ALL for Science™
Authentic Literacy and Language for Science

Baylor College of Medicine
CENTER FOR EDUCATIONAL OUTREACH

DAY 8: WHAT ARE GYMNOSPERMS?

MINI-LESSON

Teacher introduces the "Synthesizing" anchor chart and models writing a synthesis statement using evidence from multiple sources.

SCIENCE INQUIRY CIRCLES

Teams work together to create a synthesis statement that combines the important information from one column on their Inquiry Chart.

GUIDED SCIENCE INVESTIGATIONS

Teams examine pine cones and pine needles and record their observations in their "Plant Observations" booklet.

ABBREVIATED STANDARDS

- Reading TEKS: 4.6.H
- CCSS: RI.4.9
- 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 8: What Are Gymnosperms?

Literacy Strategy: Synthesizing information.

Science Concept: Environmental changes over time created or destroyed habitats, requiring organisms to develop structures to improve their chances for survival. Gymnosperms produced pollen and seeds that allowed them to colonize new environments.

Science and Literacy Connection: Scientists synthesize what they already know about a topic with new information that comes from observations and investigations.

Mini-Lesson (15 minutes)

OVERVIEW

Scientists put together new information about the world every day. Before they conduct their own investigations, scientists read a lot of texts written by other scientists and "synthesize" what they read with what they already know, putting that information together in a new way. "Synthesis" means making something new by putting things together.

In this unit, two days are dedicated to synthesis:

- On the first day, you might want to start by modeling how to write a whole-class synthesis statement about all plants, then support inquiry circle teams in creating a synthesis statement for one of their Inquiry Chart questions.
- On the second day, teams can create a synthesis statement for each remaining inquiry question by combining (synthesizing) the findings in **each column** of their Inquiry Chart.

Both synthesizing and the main idea are about getting to the "gist" of the information, but they are different. We think about the main idea when we read a text and want to know what the author wants us to take away from that text. When we synthesize, we look at the information we have gathered from multiple texts and combine (or synthesize) the information into a few concise sentences that answer our inquiry questions.

NOTE: You are encouraged to create the "Synthesizing" 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)
- "Synthesizing" anchor chart as a model
- informational texts to model with (see "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.

Tell what the strategy is (declarative knowledge)

1. *Today we will practice synthesizing our evidence from multiple sources. We will combine information from all of our sources and create our own, new information. This is different from re-stating what other scientists have written. When I write a synthesis statement, I combine my evidence from multiple sources with my own knowledge and state the information in a new way.*

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

1. *I write synthesis statements because other scientists expect me to show that I have read scientific writing about my topic, but they also expect me to write in my own words. I also synthesize because it helps me construct a deeper and broader meaning about my topic across all of my resources. As a strategic reader and writer, I synthesize to make sense of lots of information. I write a synthesis statement when I find information from different books, online resources, experts, and videos.*

Tell how to use the strategy (procedural knowledge)

1. *The first thing I will do is look at my Inquiry Chart and think about what was important from each source. I'll do that as I consider each of my inquiry questions.*
2. *Then I will compare and contrast the important information from each of the sources.*
3. *Next, I check that all of my information fits together in a way that makes sense. If the information across sources is similar, I often do not need to do anything. If my sources contradict or disagree with each other, I need to stop and try to evaluate the claims or statements the authors are making.*
4. *Now, I need to think about what I know about this important information and if I can add something from my own knowledge that the authors did not mention directly. I will be careful to include only my knowledge that is factual and that matches what I have read in the writing of other scientists. I will not include opinions or information that I have heard someone in my life say. If what I know is in agreement with what other scientists are saying, I can include it in my synthesis statement.*
5. *Finally, I write a synthesis statement that combines evidence from my sources and my own factual knowledge.*

You might present the following as a model synthesis statement as part of this mini-lesson:

1. (Explain that their synthesis statements will focus on the plant or type of plant that they have been learning about and should include information related to the concepts the unit has focused on):
2. *One of my questions was: What features of a cactus allow it to survive and thrive in its habitat? I found that*

- *cacti live in hot, dry places like deserts.*
- *cacti have stems that store water that can be used when it does not rain for a long time.*
- *cacti are covered with spines.*
- *spines lose less water than the leaves on other plants.*
- *cacti have roots that spread out across the ground, close to the surface.*
- *when it rains, spread-out roots can take up water quickly.*

3. *To answer my question, I need to include two things in my synthesis statement: what kind of environment cacti live in, and how their features help them survive in that environment.*
4. *My synthesis statement might be, "Cacti can survive in hot, dry places where it does not rain for long periods of time. This is because they have roots that take up water quickly, stems that store water, and spines that keep water inside the plant."*

Science Inquiry Circles (30 minutes)

OVERVIEW

Today teams will select one question from their Inquiry Chart to write a synthesis statement that combines all the information they have for that one question from multiple resources.

MATERIALS

Each team member needs:

- science notebook
- pencil

Each team needs:

- team Inquiry Chart
- 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 circle teams. You will be with the same inquiry team as yesterday.*
2. *We have answered all (or most) of our Inquiry Chart questions. Today we will start on our synthesis statements so we need to be sure we have completed the Inquiry Chart.* (Make adjustments for teams that have not yet completed their inquiry charts.)
3. *Now, inquiry teams will work together on their synthesis statements.*

During Inquiry Circles (20 minutes)

1. *Today your team will work on creating a synthesis statement for one of your inquiry questions. Your team should agree on which inquiry question to focus on today. Once you have selected the question, look at all the information in the column under your chosen question. You*

probably have information from multiple sources as well as some information from your own knowledge.

2. *Work together as a team to write a synthesis statement in your science notebooks that combines all the important information from one column in your Inquiry Chart that answers the inquiry question for that column.*
3. (Remind learners they can use the "Synthesizing" anchor chart to help them, as well as any other anchor charts they have used.)
4. *My role is to help guide the inquiry circles, but I expect you to work as a team to solve your problems together.* (While teams are working together, walk around the room to facilitate as needed.)

After Inquiry Circles (10 minutes)

1. *As we conclude our inquiry circles for today, the Data Scientist from each team will have a chance to share the synthesis statement the team created (or the question they answered,) as well as what they accomplished and what reading strategies they used. The Lab Director will lead the discussion about today's results. What did the team learn about synthesizing? Which reading strategy did team members use, and how did it help? What other problems did the team encounter? How did the team resolve those problems?* (After you have allowed the teams to gather their thoughts, have the Data Scientist share with the class.)
2. *The Data Scientist will now share with the entire class either their synthesis statement, something the team learned about their plant group, a reading strategy, or how the team solved a problem.* (**Encourage teams to share how they developed their synthesis statements.** If you saw a great example in action, encourage that team to share with the entire class.)

Guided Science Investigation (30–45 minutes)

OVERVIEW

Learners examine pine cones, pine needles, and images of other representative gymnosperm plants.

GUIDING QUESTIONS

What are gymnosperms? How do their plant structures compare to those of plants observed in the previous days?

BACKGROUND INFORMATION FOR THE TEACHER

Documenting the early forms of seed plants is difficult. The fossil record shows that gymnosperms with "naked" (or unenclosed) seeds were the earliest true seed plants, appearing about 390 million years ago in the fossil record. Seeds were produced within cones and typically were spread by wind. Seeds and the production of pollen allowed gymnosperms to spread and colonize new environments. Sturdy wooden stems (trunks) and roots allowed these plants to grow taller into shrubs or trees and to live for many years.

Gymnosperms do not produce flowers or fruit. Examples of gymnosperms include cycads, conifers, gingkos, and gnetophytes. Conifers make up the largest group of gymnosperms. Conifers produce cones to produce pollen and grow their seeds. Many conifers have long, thin, needlelike or scalelike leaves. Conifers include the magnificent giant Sequoias, which hold the world's record for the tallest, oldest, widest, and largest trees! Conifers are present in all continents except Antarctica.

The fossil record covered in this lesson spans a time period of about 200 million years and marks significant changes in environments and organisms. There are many different types of animal organisms on the land, in the seas, and in the air.

The action of glaciers at the South Pole during this time period resulted in periods of fluctuation between land flooding and then drying up. Later, the climate that began warm and wet became increasingly more tropical with global temperatures dramatically increasing. Evaporating seas made coastal areas hot and humid, while land away from the coast is dry. In spite of a mass extinction caused by global temperatures evaporating oceans in the middle of this time period, life continued. Conifers emerged as vegetation best adapted to these dramatic climatic changes.

In discussions, it is important to reiterate that we know environmental changes occurred because we have evidence in the form of the fossil records.

MATERIALS

Each team member needs:

- science notebook
- pencil
- goggles
- gloves

Each team needs:

- 1 bag containing pine cones and pine needles
- 1 bag containing paper copies of the Day 8 plant images, or electronic access to them
- 1 bag containing hand lenses, goggles, gloves, rulers or measuring tapes, and a copy of the "Leaf Morphology" chart
- team "Plant Observations" booklet

Teacher needs:

- Day 8 Plant Images PPT
- gallon ziplock bags
- assortment of pine cones and pine needles

SETUP

- **Before the class**, the teacher will collect enough female pine cones and pine needles to prepare a bag of samples of both for each team. (Female pine cones are the larger, open cones you would likely pick for decorating with).
- **Before class**, make color copies of the Day 8 Plant Images (or allow electronic access). If using paper copies, cut out **one set of images for each team** and place in a zip-top bag labeled "Day 8 Plant Images."
- Place the team "Plant Observations" booklets, pine cone/needles sample bags, plant image bags, and material bags (containing hand lenses, ruler or measuring tape, and the "Leaf Morphology" chart) in a designated area for distribution.
- **Important: Do NOT identify the specimens as representatives of "gymnosperms" 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. Hold up a bag of pine cones to get the attention of the class. Ask, *What plant did these come from? (*Accept responses, which should include "a tree" or "a pine tree"). *Why didn't I bring the tree to class?* (Too big!)
2. Explain that they will conduct their investigation on these samples in the same way they did in the previous class with the live fern and other plant images. Because of the size of these plants, they will use these parts of a representative plant (tree) to investigate, along with plant images.
3. Remind them that they are looking for an answer to the question they are investigating, and the information they record on the team "Plant Observations" booklet may help them find an answer. They also have an "expert" on their team who is investigating this plant and can provide information from the work in inquiry circles.
4. Instruct them to make notes on the back of the page or in their science notebook on any additional information that does not fit into the "Plant Observations" booklet 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, each Equipment Director should collect the team "Plant Observations" booklet, 1 bag of pine cones/needles, 1 bag of plant images and 1 bag of materials for their team.
2. As before, the Data Scientist should record the information from their observations on the "Plant Observations" booklet.
3. Let them know that they have 20 minutes for their investigation. Remind them to work as a team, with each one doing a part of the work. They can decide as a team who does what.
4. As teams work, navigate between them offering guidance as needed and asking 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 their 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 their exploration.
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 in the previous days?* Accept and discuss all responses. **Accept all responses, but do not correct them nor give them any additional information.** On Day 10, a review and descriptions of all the plant structures by groups will be discussed.

3. Share that the pine cones and pine needles they explored today represent **conifers**, and are from the **group of plants called gymnosperms**. Gymnosperms also have a vascular system, which is important for moving water and nutrients in these large plants.
4. Add that **gymnosperms first appear in the fossil record about 390 million years ago** at a time when Earth's weather was warm and humid; it rained a lot. However, for millions of years, the action of glaciers caused the Earth to go through many changes, going between times of drying up and times of flooding. More importantly, later in this time period the temperature on Earth became very hot, causing oceans to evaporate and leading to the extinction of many species. **Remind them that all of these changes occurred over millions of years!**
5. Add that **many plants appear in the fossil record during this time period**, and there is evidence that different species of animals lived on land, the oceans, and in the air. Conifers were a species of plants that adapted well to the environmental changes caused by the climate.
6. 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 in their science notebooks and considered as they work in inquiry circles.

Elaborate

1. Ask the "experts" on conifers to share any other information they have found in their inquiry circles.
2. Remind them to look for answers during inquiry circle time for any new questions that came up during the investigation.
3. Instruct the Lab Directors to collect and store all of the materials used today.
4. **Optional:** The teacher may choose to show the following 5-minute video about gymnosperms. https://vimeo.com/421075272

Evaluate

1. In their communications (verbal or written) is there evidence learners are making sense of how plants are changing over time?
2. Are learners using evidence to back up their statements?
3. Was any information from the science inquiry circle work included?

Science Language

- **Plant adaptations** made some species of plants better suited to living in a particular habitat or environment.
- **Gymnosperms** include cycads, conifers, gingkos, and gnetophytes. Conifers make up the largest group of gymnosperms.
- 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.
- **Species** refers to a group of organisms that share similar characteristics.
- An **extinct** species has no living members of its group in existence.

Expanded Standards

Reading TEKS

4.6H: Synthesize information to create new understanding.

CCSS

RI.4.9: Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably.

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.