Grade 4: Life Science Module

Lesson Sequence 9: Structure of Seeds

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Overview

Total Time: 2 hours of instruction (divided into three sections)

NOTE: Allow two weeks between Section 2 and Section 3 for seed germination. Students will observe the seeds planted in Section 2 for 10 to 14 days before they can move on to Section 3.

In this lesson sequence, students continue to build knowledge about the structures of plants. Students learn that seeds are specially adapted for survival and that the parts of the seed form a system that helps a plant survive. Through dissecting a seed and creating a germination bag, students observe the three parts of a seed and how they work together as a system. Students create an explanatory model of a seed that names each component of the seed and its function and its relationship to the other components.

Lesson Sequence Focusing Question and Big Ideas

How do the parts of the seed work together as a system in order to grow and survive?

- The parts of a seed are the seed coat, the embryo, and the cotyledon. The seed coat provides protection for the seed, the embryo is the baby plant, and the cotyledon provides food for the embryo before the plant is able to make its own food through photosynthesis.
- The parts of a seed function together to ensure that a seed is able to germinate and eventually grow into a young plant that will continue the survival of its species.

Long-Term Learning Addressed (Based on NGSS)

Develop a diagram to explain that once growing conditions are favorable, seeds contain everything a new plant needs to germinate, grow, and reproduce, including an embryo (baby plant), cotyledon (food), and seed coat. (Based on NGSS 4-LS1-1)

This lesson sequence explicitly addresses:

Science and Engineering Practices:

- **Developing and Using Models:** Develop and/or use models to describe and/or predict phenomena. *Students construct an explanatory model describing the parts of a seed, namely the embryo, cotyledon, and seed coat. The diagram created and revised by students identifies the components of the seed and the relationships among those components. Note: This Science and Engineering Practice is not explicitly aligned with 4-LS1-1.*

Crosscutting Concepts:

- **Structure and Function:** The way in which a living thing is shaped and its substructures determine its properties and function. *Students learn the different components of a seed, a substructure of plants, and observe how they work together to germinate and turn into a plant. Students also observe the specialized adaptation of roots called geotropism. Note: This Crosscutting Concept is not explicitly aligned with 4-LS1-1.*
- **Systems and Systems Model:** A system can be described in terms of its components and their interactions. *Students learn the components of seeds and how they work together to form a system that enables growth and survival.*

Disciplinary Core Ideas:

- **LS1.A Structure and Function:** Plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. *Students learn the structure and function of seeds, and how they help plants survive and reproduce.*

Lesson Sequence Learning Targets

- I can explain the function of the parts of a seed through an explanatory model.
- I can explain how geotropism supports the function of the roots.
- I can explain how the structures of a seed work together as a system to grow new plants.

Ongoing Assessment

- Scientists Meeting: Building Understanding
- Participation in Back-to-Back and Face-to-Face protocol
- Student science notebook: Seed Structure entry
  - Conclusion: Seed Explanatory Mode l

Agenda

Total Time: 2 hours of instruction, plus two weeks for seed germination

As part of their investigation, students will observe the seeds in Section 2 for 10–14 days before they can move on to Section 3. While students carry out their investigation, they should move on to Lesson Sequence 10 and revisit Lesson Sequence 8.

Section 1

1. **Opening**
   A. Reviewing Learning Targets (5 minutes)
   B. Scientists Meeting: Building Understanding (15 minutes)
2. **Carrying Out an Investigation**
   A. Dissecting Lima Beans (20 minutes)
   Optional Extension: Corn Seed Dissection

Section 2

1. **Carrying Out an Investigation**
   A. Creating Germination Bags (20 minutes)
   B. Observing Germination Bags
   (Note: This time is spread out over two weeks. Times will vary.)

Section 3

1. **Obtaining Information**
   A. Reviewing Learning Targets (5 minutes)
   B. Gathering Information about Seeds (15 minutes)
   C. Revisiting Germination Bags (20 minutes)

2. **Evaluating and Communicating Information**
   A. Scientists Meeting: Building Understanding (10 minutes)
   B. Creating the Seed Explanatory Model (10 minutes)
      Optional Extension: Scientific Drawing Mini Lesson

Teaching Notes

Purpose of lesson sequence and alignment with NGSS standards:

- In this lesson sequence, students continue to build knowledge about the structure and function of plants (a Disciplinary Core Idea and Crosscutting Concept) by studying seeds and the germination process. They observe the different parts of seeds and how they work as a system (a Crosscutting Concept) to germinate, grow, and survive.
- In Section 1, students participate in a Scientists Meeting to generate ideas about seeds. They then dissect a lima bean and compare what they find to a diagram of a corn seed and a radish seed dissection. They note the pattern of similar features in each seed and begin to develop a seed model (a Science and Engineering Practice).
- In Section 2, which will be spread out over two weeks, students create and observe germination bags. As the first roots of the seed emerge and grow downward, students turn the germination bag upside down. Students will then see the phenomenon of geotropism in which the roots are adapted to always grow downward.
- In Section 3, students watch a short video that reinforces their learning about the parts of a seed and teaches them the scientific vocabulary and function of these parts. Finally, students return to their initial models of seeds and revise to include the additional information. The final explanatory model of a seed names each component of the seed and its function and relationship to the other components.

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

- In Lesson Sequence 7, students learned about the different structures of plants and how those structures help plants survive. In Lesson Sequence 8, students started an investigation that ultimately helps them learn about the specialized structures of grass that allow it to survive in a variety of ecosystems. In this lesson sequence, students continue to focus on specialized structures of plant—the seed. Building on the drawing students did in Lesson Sequences 5 and 7, students practice creating high-quality explanatory models, which will continue to prepare them for when they have to do this as their performance task in Lesson Sequence 11.

How it connects to the CCSS Standards and EL Education's Language Arts Grade 4 Module 2:

- Language Arts Grade 4 Module 2 focuses on defense mechanisms needed for survival. Encourage students to see connections between animal adaptations for survival and plant adaptations for survival.
- Students use the Back-to-Back and Face-to-Face and Think-Pair-Share protocols in the Language Arts module.

- The reading skills used in the Language Arts module will be applicable in this lesson sequence as students try to make sense of the geotropism article. This text provides students the opportunity to practice reading informational texts (CCSS ELA RI.4.1 and RI.4.3).
- The Scientists Meetings in Section 1 and Section 3 provide students with the opportunity to practice their speaking and listening skills while collaborating in whole-group discussions (CCSS ELA SL.4.1).

Possible student misconceptions:

- Students may think that seeds are not alive. Inquire as to why they think that. If students think that seeds are dead because they are not moving and changing, ask them to name the time when seeds do move and change.
- Students may not understand seed dormancy as being important to the survival of plants in nature due to different seasons. Consider asking: "Why don't seeds just start growing immediately?" and "What would happen to seeds if they germinated just before winter started?"
- Students may think seeds need sunlight to germinate. Seeds actually only need the temperature to be correct, as well as adequate space and water. To correct this misconception, place a few germination bags in a cupboard or other dark space until they have sprouted (once they have sprouted, bring them into the light) and keep other germination bags out for students to easily observe throughout the day. All other variables should stay the same (amount of water in the observation bag and space for the seeds). Have students compare the germination bags that were kept in the dark with those that were kept in the light.
- Students may think that properties and functions differ among seeds. Support students in seeing the commonalities among all seeds by comparing multiple seed diagrams during the seed dissection, including making a prediction about a grass seed's structures, and using a variety of seeds in the germination bags. When selecting seeds to use in the germination bags, be sure to include a combination of monocots (corn, grass) and dicots (radish, lima bean).

Possible broader connections:

- Ask students to share if they have ever planted seeds at home, focusing on the process and result.
- Connect to students' understanding of systems if they have studied other systems, such as the circulatory system or the solar system.
- Consider discussing seeds that are regularly eaten, such as grains and beans.

Areas where students may need additional support:

- Students who need additional support with fine motor skills may find the lima bean dissection to be challenging. Consider pairing students intentionally and specifying roles. One student can dissect while another student can be in charge of holding the magnifying glass for others.

Down the road:

- Students will not learn the scientific names of the parts of the seed until Section 3 of this lesson sequence. Allow them to use whatever terms they choose until that time.

- Students will observe the germination bags for the next two weeks. Provide at least 5 minutes, at least three times a week, for students to collect observational data in their student science notebook. Consider alternating days with the grass and radish plant observations from Lesson Sequence 8.

In advance:

- Read each section and complete the Preparing to Teach: Self-Coaching Guide.
- Prepare technology necessary to play the "Seeds" video <https://www.youtube.com/watch?v=wMcMPIKP6S8>.
- Choose an exemplar student plant explanatory model from Lesson Sequence 7 to use as a model during Section 1 to remind students of the parts of an explanatory model.
- Set up a document camera to display the exemplar student plant explanatory model and other documents throughout the lesson sequence (optional).
- Soak the lima beans for 24 hours before the lima bean dissection in Section 1. Prepare extra lima beans for students who damage their first bean or are unable to dissect the bean accurately on the first try.
- Create intentional groups of four students for creating germination bags in Section 2.
- Gather materials for the seed dispersal design challenge in Lesson Sequence 10.
- Review the Back-to-Back and Face-to-Face and Think-Pair-Share protocols (see the Classroom Protocols pack on Curriculum.ELeducation.org).
- Post: Norms of a Scientists Meeting anchor chart, Lesson sequence learning targets, Life Science Module guiding question, Scientists Do These Things anchor chart, Plant Structures and Functions anchor chart, Concepts Scientists Think About anchor chart.

Optional extensions:

- *Corn seed dissection:* Students can dissect corn seeds instead of looking at pictures.

Vocabulary

adaptation: a change in a plant or animal that happens over many generations and helps the plant or animal survive better
system: multiple parts that must all be present and working together
germination: when a seed begins to grow
variable: something that is changed in an experiment
cotyledon: food "leaf" for a baby plant
embryo: the baby plant inside a seed
seed coat: protection for seed
geotropism: how the roots of a plant always grow down

Materials

General Materials

- ☑ Norms of a Scientists Meeting anchor chart (begun in Lesson Sequence 1)
- ☑ Life Science Module guiding question (from Lesson Sequence 1; one to display)
- ☑ Teacher science notebook (one for teacher use)

- ☑ Exemplar student plant explanatory model (from Lesson Sequence 7; one to display; see Teaching Notes)
- ☑ Scientists Do These Things anchor chart (begun in Lesson Sequence 2; added to in Section 1)
- ☑ Student science notebook (from Lesson Sequence 1; one per student)
  - Seed Structure entry (page 48 of student science notebook)
  - Plant Structures Are a System entry (page 36)
- ☑ Corn and radish seed diagrams without labels (one to display)
- ☑ Corn and radish seed diagrams with labels (for teacher reference)
- ☑ Directions for Creating Germination Bags (one to display)
- ☑ "Seeds" (Video; play from 0:00 to 1:01; see Teaching Notes)
- ☑ Colored pencils (two different colors per student)
- ☑ Plant Structures and Functions anchor chart (begun in Lesson Sequence 7; added to in Section 3)
- ☑ "Roots and Geotropism" (one per student)
- ☑ Concepts Scientists Think About anchor chart (begun in Lesson Sequence 2; added to in Section 3)

Science-Specific Materials (gathered by the teacher)

- ☑ Materials for lima bean dissection (One set for every two students; used in Section 1)
  - Lima bean (soaked for at least 12 hours)
  - Magnifying glass
  - Tweezers
- ☑ Grass seeds (a few per pair)
- ☑ Materials for germination bags (One set for every four students; used in Section 2)
  - Clear plastic bags
  - Paper towel
  - Seeds (Any combination of grass, green bean, corn, lima bean, barley, radish)
  - Permanent marker
  - Water spray bottle
  - Stapler

Section 1: Opening

A. Reviewing Learning Targets (5 minutes)

- 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 (1):

  — "I can explain the function of the parts of a seed through an explanatory model."

- Using a total participation technique, invite responses from the group:

  "What will we be learning and doing today?"

- Clarify for students that they will only be starting their models today based on the seed dissection. They will continue to revise their models as they learn more about seeds.

Preparing to Teach: Self-Coaching Guide

1. Students will not be writing in their student science notebooks during this opening. How can I lead an effective conversation about the learning for today?

B. Scientists Meeting: Building Understanding (15 minutes)

- Ask students to bring their student science notebooks and gather for a Scientists Meeting.
- Remind them 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 **Norms of a Scientists Meeting anchor chart**:
  - We take turns talking.
  - We build on one another's ideas.
  - We disagree respectfully.
  - We ask questions when we don't understand.
- Direct students' attention to the posted Life Science Module guiding question:
  - "How do the internal and external structures of plants or animals function together as a system to help them survive well in a given habitat?"
- Tell students the goal of this meeting is to build their understanding of the structures and functions of plants.
- Remind students that they already have some ideas on how to answer the guiding question.
- Using a total participation technique, invite responses from the group [1]:

  "What structures of plants do you know help plants to survive? How do they support survival?" (stem, leaves, roots, thorns, flowers)

  "How do the parts work together?" (Responses will vary. Example: Roots collect water from underground, and the stem transports the water through the plant.)

  "Are there structures that support survival in a particular habitat? How?" (Responses will vary. Example: Tiny hairs on leaves of plants in the tundra help insulate the plants against the cold.)

- Encourage students to listen to and respond to one another's ideas. Consider using or prompting students to use the following [2]:

  "What do you mean by ...?"

  "Tell me more about ..."

  "This is what I think you are saying ..."

  "Who can add to this idea?"

  "Explain what John said in your own words."

- After a few minutes, assure students they will learn more information to help them answer the guiding question. Tell them they will build a deeper understanding of the function of one particular structure in plants.
- Remind students that part of the flower (a specialized structure they learned about in Lesson Sequence 7) turns into seeds, and seeds are an important part for plant survival.

- Pose questions designed to elicit students' current understanding about seeds. Allow time for students to turn and talk to an elbow partner before facilitating a whole group conversation. Consider recording this initial conversation so students can listen and respond to it in Section 3 [3]:

  "What do you know about seeds?"

  "What do you think is inside a seed?"

  "What do seeds need in order to start to grow or germinate?"

  "What are adaptations? How do you think seeds are adapted for survival?"

  "The parts of a seed are a system. What do you think that means?"

- Ask pairs to share out. Clarify and capture their ideas in the **teacher science notebook**. Encourage students to provide evidence for their ideas, and follow up on outstanding questions they have. Consider prompting with questions such as [4]:

  "Why do you think that—what have you seen, heard, or read?"

  "What questions do you have about seeds?"

- Avoid feedback aimed at the scientific accuracy of students' thinking at this point, because the goal of this discussion is to understand students' current thinking [5].
- Record students' questions in the teacher science notebook [6].
- Assure students they will continue to build understanding of seeds and that they will return to these ideas throughout their study of plants.
- Invite students to return to their seats.

Preparing to Teach: Self-Coaching Guide

1. What do I expect my students to be able to articulate from their learning from Lesson Sequences 7 and 8?
2. Highlight two "productive talk moves" or prompts I'd like to try.
3. What experience have my students had with seeds? What will my students likely say?
4. Will I capture students' questions publicly, or in my notebook?
5. What student responses will indicate misconception? (See Teaching Notes for suggestions.)
6. How will I use students' questions that I've captured in my notebook?

Section 1: Carrying Out an Investigation

A. Dissecting Lima Beans (20 minutes)

- Use a document camera to display an **exemplar student plant explanatory model**.
- Tell students that this is a strong example of an explanatory model and give them a few minutes to observe it [1].
- After 2 minutes, use a total participation technique to invite responses from the group:

  "How would this drawing be helpful to someone who has never seen a plant before? Why?"
  (Responses will vary but may include: They would be able to see the parts of the plant working together.)

- Record students' explanations on the **Scientists Do These Things anchor chart** under the "Making Models" column.
- Arrange students in pairs, asking them to take their **student science notebook** with them.
- Distribute the **materials for lima bean dissection**.
- Invite students to open their student science notebooks to the **Seed Structure entry** and follow the procedure for dissecting a lima bean.
- Circulate to support students, providing extra lima beans in case students need to repeat the dissection [2] [3] [4].
- Monitor student progress. Take special note of students who are beginning to guess about the function of the various structures. Ask these students to share their ideas during the whole class sharing.
- When most groups have completed the dissection, post the **corn and radish seed diagrams without labels**. Encourage students to compare their diagrams with these diagrams of the corn and radish seeds.
- Ask pairs to consider and discuss:

  "What do these seeds all have in common?" (The three parts of the seed)
- Remember that students will learn the proper scientific vocabulary in Section 3. At this point, they should use whatever descriptive words they like.
- Refocus the whole class. Identify a few groups to share their diagrams.
- Ask [5]:

  "What patterns or similarities do you notice among the different seeds?" (They each have three parts.)
- Distribute **grass seeds** to each pair and explain that because these seeds are so small, students cannot dissect them; however, because students have seen a pattern in lima, corn, and radish seeds, they can reasonably predict what the inside of this seed will look like.
- Direct students' attention to their student science notebooks. Ask them to put their finger on the "Grass Seed Prediction" section of the Seed Structure entry.
- Once all students have their finger on the correct section, invite students to complete it.

Preparing to Teach: Self-Coaching Guide

1. What do I want students to name about the exemplar student plant explanatory model? (Preview the student task in Section 3; consider "accurate details" and "shows relationships" and then list two more criteria.)
2. What do I want each group to understand about lima bean seeds? (The seeds contain three distinct parts—endosperm, seed coat, embryo. Remember that students should not be expected to use the scientific terms yet.)
3. If students are having trouble identifying the three parts of the seed, what can I do to help? (Consider prompting students to make a closer observation; let student groups quickly share observations with other groups so both groups can get new ideas.)
4. What probing questions can I ask if they are not getting it? (Consider questions that ask them to look closer, such as: "Did you notice ...?" and "What else do you see?")
5. What pattern do I want them to name?

Section 2: Carrying Out an Investigation

Note: This section will be completed over a 10-day span.

A. Creating Germination Bags (20 minutes)

- Tell students that by dissecting seeds they have seen the parts of the seed. When these parts work together as a system, the seed is able to sprout—in other words, start growing into a young plant. This is called *germination*.
- Using a total participation technique, invite responses from the group [1]:

  "What does a seed need to germinate?" (Responses will vary. Students will likely say water, sunlight, and dirt.)
- Tell students that the only things a seed actually needs to germinate are the correct temperature, enough space, and the right amount of water.
- Display **Directions for Creating Germination Bags** and tell students that they are going to create a germination bag in order to observe how the parts of the seed work together so that the seed can grow into a young plant.
- Read the directions aloud as students follow along, reading silently in their heads. Answer clarifying questions.
- Discuss where the germination bags will be kept. Clarify for students that the seeds do not need light to germinate, but that the light won't hurt them either. Consider keeping some germination bags out in the open for students to observe easily while keeping others in a dark cupboard in order to demonstrate that light is not necessary.
- Arrange students in groups of four and assign roles. Each student should have one of the following roles:
  - Retrieve the materials
  - Wet the paper towel
  - Label the bag
  - Staple the seeds in place
- As groups finish, direct them to hang up the germination bags in the decided upon location(s) [2].
- Invite students to turn to the "Carrying Out an Investigation" section of the Seed Structure entry in their student science notebook and record their prediction for what they think will happen to the seeds in their germination bag.

Preparing to Teach: Self-Coaching Guide

1. If students name sunlight as a requirement, I might correct this misconception by placing a few germination bags in a cupboard or other dark space until the seeds have sprouted. See Possible Student Misconceptions in the Teaching Notes.
2. Where will I direct students to hang the germination bags?

B. Observing Germination Bags (5–10 minutes; times may vary)

- For the next 10 days, continue to spray the germination bags with water in order to keep the paper towel moist.

- Invite students to take their student science notebooks and move to sit with their germinating groups.
- Ask students to open their student science notebooks to the Seed Structure entry and find the "Data/Observation" section and draw a picture of what the sprouting seeds look like [1].
- Model making observations and recording data using the grass and radish control samples [2].
- Once the roots have grown to about an inch, ask:

  "How are your predictions similar to and different from what you are observing?" (Responses will vary but may include: The roots grew downward like I expected.)
- Ask students to make a prediction under "Prediction #2" in the Seed Structure entry regarding what will happen to the roots if the seeds are turned upside down.
- Rotate the bags. Consider turning some bags completely upside down and others only onto their side.
- Over the next few days, continue to have students record their observations in their student science notebooks [3].
- Students will observe the roots turning so that the roots are again pointing downward and name the phenomenon in their own words. Do not give them the term *geotropism* yet. They will learn it when they read "Roots and Geotropism" in Section 3.

Preparing to Teach: Self-Coaching Guide

1. How will I quickly and effectively have students make observations?
2. How can I encourage my students to be precise in their observations?
3. Some of my students may need more room to draw their observations in the student science notebook. I can staple additional pages into the notebook or give them sticky notes to add to the entry. Which students may benefit from this?

Section 3: Obtaining Information

Note: Begin Section 3 once students' observations from Section 2 are complete (after approximately 10 days).

A. Reviewing Learning Targets (5 minutes)

- Direct students' attention to the posted lesson sequence learning targets, and ask for a volunteer to read the first learning target aloud while the other students follow along, reading silently in their heads:

  — "I can explain the function of the parts of a seed through an explanatory model."
- Ask a student to explain what *function* means. (something's job)
- Tell students that they are going to collect some more information about seeds to learn the function of the different parts of the seed they observed during the lima bean dissection.
- Ask for a student volunteer to read the second learning target aloud while the other students follow along, reading silently in their heads:

  — "I can explain how geotropism supports the function of the roots."
- Underline the word *geotropism* and tell students that this is a scientific vocabulary word that they are going to define and learn about today.

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

  — ***"I can explain how the structures of a seed work together as a system to grow new plants."***

- Remind students that they have talked about structures and systems in previous lessons and are going to add more to their understanding of these concepts today[1].

Preparing to Teach: Self-Coaching Guide

1. What additional information would be helpful to review with students at this point?

B. Gathering Information about Seeds (15 minutes)

- Invite students to take out their student science notebooks.
- Prepare students for viewing the "Seeds" video, ensuring that all students can see and hear.
- Tell them that as they watch the video, they should record new vocabulary and definitions in the "Obtaining Information" section of the Seed Structure entry in their student science notebooks, as well as consider the gist of the video.
- Show **"Seeds"** [1].
- Ask students to turn and talk to an elbow partner:

  "What is the gist of the video?" (Seeds have three parts, that each perform a function to help the seed survive.)

- Tell students you are going to play the video again, and this time they should pay particular attention to the vocabulary words.
- Play the video again and pause it as new vocabulary is introduced. At each pause point, let students turn and talk about the word and possible definition with an elbow partner[2].
- Once students have completed their second viewing, invite them to turn and talk to an elbow partner:

  "What new information have we learned about the structures in a seed?" (Seeds have an embryo, cotyledon, and seed coat.)

- Invite students to turn to the lima bean dissection diagram in their student science notebook. Then ask students to turn and talk with an elbow partner:

  "How can we revise this diagram of a lima bean seed to reflect that new information?" (Add labels and explanations)

- Invite students to turn and talk with an elbow partner:

  "How do you plan to revise your diagram of a lima bean seed?" (Add labels to the seed coat, embryo, and cotyledon and explanations about how they work)

- Remind students that scientists frequently go back and revise their ideas as they get new information. Tell students they are going to use a colored pencil to revise their diagram so they can easily see their revisions.
- Distribute **colored pencils**.
- Direct students to revise their lima bean dissection diagram.
- After 5 minutes, ask for volunteers to share their definitions of the structures *seed coat, cotyledon,* and *embryo* and explain how they function together.
- Record student thinking on the **Plant Structures and Functions anchor chart**.

Preparing to Teach: Self-Coaching Guide

1. If I'm short on time, the first minute of this video provides the most crucial information. Students learn about seed dispersal in Lesson Sequence 10.
2. How will I support students as they try to spell these new terms?

C. Revisiting Germination Bags (20 minutes)

- Invite students to take their student science notebooks and sit with their germinating groups.
- Draw students' attention to their germination bags and ask them to discuss with their group [1]:

  "Can you still see any of the original parts of seed?" (Responses will vary.)
- Ask students to reread the predictions in their student science notebooks under the Seed Structure entry in the "Prediction #2" section that they made about what would happen to the roots when the seed turned upside down.
- Ask students to discuss with their group:

  "How are your observations similar to or different from your predictions?" (Responses will vary.)
- Invite students to return to their seats.
- Tell them they are going to read an article that explains why the roots of the seed function this way.
- Distribute the article **"Roots and Geotropism"** [2].
- Remind them of the reading skills they use in the Language Arts module when they encounter new and challenging texts.
- After 5 minutes tell students they are going to respond to the reflection questions at the bottom of the "Roots and Geotropism" article using the Back-to-Back and Face-to-Face protocol. Remind them that they used this protocol in the Language Arts module. 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 does geotropism help plants survive?"
  - Invite students to turn face-to-face to share their responses.
  - Have students repeat with a new partner for the following question:

  "What do you think might happen if there wasn't geotropism?"
- As students share, circulate to take notes on student conversations in the teacher science notebook.
- If time allows, repeat questions with a new partner. Once students have shared with a few partners, invite them to return to their seats.
- Ask students to open their student science notebooks to the **Plant Structures Are a System entry** and put their finger on their plant explanatory model.
- Instruct students to add information about the function of geotropism to their plant diagrams using a different colored pencil.

Preparing to Teach: Self-Coaching Guide

1. Which bag will I direct the students' attention to if they are having trouble seeing the parts of the seed? (The seed coat will be clearly visible with the developed embryo pushed out of it. The cotyledon will have been used for food by the seed during this early growth.)
2. How can I support readers who may need support with this text?

Section 3: Evaluating and Communicating Information

A. Scientists Meeting: Building Understanding (10 minutes)

- Ask students to bring their science notebooks and gather for a Scientists Meeting.
- Remind them 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 Norms of a Scientists Meeting anchor chart:
  - We take turns talking.
  - We build on one another's ideas.
  - We disagree respectfully.
  - We ask questions when we don't understand.
- Direct students' attention to the posted Life Science Module guiding question:
  - "How do the internal and external structures of plants or animals function together as a system to help them survive well in a given habitat?"
- Tell students the goal of this meeting is to build deeper understanding of the structures and functions of the plant parts they've been studying. They will create an explanation of how the parts of the seed work together as a system in order to grow and survive.
- Draw students' attention to the "Systems" column of the **Concepts Scientists Think About anchor chart**.
- Ask a volunteer read the definition of systems aloud.
- Record "seeds" as an example in the "Systems" column of the anchor chart.
- Tell students they are going to discuss their learning about how the parts of seeds function as a system to help a plant survive.
- Encourage students to use their student science notebooks as they discuss their learning. Ask [1]:

  "What do we know about seeds?" (There are three parts: cotyledon, embryo, seed coat.)

  "Why is a seed a system? What are the components of the seed that work together?" (The three parts of seeds work together.)

  "How does each part help the seeds survive?" (The seed coat protects the embryo and cotyledon. The cotyledon feeds the embryo.)

  "What would happen if a seed didn't have a seed coat?" (The embryo could be damaged and not survive.)

  "What evidence do you have to support your claims?"

  "What new questions about seeds do you have?"

- Prompt students to build on one another's ideas by asking questions such as:

  "Can someone paraphrase what John said?"

  "Who thinks something similar to John?"

  "Who thinks something different from what John thinks?"

  "Can you add to what John said?"

- Invite students to return to their seats.

Preparing to Teach: Self-Coaching Guide

1. Would it be helpful to play my students a recording of the initial conversation so they can see what they have learned?

B. Creating the Seed Explanatory Model (10 minutes)

- Direct students' attention to the "Modeling" column of the Scientists Do These Things anchor chart and tell them they are going to demonstrate what they know about seeds through an explanatory model. Their model should include pictures, words and arrows in order to make their understanding clear [(1)].
- Tell students to turn to the "Conclusions" section of the Seed Structure entry of their student science notebook in order to draw an explanatory model. Emphasize that their explanatory model should explain the following:
  - How do the parts of the seed—the seed coat, cotyledon, and embryo—work together as a system to do something that each part could not do alone?
  - What would happen if one of the parts was missing?
- Encourage students to use evidence from their lima bean dissection, the germination bags, and the video to create their model.
- Invite students to begin working on their explanatory model. Circulate to support students.
- Collect students' notebooks to assess their explanatory model for how well they describe how the parts of a seed are connected as a system [(2)].

Preparing to Teach: Self-Coaching Guide

1. This is the last chance my students have to practice making an explanatory model before the performance task. What support or additional practice do they need?
2. I want my students to understand that the seed coat protects the seed until conditions are right for the seed to germinate, and the cotyledon provides the food that the embryo needs to grow. If the seed did not have the seed coat, the seed could get damaged before starting to grow. If the seed did not have the cotyledon, it would not have the food it needs to start to grow. If their model doesn't reflect this understanding, what will I reteach?