ALL for Science™
Authentic Literacy and Language for Science

Baylor College of Medicine
CENTER FOR EDUCATIONAL OUTREACH

DAY 4: Who Are the Soil Dwellers?

MINI-LESSON

Teacher introduces the "Intratextual Synthesis" anchor chart and models the process.

SCIENCE INQUIRY CIRCLES

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

GUIDED SCIENCE INVESTIGATIONS

Teams play the Soil Dwellers game and are introduced to the organisms that make up a soil ecosystem.

ABBREVIATED STANDARDS

- ELA and Reading TEKS: 5.9(D)
- CCSS: RI.5.3
- NGSS: 5-LS2-1, LS2.A
- TEKS: 5.1(A)(D)(E), 5.3(B), 5.5(D)(E)(G), 5.12(A)(B), 5.13(A)

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Day 4: Who Are the Soil Dwellers?

Literacy Strategy: Intratextual synthesis (synthesizing information across a single text)

Science Concept: A soil ecosystem is made up of a diverse range of microorganisms, soil animals, and plant life.

Science and Literacy Connection: Scientists synthesize the written words and the visual representations they encounter when they read scientific texts.

Mini-Lesson (15 minutes)

OVERVIEW

A unique feature of scientific texts is that they contain written words and visual representations, such as images, charts, tables, graphs, and diagrams. This is also common in informational texts designed for young readers. If you have taught your learners about informational text features, you might have already pointed out such elements as images, charts, tables, graphs, and diagrams in the texts we read. These are usually called external text features. Other informational text features, such as headings, subheadings, indices, and tables of contents, are important features to consider but are not the focus of this lesson because they are not visual representations. Headings and subheadings are internal text features, while indices and tables of contents are external.

Scientists must pay attention to the written words and the visual representations (images, charts, tables, graphs, and diagrams) they encounter when they read scientific texts. In a scientific text, visual representations contain unique information usually not repeated in the written words. This means that scientists have to synthesize the information found in the written words and the information found in the visual representations to make sense of the text as a whole.

Synthesizing is different from summarizing. Summarizing information from a section of written text and then summarizing the information from visual representations does not help scientists understand what these two pieces of information mean *together*. Synthesizing means bringing these two pieces of information together to create a new understanding; this type of synthesis is called *intratextual synthesis.*

NOTE: This reading strategy includes the subroutine of "Extracting the Main Idea." If your learners need support with this subroutine, this topic is covered in the optional additional mini-lesson found in the supporting files for Day 4. Additionally, learners will not be asked to interpret data from graphs in this mini-lesson; however, learners may encounter graphs along with other visual representations as they

conduct their inquiry and practice intertextual synthesis. If learners need support, an additional mini-lesson on "Reading Data from Graphs" is available in the supplementary files for Day 4.

MATERIALS

Teacher needs:

- chart paper
- marker(s)
- "Intratextual Synthesis" 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 synthesize information presented across multiple elements within one text. We will call this strategy "intratextual synthesis." Intratextual synthesis is synthesizing across information contained in a single text. Intratextual synthesis often involves synthesizing information presented by the written words and the visual representations of a text and putting those together to make sense of the whole text.*

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

1. *I use intratextual synthesis when I read a text that includes written words and other visual representations, such as images, charts, tables, graphs, and diagrams.*
2. *This is an important strategy because, in scientific texts, the information in the visual representations is unique and cannot be found in the written words. To understand the whole text, I have to put together the information that the visuals give me and the information that the written words give me; I do that through the reading strategy intratextual synthesis.*

Tell how to use the strategy (procedural knowledge)

1. *I first remind myself why I am reading and what I already know about this topic.*
2. *Then I read the written words in the text, noting what's important and what helps me answer my inquiry question.*
3. *When I come to a visual representation, I stop and ask myself what the written words have told me so far. This is the "main idea" of the part of the text I have read so far.*
4. *Then, I interpret the visual representation.*
    - *For charts, tables, and graphs, I read the titles, labels, and numbers and look at the shape of the graph to figure out what new information the visual is telling me.*
    - *For images and diagrams, I read any titles, labels, or captions and look at the pictures to figure out what new information the visual is telling me.*
5. Then I continue reading any more written words that come after the visual representation. I think about what new information I can add to the information from the visual representation.
6. *Finally, I tie the information from the written words (the main idea) and the visual representation together. I think about what information the written words gave me and what new information the visual representation added. I combine these to build my understanding of the whole text.*

7. *Some texts include more than one visual representation, and each paragraph or page may have a different main idea. I repeat this strategy for each new section of written words and each new visual representation.*

NOTE: This model presumes the reader is reading the page top-to-bottom and left-to-right. Readers might not read an informational text in this order. For example, a reader's eyes might be drawn to the visual representation first. In this case, the reader might infer the meaning of the visual representation before reading the words on the page. Presumably, the reader would then begin reading the text and may return to reinterpret the visual representation. This model is only one approach to intratextual synthesis and may not capture all of the synthesizing readers engage in.

Model the Strategy

Use page 1 of this text to model the strategy: https://www.ediblecommunities.com/kids/wp-content/uploads/sites/9/2024/03/science-behind-food-waste-anchor-reading.pdf

1. *First I start reading the written words* (read from page 1, paragraph 5): "Let's say an apple falls from a tree. What happens as it breaks down? First, larger organisms like earthworms are likely to break it down into smaller pieces. This is important because it allows smaller microorganisms like bacteria to also break down the apple."
2. *Then I come to a visual representation* (the time-lapse of an apple decomposing) *and ask myself what the written words have told me so far or "what is the main idea of the text so far?" I know this part of the text is about what happens to an apple that falls from a tree. From what I read, I think the main idea is that apples begin to break down after falling from the tree, and large organisms like earthworms and small organisms like bacteria are responsible for the apple breaking down.*
3. *Then I interpret the visual representation: In the image, I can see three images of an apple. The first apple looks fresh, but the second apple looks wrinkly, and the third apple looks very wrinkly, brown, and a little bit smaller. Because the text so far has been about how organisms break down an apple, I think this visual is telling me what it looks like when an apple is broken down. Each apple is more broken down than the last, which helps me understand how the apple is broken down little by little over time.*
4. *Next, I keep reading:* "Over time, the apple will change into a new substance. It not only physically breaks down into very small parts, but it also changes in color and smell. Factors like moisture (from rain), temperature, and availability of oxygen affect how quickly decomposition occurs."
5. *Then I think about what new information is added by this section of written words: I can see from the image that the apple changes color as it is broken down, but this part of the text adds that the smell of the apple will also change as it is broken down. The text also tells me that the apple might be broken down faster or slower because of the conditions (rain, temperature, etc.) of the environment around the apple.*
6. *Finally, I think about all the parts of the text together to build my understanding. From both the written words and images, I learned that an apple that falls from a tree will be broken down by multiple organisms, and as these organisms break down the apple, the shape, texture, color, and smell of the apple will change. I tie it all together and come up with the synthesis: different conditions in the environment might speed up or slow down the process of breaking down the apple.*

Science Inquiry Circles (30 minutes)

OVERVIEW

Scientists often work in teams when conducting inquiry and investigations. Today, learners will work in inquiry circles to investigate different questions about their food-disposal method, how schools reduce their food waste using this method, and what happens to the organic matter and stored energy in the food scraps. Prior to starting the inquiry circle work, be sure to have texts and technology available for your learners. Remember, the "Food Waste Resources" spreadsheet contains a list of suggested books and media, but feel free to use other resources.

You may need to provide learners with specific instructions on how to access websites within your school district, or you may want to create a click sheet of approved websites for learners to be distributed through your learning management system (Google Classroom, Schoology, etc.).

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 today's anchor chart and the other anchor charts already introduced. 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 carefully keep track of your sources because you will create a list of your sources at the end of your inquiry.* (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.)
5. *Everyone should help find the answers to the questions online and in texts.* (Remind learners how the Inquiry Chart will organize their progress.)
6. *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 play the Soil Dwellers game as an introduction to the organisms that make up a soil ecosystem.

GUIDING QUESTIONS

Who are the organisms that live in the soil? How do they support each other?

BACKGROUND INFORMATION FOR THE TEACHER

A soil ecosystem is made up of many diverse organisms that live all or part of their life in or on the soil.

Some are microscopic, like bacteria, fungi, and other microorganisms. Soil animals that can be seen vary in size and include ants, snails, beetles, and earthworms.

As in all ecosystems, food chains in the soil are formed by producers and consumers. These organisms are dependent on each other for food and energy. Moreover, soil organisms play a crucial role in soil formation and are essential for maintaining its health; they can also create, modify, and maintain habitat space for other 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:

- 1 Tracking Log
- 1 plastic bag (for collecting the game cards)

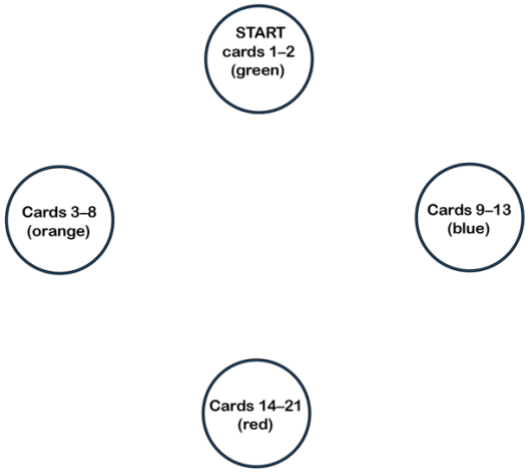
Teacher needs:

- "Animal Carcass" image (from Day 1)
- Soil Dwellers game
- copy of the Tracking Log
- "Tracking Log Instructions" page

SETUP

- Make copies of the Tracking Log (1 per team).
- Write the words "Food Chain" on the whiteboard.
- Prepare to project the "Animal Carcass" image (from Day 1) **at the end of today's activity**.
- Set up the Soil Dwellers game:
    - Print 1 copy of the START page and 4 color copies of the number cards (pages 5–12 of the game). **NOTE: make sure to select the "double-sided" print option so that the colored numbers print on the back of the card images!**
    - Cut out the cards.
    - Designate a START station with number cards 1 and 2 (green numbers).
    - Designate stations for cards 3–8 (orange numbers), cards 9–13 (blue numbers), and cards 14–21 (red numbers).
    - Place the cards face down so that only the colored numbers show.

Example station setup



PROCEDURE

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

Engage

1. Begin by pointing to the words "Food Chain" on the whiteboard and asking the class, *What do you think of when you see these words?* Accept responses and write them under "food chain." (Responses may include references to one organism eating another; words like "producers" and "consumers"; animals eating plants, etc. Decomposers may or may not be included in their ideas.)
2. Read over the list of their ideas and validate correct responses. Explain that when we think of food chains, most people begin with the producers: plants that get their energy from sunlight to grow. Then we consider the consumers: animals that eat the plants, and other animals that eat animals. These simple food chains then become complex food webs in many different ecosystems. *Did you know that one of the most important food webs is right under our feet? It's in the soil!*
3. Announce*, Today we'll meet and learn more about the organisms that make up a soil ecosystem.*

Explore

1. Distribute 1 copy of the Tracking Log and 1 plastic bag to each team. Project the "Tracking Log Instructions" page and read it aloud for your learners to ensure they understand what they are to do. Leave the instructions projected for learners to refer to during gameplay.
2. Have teams stand by the START station and review how they are to rotate through the different stations. Learners will move together with their own team. Stagger teams by waiting for the first team to move beyond the next station before the next team proceeds.
3. The Data Scientists will use the Tracking Log to record where their team has been and what happened to them.
4. The Equipment Directors will collect each card the team chooses and place them in the plastic bag. **NOTE:** Instruct the teams that if they select a card that directs them to return to START, the team should wait for any team ahead of them to move first before proceeding. Ask if there are any questions before they begin.

5. Let teams know they have about 10 minutes to complete the game. (Time allotted for the game is at the teacher's discretion, based on the needs of the class.) When ready, say "GO!" and begin timing.

Explain

1. When time is up, teams will sit on the floor with the cards they collected and their Tracking Log.
2. Explain that the number of cards they have correspond to the number of organisms they supported through food chains in the soil. Ask them to use the information on their Tracking Log to lay out their cards in the order they were collected.
3. Point out that some of them were "decomposed" and had to return to START. If they only have 2 cards before they had to go back to START, that represents one food chain. Each time they had to go back to START represents a different food chain. *How do you think being decomposed affects the food chain or food web?* Accept responses. (Decomposed organisms can provide important nutrients back into the soil, supporting the growth of producers and the entire soil ecosystem.)
4. *In the game, who did the decomposing?* Answers may vary. Explain they will learn more about decomposers in the next class.
5. End by asking how many different food chains each team supported and how far up the food chain they went.
6. After discussion, have teams return their game cards to the plastic bag. Tell them they will use their cards again in the next class session.

Elaborate

1. Remind the class of the videos and image they saw on the first day of the unit. Project the "Animal Carcass" image. Identify the animal as a moose and randomly call on several learners to share what they think happened to the moose after it died. Tell learners they can read what they wrote on Day 1 in their Investigation journals. Then ask, *Has your thinking about this changed since Day 1 based on what you have learned?*
2. Answers will likely include references to other animals eating it. Accept all responses and allow a few minutes for them to justify their answers before asking, *Why do you think that?*

Evaluate

1. Ask what role the soil ecosystem may have had in the decomposition of the moose. Instruct learners to turn and talk with a partner, then write their answers at the bottom of Day 4 in their Investigation Journals.

Science Language

- **Decomposition** is the breaking down of certain types of matter, including dead organisms like plants and animals.
- **Soil** is made up of both biotic and abiotic components and is constantly being changed by the action of weather, water and organisms.
- **Biotic** components in soil include all the living organisms, their waste, and dead organisms.
- The **abiotic** (nonliving) components in soil include rocks and minerals, water and air.
- A **food chain** describes the sequence of who eats whom that transfers energy between organisms.

- An **ecosystem** is a community of organisms that live and interact with each other and their nonliving environment.
- **Producers** make their own food from simple substances and energy from the Sun. Plants are producers.
- **Consumers** cannot make their own food. They get their energy from eating producers and other consumers.

Expanded Standards

English Language Arts and Reading TEKS

5.9(D) recognize characteristics and structures of informational text, including: **(ii)** features such as insets, timelines, and sidebars to support understanding.

CCSS

RI.5.3 Explain the relationships or interactions between two or more individuals, events, ideas, or concepts in a historical, scientific, or technical text based on specific information in the text.

NGSS

5-LS2-1 A system can be described in terms of its components and their interactions; **LS2.A**: The food of almost any kind of animal can be traced back to plants. Organisms are related in food webs in which some animals eat plants for food and other animals eat the animals that eat plants. Some organisms, such as fungi and bacteria, break down dead organisms (both plants or plants parts and animals) and therefore operate as "decomposers." Decomposition eventually restores (recycles) some materials back to the soil. Organisms can survive only in environments in which their particular needs are met. A healthy ecosystem is one in which multiple species of different types are each able to meet their needs in a relatively stable web of life. Newly introduced species can damage the balance of an ecosystem.

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)** investigate 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; **5.12(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.