ALL for Science™
Authentic Literacy and Language for Science

Baylor College of Medicine
CENTER FOR EDUCATIONAL OUTREACH

DAY 7: WHAT ARE VASCULAR PLANTS?

MINI-LESSON

Teacher introduces the "Main Idea" anchor chart and models the strategy using an informational website about cacti.

SCIENCE INQUIRY CIRCLES

Teams review their Inquiry Charts to determine if questions still need to be answered or expanded on.

GUIDED SCIENCE INVESTIGATIONS

Teams examine a live fern specimen and record their observations in their am "Plant Observation" booklet.

ABBREVIATED STANDARDS

- Reading TEKS: 4.6.C, 4.6.F, 4.6.G, 4.9.D(i)
- CCSS: RI.4.2, SL.4.2
- NGSS: 4-ESS2-1, 4-LS1-1
- Science TEKS: 2018–19: 4.2B, 4.10A; 2024–25: 4.1E, 4.13A

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Day 7: What Are Vascular Plants?

Literacy Strategy: Extracting the main idea by drawing conclusions.

Science Concept: Over long periods of time, plant populations developed a vascular system made up of tube-like tissues that moved water and nutrients throughout the plant.

Science and Literacy Connection: Science consists of asking questions and conducting investigations to find answers, then drawing conclusions from the information found.

Mini-Lesson (15 minutes)

OVERVIEW

Scientists draw conclusions every day. When conducting an investigation, scientists look at the data, think about what they already know, and read text to collect new information. Sometimes, scientists must decide what is most important in what they are reading because the main idea is not explicit. In this way, scientists draw conclusions about the information they have read. When we do this, we are determining the main idea to draw conclusions about what the author wants us to know.

NOTE: You are encouraged to create the "Main Idea" anchor chart with your learners as you move through the lesson, using the provided anchor chart as a model. Post it for easy reference when completed and remind learners to refer to the anchor charts during inquiry circles.

MATERIALS

Teacher needs:

- chart paper
- marker(s)
- "Main Idea" anchor chart as a model
- informational text about cacti to model the strategy (suggested resource: https://www.dkfindout.com/us/animals-and-nature/plants/saguaro-cactus/)

PROCEDURE

Each *italicized statement* below contains suggested wording the teacher may choose to use for the lesson; additional teacher actions and considerations are in parentheses.

Tell what the strategy is (declarative knowledge)

1. *Today, as we read, we will practice drawing conclusions to determine the main idea of a section about plants. The main idea is the most important thing the author wants us to know about their*

topic. Getting the main idea is sometimes called "getting the gist" of a piece. Remember that the author doesn't always tell us what the main idea is, which means we have to "read between the lines." When we read between the lines, we are trying to draw conclusions about something that isn't specifically written or said. This is an important step in figuring out the author's main idea.

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

1. *Sometimes authors tell us the main idea. Usually, they do that in the first or last sentence of a section. But they don't always do that. Authors can't possibly give me all the information I need to know while I am reading. The text would be too long! Sometimes, they leave out the main idea and make us (as readers) work to extract it. As a strategic reader, I have to 'read between the lines' or draw a conclusion. As a strategic reader, I will do this after each paragraph or section in the text I am reading. I do this because it makes my reading clear and helps me remember what I read.*

Tell how to use the strategy (procedural knowledge)

1. *The first thing I need to do is think about the topic (my plant) and what I already know about the topic (my plant).*
2. *Now, I will draw a conclusion about what the author wants me to know about the topic (my plant). When I draw a conclusion,*
    - *the first thing I will do is pay attention to the details the author gives me in the text;*
    - *next, I will think about the author's intentions (what the author wants me to know);*
    - *then, I will combine what I already know, the details from the text, and the author's intentions to draw a conclusion."*
3. *Now, I have to put all these things together to get the main idea. I will think, "What would the author tell me was the most important idea from the reading if he or she were standing here next to me?"*
4. *I will put the main idea into my own words and record it on my Inquiry Chart.*

Model the strategy

1. *One of my inquiry questions is, What features of a cactus allow it to survive and thrive in its habitat?* I can learn more about the features of a cactus on this website: https://www.dkfindout.com/us/animals-and-nature/plants/saguaro-cactus/
2. *Let's practice using our new strategy. On this website, the author writes, "The Saguaro, like all desert cacti, stores water in its stem and is covered with spines." I think one of the conclusions the author wants me to draw from this statement is that there are many different types of cacti, including the Saguaro cactus, but all cacti have stems that store water and are covered with spines. I know this because the author says, "The Saguaro, like all desert cacti," which makes me think there are different kinds of cacti that all have something in common. Then the author says that the Saguaro "stores water in its stem and is covered with spines." This makes me think that, if the Saguaro is "like all other desert cacti," I can conclude that all desert cacti have stems that store water and are covered with spines.*
3. *Next, the author writes, "The thin sharp spines lose less water than ordinary leaves." I think about what I already know about cacti from my research: cacti live in hot, dry places like deserts. Then I think about the author saying that cacti "have stems that store water." I know that cacti need water to live, but hot, dry places like deserts do not have very much water. I think that having spines that lose less water and stems that store water would be helpful for a cactus.*

4. *In put this into my own words: I think the main idea of this text is that cacti have spines and stems that store water because these features help cacti survive in hot, dry places like deserts. I can write this on my Inquiry Chart.*
5. (You might also want to model adding information in your own words to the class Inquiry Chart.)

Science Inquiry Circles (30 minutes)

OVERVIEW

Work continues on team Inquiry Charts as learners add additional information from a different resource, such as a book, website, or eBook.

MATERIALS

Each team needs:

- team Inquiry Chart
- pencils
- access to informational texts/media

Teacher needs:

- "Plant Resources" spreadsheet for ideas

PROCEDURE

Each *italicized statement* below contains suggested wording the teacher may choose to use for the lesson; additional teacher actions and considerations are in parentheses.

Before Inquiry Circles

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. *You have answered most (or all) of your Inquiry Chart questions. Review your Inquiry Chart to determine if you have questions that still need to be answered or if you have a question that needs more information from a different book, website, or an eBook.*
3. *We will start on our synthesis statements soon, so we need to be sure to complete the Inquiry Chart today.*

During Inquiry Circles (20 minutes)

1. *You should make sure that 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?*
2. *Remember, you have anchor charts to help guide your thinking. Don't forget to use them while in teams.* (Refer to all the mini-lesson anchor charts used to date, which should be posted in the classroom where learners can easily refer to them.)
3. *The Lead Scientist will guide all inquiries for the day by picking which question(s) will be answered. The Data Scientist will record all source information and the answers to your inquiry questions on the Inquiry Chart.*
4. *Remember, it is important to record where you found the information (source) on the Inquiry Chart so that you do not plagiarize.* (Remind your learners to record the title and author for texts and the title and URL for websites or videos.)

5. (At this point, teams might have information under multiple questions and from multiple sources. You many 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.)
6. *Everyone should help find the answers to the questions online and in texts.* (Remind learners how the Inquiry Chart will organize their progress.)
7. *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 (10 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 the team accomplished, and what literacy strategies the team used. The Lab Director will lead the discussion about today's results. What has the team learned about its plant? 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 Scientist share with the class. Try to encourage teams to share a variety of things—you do not want just facts about plants, just reading strategies, or just cooperative learning strategies.)
3. (After all teams have shared, thank them for their hard work, and point out any excellent behaviors that 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 make observations on a live specimen, a fern, and are introduced to representative vascular plants.

GUIDING QUESTIONS

How do the structures of vascular plants compare to those of bryophytes?

BACKGROUND INFORMATION FOR THE TEACHER

The fossil record provides evidence that approximately 440–354 million years ago, Earth's weather became stable again. Glaciers had melted and raised ocean levels, creating warm, shallow seas. New land was formed.

The move from primarily aquatic environments to land required that plants develop structures (a vascular system) to transport water, minerals, and nutrients throughout the plant. Early vascular plants grew taller than the bryophytes to capture sunlight but were still small in size. Fossils of *Cooksonia pertoni* show that the earliest plants had simple structures and were very tiny in size. However, by the end of this time period, giant ferns, horsetails, and club mosses produced the first forests. The first true ferns appeared about 360 million years ago.

MATERIALS

Each team member needs:

- science notebook
- pencil
- goggles
- gloves

Each team needs:

- 1 bag containing paper copies of the Day 7 Plant Images (or electronic access to the images)
- 1 bag containing hand lenses, goggles, gloves, rulers or measuring tapes, and a copy of the "Leaf Morphology" chart
- the team "Plant Observations" booklet
- 1 live specimen (fern)

Teacher needs:

- Day 7 Plant Images PPT
- "Vascular Plant" image
- gallon ziplock bags
- live fern

SETUP

- **Before class**, make color copies of the Day 7 Plant Images (or allow electronic access). If using paper copies, cut out **one set of images for each team** and place in a ziplock bag labeled "Day 7 Plant Images."
- Place the live specimens, the bag of plant images, the bags of materials (with hand lenses, ruler or measuring tape, and "Leaf Morphology" chart), and the team "Plant Observations" booklets in a designated area for distribution.
- Be prepared to project or show the image of the vascular plant.
- **Important: Do not identify the plants as representatives of vascular plants until after the children have completed their observations.**

SAFETY

- Instruct children not to tear off or cut any part of the plants. They may gently lift leaves for inspection if needed.
- Children should wear safety goggles and gloves during plant observations.
- Children should avoid touching their faces while handling the plants and should wash their hands after their work.

DAILY OBSERVATIONS

Learners conduct daily observations of a live plant specimen and different plant images.

PROCEDURE

Engage

1. Announce that it's time for another live specimen observation. Hold up a live fern and say, *This is the live specimen for today.*
2. Explain that teams will conduct their investigations on this new plant in the same way they did in the previous class using the live specimen and a set of plant images.

3. Remind teams that they are looking for an answer to the question they are investigating, and the information they record in their "Plant Observations" booklets may help them find an answer.
4. Add that they have an expert on their team who is investigating this plant and can provide information from the work in inquiry circles.
5. Instruct them to use the back of today's page or their science notebook to record any additional information that does not fit into the "Plant Observations" booklets but is important to remember (e.g., information they learn from discussions with the teacher or each other, or additional questions to investigate during inquiry circles).

Explore

1. When ready, the Equipment Directors should collect the team "Plant Observations" booklet, 1 live specimen, 1 bag of plant images, and 1 bag of materials for their team.
2. As before, the team Data Scientists should record information from the observations in the "Plant Observations" booklet.
3. Let teams know that they have 20 minutes for their investigations. Remind them to work as a team, with each team member doing a part of the work. They can decide as a team who does what.
4. As teams work, navigate between them to offer guidance and ask open-ended questions, such as, *Are you finding the information you need? What do you notice about these plants compared to the plants you observed yesterday?*
5. Ask teams to prepare a 6-word summary of the most important information they discovered to share after the observations.

Explain

1. When time is up, ask the Data Scientist from each team to share the 6-word summary about what was discovered during the team's exploration. (Learners may identify the live plant as a fern.)
2. If not discussed, ask, *How was this live plant different from plants in the images? How were they the same? How do they compare with the plants you examined yesterday?* **Accept all responses, but do not correct them or give them any additional information.** (On Day 10, a review and descriptions of all the plant structures by groups will be discussed.)
3. Confirm that the plants they explored today are **ferns** that belong to a group of plants called **vascular plants**. Add that when Earth's environment changed and plants no longer lived only in water, they had to have a way to stay alive on land. Over millions of years, plants developed a system of tubelike structures for moving water and food throughout the plant. This is called a vascular system. **Project the "Vascular Plant" image and explain how the tubelike structures move water, nutrients, and food throughout the plant.**
4. Share that the earliest plants related to bryophytes did not have a vascular system. Explain that since they lived in or near water, the nonvascular earliest plants were able to absorb water and nutrients that flowed over the outside of the plant.
5. Inform teams that that ferns, horsetails, and club mosses are relatives of the earliest vascular plants on Earth. Horsetails first appear in the fossil record about 400 million years ago and the **first true ferns appeared around 360 million years ago.**
6. Add that the fossil record provides evidence that **the climate during this time period warmed up** again after the previous ice age on Earth. **Melting ice raised sea levels and created new habitats for organisms in or on land near shallow seas.** Remind learners that all of these

environmental changes occurred over millions of years. Some plants had adaptations that allowed them to survive in these new environments.

7. Allow time for them to make notes about plant groups and their environments in the appropriate places in their "Plant Observations" booklet. Any other information should be written on the back of the page or in their science notebooks for consideration as they work in inquiry circles.

Elaborate

1. Invite the "experts" on ferns to share any other information they have discovered in their inquiry circles.
2. If children ask if club mosses are related to the type of moss they explored in the previous class, explain that club mosses are more closely related to ferns. Club mosses have a vascular system, while true mosses do not.
3. Remind teams to use inquiry circle time to look for answers to any new questions that came up during the investigation.
4. Instruct the Lab Directors to collect and store all of the materials used today.

Evaluate

1. Is there verbal or written evidence that learners notice the changes occurring in plants?
2. Are learners using evidence to back up their statements, or claims?
3. Was any information from the science inquiry circle work included in their communications?
4. Are learners correctly using science language in their communications, either written or verbal?

Science Language

- **Plant adaptations** made some species of plants better suited to living in a particular habitat or environment.
- A **specimen** is an organism or part of an organism used in scientific investigations.
- **Evidence** is data collected during an investigation to support (back up) explanations and answers.
- **Data** are facts and information (such as images, words, and measurements) collected during an investigation.
- A **vascular** plant has a special system of tissues that move water and food throughout the plant. Ferns, horsetails, and club mosses are examples of vascular plants.

Expanded Standards

Reading TEKS

4.6C: Make and correct or confirm predictions using text features, characteristics of genre, and structures. **4.6F:** Make inferences and use evidence to support understanding. **4.6G:** Evaluate details read to determine key ideas. **4.9D(i):** [Recognize] the central idea with supporting evidence.

CCSS

RI.4.2: Determine the main idea of a text and explain how it is supported by key details; summarize the text. **SL.4.2:** Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally.

NGSS

4-ESS2-1: Make observations and/or measurements to produce data to serve as the basis for evidence for an explanation of a phenomenon. **4-LS1-1:** Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

Science TEKS

2018–19: 4.2B: Collect and record data by observing and measuring, using the metric system, and using descriptive words and numerals such as labeled drawings, writing, and concept maps. **4.10A**: Explore how structures and functions enable organisms to survive in their environment.

2024–25: 4.1E: Collect observations and measurements as evidence. **4.13A:** Explore and explain how structures and functions of plants such as waxy leaves and deep roots enable them to survive in their environment.