when you fed the yeast?* Accept responses. Learners should notice that the yeast with the sugar will become foamy and bubbly as it produces carbon dioxide.
2. Help learners understand that the yeast cells used the sugar as a source of energy and, in the process of breaking it down, gave off carbon dioxide as a gas (bubbles), transferring energy into the environment

Elaborate (Refer to the modified version of this section in the "Before the Unit Begins" document.)

1. *How do we know it was carbon dioxide?* Tell them they will use the cabbage indicator in the bag to test for the presence of carbon dioxide.
2. Explain that the cabbage juice turns bright pink in the presence of acids. Some examples of acids they are familiar with include lemon juice and vinegar. Carbon dioxide becomes a weak acid in water, and adding the red cabbage juice will "indicate" if carbon dioxide is present.

3. Instruct Equipment Directors to add 1 teaspoon of red cabbage indicator to each cup and stir. What happens? The cup with sugar will turn pinker, providing evidence of the presence of carbon dioxide.
4. *Do you see any evidence that indicates microorganisms may be living in our columns?* Accept responses. (Presence of bubbles.)

Evaluate

1. *Our Soil Dwellers game modeled how matter is cycled through food webs as organisms feed on each other. As this occurs, energy is transferred between organisms. The different levels of producers and consumers in our game represent trophic levels that describe how organisms consume and transfer energy.*
2. Instruct learners to answer the two questions at the bottom of the Day 6 page:

This lesson is adapted from the Baylor College of Medicine The Science of Global Atmospheric Change: Fuel for Living Things. This and other free science resources can be found on https://www.bioedonline.org/.

Science Language

- **Organisms** are living things that are able to carry out the actions needed to live, grow, and survive
- **Energy** is the ability to do work or cause change and can be transferred through the interactions of organisms in an ecosystem.
- **Producers** make their own food from simple substances and energy from the Sun. Plants and algae are producers.
- **Consumers** cannot make their own food. They get their energy from eating producers and other consumers.
- **Algae** are producers capable of making their own food using energy from the Sun.
- **Carbon dioxide** is a colorless gas produced when organisms break down the sugars in food into simpler products

Expanded Standards

English Language Arts and Reading TEKS

5.13(C) identify and gather relevant information from a variety of sources.

CCSS

RI.5.7 Draw on information from multiple print or digital sources, demonstrating the ability to locate an answer to a question quickly or to solve a problem efficiently.

NGSS

5-LS2.B Matter cycles between the air, water, and soil and among plants, animals, and microbes as these organisms live and die. Organisms obtain gases, and water from the environment, and release waste matter (gas, liquid, or solid) back into the environment.

Science TEKS

5.1(A) ask questions and define problems based on observations or information from text, phenomena, models, or investigations; **(D)** use tools, including calculators, microscopes, hand lenses, metric rulers, Celsius thermometers, prisms, concave and convex lenses, laser pointers, mirrors, digital scales, balances, spring scales, graduated cylinders, beakers, hot plates, meter sticks, magnets, collecting nets, notebooks, timing devices, materials for building circuits, materials to support observations of habitats or organisms such as terrariums and aquariums, and materials to support digital data collection such as computers, tablets, and cameras to observe, measure, test, and analyze information; **(E)** collect observations and measurements as evidence; **5.3(B)** communicate explanations and solutions individually and collaboratively in a variety of settings and formats; **5.5(B)** Identify and investigate cause-and-effect relationships to explain scientific phenomena or analyze problems**; (E) i**nvestigate how energy flows and matter cycles through systems and how matter is conserved**; (G)** explain how factors or conditions impact stability and change in objects, organisms, and systems; **5.6(D)** illustrate how matter is made up of particles that are too small to be seen such as air in a balloon; **5.12(A)** observe and describe how a variety of organisms survive by interacting with biotic and abiotic factors in a healthy ecosystem.