ALL for Science™
Authentic Literacy and Language for Science

Baylor College of Medicine
CENTER FOR EDUCATIONAL OUTREACH

DAY 6: WHAT WERE THE FIRST LAND PLANTS?

MINI-LESSON

Teacher uses today's mini-lesson to review and practice evaluating claims and making connections across informational texts.

SCIENCE INQUIRY CIRCLES

Teams use a different resource to answer another inquiry question or add information to a question already answered.

GUIDED SCIENCE INVESTIGATIONS

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

ABBREVIATED STANDARDS

- Reading TEKS: 4.6.E, 4.9.E (i)(iii)
- CCSS: RI 4.8, RI.4.9, W.4.7, W.4.8
- 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 6: What Were the First Land Plants?

Literacy Strategy: Practice evaluating claims and making connections.

Science Concept: Scientists know that collecting information through observations and measurements may provide the evidence they need for answering questions. Investigating bryophytes, the closest living relatives of the first land plants, gives us information about what the earliest plants may have been like.

Science and Literacy Connection: Scientists make connections between what is already known and new information that is collected through observations and investigations.

Mini-Lesson (15 minutes)

OVERVIEW

Today's mini-lesson should be used as a time to review and practice the reading strategies introduced over the past two days: evaluating claims and making connections across informational texts. Teachers are encouraged to use this time to best meet the needs of their learners.

Teachers can determine if the mini-lessons will be facilitated with the whole class or a particular inquiry circle needing additional support. If you are working with a specific team, we suggest your other learners spend additional time working in inquiry circles. You may want to return to the information in the mini-lessons from Days 4 and 5 with some or all of your teams.

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 already answered many of your Inquiry Chart questions. Use your Inquiry Chart to determine what questions still need to be answered.*
3. *As you look for answers to your questions, you will practice your roles as scientists. As scientists, you will make sure to record your findings and your sources carefully on your Inquiry Chart.*

During Inquiry Circles (20 minutes)

1. *Today you will use a different book, website, or eBook to find answers to the question you're investigating about your plant group or add information to a question you've already answered.* (You might choose to show or project the sample Inquiry Chart as a guide.)
2. *Remember, you have anchor charts to help guide your thinking. Do not 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 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.)
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 scientific 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 group? 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?* (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.)
2. (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 begin their investigation into plant structures with their first observations. **The teacher can expect to spend a little more time today laying the groundwork in preparation for the four days of observations.**

GUIDING QUESTIONS

What do I want to know about plant structures? What information do I need to answer my question? What structures are present on my live plant? How is it similar to or different from the plants in the photographs?

BACKGROUND INFORMATION FOR THE TEACHER

By studying the fossil record, scientists believe plants first appeared on land about 500–450 million years ago. The fossil record of plants is not as abundant as that of animals because plants decompose quickly. But spores, seeds, stems, leaves, roots, and other plant parts that are covered by sediments before they decompose can form fossils such as imprints or petrification (like petrified wood). Trace amounts of carbon or plant tissue in rocks and in animal waste can also give scientists evidence of plant life.

Bryophytes, which include nonvascular plants such as liverworts, hornworts, and moss, first appear in the fossil record about 500–470 million years ago. These nonvascular plants do not have a water-transport system or well-developed stems and roots. Bryophytes can absorb water and nutrients from water that flows over the outside of the plant. For this reason, mosses and their relatives typically grow in damp habitats. However, some bryophytes can also survive in deserts and even in the extremely low temperatures of the Arctic tundra.

The climate on Earth at the beginning of this fossil time period (which spans over a 100 million years) was warming up after ice sheets had covered the Earth for millions of years. The fossil record shows new organisms appearing in the seas. By the end of this time period, the climate becomes colder and glaciers form again, causing sea levels to drop and some shallow seas to dry up. Some of the earliest land plants had adaptations that allowed them to survive when they were no longer surrounded by water. However, many species died off due to several extinction events caused by environmental change.

NOTE: As children move through their investigations on different plant groups, it is important for them to make their own discoveries and explanations about what they observe. The teacher can provide limited information as described in the lessons. After the children complete all their observations, they will analyze their data on Day 10 to make sense of how plant structures changed over time in response to a changing environment. At that point, the teacher can provide additional information to fill in the gaps or for clarification.

MATERIALS

Each team member needs:

- science notebook
- pencil
- goggles
- gloves

Each team needs:

- 1 bag containing paper copies of Day 6 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
- 1 copy of the "Plant Observations" booklet
- live moss specimen

Teacher needs:

- Day 6 Plant Images
- gallon ziplock bags (2 for each team)
- copy of the "Plant Observations" booklet
- "Leaf Morphology" chart (copy or electronic access)
- hand lenses
- rulers or measuring tapes
- live moss specimen

SETUP

- Before class, if using paper images of the "Day 6 Plant Images" PowerPoint, make and cut out **one set of color copies for each team**, and place in a ziplock bag labeled "Day 6 Plant Images." If you plan to use digital images, plan how you will give learners access to them.
- For each team, prepare a second ziplock bag containing hand lenses, goggles, gloves, ruler or measuring tape, and a copy of the "Leaf Morphology" chart. This bag will be used daily during observations.
- Place live (moss) specimens, the bags of plant images, and the bags of materials (hand lenses, goggles, gloves, ruler or measuring tape, and a copy of the "Leaf Morphology" chart) in a designated area for distribution.
- Make copies of the "Plant Observation " booklets (1 per team). The teacher may want to assign (or allow learners to choose) a team name or number to designate the "Plant Observation" booklets.
- **Important: Do not identify the plants as being representatives of the first land plants or as bryophytes until after the children have completed their observations.**

SAFETY

- When making live plant observations, 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 the live specimen so all can see and announce, *Today you will use this live specimen to begin your science investigations on the structures of plants.*
2. Remind teams that, in the previous class, they developed a question they wanted to investigate about the structures of plants. Ask them to find that question in their science notebooks. If they have more than one question, they need to decide as a team which one they will investigate. Allow 3–4 minutes for them to agree on a question.
3. When ready, distribute one copy of the "Plant Observations" booklet to each team. Ask the Data Scientists to record the team name or number and the question they are investigating in the appropriate spaces. **Remind them that this same question will apply to all the plants they will make observations on.**
4. Explain that they will be using this booklet every day to record important information from their investigations. Tell them they will do 4 days of observations. Review the instructions on the cover of the booklet.
5. Remind learners that they have an expert from each plant group on their team.
6. Next, instruct the teams to open the booklet to the second page. Review the information they will need to record (drawing, labeling, answers to questions, etc.), and point out the information you will be providing them.
7. Let them know that information about the plant environments the fossil plants lived in and the name of the group of plants will be given **after** their daily observations. **Assure them that you will give them time to include this in their daily work.**
8. Remind the teams that they will begin their investigation by making observations on this first live plant specimen. (Hold up the moss again.)
9. If learners ask what the specimen is, let them know that you will reveal what the plant is and what plant group it comes from **after** their observations. If the "expert" on mosses identifies it as such, let him/her know you will validate after the observations.
10. Holding up the bag of photos (or projecting a digital sample), tell the teams that they will also examine these images to compare them to the live specimen. Add that the plant images show representatives from the same group of plants that the live specimen belongs to. Explain that the fossil images included are of real plants that lived millions of years ago and are related to the live plants they are investigating. Emphasize that teams should look for similarities and differences between all of the plants, including the fossil. Remind them that the morphology chart is a good tool to use.
11. Explain that scientists use what they learn from text information along with data collected through observations and measurements as evidence when trying to answer questions and make explanations.
12. Tell them they will need to work as a team to make careful observations and to provide all the data required in the "Plant Observations" booklet. **Remind them to use the science language they are learning in their writing.**
13. Suggest the option of having different team members working on different parts of the daily work (e.g., someone can do the illustrations, another can do the labeling or document the leaf morphology, others can work on answering the questions).
14. If teams need more space to write, they can use the back of the pages in their "Plant Observations" booklet or their science notebooks. This can include information they learn from discussions with the teacher or from each other, or additional questions to investigate during inquiry circle time.

15. Ask if there are any questions before proceeding. Remind them that they have an expert on their team who is investigating this plant and can provide information from the work in inquiry circles.

Explore

1. When ready, Equipment Directors should collect 1 live specimen, 1 bag of plant images (or electronic access), and 1 bag of materials for their team. Point out the tools they have available for use in their materials bag.
2. Review the safety rules for plant observations.
3. Let them know they have 20 minutes for their investigation. 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 the teams work, navigate between them to offer guidance or ask open-ended questions, such as, *What question is your team trying to answer? What do you notice about these plants or their structures? What things do they all have in common? How are they different?*

Explain

1. When time is up, ask the Data Scientist from each team to share the question their team is investigating and a brief explanation of what the team discovered today.
2. If not addressed, ask, *How was the live plant you observed different from plants in the images? How were they the same? What plant structures were present? What did you learn from the fossil image?* **Accept all responses, but do not correct them.** (On Day 10, a review and more information about all the plants groups will be discussed.)
3. Tell the class that the live specimen they examined today is a **moss** and belongs to the group of **plants** called **bryophytes**. Write **bryophytes** on the whiteboard and ask learners to write it in the correct space in their "Plant Observation" booklets. Explain that bryophytes are the closest living relatives to the first land plants found in the fossil record. Early bryophytes lived in aquatic environments; as water flowed over the surface of the bryophytes, they absorbed water and nutrients. Bryophytes include liverworts, hornworts, and the moss they examined today.
4. Share that the time period when **bryophytes appear in the fossil record was as early as 500 million years ago.** However, the plant fossil record for that time period is poor because plants had no rigid parts, were tiny in size, and had simple structures. Add that the fossil image in the bag is an example of a **compression fossil**, which means that the plant was flattened or deformed as a result of being buried in the rock. Because it was deformed, it is hard to identify it; however, scientists believe the fossil image was most likely a fossil liverwort.
5. Explain that the fossil record also provides evidence that, at the beginning of this time period, **the climate was warm and wet, providing a damp environment in or near water for plants to live.** Allow time for learners to add this information to their booklets.
6. Conclude by noting that millions of years later, the climate became much colder and massive glaciers form. With so much water frozen into glaciers, sea levels were much lower and some shallow seas dried up completely. **Some plants no longer surrounded by water adapted in ways that allowed them to survive.** Tell the children that they will learn more about this in the next class.

Elaborate

1. Pose the question, *Can the "experts" who are investigating moss during inquiry circle time share any other information about mosses?* Accept all responses.

2. Remind learners that they can use inquiry circle time to make notes about any new information that is shared and to look for answers 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.

Evaluate

1. Did learners communicate their written or verbal observations effectively?
2. Did they include any information from their work in inquiry circles?
3. 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.
- **Bryophytes** absorb water and nutrients through their leaves. They include liverworts, hornworts, and moss.
- 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.
- In **compression fossils**, the plant is physically compressed, or flattened, but some plant matter remains.
- **Climate** refers to the average weather in an area over a long period of time.
- **Glaciers** are large, thick masses of ice that form on land when snow gets compressed into ice over hundreds of years.

Expanded Standards

Reading TEKS

4.6E: Make connections to personal experiences, ideas in other texts, and society. **4.9E:** Recognize characteristics and structures of argumentative text, including **(i)** identifying the claim and **(iii)** identifying the intended audience or reader.

CCSS

RI.4.8: Explain how an author uses reasons and evidence to support particular points in a text. **RI.4.9:** Integrate information from two texts on the same topic in order to write or speak about the subject knowledgeably. **W.4.7:** Conduct short research projects that build knowledge through investigation of different aspects of a topic. **W.4.8:** Recall relevant information from experiences or gather relevant information from print and digital sources; take notes and categorize information, and provide a list of sources.

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.