ALL for Science™
Authentic Literacy and Language for Science

Baylor College of Medicine
CENTER FOR EDUCATIONAL OUTREACH

DAY 2: HOW DO ENVIRONMENTAL FACTORS AFFECT INHERITED TRAITS?

MINI-LESSON
Teacher introduces the "Generating Questions" anchor chart and models the strategy for the class.

SCIENCE INQUIRY CIRCLES
Teams are introduced to the Inquiry Chart and begin text-based exploration of their assigned ecoregion.

GUIDED SCIENCE INVESTIGATIONS
Teams explore inherited plant traits and the environmental factors that can affect these traits.

ABBREVIATED STANDARDS
- Reading TEKS: 4.13A, 4.13C
- CCSS: W.4.7
- NGSS: 3-LS3-1
- Science TEKS: 2018–19: 4.10B; 2024–25: 4.13B

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Day 2: How Do Environmental Factors Affect Inherited Traits?

Literacy Strategy: Generating questions.

Science Concept: Inherited traits, passed down from parents to their offspring, may be affected by environmental factors.

Science and Literacy Connection: In their work, scientists ask questions and find answers to their questions through inquiry and investigations.

Mini-Lesson (15 minutes)

OVERVIEW

The vast majority of scientists' work revolves around asking questions and finding answers to those questions through inquiry and investigation. Very few elementary learners have been allowed or encouraged to ask questions within a standardized curriculum; however, it is important that learners not only be allowed and encouraged to ask questions but that they be taught how to ask **quality** questions.

When given a chance to generate their own research questions, many children often ask known-answer questions (questions they can likely already answer) or "go Google it" questions (such as, "How often should I water my ivy?"). While there is justification for these kinds of questions, they will not move learners into more complex understandings of the construct/phenomenon they are learning in science.

The types of questions we want children to ask are those that come from a place of personal interest, that are aligned with the topic of study, and that are answerable after consulting multiple informational sources (text, audio, and video) and then comparing, contrasting, and synthesizing the information they gather across these sources.

One of the most difficult things to teach learners is how to ask questions that require multiple sources to answer (or at least to compare/contrast answers). Often, questions have to be "tweaked" once inquiry has begun because we sometimes don't yet know the true question we're asking until we see what others have asked/answered. It's important to keep this in mind and to support learners as they "find the right questions to ask" that build on their current knowledge about their topic and also contribute to the learning of their team and the class.

NOTE: You are encouraged to use "think aloud" as you create the "Generating Questions" anchor chart with your learners and move through this lesson, using the provided anchor chart as a model. Post the

anchor chart for easy reference when completed and remind learners to refer to the anchor charts during inquiry circles.

MATERIALS

Teacher needs:

- chart paper
- marker(s)
- "Generating Questions" anchor chart as a model
- class Inquiry Chart

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 how to generate inquiry questions for your science inquiry circle project. Generating questions means asking questions that will guide your inquiry.*

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

1. *Generating questions is the same as "asking" questions. I generate questions at the beginning of every inquiry project I do.*
2. *This is an important strategy because the questions I generate (or ask) will guide my research and keep me focused as I read interesting and important information about my topic.*

Tell how to use the strategy (procedural knowledge)

1. *The first thing I do is think about what I (and the others on my team) already know about my topic. It helps me to write down everything on a "What I know" chart.*
2. *I then think about all the things I'd like to know about my topic. I sometimes think about these words as starters to my questions:*
    - *Why . . .*
    - *How . . .*
    - *Under what conditions . . .*
    - *When . . .*
3. *Once I've brainstormed questions, I try to organize them, looking for the questions that are most important for me to answer and that are "quality" questions. Quality questions are those that are (a) neither too broad or too narrow; (b) that are interesting to me and will be of interest to others; and (c) that are answerable.*
4. *I then record my inquiry questions on my Inquiry Chart.*

Model the Strategy

1. *Let's say I am investigating the salt marsh ecosystem found in the Gulf Coast region of Texas. I'm going to brainstorm everything I know about the salt marsh and the traits of plants that live there.* (Encourage learners to contribute to your brainstorming document.)

What I know (about plants in the salt marsh)	What I want to know (about the salt marsh and the traits of plants that live there)
A kind of wetland with salty water Plants live in and near the water Plants can live in wet, muddy conditions Tall grasses	

2. *Now, I'll think about the things I want to learn about the salt marsh and the traits of plants that live there.* (Encourage learners to contribute to your brainstorming document.)

What I know (about plants in the salt marsh)	What I want to know (about the salt marsh and the traits of plants that live there)
A kind of wetland with salty water Plants live in and near the water Plants can live in wet, muddy conditions Tall grasses	What physical traits do plants in the salt marsh have? How are the plants different depending on where they grow (in the water, close to the water)? How does too much or too little water affect the plants? What other kinds of plants live in the salt marsh?

Science Inquiry Circles (30 minutes)

OVERVIEW

Scientists identify inquiry questions and record their data in an organized manner. Today teams will be introduced to the Inquiry Charts they will use as they investigate ecosystems and the plants that live there. You may want to model how to use the Inquiry Chart. The blank Inquiry Chart provided below can be used to create a larger version on chart paper so that it can be seen easily by the whole class, or it can be projected onto a large screen. In future lessons, the teacher will use the Gulf Coast/salt marsh (and resources about the Gulf Coast/salt marsh) to model the various strategies. The teacher might also consider creating a model Inquiry Chart using the Gulf Coast (salt marsh) as the inquiry topic.

A true inquiry allows learners to develop their own inquiry questions. The resources compiled for this inquiry are focused on the environmental conditions of ecosystems and the physical traits (both inherited and acquired) of the plants that live there. At this point, each team has chosen (or been assigned) one ecosystem to learn more about. The teams will generate questions about their ecosystem and the traits of plants that live there that can be answered by the available resources. For example, a team learning more about the Trans-Pecos (desert) might generate questions about the characteristics that many desert plants inherit, characteristics that desert plants might acquire, or anything else about the desert plants that the learners want to know. Throughout the unit, learners may develop additional questions that can be added to the Inquiry Charts.

Blank Sample Inquiry Chart

Our Inquiry Questions →	Inquiry Question 1	Inquiry Question 2	Inquiry Question 3	Inquiry Question 4	Other Interesting Facts
What we know →					
Source 1 Title: Author: Publisher: Date: URL (for online):					
Source 2 Title: Author: Publisher: Date: URL (for online):					
Source 3 Title: Author: Publisher: Date: URL (for online):					
Source 4 Title: Author: Publisher: Date: URL (for online):					

MATERIALS

Each team needs:

- a team Inquiry Chart on 11" x 17" paper (**created by the teacher; see model above**)
- pencils
- informational texts/media about ecosystems

Teacher needs:

- "Ecosystem Resources" spreadsheet for ideas

NOTE: If you feel your learners need more space, you have the option to recreate these charts on large pieces of chart or butcher paper, but be sure the size is easy for the learners to record on and manageable for storage when teams are not working on them. **If your learners have not used an Inquiry Chart before, it is suggested that you have each team's Inquiry Chart created prior to starting the lesson.** If Inquiry Charts are familiar to your learners, you might give them the option to create their own Inquiry Chart.

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. *Now we will get into our Inquiry Circle teams.* (Help learners find their assigned teams. Ask Equipment Directors to gather the Team Inquiry Chart and writing utensils. Once all items have been distributed, the teacher will tell each team which ecosystem they have been assigned.)
2. *You will work in the same team every day during inquiry circles and the science investigations. Now that you know which ecosystem you have been assigned, please write it in the top corner of the Inquiry Chart, along with each team member's name.*
3. *Today we are going to start a guided inquiry. You can see along the top of the Inquiry Chart, there are four column headers where you will write your inquiry questions as well as a column for other interesting facts.*

During Inquiry Circles (20 minutes)

1. *We have a variety of resources available where you can find information about your ecosystem and the traits of plants that live there.* (You might remind learners that they discussed the term "trait" in yesterday's science investigation). *In your teams, you'll start by thinking about our shared questions (from the mini-lesson), and then your team will generate questions about the team's ecosystem and the traits of plants in the ecosystem.*
    - *What would you like to know about your ecosystem and the traits of plants that live there? Decide as a team and write your questions in the column headers on your Inquiry Chart.*
    - *You might not have four inquiry questions yet. That is okay! You can add more questions after today.*
    - *If you have more questions about your ecosystems or the traits of plants that live there, you can add additional columns.*
    - *You can add additional findings in the column titled "Other Interesting Facts."*
2. *Take a few moments to discuss **what you already know** about your ecosystem and the plants that live there. The Lab Directors will lead the discussion. Be sure everyone has a chance to share. Do not write anything on your Inquiry Chart just yet.* (While teams are working, walk around the room and assist as needed.)
3. *Now, everyone should assist the Data Scientist in recording what you already know in the correct column. For example, if you already know something related to one of your inquiry questions, write it in the column below that question. If you know something that doesn't fit into these inquiry questions, record it in the "Other Interesting Facts" column.* (While teams are working, walk around the room and assist as needed.)

After Inquiry Circles (10 minutes)

1. *As we conclude our inquiry circles for today, each team will have a chance to share what they already know about their ecosystem and the plants that live there, as well as what the team accomplished and learned. The Lab Director will lead the discussion about today's results.* (You may want to post or project a guiding list of questions for learners to use during their team discussions. The following questions may be used, though you may add any of your own based on your class's needs: *What did the team already know about its ecosystem and the plants that live there? What problems did the team encounter? How did the team resolve those problems? What new questions came up during the discussion?*)
2. *The Data Scientist will now share with the entire class either something the team learned about its ecosystem and the plants that live there or any new questions that came up.*
3. (After all learners have shared, thank them for their hard work and point out any excellent behaviors you observed. If you notice any problems in the teams during the lesson, 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

Today children discuss inherited plant traits then consider how a plant's environment may affect them.

GUIDING QUESTIONS

What are examples of traits that plants inherit? Can environmental factors affect inherited traits?

BACKGROUND INFORMATION FOR THE TEACHER

While there is some evidence that acquired traits may be passed on, for this study we are focusing on physical acquired traits that can be observed by young learners.

Acquired physical traits are characteristics that develop as the result of interactions with external or environmental factors. Organisms are not born with them—they are not inherited from parents, and they cannot be passed on. Environmental factors that can affect the inherited traits of plants include temperature, air, and water.

The amount of water plants receive is not the only thing that can affect their structures and functions. Plant growth and where plants can live successfully is determined by other environmental factors, including temperature, light, and the availability of nutrients.

Temperature plays a big role in such plant functions as respiration, photosynthesis, seed germination, and flowering. Adverse temperatures—too high or too low—affect these processes and can also stunt the plant's root and shoot growth.

The duration and type of light plants receive and the availability of nutrition from basic chemical elements in the air and soil can result in such changes as leaf curling, leaf burn, or spotting on leaves.

MATERIALS

Each team member needs:

- science notebook
- pencil

Each team needs:

- 1 set of the Trait Cards

Teacher needs:

- T-chart from previous class
- Traits Cards

SETUP

- Copy one set of the Trait Cards per team. Cut them out and secure them with a paper clip or rubber band.
- Before the lesson begins, instruct the children to get into the same teams they were in during inquiry circles. Explain that they will work in these same teams every day during their science investigations, although their roles (and duties) may change.

SAFETY

There are no safety issues.

DAILY OBSERVATIONS

There are no observations today.

PROCEDURE

Engage

1. *In our last class we learned that a trait is an observable physical attribute that animals and plants that are alike share. What examples did you list on our T-chart yesterday?* Accept responses.
2. Explain that the traits they have described are called **inherited** traits. Organisms **inherit** traits from their parents**.** This just means that traits are passed from parent to offspring. Both plants and animals, including humans, produce **offspring**.

Explore

1. Distribute 1 set of Trait Cards to each team. Point out that each card has a number.
2. Instruct learners to work as a team to identify the traits that the plants in the images likely inherited from a parent plant. Tell them to write the number of the image in their science notebooks and a brief description of the traits they believe are inherited. They can also add any questions they might have about an image.
3. Allow 15 minutes for the exploration as you move between the teams listening to their discussions.

Explain

1. *What traits did you find that were likely inherited from a parent plant?* Ask the Data Scientists from each team to describe the team's observations about one or two of the Trait Card images. Invite other teams to share if they have different ideas.
2. Summarize their observations by image number on the whiteboard as learners respond.
3. Listen for questions or comments about **images 1, 3, 4, and 7**, which contain some fairly obvious acquired traits, and record those observations as well.
4. After all of the observations have been recorded, share that plants inherit particular traits from a parent plant. Those traits include the color and shape of a flower, flower position, seed color and shape, leaf patterns, and stem height. *You have correctly identified some of those traits in your observations!*
5. *Let's look again at the images you had questions or special comments about.* (Learners may have pointed out the brownish discoloration on the cactus in image 1; the holes or "bite" on image 3; the dried-out leaves on image 4, and the strange bend of the tree in image 7.)

6. Review the comments they made in their observations about these images. Add that while we may not know exactly what has happened to cause these changes in the plants, we can assume they were not inherited traits.
7. Explain that these are examples traits that are **acquired,** not inherited from a parent**.** Acquired traits can be caused by environmental conditions or external factors, such as an accident, injury, or an intentional act. For example, the holes or bites in the fruit in image 3 may have been the result of insects or other animals. The dried leaves in image 4 may have been caused by too much or too little water or heat.

Elaborate

1. *Let's take a closer look at how a plant's environment can affect inherited traits*. *What do we know about what a plant needs to live and survive?* Accept responses, which may include air, water, light, the right temperature, nutrients, space, and time.
2. Encourage learners to think about how a change in the environment might affect the ability of the plant to meet its needs.
3. Refer back to image 4 (corn stalk). *Let's suppose for a moment that the dried leaves on this plant were the result of the amount of water it received as it was growing. Did it get too much? Not enough?*
4. *Where do plants in the natural environment get water from?* Accept responses which should include rainfall.
5. Announce that in the next class they will investigate how rainfall amounts affect plants.

Evaluate

1. Pose the question, *How can a trait be both inherited and acquired? Take a minute to turn and share your ideas with a partner in your team.* Listen for children to describe how an inherited trait might be changed.

Science Language

- 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.
- **Acquired traits** are not passed down but are the result of environmental or external factors.
- Plants and animals, including humans, produce **offspring**.

Expanded Standards

Reading TEKS

4.13A: Generate and clarify questions on a topic for formal and informal inquiry. **4.13C:** Identify and gather relevant information from a variety of sources.

CCSS

W.4.7: Conduct short research projects that build knowledge through investigation of different aspects of a topic.

NGSS

3-LS3-1: Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.

Science TEKS

2018–19: 4.10B: Explore and describe examples of traits that are inherited from parents to offspring such as eye color and shapes of leaves and behaviors that are learned such as reading a book and a wolf pack teaching their pups to hunt effectively.

2024–25: 4.13B: Differentiate between inherited and acquired physical traits of organisms.