ALL for Science™
Authentic Literacy and Language for Science

Baylor College of Medicine
CENTER FOR EDUCATIONAL OUTREACH

DAY 5: HOW DO PLANTS GROW FROM SEEDS?

MINI-LESSON
Teacher introduces the "Evaluating Claims" anchor chart and models the strategy for the class.

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 learn about seed germination and explore the stages of seed growth.

ABBREVIATED STANDARDS
- Reading TEKS: 4.9E; 4.9E(i)(ii)
- CCSS: RI.4.8
- NGSS: 4-LS1-1A
- Science TEKS: 2018–19: 4.10A, 4.10B; 2024–25: 4.13A, 4.13B

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Day 5: How Do Plants Grow from Seeds?

Literacy Strategy: Additional time to work in inquiry circles.

Science Concept: Seed germination is the process by which a plant grows from a seed.

Science and Literacy Connection: Scientists look for answers to questions through observations and text inquiry.

Mini-Lesson (15 minutes)

OVERVIEW

Did you know that anyone can publish a website? Anyone who can write and who has access to the internet can write a webpage. So, how do scientists know that the information they are reading on a website is true and reliable? They use a reading strategy called "evaluating claims." A claim is a statement that can be supported by evidence. This strategy can be used to evaluate the claims in online material to determine if the claims are true and reliable.

NOTE: You are encouraged to create the "Evaluating 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)
- "Evaluating Claims" anchor chart as a model
- informational text to model the strategy (for example, https://www.usgs.gov/news/extreme-rainfall-and-flooding-contributes-sudden-vegetation-dieback-texas-salt-marsh)

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're going to learn a strategy that will help us determine if the claims an author is making are true and reliable. This strategy is called evaluating claims.*

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

1. *I use this strategy when I read informational text, including text in reports written by scientists, but also when I'm reading on social media and someone is making a claim about something happening in the world. I know to use this strategy because it's important to me that I can believe things I read and that I know what I'm reading is real and supported by science.*

Tell how to use the strategy (procedural knowledge)

1. *The first thing I do as I evaluate an author's claim is to think about what I know to be true about a topic.*
2. *Next, I think about where the information is coming from. I ask myself questions:*
    - *Is the source reliable? Is it a source I've used before, and do I generally trust this source and the information I get from it? If so, I can probably believe the claims made by the source.*
    - *Is the website hosted by a research center or university (e.g., is the domain address .net, .org, or .edu)? If so, I can probably believe the claims made by the source.*
    - *Is the site one that is hosted by the government (e.g., is the domain address .gov)? If so, it's probably trustworthy, but it may be a controversial source. I might need to see if the claims in the source agree with claims made by other authors.*
    - *Is the site one that is hosted by a for-profit (e.g., is the domain .com)? If so, I want to read the claims made by the authors very carefully. I want to be sure that the claims are grounded in evidence and facts and that the claims made agree with claims I've read by other reliable sources.*
    - *What is the credibility of the author—is the author a scientist or an expert on the subject? Is the author making claims that are grounded in evidence instead of opinions? If not, I might consider not including the author's statements in my inquiry, as the claims may not be evidence based.*
3. *I will note on my Inquiry Chart the claims that I take as authentic and true and the information about the source where I found them.*

Model the strategy

Suggested resource for modeling the strategy:
https://www.usgs.gov/news/extreme-rainfall-and-flooding-contributes-sudden-vegetation-dieback-texas-salt-marsh

1. *The author's claim is that "Smooth cordgrass and other salt marsh plants can tolerate some flooding. However, as noted by the USGS study, the significant amount of rainfall and flooding associated with Hurricane Harvey exceeded the threshold for plant survival. As storms are expected to increase in frequency and intensity, bringing heavier rainfall in shorter periods, more vegetation dieback events may occur."*
2. *I ask myself if this matches what I know to be true.*
    - *I remember the last time a hurricane hit the Gulf Coast region of Texas. I know that it caused a lot of damage for land and vegetation (plants).*
3. *Then I look for a statement about who created the website.*
    - *This site ends in .gov and is associated with a research center and government agency (USGS Wetland and Aquatic Research Center and the U.S. Fish and Wildlife Service). We can most likely trust this site.*
    - *The author is a research ecologist—a scientist who studies ecosystems. This author is most likely credible.*

4. *This claim makes me curious and gives me an idea for a new research question: How might flooding and hurricanes damage plants in the Gulf Coast salt marsh, resulting in acquired physical traits?*

Science Inquiry Circles (30 minutes)

OVERVIEW

Scientists often work in teams when conducting inquiry and investigations. Today, inquiry circle teams will investigate different questions about ecosystems and the traits of plants that live there. Prior to starting the inquiry circle work, be sure to have texts and technology available for your learners. As children begin working, you may have some teams working online while others are working with traditional texts. This will depend on your access to technology and texts.

MATERIALS

Each team needs:

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

Teacher needs:

- "Ecosystem 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 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 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.*

During Inquiry Circles (20 minutes)

1. *Today you will use a different book, eBook, website, or video to find answers to the question you're investigating about your ecosystem or add information to a question you've already answered.* (You may want to show or project a blank sample Inquiry Chart or your model Inquiry Chart. Also, you may choose to be more explicit for your class and only allow them to answer one question at a time daily. Use your judgement on the level of guidance, especially in the first few days.)

2. *We have anchor charts to help guide your thinking. Do not forget to use them while working.* (Refer to the "Evaluating Claims" 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 all source information and the answers to your inquiry questions on the Inquiry Chart.*
4. *Remember, it is important to record on your Inquiry Chart where you found the information (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.* (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.)
5. *Everyone should help find the answers to the questions online and in texts.* (Remind learners how the Inquiry Chart will organize their progress.)
6. *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 they accomplished, and what literacy strategies they used. The Lab Director will lead the discussion about today's results. What has the team learned about its ecosystem and the traits of plants that live there? 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 learners 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 explore the stages of seed growth during germination.

GUIDING QUESTIONS

What is germination? How do plants grow from seeds? What seed traits are inherited?

BACKGROUND INFORMATION FOR THE TEACHER

Germination is the process by which a plant grows from a seed. A seed has a protective layer on the outside called the seed coat, and inside the seed is a tiny plant called an embryo. One end of the embryo is called the radicle, which becomes the root system; the other end is called the hypocotyl (high-

puh-**ko**-tl), which becomes the stem and leaves. The radicle is the first part of the seedling to emerge from the seed. The seed also contains cotyledons where food is stored for the young plant.

Germination requires water, warm temperature, and oxygen. In the first step of germination, the seed takes in water, which swells and softens the seed coat. As the seedling grows, a shoot emerges up from the cotyledons, and the cotyledons themselves become leaf-like structures called seed leaves. The radicle becomes a tiny root that grows downward.

Angiosperms (flowering plants) and gymnosperms produce seeds. However, not all plants grow from seeds. Some plants, like ferns and mosses, grow from spores, and others reproduce asexually.

In this lesson, children will learn how seeds sprout into seedlings and make inferences about which seed traits are inherited.

MATERIALS

Each team member needs:

- science notebook
- pencil
- copy of the Unlabeled Seed Image

Each team needs:

- access to their investigation setup

Teacher needs:

- copy of the Unlabeled Seed Image
- copy of the Labeled Seed Image

SETUP

- Copy the Labeled Seed Image on a large 11 X 17 paper **or** prepare to project for the class. This will be used for discussion.
- Make copies of the Unlabeled Seed Image (1 per learner).

SAFETY

There are no safety issues today.

DAILY OBSERVATIONS

Today's seed observations will be conducted during the lesson.

PROCEDURE

Engage

1. Begin, *Yesterday you set up your investigation to see how the amount of rainfall might affect a plant's physical characteristics. Things to look for may include changes in the color of the leaves, overall growth, or any other observed differences between the plants.*
2. *Have you ever wondered how a seed becomes a plant? What do you think happens inside of the seed?* (Accept all responses.)

Explore

1. Use the Labeled Seed Image to explain that flowering plants grow from seeds that can vary in size: some seeds are very tiny, like the Wisconsin Fast Plants, and other seeds are larger. All seeds have a protective coat on the outside, and inside there is a very tiny plant, or embryo, and some stored food.
2. One end of the embryo is called the radicle, and it becomes the root system; the other end is called the hypocotyl (high-puh-**ko**-tl), and it becomes the stem and leaves. The radicle is the first part of the seedling to emerge from the seed.
3. The stored food is in structures called cotyledons (kaa-tuh-**lee**-dnz). Cotyledons are the first leaves that emerge during the process called germination, when the plant begins to grow. Angiosperms and gymnosperms have cotyledons in their seeds, although the number of cotyledons can vary in gymnosperms.
4. Flowering plants that have one cotyledon or seed leaf are called monocots; plants with two seed leaves are called dicots. The plants you are using in your investigation are dicots.
5. When conditions are right, the seed and the embryo take in water, consume their food reserves, and begin to grow. Germination is the process by which a plant grows from a seed.
6. During germination, the young plant sends out the single root called the radicle to begin taking in water and anchoring the plant. Let them know that they may not be able to see the radicle in their plants, but they will see root growth during the investigation.
7. Remind them that in their investigations, they're using different amounts of water that reflect an average monthly rainfall to see how the plants respond.
8. Besides water, seed germination also needs oxygen and the right temperature. The Wisconsin Fast Plant seeds you are germinating also require constant light; however, not all seeds need light to germinate.
9. End the discussion by stating that not all plants grow from seeds, but for their investigations they are focusing on plants that do.

Explain

1. Instruct teams to go to their seed-growth setups for their daily observation. **Remind them not to move the cups.** As they make their observations and record their data (sketches and descriptions), ask them to consider what they have just learned about the process of germination and to include a description of any changes that have happened in their own seeds. Encourage them to use their new science language in their writings. Allow 10 minutes for completion.
2. As teams work, move between them and listen to their ideas, offering guidance as needed.
3. When time is up, gather the attention of the class. Ask the Data Scientists from each team to report on the status of the team's seeds.

Elaborate

1. Refer back to the Labeled Seed Image. Ask, *What parts of the seed do you think are inherited traits?* Responses may vary. Confirm that the inherited parts of a seed include seed color, seed shape, the number of cotyledons, leaf shape, plant height, and root shape.
2. Remind learners that although these traits are inherited, variations may occur within the same type of plant. Encourage teams to look for any changes in their plants or the plants of other teams during their investigations.
3. Ask team members to share anything they have read about seeds in their inquiry circles.

Evaluate

1. Distribute a copy of the Unlabeled Seed Image for learners to complete, then collect and review.

Science Language

- A **seed** is an undeveloped plant embryo and food reserve enclosed in a protective outer covering.
- **Germination** is the process by which a plant grows from a seed.
- The **embryo** is the tiny plant inside the seed.
- The **cotyledon** is the seed leaf within the embryo and is a source of stored food for the seedling. Plants that have one cotyledon or seed leaf are called **monocots**; plants with two seed leaves are called **dicots**.
- The **radicle** is the first part of the seedling to emerge from the seed. It will become the root system as the plant grows. The **hypocotyl** is the part of the embryo that becomes the stem and the leaves.
- A **trait** is physical attribute of an organism such as eye color, feathers, or the shape of leaves. Traits can be inherited or acquired.
- **Inherited traits** are passed down from parent to offspring.

Expanded Standards

Reading TEKS

4.9E: Recognize characteristics and structures of argumentative text; **(i):** identifying the claim; **(ii):** explaining how the author has used facts for an argument.

CCSS

RI.4.8: Explain how an author uses reasons and evidence to support particular points in a text.

NGSS

4-LS1-1A: Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

Science TEKS

2018–19: 4.10A: Explore how structures and functions enable organisms to survive in their environment. **4.10B:** Explore and describe examples of traits that are inherited from parents to offspring such as eye color and shapes of leaves.

2024–25: 4.13A: Explore how structures and functions enable organisms to survive in their environment. **4.13B:** Differentiate between inherited and acquired physical traits of organisms.