ALL for Science™
Authentic Literacy and Language for Science

Baylor College of Medicine
CENTER FOR EDUCATIONAL OUTREACH

DAY 10: PUTTING THE PIECES TOGETHER!

MINI-LESSON

Teacher introduces the "Making Evidence-Based Claims" anchor chart and models the strategy for the class.

SCIENCE INQUIRY CIRCLES

Teams make a claim about one of their synthesis statements and support the claim with evidence.

GUIDED SCIENCE INVESTIGATIONS

Teacher guides teams in reviewing and combining all the data they have recorded on the four representative plants.

ABBREVIATED STANDARDS

- Reading TEKS: 4.7.C, 4.13.H
- CCSS: SL.4.2, W.4.7, W.4.8
- NGSS: 4-ESS2-2, 4-LS1-1
- Science TEKS: 2018–19: 4.2C. 4.2D, 4.2F; 2024–25: 4.1E, 4.1F, 4.2B, 4.3B

ALL for Science™
Authentic Literacy and Language for Science

Baylor College of Medicine CENTER FOR EDUCATIONAL OUTREACH

Day 10: Putting the Pieces Together!

Literacy Strategy: Making evidence-based claims part 1: communicating oral claims.

Science Concept: Plant adaptations developed over long periods of time helped them survive as the environment changed around them.

Science and Literacy Connection: Scientists formulate claims about their investigations, then use evidence acquired through their work to validate them.

Mini-Lesson (15 minutes)

OVERVIEW

Scientists often communicate the findings from their investigations to other scientists. Whether they do so in writing or in oral presentations, they must include their claims and the procedures they used to prove their claims are true. Rather than explain every single detail of their investigations, which would take a very long time, scientists must decide which parts of their findings are most important for other scientists to know—they focus on stating their claims and detailing the supporting evidence so that the claims make sense to others.

In this unit, three days are dedicated to making claims:

- On the first day, teams can orally discuss and present to the class one claim that answers one of their inquiry questions.
- On the second day, teams can begin writing a claim for each remaining inquiry question and include evidence and reasoning for each claim.
- On the third day, teams can finish writing a claim for each remaining inquiry question and include evidence and reasoning to support each claim.

NOTE: You are encouraged to create the "Making Evidenced-Based Claims" 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)
- "Making Evidence-Based Claims" anchor chart as a model

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 learn about making evidence-based claims. Evidence-based claims are statements that I make (as a scientist) that I believe are true because I have data to support those statements. These are different from statements that may be my opinion or something I think about a topic. Evidence-based claims can be communicated orally or in writing. We will learn how to write evidence-based claims, but today we will learn to communicate evidence-based claims in oral presentations.*
2. *For example, in one of the books I read yesterday, the author said that cacti often have sharp spines to ward off predators. This was different from what my cousin told me, which was that the spines on cacti are there to poison me. The information I got from a book could be considered evidence-based while what my cousin told me is really just his opinion or something he heard from someone else. You have probably heard a lot of proposed claims on the internet and on the TV that are not based on evidence.*

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

1. *Making evidence-based claims is an important part of being a scientist. When I talk to other scientists, they expect me to say things that are true, that are based on evidence I can prove or show that someone else has proven. This is also true when I'm talking to someone who may not be a scientist).*
2. *I make evidence-based claims to communicate valid information to other scientists. I do this when I have learned something new and want other scientists to learn it too. When I state my evidence-based claims, I include the evidence I found through my inquiry AND how I found it. I also explain how my evidence supports my claim.*
3. *When I talk about my claims, I make sure to include details that help my audience understand me because other people might not know what I know yet.*

Tell how to use the strategy (procedural knowledge)

1. *The first thing I do is choose one of my inquiry questions and look at the synthesis statement I wrote for that question.*
2. *Then, I will use my synthesis statement to make a claim. A claim will sound like an answer to my inquiry question. My synthesis statement and my claim might be very similar.*
3. *Next, I will look at the evidence in my Inquiry Chart and the sources I listed.*
4. *Then, I will decide which piece(s) of evidence or which source(s) best support the claim. This could be evidence from my reading or from my scientific investigations.*
5. *Then, I will think about what I already know that validates my claim. 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. My claim should not include my opinions. If what I know agrees with what other scientists are saying, I can consider the claim valid.*
6. *Next, I will think about what I know and what my audience might not know yet. I ask myself, what details should I include to help everyone understand my claims?*
7. *Next, I will think about how my evidence supports my claim. I will ask myself, "Why is this piece of evidence important, and how does it make my claim more valid?" This is called reasoning.*
8. *Finally, I tell other scientists my claim, citing my evidence as part of my statement.*

You might present the following as a model claim as part of this mini lesson:

1. *My inquiry question was, "What features of a cactus allow it to survive and thrive in its habitat?" My synthesis statement was, "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."*
2. Based on my synthesis statement, I can make a claim. To support my claim with evidence, I need to return to my Inquiry Chart and reference some of the sources I used to gather information. Finally, I will explain why my evidence is important and how the evidence supports my claim.

   Claim: *Cacti have structures that help the cacti survive in hot, dry environments.*

   Evidence: *I read in* Prickly Plants: Stuck! *by Ellen Lawrence that cacti live mostly in hot, dry places. Then I read in* From Seed to Cactus *by Lisa Owings and* What Do You Find on a Saguaro Cactus? *by Megan Kopp that cactus roots spread out wide to take up water quickly when it rains. Finally, I read on the DK Find Out website that cacti have thick stems to store water and spines that lose water more slowly than leaves. In my investigation, I observed the spines on the surface of a cactus. I have also seen cacti living in dry places like Texas and Arizona.*

   Reasoning: *The evidence supports my claim because these are structures that would help plants survive in hot, dry places. Having wide roots would help a plant take up water quickly when it rains, and having stems and spines that keep water inside the plant would be helpful when it does not rain again for a very long time. This is important because these structures would prevent a cactus from drying out so it can live longer in a hot, dry environment.*

3. *Note that there are no opinions in this example. I might have an opinion about cacti, such as how some cacti can be scary looking, and some are pretty, but this is my opinion and not a fact, so it does not serve to make my claim more valid.*

If learners need further support, you might offer sentence stems as a scaffold. Here are some examples:

Claim
We claim …

Evidence
We read in [title] by [author] that …
[Author] said that …
In our investigation, we observed …

Reasoning
The evidence supports my claim because …
This is important because …

Science Inquiry Circles (30 minutes)

OVERVIEW

Today teams will select one question from their Inquiry Chart, examine the synthesis statement they wrote for the question, and deliberate as a group to make a claim and support the claim with evidence.

MATERIALS

Each team member needs:

- science notebook
- pencil

Each team needs:

- team Inquiry Chart
- team "Plant Observations" booklet

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 working on our claims, so we need to be sure that we have completed our synthesis statements.* (Make adjustments for teams that have not yet completed their synthesis statements.)
3. *Now, inquiry teams will work together to make claims.*

During Inquiry Circles (20 minutes)

1. *Today your team will work on making one claim that answers 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 examine the important information from one column in your Inquiry Chart and how it supports the synthesis statement you wrote. Ask yourselves, what can we claim about all this information?* (Remind learners that a claim might be similar to the synthesis statement, and it will sound like an answer to the inquiry question for that column.)
3. *After deciding on a claim, your team will discuss which piece(s) of evidence from the Inquiry chart or which source(s) were most important in supporting the claim. You might also support your claim with evidence from your scientific investigations. Identify at least one piece of evidence that supports your team's claim.*
4. *Finally, discuss how the selected piece(s) of evidence support the claim. This is your reasoning. The Data Scientist should be ready to share the team's claim, evidence, and reasoning with the class.* (Learners will discuss in their teams and share orally with the class. They do not need to write out their claims, evidence, and reasoning today, but they are welcome to jot down notes if this helps them prepare to share with the class.)
5. (Remind learners that they can use the "Making Evidence-Based Claims" anchor chart to help them, as well as any other anchor charts they have used.)

6. *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 claim the team made, one piece of evidence that supports the team's claim, and one reason that the evidence supports the claim. Teams may also share a problem they encountered or how they resolved a problem. Lab Directors, take a moment to make sure that your team is ready to share.* (After you have allowed the teams to gather their thoughts, have the Data Scientists share with the class.)
2. *The Data Scientists will now share with the class their team's claim, including the team's evidence and reasoning.* (**Encourage teams to share how they developed their claims.** If you saw a great example in action, encourage that team to share with the entire class.)

Guided Science Investigation (30–45 minutes)

OVERVIEW

Today teams review and combine all of the data they have recorded from their science investigations.

GUIDING QUESTIONS

What differences in plant structures do we see in the plant groups we are investigating? How did these plant structures allow plants to survive in changing environments?

BACKGROUND INFORMATION FOR THE TEACHER

As the investigations on plants wrap up, teams are asked to take a critical look at how plant structures helped plants survive as the environment changed around them. But not all species survived—why did some plant species die off or become extinct?

In this unit, descriptions of geologic time and environmental change have been purposely limited to provide a snapshot of Earth's climate during time periods in the fossil record when plants appeared. To be sure, changing landforms, continent building, and the emergence of other life-forms all contributed to changes in Earth's environment through time. However, that full discussion is better suited for children in upper grades.

As you guide the children through this lesson, allow them to present their findings as they see them, and in their own words They will be asked to use this information as evidence that supports the answers to the questions they have been investigating.

MATERIALS

Each team members need:

- science notebook
- pencil

Each team needs:

- team "Plant Observations" booklet
- team Inquiry Chart

- access to all plant specimens
- access to all plant images (Days 6–9)

Teacher needs:

- chart paper
- marker
- "Organizing the Data" page

SETUP

- On sheets of chart paper, reproduce the information from the "Organizing the Data" page. You may need one sheet per heading to make it large enough to record each team's information. These visuals will remain posted and accessible to all children after the discussion.
- Make plant images, Inquiry Charts, and the team "Plant Observations" booklets accessible for learners.
- Assemble all full plant specimens together **in the order they were introduced** and display where they can be seen by the class.

DAILY OBSERVATIONS

Learners take a final look at all of the plant specimens they have observed.

PROCEDURE

Engage

1. Begin by pointing to the assembled plant specimens and ask, *What do you notice about the plants now that they are all side by side?* Children may note differences in structures, size, etc. Accept all responses. Refer back to the live specimens throughout today's discussion.
2. Remind teams that the differences they see in plant groups happened over millions of years. Scientists don't always agree on the number of years it took for these differences to take place because new information continues to emerge as scientists learn more from fossils and the rock record. Add that the fossil rock record also provides evidence that Earth's environment changed many times over millions of years. *What is the connection between plant adaptations and their changing environments?*
3. Point to the "Organizing the Data" charts you have created. Tell the class that today they will all work together to share the data they have recorded from their team investigations. Explain that, like pieces of a puzzle, real-life science teams put together their pieces of information in order to see and make sense of the "big picture" of their findings and what it means.
4. Tell them you will work **across the row** of questions, asking for volunteers from each team to share information, which you will record on the sheets of chart paper. Later they will analyze, or carefully examine, this information.
5. Instruct them to use the data they have recorded in their "Plant Observations" booklets, any notes they have written in their science notebooks, or information from their Inquiry Charts in the class discussion.
6. Remind them to be respectful, listening and considering what each team contributes to the discussion, and let them know that the recorded information will remain posted for them to refer to after the discussion.

Explore

1. Choose learners randomly from each team to provide information as you proceed. *Let's begin by listing the name of the first plant specimen you observed and the name of the plant group it represents.*
2. *What plant structures were present on the live specimens?*
3. *What plant structures were present in the plant images?*
4. *How do the plant structures enable the plant to meet its needs?*
5. W*hen does this plant appear in the fossil record?*
6. *What was Earth's climate and environment like during that time period?*

Explain

1. After all the information has been recorded, ask learners to think, pair, and share with another team member to describe or explain what the "big picture' or "big idea" is about all the plant groups we have observed. Then ask them to rotate to another team member and do the same. Listen for descriptions related to how plant structures changed and how adaptations allowed plants to survive in different places and in diverse conditions.
2. Referring to the recorded responses, ask, *What plant structures appear over time in the different plant groups? How do you think these plant structures helped plants survive so many changes in the environment?* Accept and discuss responses.
3. To wrap up the discussion, explain that the physical changes we see over time were the adaptations that allowed plants to better "fit" into the habitats that were changing around them. Some plant species didn't survive the environmental changes that occurred over millions of years, becoming extinct as a result.
4. Share the following information about plant groups for validation or clarification. You may add information to the chart if not already recorded there.
5. Reveal that **bryophytes** do not have true roots, stems, or seeds. Some bryophytes have hairlike structures called rhizoids that act like roots to help anchor the plants. They also have leaflike structures (that are not true leaves) to produce food on their own through photosynthesis. Bryophytes are **nonvascular** plants**,** which means they do not have any way to transport water and nutrients throughout the plant. However, mosses and liverworts can absorb water and nutrients from water that flows over the outside of the plant. When early plants lived mostly in water, this worked well for them.
6. When Earth's environment changed and plants no longer lived only in water, they had to adapt in ways that enabled them to stay alive on land. Fossil evidence shows that, over time, plant populations developed tubelike structures for moving water and nutrients throughout the plant. This is called a **vascular** system. **Vascular plants** also developed true stems, leaves, and roots. Their rigid stems held them up and growing taller gave them a way to capture more sunlight.
7. **Gymnosperms,** another group of vascular plants**,** were the first group of plants to have seeds. However, their seeds are not covered or enclosed. They can produce cones (like conifer pine cones) but do not produce flowers or fruit. Gymnosperms have large, woody stems (trunks) and roots, and their leaves have many different shapes. The seeds of gymnosperms carried away by wind, water, and animals made it easier for the seeds to spread over the Earth and ensure the survival of this group of plants.
8. **Angiosperms** are vascular flowering plants. They have hidden or enclosed seeds and produce fruit to protect the seeds. Angiosperms are divided into two types: monocots and dicots. The differences include how many leaves are in a seed, the types of roots they have, the types of veins they have in their leaves, and the number of petals they have. Angiosperms can live in many different climates all over the world, from hot deserts to very cold polar regions. This

ability to live in many different climates made it easier for them to survive changes in Earth's environment.

9. Conclude this part of the lesson by emphasizing that teams will need to work together to make sense of all the data recorded today and in their "Plant Observations" booklets, science notebooks, and Inquiry Charts.

Elaborate

1. Inform the children that in the next class, they will use the evidence from their investigations and text inquiry to support an answer to the question they have been investigating. The information from these sources should provide them with evidence they can use.
2. Ask, *How is this similar to the evidence-based claims you worked on during inquiry circles?* (The process is the same because it uses evidence to back up the answers.)

Evaluate

1. Are learners communicating a reasonable understanding of the relationship between plant adaptations and changing environments?
2. Are learners using evidence from their investigations to support their written and verbal communication?
3. Are learners correctly using new science language in their communications (written or verbal)?

Science Language

- **Plant adaptations** made some species of plants better suited to living in a particular habitat or environment.
- **Evidence** is data collected during an investigation to support (back up) explanations and answers.
- **Analyze** means to carefully examine details or specific information.
- **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

4.7C: Use text evidence to support an appropriate response. **4.13H:** Use an appropriate mode of delivery, whether written, oral, or multimodal, to present results.

CCSS

SL.4.2: Paraphrase portions of a text read aloud or information presented in diverse media and formats, including visually, quantitatively, and orally. **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-ESS2-2: Analyze and interpret data to make sense of phenomena using logical reasoning. **4-LS1-1:** Construct an argument with evidence, data, and/or a model.

Science TEKS

2018–19: 4.2C: Construct simple tables, charts, bar graphs, and maps using tools and current technology to organize, examine, and evaluate data. **4.2D:** Analyze data and interpret patterns to construct reasonable explanations from data that can be observed and measured. **4.2F:** Communicate valid, oral, and written results supported by data.

2024–25: 4.1E: Collect observations and measurements as evidence. **4.1F:** Construct appropriate graphic organizers to collect data, including tables, bar graphs, line graphs, tree maps, concept maps, Venn diagrams, flow charts or sequence maps, and input-output tables that show cause and effect. **4.2B:** Analyze data by identifying any significant features, patterns, or sources of error. **4.3B:** Communicate explanations and solutions individually and collaboratively in a variety of settings and formats.