ALL for Science™

Authentic Literacy and Language for Science

Baylor College of Medicine

CENTER FOR EDUCATIONAL OUTREACH

DAY 8: Matter and Energy in Decomposition

MINI-LESSON

Teacher introduces how scientists create diagrams to represent a complex process or system they are investigating.

SCIENCE INQUIRY CIRCLES

Teams use key information from the mini-lesson to plan and create a diagram about their food-disposal method.

GUIDED SCIENCE INVESTIGATIONS

Teams synthesize what they know about the cycling of matter and transfer of energy and apply it to the process of decomposition.

ABBREVIATED STANDARDS

- ELA and Reading TEKS: 5.10(C)
- CCSS: W.5.7
- NGSS: 5-LS2-1
- TEKS: 5.1(A)(D)(E), 5.3(B)(E), 5.5(D)(E),(F) 5.12(A)(B), 5.13(A)

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Day 8: Matter and Energy in Decomposition

Literacy Strategy: Creating diagrams

Science Concept: The flow of energy and cycling of matter in the soil is vital for sustaining terrestrial plants and microorganisms, and, in turn, most food webs.

Science and Literacy Connection: Scientists create diagrams (like food chains and webs) to represent complex processes and systems.

Mini-Lesson (15 minutes)

OVERVIEW

As children learned previously, a diagram is a model that represents a complex process or system. Today children learn how scientists create diagrams that represent a process or system they are investigating.

Scientists might use models during an investigation (to strengthen their own understanding) or after the investigation is complete (to explain a process or system to someone else). Scientists use diagrams to make complex processes and systems easier to understand. They do this by showing and labeling individual components of the model, such as steps in a process or parts of a system. They might also use lines or arrows to show how different steps or parts in the model are connected to each other. Scientists usually create diagrams as part of a text they are writing, such as a scientific report or an informational book. Scientists include diagrams in their writing to help readers, including other scientists, better understand the topic they (the authors) are writing about.

MATERIALS

Teacher needs:

- chart paper
- marker(s)
- “Creating Diagrams” anchor chart as a model
- model Inquiry Chart

PROCEDURE

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

Tell what the strategy is (declarative knowledge)

1. *Today we're going to learn how to create diagrams. Creating diagrams means using images, symbols, and words to visually represent a complex process or system.*

Tell when and why to use the strategy (conditional knowledge)

1. *Scientists create diagrams to represent the complex process or system they are writing about and to make the process or system easier to understand.*
2. *When I am writing about a complex process or system I am investigating, I can create a diagram. Creating a diagram can help me make my ideas more clear for the reader of my scientific text.*

Tell how to use the strategy (procedural knowledge)

1. *First, I think about my writing (e.g., a scientific report) and ask myself if including a diagram would help my reader better understand what I am writing about. I ask myself, "Am I writing about a complex process or system? Would a diagram help make this complex process or system easier to understand?"*
2. *Then I brainstorm a list of important information that needs to be included in my diagram.*
    - *If I am representing a process, what steps in the process should I represent?*
    - *If I am representing a system, what parts of the system should I represent?*
3. *Then I make decisions about the words, images, or symbols I will use in my diagram. I use images to highlight important details, symbols to represent processes that are difficult to show directly, and words to label and describe steps in a process or parts in a system. For example, I can use an arrow to represent the cycling of matter or the transfer of energy because these are hard to show in an image, and I would label the parts of the cycle so my reader knows what each part represents.*

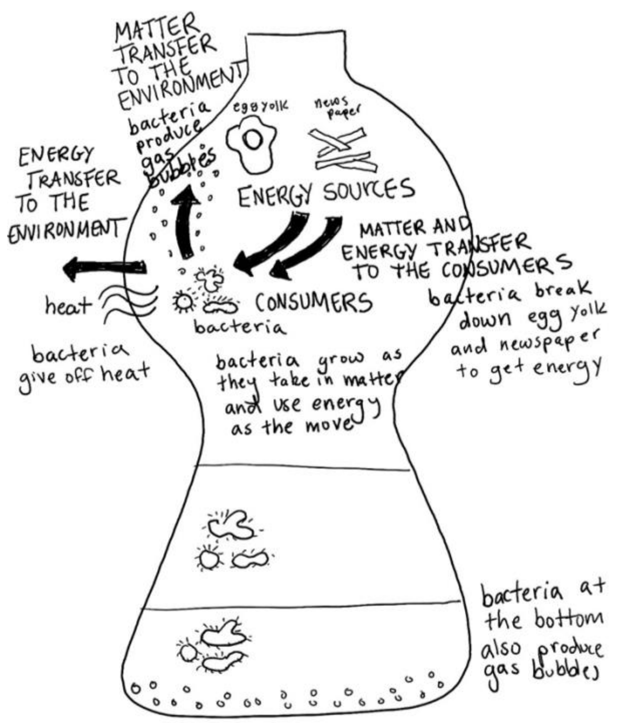
Model the Strategy

1. *If I were writing a scientific report about how matter is cycled and energy is transferred in our bottle systems that we have been investigating, it would be helpful if I included a diagram to explain what is happening inside the water bottle.*
2. *I need to brainstorm a list of important information to include in the diagram. You can help me brainstorm! We are representing a process: the cycling of matter and the transfer of energy. That means we need to list all of the steps in the process and all of the living things that play a role in the process.* (Guide learners toward the labels listed below. Make sure to mention any components that are missed.)
    - Consumer: Who or what is getting energy from the energy source?
    - Energy source: Organic matter, or matter that contains stored energy
    - Matter transfer from the Energy Source to the Consumer
    - Matter Transfer from the Consumer to the Environment
    - Energy Transfer from the Energy Source to the Consumer
    - Energy Transfer from the Consumer to the Environment
    - Waste That Can Be Used by Other Living Things
3. *Now we need to make some decisions about how to represent all the important information we listed, using words, images, or symbols.* (Use chart paper to construct the diagram with learners. Invite them to help you make representational decisions).
    - *The first thing we need to represent is the consumer. I'm going to write the word "CONSUMER" here. What living thing is getting energy in our bottle systems* (listen for

words like “bacteria” or “microorganisms”). *That’s right, bacteria. I’ll add the word “BACTERIA.” How could we represent the bacteria?* (Accept suggestions and add to the diagram.)

- *And where are the consumers, the bacteria, getting energy from? What did we add to the bottle system to help the bacteria grow?* (Egg yolk and shredded newspaper.) *Those are our energy sources. I’ll write “ENERGY SOURCES” here. How could we represent those?* (accept suggestions and add to the diagram).
- *Now we need to represent the matter from the energy source being transferred to the consumer. The bacteria consume bits of egg yolk and newspaper, or matter. How could we represent this step in the process?* (Accept suggestions and add to the diagram.)
- Continue guiding learners and co-constructing the class diagram. Make sure to prominently include the seven labels listed in step 2 above.

Example Diagram
Your co-created model might look something like this, but diagrams will vary.



Science Inquiry Circles (30 minutes)

OVERVIEW
During the mini-lesson, learners co-created a diagram to represent matter cycling and energy transfer in the bottle systems they have been investigating. Now teams will use the list of important information generated during the mini-lesson to begin planning and creating a diagram to represent how matter is

cycled and energy is transferred within the food-disposal method they are investigating. This diagram will not be completed today but will be finished as part of their final reports.

As learners begin their work, they will likely notice that they do not have all the information needed to complete their models. Learners should take note of the information they still need. This will be the focus of tomorrow's mini-lesson.

MATERIALS

Each team needs:

- team Inquiry Chart
- pencils
- sticky notes
- paper for creating diagrams
- drawing materials

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 circles. 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 team).
2. *We have answered all (or most) of our Inquiry Chart questions. Today we will begin planning and creating a diagram to represent how matter is cycled and energy is transferred within the food-disposal method you are investigating.*

During Inquiry Circles (20 minutes)

1. *In our mini-lesson, we brainstormed a list of important information. These are labels that we included in our diagram of the water bottle system, and you will include these same labels in your diagram about matter cycling and energy transfer.* (Review the list with learners.)
    - Consumer: Who or what is getting energy from the energy source?
    - Energy Source: Organic matter or matter that contains stored energy
    - Matter Transfer from the Energy Source to the Consumer
    - Matter Transfer from the Consumer to the Environment
    - Energy Transfer from the Energy Source to the Consumer
    - Energy Transfer from the Consumer to the Environment
    - Waste That Can Be Used by Other Living Things
2. *As you begin planning your diagram, you and your team will go through each of these labels and discuss what you have learned so far related to the label and your food-disposal method. Let's start with just the first two labels. In your teams, discuss the consumer and the energy source in your food-disposal method. What consumer, or living thing, is getting energy in your chosen method, and what are they consuming to get energy? Lead Scientists will lead the conversation and Data Scientists should be ready to share out.* (Move around the room and facilitate conversation as needed.)

3. Facilitate whole-group sharing. Point out that all groups identified the same energy source (food scraps or uneaten food), but each team identified a different consumer (bacteria/fungi in composting; worms in vermicomposting; pigs; or humans).
4. *Now you will continue your discussion in your teams. Talk about what you have learned about how matter and energy are transferred from the energy source to the consumer and from the consumer to the environment. You can refer back to your Inquiry Charts. You will probably find that there are some things you have not learned yet, or you might have new questions about matter cycling and energy transfer in the food-disposal method you are investigating. Lab Directors should use sticky notes to write down these areas of confusion or any new questions the team has. These will be important for our work tomorrow.*
5. If learners finish their discussion early, they can begin sketching out their diagram. Remind learners to leave plenty of space for new information.

After Inquiry Circles (5 minutes)

1. *As we conclude our inquiry circles for today, each team will have a chance to share takeaways from their discussion, areas of confusion, or new questions that arose.*
2. After you have allowed the teams to gather their thoughts, have the Data Scientists share with the class. When all learners have shared, thank them for their hard work, and point out any practices of scientists you observed.
3. Collect all Inquiry Charts or have learners put them in their normal classroom place for ongoing work so they can easily access them. Collect sticky notes from teams and organize them in a way that they can be returned to teams or accessed by teams tomorrow.

Guided Science Investigation (30–45 minutes)

OVERVIEW

Learners synthesize what they know about the cycling of matter and transfer of energy then apply it to the process of decomposition.

GUIDING QUESTIONS

What happens to matter and energy during decomposition? What happens to matter and energy in food waste?

BACKGROUND INFORMATION FOR THE TEACHER

Plants play a critical role as the basis of many food chains in an ecosystem. When we consider soil organisms, that includes plants and plant roots. Plants absorb nutrients from the soil, making these nutrients available to other organisms in a food chain. When plants decompose, organic matter is added to the soil, which helps keep the soil healthy and supports nutrient cycling. Importantly, decomposing plants become food for microorganisms that support robust food webs.

In the previous lessons, learners explored how food chains in a soil ecosystem cycle matter and transfer energy between organisms in different ways. The matter that makes up living things contains stored energy. What happens to that matter and energy during decomposition? What happens to that matter and energy in food waste?

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:

- sticky notes

Teacher needs:

- 1 sheet of chart paper
- marker

SETUP

- Label a sheet of chart paper "Decomposition" and post it where learners can write on it.

PROCEDURE

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

Engage

1. Tell learners, *Today we will construct a "lightning quick" graffiti wall.* Point to the posted sheet of chart paper and tell them this is the "wall."

Explore

1. Explain that teams will have 1 minute to brainstorm who is responsible for decomposition in a soil ecosystem and why decomposition is important. They will write their answers on a sticky note. When time is up, the Data Scientists will post their team's answers on the graffiti wall.
2. Distribute the sticky notes and instruct teams to begin on "GO!" as you begin the timer.
3. When time is up, ask everyone to return to their seats.

Explain

1. Ask the Lead Scientist from each team to come up to the graffiti wall and explain their team's answers. Answers should include decomposers (bacteria, fungi, other microorganisms) and detritivores (worms and insects) either by name, category, or how they decompose (e.g. chemically, physically). The importance of decomposition should describe how matter is changed, energy transferred, and nutrients recycled to benefit the soil and food chains.
2. As learners explain their answers, validate or clarify their responses with open-ended questions, such as, *Can you describe how that works? What makes you think that? Can you tell me more?*
3. After all teams have shared, return to the role of decomposers. Explain that the bacteria and

fungi teams learned about in the Soil Dwellers game represent a very diverse group of these microorganisms. There can be close to 1 million different species of bacteria and thousands of species of fungi in just one teaspoon of uncontaminated soil. Explain that *species* refers to a group of organisms that share similar characteristics and can reproduce.

4. Clarify that while detritivores are involved in the early process of decomposing organic matter when they grind, tear, and chew materials into smaller pieces, it's the work of bacteria, fungi, and other microorganisms that recycles important nutrients back into the soil.
5. Decomposers and detritivores consume dead organisms because they need the matter and energy stored in these organisms. Like plants and animals, decomposers and detritivores also use energy for life processes, which releases some energy into the environment as *heat*. They also excrete matter as waste which becomes part of the soil.
6. *So, what happens when dead plants and animals seem to "disappear"?* Accept responses, then clarify if needed with, "*When we see something decomposing, we are seeing matter being broken down by decomposers (like bacteria) and detritivores (like worms and insects).*
7. Remind the learners of the questions they answered on Day 6 in their journals. W*hat happens to the matter in decomposition? (*Accept responses and clarify if needed.) *The matter becomes part of the decomposer or is excreted as waste where it becomes part of the soil.*
8. *What happens to the energy?* (Accept responses and clarify if needed.) *The energy stored in the decomposing plant or animal is used as fuel for the decomposer and released into the environment primarily as heat.*

Elaborate

1. Remind the class that, when they observed yeast consuming sugar, they were observing the presence of carbon dioxide being released in the process. *What did you see?* (Bubbles.) Point out they also described the presence of bubbles in the bottles they are observing.
2. Reveal that the bottle is a model of a diverse microorganism ecosystem. *While we cannot see the actual microscopic organisms inside, we can observe their actions, such as the production of bubbles and the formation of layers.*

Evaluate

1. Randomly call on a learner and ask, *What do you think is happening in your bottle?* Accept the response, then ask another learner if that answer is reasonable or correct. Accept the response, then ask a third learner, *Can you explain why there is agreement (or disagreement) about the first two responses?* Accept the response and, if time permits, allow other learners to weigh in.

Science Language

- **Nutrients** are nourishments and substances found in food that help organisms survive and grow.
- **Species** refers to a group of organisms that share similar characteristics and can reproduce offspring.
- Living things get **energy** from the food they eat to help them move, grow, and survive.
- In nature, **cycling** refers to the recurring flow of matter and energy through ecosystems.
- **Carbon dioxide** is a colorless gas produced when organisms break down the sugars in food into simpler products
- **Bacteria** are organisms so small they can only be seen through a microscope. Some are decomposers that break down dead organisms.

- **Fungi** are a group of decomposers that feed on decaying matter. Mushrooms are a type of fungi.
- **Detritivores** are animals that physically break down dead organic matter into smaller particles in the process of eating it.
- **Decomposers** secrete substances to chemically break down organic matter and recycle nutrients from the decaying material.
- **Models** in science help us understand objects, systems or events that are difficult to observe directly in the natural world.

Expanded Standards
English Language Arts and Reading TEKS **5.10(C)** analyze the author's use of print and graphic features to achieve specific purposes.
CCSS **W.5.7** Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.
NGSS **5-LS2-1** A system can be described in terms of its components and their interactions.
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(D)** examine and model the parts of a system and their interdependence in the function of the system; **(E) i**nvestigate how energy flows and matter cycles through systems and how matter is conserved**; (F)** explain the relationship between the structure and function of objects, organisms, and systems; **5.12(A)** observe and describe how a variety of organisms survive by interacting with biotic and abiotic factors in a healthy ecosystem; **(B)** predict how changes in the ecosystem affect the cycling of matter and flow of energy in a food web; **5.13(A)** analyze the structure and functions of different species to identify how organisms survive in the same environment.