ALL for Science™
Authentic Literacy and Language for Science

Baylor College of Medicine
CENTER FOR EDUCATIONAL OUTREACH

DAY 7: What Is a Winogradsky Column?

MINI-LESSON

Teacher introduces the genre of scientific reports and why scientists write them.

SCIENCE INQUIRY CIRCLES

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

GUIDED SCIENCE INVESTIGATIONS

Teams compare and contrast their modified Winogradsky columns.

ABBREVIATED STANDARDS

- ELA and Reading TEKS: 5.9
- CCSS: W.5.7
- NGSS: 5-LS2-1, LS1.C, LS2.A, LS2.B
- TEKS: 5.1(A)(D)(E), 5.3(B), 5.5(E)(F)(G), 5.12(A)(B)

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Day 7: What Is a Winogradsky Column?

Literacy Focus: Exploring the genre of a scientific report

Science Concept: One group of microorganisms can live and survive on the byproducts of another group within the same microenvironment.

Science and Literacy Connection: Scientists write reports to describe their investigations and report their findings in a way that other scientists can easily recognize.

Mini-Lesson (15 minutes)

OVERVIEW

Yesterday children learned to recognize the features of a diagram and interpret a diagram within a scientific report. Today they will learn more about scientific reports, including how and why scientists write them. A *scientific report* is a kind of descriptive informational text—a text that explains a topic, idea, or process. Specifically, scientific reports describe the process of conducting an investigation. When writing a scientific report, scientists use language in specific ways, include visual representations, and organize the report in a predictable format.

When scientists describe their investigations in scientific reports, they use technical vocabulary. Using technical vocabulary allows scientists to describe scientific information accurately and in enough detail that other scientists can understand them.

When writing scientific reports about their investigations, scientists also use visual representations. They might include diagrams, labeled illustrations, tables, charts, or graphs. Scientists use these visuals to represent the process or system they are investigating, how they conducted their investigation, or the results of their investigation (or all of these).

Finally, scientists organize their reports in a predictable way. This helps other scientists understand the report and ensures that the author of the report includes all the information other scientists will expect them to include. Scientific reports usually include five main sections: introduction, methods, results, discussion, and conclusion. Some reports also include an abstract or summary of the report. The scientific community might not trust a scientific report that leaves out important information about the investigation. Authors often use headings to label the parts of their report. This helps the reader find each part.

NOTE: Scientific reports describe investigations. There are many different kinds of investigations. Some investigations involve observing or measuring a phenomenon. Other investigations involve reading

about what other scientists have observed and measured. We call this "reviewing the literature." Learners have been reviewing the literature during their inquiry circle time. The results learners will report will come largely from the texts they have read, but learners might also include observations or measurements from their science investigations.

Mentor text: What Makes You Choose the Food You Eat? by Lynnette M. Neufeld

MATERIALS

Each team member needs:

- What Makes You Choose the Food You Eat? by Lynnette M. Neufeld (suggested)

Teacher needs:

- chart paper
- marker(s)
- "Exploring the Genre of Scientific Reports" anchor chart

PROCEDURE

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

Tell about the genre and genre features

1. *Today we are going to learn about scientific reports. Scientific reports are a specific kind of scientific writing. Scientists write reports to share about their investigations. When scientists write reports, they use technical vocabulary to describe scientific information accurately and in enough detail so that other scientists can understand them. Scientists use visual representations in their reports to help the reader understand their investigation. Finally, scientists organize their reports in predictable ways. Most scientific reports include the same sections, usually in the same order. Scientists use headings to label their sections.*

Invite learners to explore genre features

1. *I am going to assign each of your teams a number* (Give each team a number: 1, 2, or 3).
2. *If I give your team a number 1, you are going to explore the scientific report and notice the author's use of language.*
    - *What technical vocabulary does the author use?*
    - *How does the author help us understand the meaning of technical words?*
3. *If I give your team a number 2, you are going to explore the scientific report and notice the author's use of visual representations.*
    - *What kinds of visual representations does the author use?*
    - *How do these visual representations help us understand the author's investigation?*
4. *If I give your team a number 3, you are going to explore the scientific report and notice the author's organization of the report.*
    - *How does the author organize the report? (Hint: look at the headings.)*
    - *What seems to be the purpose of each section?*

Discuss and clarify the genre features

1. Invite each team to share what they noticed. Listen for the following ideas and prompt for or directly mention any of the following ideas if they aren't addressed by learners:

- Technical Vocabulary
    - Learners might notice that some technical vocabulary is **bolded**.
    - Learners might notice that the author sometimes explains a new word when they use it for the first time, e.g. “A food environment is where we make decisions about getting, preparing, and eating food” (p. 1).
    - Learners might notice that there is a glossary of key terms.
- Visual Representations
    - Learners might notice that the author includes a photograph (p. 1) to help the reader understand the topic of the investigation.
    - Learners might notice that the author includes a graph (p. 2) to explain the results of the investigation.
- Organization
    - Learners might notice these headers/sections: abstract, introduction, methods, results, discussion, and conclusion.
    - Learners might describe the purpose of the section in ways that approximate the descriptions below:
        - An introduction where the author explains the topic of the investigation and the research questions the author wants to answer;
        - The methods where the author describes how they conducted their investigation and collected their data;
        - The results section where the author makes claims that answer the research questions and gives evidence to support those claims;
        - The discussion where the author interprets the data collected and draws conclusions about how the data answers the research questions; and
        - A conclusion where the author makes a final statement about why the study is important and what the reader should learn from the report.
        - Many scientific reports also include an abstract at the very beginning of the report: the abstract is a short summary of the report.

2. We recommend co-constructing an anchor chart summarizing the learner’s observations of the genre and genre features of a scientific report.

NOTE: The model text used in this lesson is an example of adapted primary literature—scientific journal articles adapted for younger audiences. The inclusion of bold words and a glossary are features designed to support young readers. These features would not be found in the original journal article published for an audience of other scientists.

Science Inquiry Circles (30 minutes)

OVERVIEW

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

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.*
5. *If your team finishes answering your inquiry questions with time to spare, begin checking the information in your column of sources and note if any information is missing.*

During Inquiry Circles (20 minutes)

1. *You should make sure your Inquiry Chart is complete. Have all questions been answered? Do you need more information? Have you recorded all of your resources on the Inquiry Chart?* (While teams are working together, walk around the room to facilitate as needed and to monitor progress.)
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 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

Teams compare and contrast the modified Winogradsky columns.

GUIDING QUESTIONS

What is happening in our bottles? What is causing these changes?

BACKGROUND INFORMATION FOR THE TEACHER

By this point in the unit, change has occurred in the bottles the teams have been observing. There may be color change and layering. Species of microorganisms may vary, depending on the source of the water you used.

It is time to reveal the contents of the bottles and how the microorganisms present support each other. Understanding this dynamic process will help learners build new knowledge about the role of microorganisms in decomposition and apply what they know as they consider different ways to address the issue of 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:

- team's modified Winogradsky column
- "Sample Columns Table" page
- 2–3 hand lenses
- access to Winogradsky column video

Teacher needs:

- Winogradsky column video
- "Sample Columns Table" page
- hand lenses

SETUP

- Prepare to project the video.
- Make copies of the "Sample Columns Table" page (1 per team).

PROCEDURE

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

Engage

1. Have the Equipment Directors bring the team's bottle to their work area.
2. Announce that teams will learn more about their bottles today. *Have you observed any changes? If so, can you describe them? What does that make you wonder?*

Explore

1. Introduce the video by sharing that Sergei Winogradsky was a Russian microbiologist in the 1880s. A microbiologist is a scientist who studies microorganisms such as bacteria, fungi, and algae. They study the interactions between them, their growth, and unique characteristics of each.
2. As you begin the video, tell the learners they will be discussing what they see within their teams after the video. Play the video.
3. After the video, ask the Lead Scientists to begin a discussion with their team about what the team has observed and learned. After 3–5 minutes, ask the Data Scientists to report on their team's discussion.
4. Hand out the "Sample Columns Table" page and instruct the teams to open their Investigation Journals to Day 7.
5. Find the Venn diagram page and ask them to compare and contrast their own modified Winogradsky column (bottles) to the information on the "Sample Columns Table" page.

6. Ask them to consider things such as the number of layers, colors, or any behaviors or other physical qualities they observe.
7. Remind them to work as a team. Allow 5–8 minutes for completion.

Explain

1. Ask the Data Scientists to report on what their team came up with on their Venn diagram. (Expect different responses on size, colors, or amount of mud or water, etc. Sameness might include water, layers and colors.) After their reports, make clear that their bottles are a modified version of a Winogradsky column and are being used to provide evidence that microorganisms are living in the column and are involved in the cycling of matter and the transfer of energy.
2. Explain that the microorganisms in their bottles come from a sample of pond water and soil sediments. The different layers and colors that form are made up of different kinds of bacteria and other microorganisms.
   Although the bottles may have fewer layers, it offers proof that microorganisms are living and reproducing. To live and grow, they need specific nutrients available.
3. Soil microorganisms play an important role in recycling oxygen, carbon, and sulfur and other nutrients. Explain that when the bottles were made, shredded newspaper was added, which provided a source of organic matter (plant cellulose) containing stored energy. An egg yolk was also added to provide additional nutrients (sulfur) for the microorganisms living in the column.
4. The bacteria and other microorganisms consume these materials to gain energy and nutrients to carry out their life functions, and they also release waste products into their environment. This waste can be solid, liquid, or even gas, which we can see in the bottles as bubbles. Bubbles in the upper layer show that oxygen is being produced, and bubbles in the lower layers show the activity of anaerobic bacteria breaking down matter and producing gases, such as carbon dioxide and methane.
5. Tell learners that the Winogradsky column and their bottles model how an ecosystem can support a variety of microorganisms, and the role that decomposers such as bacteria can play in keeping these microenvironments productive.
6. *What do you think would happen to the microorganisms and their environment if we shook the bottles?* Accept all responses and listen for their ideas on how it may affect the layering, the oxygen, and the microorganisms.

Elaborate

1. Refer back to the “Sample Columns Table” page. *Can someone explain what the arrow on the right is telling us?* Accept responses. (We are looking at all of the information from top to bottom.)
2. *What does the list of colors tell us?* Accept responses. Clarify that this represents the general order of where the different types of bacteria and other microorganisms live and grow in the column or bottle. However, it is not a “neat” layering of colors.
3. Refer to the images shown on the “Sample Columns Table” page. *As you can see, the colors show up differently in a column. What colors do you see in your bottles? Where are they positioned?* Accept responses. Share that the microorganisms listed on the “Sample Columns Table” page are examples of some of the bacteria that may be present.
4. *In the following days, we will explore how we can use the important role of decomposers, such as bacteria, to tackle some real-life problems, like that of food waste.*

Evaluate

1. Think, pair, share: describe to a partner how a variety of organisms in your bottle can interact with each other and their environment. (They can provide the essential nutrients, energy, and gases needed by other microorganisms to live within their own niche in the microenvironment.)
2. As learners share, listen to their ideas. Are they communicating an understanding of what is happening in the bottles?

Science Language

- **Bacteria** are organisms so small they can only be seen through a microscope. Some are decomposers that break down dead organisms. **Aerobic bacteria** need oxygen to live. **Anaerobic bacteria** do not.
- A **Winogradsky column** is a column of mud and water with added nutrients used to produce a diversity of microorganisms.
- **Sergei Winogradsky** was a microbiologist in the 1880s known for inventing the Winogradsky column to study sediment microbes.
- A **microbiologist** is a scientist who studies microorganisms such as bacteria, fungi, and algae and their processes.

Expanded Standards

English Language Arts and Reading TEKS

5.9 The student recognizes and analyzes genre-specific characteristics, structures, and purposes within and across increasingly complex traditional, contemporary, classical, and diverse texts.

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; **LS1.C** Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion **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. **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(E**)investigate 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; **(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.