Grade 5: Life Science Module

Lesson Sequence 3: Plant Growth

Lesson Sequence 3: Plant Growth

Overview

Total Time: 3 hours of instruction (divided into four sections with additional time for plant growth)

Note: Allow at least one week between Section 2 and Section 3 for observation of the Matter and Growth plant investigation. (Students will observe the plants under investigation from Section 2 for at least one week before they can move on to Section 3. Lesson Sequence 4 can be completed during this observation period.) If time allows, 2 weeks will provide better results.

In this lesson sequence, students learn about the role of plants in the cycle of energy and matter in an ecosystem. They read about the methodology of investigation and then conduct an original investigation where they observe how different types and amounts of matter affect plant growth. Then, with the aid of the teacher, the class develops a model for photosynthesis that articulates their learning about the role of plants in the cycle of matter and energy.

Lesson Sequence Focusing Question and Big Ideas

How do plants use energy and move matter through an ecosystem?

- Plants use solar energy to convert water (liquid) and carbon dioxide (gas) into oxygen (gas) and sugar (food matter).
- Sugar contains stored energy that animals can consume and use.

Long-Term Learning Addressed (Based on NGSS)

Collaborate to develop a model that explains how plants use water (matter), air (matter), and energy from the sun to make matter with stored energy (food). (Based on NGSS 5-LS1-1)

This lesson sequence explicitly addresses:

Science and Engineering Practices:

- **Developing and Using Models:** Develop a model to describe phenomena. *Students develop a model, under teacher direction, to demonstrate the process of photosynthesis.*
- **Planning and Carrying Out an Investigation:** Plan and conduct an investigation collaboratively to produce data to serve as the basis for evidence, using fair tests in which variables are controlled and the number of trials considered. *Students design an original experiment to see how matter affects the growth of plants. Note: This Science and Engineering Practice is not explicitly aligned with* **5-LS1-1**.

Crosscutting Concepts:

- **Energy and Matter**: Matter is transported into, out of, and within systems. *Students learn that matter moves through an ecosystem as producers change matter into different forms.*

Disciplinary Core Ideas:

- **LS1.C: Organization for Matter and Energy Flow in Organisms:** Plants acquire their material for growth chiefly from air and water. *Students design an investigation to prove that water and air are essential for plant growth.*

Lesson Sequence Learning Targets

- I can design an experiment to test how different types and amounts of matter affect plant growth.
- I can develop a model to explain how plants use matter and energy to produce food.

Ongoing Assessment

- Scientists Meeting: Planning Investigation
- Scientists Meeting: Building Understanding
- Participation in Back-to-Back and Face-to-Face protocol
- Student science notebook: Plant Growth entry

Agenda

Total Time: 3 hours of instruction, plus one week for observation.

As part of their investigation, students observe the plants in Section 2 for at least one week before they can move on to Section 3. While students observe their plants, they should move on to Lesson Sequence 4.

Section 1

1. **Opening**
   A. Introducing Learning Target and Focusing Question (10 minutes)
2. **Obtaining Information**
   A. Close Reading: "From Questions to Conclusions: The Experimental Process" (35 minutes)
3. **Planning and Carrying Out Investigation**
   A. Scientists Meeting: Planning Investigation (45 minutes)

Section 2

1. **Carrying Out Investigation**
   A. Observing Plants
   (Note: This time is spread out over one week. Times will vary.)

Section 3

1. **Analyzing and Interpreting Data**
   A. Reviewing Learning Target and Focusing Question (10 minutes)
   B. Drawing Conclusions: Plant Investigation (20 minutes)

Section 4

1. **Evaluating Information**
   A. Developing a Model (40 minutes)
   B. Scientists Meeting: Building Understanding (20 minutes)

Teaching Notes

Purpose of lesson sequence and alignment to NGSS standards:

- In this lesson sequence, students learn about the important role of plants in the cycle of energy and matter. They learn that plants get the matter they need for growth chiefly from water and air. Using the energy from sunlight, plants convert this water and air into plant matter (a Disciplinary Core Idea).
- In Section 1, students read an informational text about the experimental process and analyze the methodology used. They then use this knowledge to carry out an original investigation (a Science and Engineering Practice) to answer the question: "What type of matter do you think will affect plants' growth?"
- In Section 2, which is spread out over one week, students collect data on their investigation. During this time, students should move on to Lesson Sequence 4.
- In Section 3, students discuss the results of their investigation. The teacher leads the class in developing a model for photosynthesis (a Science and Engineering Practice), the process in which plants use energy from the sun to change the matter that flows through an ecosystem (a Crosscutting Concept).

How it builds on previous work in the Life Science Module:

- In Lesson Sequence 1, students observed an ecosystem with plants and were introduced to the idea that there are "big cycles" in an ecosystem. In this lesson sequence, they learn the important role that plants play in a healthy ecosystem, as an integral component in the cycle of energy and matter.

How it connects to the CCSS Standards and EL Education's Language Arts Grade 5 Module 2:

- The student science notebook is an opportunity for students to practice informative writing and gathering evidence (ELA CCSS W.5.2 and W.5.8).
- The close read in Section 1 provides students the opportunity to practice reading informational texts and explaining the relationship between two or more ideas (CCSS ELA RI.5.3).
- The Scientists Meetings in Sections 2 and 3 provide students the opportunity to practice their speaking and listening skills while collaborating in whole group discussions (CCSS ELA SL.5.1).
- Students may be familiar with the Think-Pair-Share and Back-to-Back and Face-to-Face protocols from Language Arts Grade 5 Module 2. These protocols provide students the opportunity to practice speaking and listening skills (CCSS ELA SL.5.1).

Possible student misconceptions:

- Students may think that plants produce their own energy. Actually, plants produce their own food by absorbing energy from the sun. Consider asking: "Can a plant grow—make its own food—without having energy from the sun?" (No, plants must have energy from the sun to be able to do photosynthesis.)

- Because plants play an important role in ecosystems, students may think that a lot of plants are necessary for the ecosystem to be healthy. In fact, as long as there are some plants and all organisms can get their needs for energy met, there isn't a set number of plants required for health. However, the more complex and diverse an ecosystem is, the more stable it is. Students will learn more about this in Lesson Sequence 9.

Possible broader connections:

- Connect to students' lives by asking students to share their own experiences with growing plants.
- Draw connections to other times in science class when investigations have been or could be designed by students.
- Consider continuing to grow plants in the classroom or school garden after this initial investigation.

Areas where students may need additional support:

- Students will closely read a text in this lesson sequence. Some may benefit from additional support. Consider these options:
  - For students who are overwhelmed by too much print on a page: Consider copying the text so that there is only one paragraph on each page, with an organized space for recording the gist and meanings of the unfamiliar words on that page.
  - For students who may need additional support with paraphrasing: Consider providing running notes on today's text.
  - Offer selected shorter passages to specific groups based on the readiness and needs of the groups. This gives students an opportunity to read a complex text within the fifth-grade level span but differentiates the length of the text, not the complexity.
  - For students who may need additional support staying on pace during the close read: Consider gathering these students in one place in the room to support them quickly and quietly throughout the close-read portion of the lesson. Give prompts to help students stay on task, point out where the class is, or offer sentence frames as needed.
  - For ELLs and students who may need additional support with reading and/or writing: Strategically pair them with a peer model.
  - For students who may need additional support determining the gist: Consider highlighting or underlining key phrases in their individual copy of the text in advance. This will lift the gist up for them.
- If students choose the investigative question "Can plants live without air?" they may require additional guidance for how to keep plants from having air. Suggest covering the leaves of the plant with a plastic bag, pushing out all the air, and then using a rubber band to secure the bag.
- When adding to the "Energy and Matter" column of the Concepts Scientists Think About anchor chart, use one color for information about matter and a different color for information about energy so students will not confuse the two concepts.

Down the road:

- Students will observe their plant for about a week. Be sure to provide at least 10 minutes at least three times a week for them to collect observational data in their student science notebook. Decide when to have these observations take place. Consider doing this during filler times, such as morning meeting, after lunch, or at the end of the day.
- Students will begin to make their own explanatory models in Lesson Sequence 5 and create a model as part of the performance task. Be sure to "think aloud" during developing the model in Section 3 to help students see how this is done.

In advance:

- Read each section and complete the Preparing to Teach: Self-Coaching Guide.
- Continue to establish expectations of behavior during group discussions and pair work.
- Pre-determine groups of three or four students for students to design and conduct their investigations of how plants interact with different types and amount of matter in Section 1.
- Designate a place in the classroom for students to store their seedlings after they have set up their investigation.
- Review the Think-Pair-Share and Back-to-Back and Face-to-Face protocols (see the Classroom Protocols pack on Curriculum.ELeducation.org).
- Post: Lesson sequence learning targets, lesson sequence focusing question, Life Science Module guiding question, Scientists Do These Things anchor chart, Concepts Scientists Think About anchor chart, and Criteria for Healthy Ecosystems anchor chart.

Optional extensions:

- N/A

Vocabulary

energy: the ability to do work

control: things that are not changed in an experiment but instead kept constant

variable: something that can be changed in an experiment; the thing that is under investigation in an experiment

Materials

General Materials

- ☑ Student science notebook (from Lesson Sequence 1; one per student)
  - — Plant Growth entry (page 10 of student science notebook)
  - — Anchoring Phenomenon entry (from Lesson Sequence 1; page 2 of notebook)
- ☑ "From Questions to Conclusions: The Experimental Process" (one per student)
- ☑ Scientists Do These Things anchor chart (begun in Lesson Sequence 2; added to in advance; see supporting materials)
- ☑ Class data sheet (new; co-created with students during Section 3)
- ☑ Class Explanatory Model of Photosynthesis (example, for teacher reference)

- ☑ Concepts Scientists Think About anchor chart (begun in Lesson Sequence 2; added to during Section 3; see supporting materials)
- ☑ Criteria for Healthy Ecosystems anchor chart (begun in Lesson Sequence 1; added to during Section 3; see supporting materials)

Science-Specific Materials (gathered by the teacher)

- ☑ Materials for plant investigation (used in Sections 1 and 2)
  - Seedling (two per group with a few extra)
  - Control seedling (one per class; maintained by the teacher)
  - Sandwich-size plastic bags (optional; several for groups to use)
  - Rubber bands (optional; several for groups to use)
  - Graduated cylinder (optional; several for groups to use)
  - Water (optional; available for groups to use)
  - Various other liquids (soda, coffee, or Kool-Aid; optional; available for groups to use)
  - Various solids (sawdust, sand, or fertilizer; optional; available for groups to use)
  - Various gases (incense, hairspray, or air freshener; optional; available for groups to use)
- ☑ Teacher science notebook (from Lesson Sequence 1; for teacher reference)

Section 1: Opening

A. Introducing Learning Target and Focusing Question (10 minutes)

- Direct students' attention to the posted lesson sequence focusing question and read it aloud:
  - "How do plants use energy and move matter through an ecosystem?"
- Underline the word *energy* [1] [2].
- Explain to students that plants use energy from the sun. This is called "solar energy."
- Using a total participation technique, invite responses from the group:

  "What matter do you think plants interact with in the ecosystem where they live?" (water and air)
- Direct students' attention to the posted lesson sequence learning targets and read the first one aloud as students follow along, reading silently in their heads:
  - "I can design an experiment to test how different types and amounts of matter affect plant growth."
- Using a total participation technique, invite responses from the group:

  "What are some different types of matter that we could experiment with? (Responses will vary, but may include: different liquids, such as Kool-Aid™, coffee, or soda; changes to the solids that plants interact with, such as soil or sand; and changes to air quality, such as adding air freshener, incense, or smoke.)

  "How could we change the amount of matter that plants have access to?" (Student ideas will vary, but may include: measuring the amount of water the plant is provided with, removing air from the space where the plant is growing, or changing the amount of soil that the plant is growing in.)

- Clarify for students that they will be designing their own experiment to test how plants use solar energy to interact with different types and amounts of matter after reading about an experiment designed by other scientists.
- Invite students to open their **student science notebooks** to the **Plant Growth entry** and find the "Opening" section.
- Ask students to take a few minutes to draw a picture or write down a few words in response to the lesson sequence learning target and focusing question.

Preparing to Teach: Self-Coaching Guide

1. What experience do my students have with energy?
2. What misconceptions did I hear them articulate in Lesson Sequence 1 or 2?

Section 1: Obtaining Information

A. Close Reading: "From Questions to Conclusions: The Experimental Process" (35 minutes)

- Give students specific positive feedback for sharing their ideas about what types of matter they could experiment with to affect plant growth. (Example: "I heard you thinking specifi cally about how we could change the air around a plant.") Assure them that they will get a chance to design their own experiments after reading about the process that other scientists use.
- Distribute "**From Questions to Conclusions: The Experimental Process.**"
- Tell students that they will work hard as readers today to learn more about the experiment process and the way plants interact with matter. Their new learning will help them understand how matter moves through an ecosystem.
- Remind students that when they read complex texts, they often need to read the text multiple times. Tell them that it's okay if they do not understand everything the text says the first time. Reiterate that generally, each reading is for a different purpose. For example, the first reading is generally to get a gist or an idea of what the text is about and to identify unfamiliar vocabulary. Then, additional readings are done to glean details and a better understanding of what the text is saying explicitly and implicitly [(1)].
- Remind students of some of the close reading routines they use in their Language Arts lessons:
  - Read small chunks of the text slowly and think about the gist.
  - Talk with my partner or group about the text.
  - Circle or underline words I don't know.
  - Write notes or answer questions about the text.
- Refer students to the "Obtaining Information" section of the Plant Growth entry in their student science notebook. Let students know they are going to have the opportunity to independently read the text. Tell them to stop after each paragraph during this first read and jot the gist of that paragraph and any unfamiliar vocabulary in their notebook. Review and model finding the gist as necessary [(2)].

- Ask students to begin reading. Circulate and support them as they read and determine the gist.
- After 10 minutes, ask students to turn to and talk to an elbow partner [3]:

  "What gist notes or vocabulary words did you write down? What similarities and differences are there between our notes?"
- After 5 minutes, refocus whole class. Point out to students that their job is to learn everything they can about how scientists design an experiment. Explain that they should gather as many *facts*, *definitions*, and *details* as they can as they read. Clarify these terms as needed.
- Tell students they are going to read the text again. This time, they should read closely for details to add to the "Obtaining Information" section of the Plant Growth entry of their student science notebook.
- Consider doing a brief guided practice, as necessary [4].
- Ask students to begin reading. Circulate and support students as they read.
- After 10 minutes, invite students to Think-Pair-Share with an elbow partner. Remind them that they used this protocol in Lesson Sequence 2, and review as necessary. Refer to the Classroom Protocols pack on Curriculum.ELeducation.org for the full version of the protocol:

  "What should be taken into consideration when planning an experiment?" (Decide what the variable is and what will be the control.)

Preparing to Teach: Self-Coaching Guide

1. How will I provide additional support to students who need it for this close read?
2. Would students benefit from a more robust note-taking sheet?
3. What intentional pairs will I create?
4. What paragraph would be good for guided practice?

Section 1: Planning and Carrying Out Investigation

A. Scientists Meeting: Planning Investigation (45 minutes)

- Ask students to bring their science notebooks and gather for a Scientists Meeting [1].
- Using a total participation technique, invite responses from the group:

  "What are the norms of a Scientists Meeting?" (take turns talking, build on one another's ideas, disagree respectfully, ask questions to clarify information.)
- Remind students that a Scientists Meeting is a conversation where they speak to one another as scientists and not just to the teacher.
- Share with students that the goal of today's meeting is to plan an investigation by thinking about the experiment they just read about and then planning their own investigation that tests how different types and amounts of matter affect the growth of plants (different liquids, different solids, different air, different quantities) [2].
- Ask students to consider what can be the variable in their experiment. Ask:

  "Think about the parts of the ecosystems where plants live in the classroom—air, water, plant, pot, soil, earth Materials, temperature, amount of light—which of these are matter?"

"Which of these can be changed in a measurable way? (water—amount, type of fluid; air—cover the plant with a plastic bag and push out the air, air quality—air freshener or incense; solid—type of soil, sand, amount of soil, pot)

- Explain that scientists always plan and record their directions for carrying out an investigation so others can replicate their process. Tell students that they will plan and record their own process in a clear and detailed way so that others could also replicate their investigations.
- Move students into predetermined Plant Investigation groups.
- Explain that scientists always follow the same directions when planning an investigation and that to plan their investigation, they will follow the same directions.
- Direct students' attention to the posted **Scientists Do These Things anchor chart** and ask [3]:

  "Based on 'From Questions to Conclusions: The Experimental Process,' what are the steps for planning an investigation?" (Responses will vary, but should include the following.)

  1. Pose a question that can be investigated with trials
  2. Decide what can be changed (variables)
  3. Set up the procedure
  4. Record observations/collect data
- Add student answers to the Scientists Do These Things anchor chart [4].
- Refocus students on the Plant Growth entry in their student science notebook. Ask them to put their finger where they will record their own question for an investigation.
- Guide students in writing their own investigative question. Consider asking [5]:

  "What type of matter do you think will affect plants' growth?"

  "Do you think the amount of a particular type of matter will affect how the plant grows?"
- Ask groups to share out. As they do so, tell them they have good investigation questions so that they can now design some tests, or trials, to see how different types and amounts of matter affect plant growth.
- Emphasize the importance of testing only one *variable* at a time. Tell students that when scientists investigate a question, they want to look at only one variable at a time. That means they should change one thing at a time so they can isolate what is causing any change.
- Encourage students to work with their group to agree on a variable that they are all interested in investigating.
- Invite students to discuss possible variables with their group and record one in the space provided in their student science notebook [6].
- Encourage groups who are having trouble deciding on a variable to talk with other groups who have decided on a variable.
- After all groups have decided on an investigative question and a variable, distribute two **seedlings** to each Plant Investigation group. Tell students the exact amount of water that seedlings have been given so that this variable can be addressed or maintained in their seedlings. Tell them the *control* seedling will continue to be watered the same way. Explain to students that you will maintain the **control seedling**. Define *control* as needed [7].
- Explain to students that they should label each seedling "Test #1" and "Test #2." They should treat the two "test" seedlings the exact same way. Briefly discuss the importance of multiple trials, as needed.

- Tell students that they must work with their group to set up a procedure for how to test their variable on the seedlings for one week. Show students the other Materials available for the experiment, including the **sandwich-size plastic bags**, **rubber bands**, **graduated cylinder**, **water**, and **various other liquids**, **solids**, and **gases**.
- Remind students that their procedure should include a Materials list and information on how to keep all other variables the same for their seedlings as the control seedling besides the one they have chosen to change. (Example: If you have chosen the variable of amount of air, then you should plan how to keep the amount of water for the plant the same as it has been.)
- Invite students to begin working with their group.
- After 10–15 minutes, check student science notebooks for completion of a Materials list and procedure and then have groups set up their investigation by following their own procedure.
- After 10 minutes, refocus whole group.
- Ask students to clean up their Materials, place their seedlings in the pre-determined place in the classroom, and return to their seats [8].
- Draw students' attention to the Scientists Do These Things anchor chart and review what steps have been completed for Planning an Investigation. Point out that they have completed steps 1–3 and must now make a plan for how they will record observations and collect data for the next week.
- Using a total participation technique, invite responses from the group:

  "What types of observations will your group need to make over the next week, and what is the best way to organize this data?" (observations about plant growth; record the date and time of each observation and perhaps organize this information in a table with columns)

Preparing to Teach: Self-Coaching Guide

1. Planning and carrying out this investigation will be run like a workshop and will require some student independence. What experience do my students have with workshop class time?
2. What experience do my students have with planning investigations? Where will they need additional support?
3. What parts of the text can I point the students to if they are not getting the steps to the experimental process?
4. What experience do my students have with the basic components of an investigation, including the need for multiple trials, variables, and controls? Do I need to spend more time explaining the reason for these components?
5. If my students are having trouble coming up with an investigation question that is measurable, what can I do?
6. How can I use some of the following questions to stimulate student thinking about variables?
   - "If we change … what would happen to …?"
   - "What do you think will happen if we change …?"
   - "What do you think will happen if …?"
   - "Have you considered …?"

7. If my students have conducted other investigations or I have the space for additional seedlings, I may consider letting student groups set up their own control.
8. How can I help my students efficiently clean up and transition?

Section 2: Carrying Out Investigation

Note: This section will be completed across a seven-day span.

A. Observing Plants (5–10 minutes; times may vary)

- For the next seven days, continue to provide time for groups to follow their decided-upon procedure for caring for their seedlings (1).
- Invite students to take their student science notebooks and move to sit with their Plant Investigation groups.
- Ask students to open their student science notebooks to the Plant Growth entry and find the "Data/Observation" section.
- Model making observations and recording data on the first day, using one of the group's seedlings.
- Encourage students to make detailed observations (touching, smelling, and looking closely) of their seedlings and to record these details in the organized format that was previously decided upon (2) (3).
- Provide students with 5–10 minutes to observe and record in their student science notebooks.

Preparing to Teach: Self-Coaching Guide

1. What classroom systems do I have in place that can accommodate observation?
2. With what level of detail are my students making observations?
3. How can I encourage them to be more thorough?

Section 3: Analyzing and Interpreting Data

Note: Begin Section 3 once students' observations from Section 2 are complete (after approximately one week).

A. Reviewing Learning Target and Focusing Question (10 minutes)

- Remind students of the focusing question for this lesson sequence (1):
  - "How do plants use energy and move matter through an ecosystem?"
- Tell students they will analyze the data from their investigation and work together to create a class model of how plants use energy to change matter into matter with usable stored energy.
- Direct students' attention to the posted lesson sequence learning targets. Tell students that they are going to wrap up their learning on the first learning target and move on to focusing on the second learning target.

- Ask a student volunteer to read the second learning target aloud while other students follow along, reading silently in their heads:

  — "I can develop a model to explain how plants use matter and energy to produce food."
- Using a total participation technique, invite responses from the group:

  "What will we be learning and doing today?" (how plants use energy to change matter into food—which is matter with usable energy)
- Answer clarifying questions.
- Invite students to open their student science notebooks to the Plant Growth entry and find the "Analyzing and Interpreting Data" section.
- Ask students to take a few minutes to draw a picture or write down a few words in response to the posted lesson sequence learning targets and focusing question.

Preparing to Teach: Self-Coaching Guide

1. How can I quickly transition my students to science time?

B. Drawing Conclusions: Plant Investigation (20 minutes)

- Give students specific positive feedback on their careful and persistent efforts to collect data through observation. Tell them that analyzing the data will help them answer their investigative question.
- Using a total participation technique, invite responses from the group:

  "How did your group's seedling respond to the matter you used in the investigated?" (Responses will vary.)
- As students share out, capture their responses on a **class data sheet** so it will be visible to everyone [1].
- Consider asking clarifying and probing questions about the data, such as the following:

  "How much?" (Responses will vary, but should provide a descriptive amount.)

  "Was there anything surprising in the data?" (Responses will vary.)

  "What type of matter are you naming?" (solid, liquid, gas)
- Avoid "show and tell" of data. Be purposeful when choosing groups to share out. Call on groups that will help the whole class see the specific needs of plants for *photosynthesis* (i.e., the groups that grew plants without water or air).
- After you have collected the data on the class data sheet, ask students to evaluate the data they collected by asking such as:

  "Why do you think that variable has that type of effect on the plant?" (The plant needs this variable to be healthy and grow.)

  "What patterns do you notice?" (Responses will vary.)
- Remind students they have all been investigating how different types and amounts of matter affect the growth of plants. Select a volunteer to read their investigation question from their student science notebook.
- Tell students they are going to share their responses to their own investigative question using the Back-to-Back and Face-to-Face protocol. Remind them that they used this protocol in the Language Arts modules. Review as necessary. Refer to the Classroom Protocols pack on Curriculum.ELeducation.org for the full version of the protocol.

- Have students find a partner and stand back-to-back with each other, being respectful of space.
- Ask students the following question and give them 30 seconds to consider how they will respond:

  "How do different types and amounts of matter affect the growth of plants?"
- Invite students to turn face-to-face to share their responses.
- Have students repeat these steps with a new partner.

- As students share, circulate to take notes on student conversations in the **teacher science notebook** [(2)].
- Be sure that students identify that plants primarily get their matter from air and water. Plants do get trace amounts of matter from the nutrients they absorb from the soil. These nutrients play an important role in the health and function of the plant but do not provide the matter that a plant converts into plant matter through photosynthesis.
- Ask students to return to their seats.

Preparing to Teach: Self-Coaching Guide

1. What if the results of the student investigations are inconclusive? What questions can I ask?
   - Consider:
     - What would happen if we extended these investigations?
     - What would you do differently if you were doing this investigation again?
     - I'm really surprised by these results because ...
2. If I hear some misconceptions about where plants get their matter from, what questions can I ask? (Consider having a text ready and saying: "Let's read more about what scientists say about this.")

Section 4: Evaluating Information

A. Developing a Model (40 minutes)

- Give students specific positive feedback on collecting information through their investigations about the matter that plants use for growth. (Example: "I saw students working collaboratively, raising questions, and recording detailed observations.")
- Remind students that their task for the day is to develop a model to show how plants use solar energy to change the matter that they have identified as necessary for plant growth into matter with usable stored energy (the plant growth) [(1)].
- Direct students' attention to the Scientists Do These Things anchor chart and read aloud the first bullet under "Develop a Model":
  - "A model can be a drawing or a diagram, a physical replica, or a simulation and can be used to explain a process or idea."
- Tell students that as a class they will make an explanatory model to explain the process of photosynthesis [(2)].

- Add "Photosynthesis Explanatory Model" to the "Examples of evidence: observations from an experiment" row on the Scientists Do These Things anchor chart.
- Remind students that during Lesson Sequence 4 they learned the vocabulary word *photosynthesis*.
- Briefly review the root words *photo-* (light) and *-synthesis* (to put together).
- Using a total participation technique, invite responses from the group:

  "What light is available to plants in their ecosystem?" (sunlight)

  "Based on what you have read and observed through your investigation, what types of matter do plants need to 'put together' for growth?" (water and air)

  "How can we show through a picture how the plant interacts with water and air?" (draw the plant, water, and air; add labels)
- Collaboratively create an explanatory model for photosynthesis. Refer to the **Class Explanatory Model of Photosynthesis** for guidance.
  - Ask students probing questions and then draw their responses. Invite students to copy the model into their student science notebook in the "Developing a Model" section of the Plant Growth entry.

  "What matter and energy is combined for photosynthesis to happen?" (Air and water are the matter, and sunlight is the source of energy.)

  "What matter and energy is a result of photosynthesis?" (food—sugar)

  "What might we add to our model to help us explain how matter and energy interact in photosynthesis?" (arrows and labels)
- After the model is complete, again direct students' attention to Scientists Do These Things anchor chart.
- Using a total participation technique, invite responses from the group:

  "What process does this model explain?" (the process of photosynthesis)

  "What if we removed the arrows from this model? How might the model be misunderstood if the arrows weren't there?" (direction of Materials would be confused)
- Tell students that in Lesson Sequence 5 they will be making their own explanatory models of ecosystems and that you look forward to seeing how they explain phenomena with a model.

Preparing to Teach: Self-Coaching Guide

1. What experience do my students have with creating models?
2. What experience do my students have with photosynthesis?

B. Scientists Meeting: Building Understanding (20 minutes)

- Ask students to bring their science notebooks and gather for a Scientists Meeting.
- Using a total participation technique, invite responses from the group [1]:

  "What are the norms of a Scientists Meeting?" (take turns talking, build on one another's ideas, disagree respectfully, ask questions to clarify information)
- Remind students that a Scientists Meeting is a conversation where they speak to one another as scientists and not just to the teacher.

- Direct students' attention to the posted Life Science Module guiding question and read it aloud:
  - "How do we assess and improve the health of an ecosystem?"
- Share with students that the goal of today's meeting is to build their understanding of how plants interact with matter in an ecosystem.
- Explain that they will evaluate the data they have collected in their notebook and on the class data sheet in order to come to consensus about how plants help matter flow.
- Direct students' attention to the "Energy and Matter" column on the **Concepts Scientists Think About anchor chart**.
- Ask students to turn and talk with an elbow partner:

  "What interaction do plants have with the matter in their ecosystem?" (Plants cause water and air [matter] to flow and cycle as they change water and air into sugar and release oxygen.)
- Add this example to the "Matter and Energy" column on the Concepts Scientists Think About anchor chart.
- Remind students that in Lesson Sequence 1 they viewed the Assessing the Health of an Ecosystem slideshow to see pictures of the Olympic National Forest ecosystem. Their job is to assess the health of that ecosystem.
- Ask [2]:

  "How might photosynthesis be important to a healthy ecosystem?" (Photosynthesis is the process through which the energy of sunlight is captured and made usable in an ecosystem.)

  "How might energy flowing be important to a healthy ecosystem?" (If energy is flowing, it is available to the animals to carry on life functions.)

  "What role do plants play in the cycle of matter?" (They convert the matter in water and air into plant matter, which animals can eat and get energy from.)

  "What role do plants play in the cycling of matter and energy?" (They capture the sunlight to begin the cycle of energy and matter.)
- Draw students' attention to the **Criteria for Healthy Ecosystems anchor chart** and ask:

  "Plants are an integral part of the big cycles of matter and energy that we see in a healthy ecosystem. How should we capture this on the anchor chart?" (Response will vary, but should include something like: Plants help cycle matter and energy through photosynthesis in a healthy ecosystem.)
- As students share out, capture their thinking on the Criteria for Healthy Ecosystems anchor chart. Refer to Criteria for Healthy Ecosystems anchor chart (for teacher reference) in the supporting Materials as necessary [3].
- Invite students to turn to the **Anchoring Phenomenon entry** in their student science notebook and put their finger on the "Scientists Meeting" section.

- Ask students to revisit their initial thinking about the health of an ecosystem and then add evidence based on information they have discussed in this Scientists Meeting.
- Invite students to return to their seats.

Preparing to Teach: Self-Coaching Guide

1. What norms will I emphasize in this Scientists Meeting?
2. Which students will I specifically encourage to participate?
3. I want to be sure students understand the importance of plants to an ecosystem. What student statements will I listen for? What will I ask to draw out their understanding? (Note: Students will talk about the role of plants as producers when they study the food chain. Reinforce the idea that plants are very important to an ecosystem then.)

Notes