Grade 4: Life Science Module

Lesson Sequence 5: Structures for Movement

Lesson Sequence 5: Structures for Movement

Overview

Total Time: 2.5 hours of instruction (divided into two sections)

Students continue their survey of the specialized structures of animals. In this lesson sequence, students focus on the structures that both invertebrates and vertebrates use to move. Students closely observe the movement of an earthworm and watch a video to explore how animals without a backbone move. Students then move through a guided dissection of a chicken wing and study the movements of a cheetah to explore how the musculoskeletal and nervous systems work together for locomotion. Students develop two explanatory models to show the way that internal and external structures work together to allow animals to move.

Lesson Sequence Focusing Question and Big ideas

How do the external and internal structures of animals work together as a system to help the animals move?

- Animals have a variety of structures that work together to move. Vertebrates, animals with a backbone, move when structures from the nervous system, such as nerves, work with structures from the musculoskeletal system, such as bones and muscles. Invertebrates have a variety of structures that work together to aid in movement.

Long-Term Learning Addressed (Based on NGSS)

Develop a model/explanatory model that shows that many animals have internal structures—such as bones, muscles, and a nervous system—working together to support movement. (Based on NGSS 4-LS1-1)

This lesson sequence explicitly addresses:

Science and Engineering Practices:

- **Developing and Using Models:** Identify limitations of a model. *Students develop an explanatory model (a drawing with labels) to explain how an earthworm moves. They also use an explanatory model to demonstrate how the components of the musculoskeletal system work together. Students also identify the limitations of their model. Note: This Science and Engineering Practice is not explicitly aligned with 4-LS1-1.*

Crosscutting Concepts:

- **Systems and Systems Model:** A system can be described in terms of its components and their interactions. *Students learn the components of the musculoskeletal system and how they work together in vertebrates. They also learn about a system of structures in invertebrates that aid in movement.*
- **Structure and Function:** The way in which a living thing is shaped and its substructures determine its properties and function. *Students learn that animals have structures with a specific function to aid in movement. These structures differ in vertebrates and invertebrates. Note: This Crosscutting Concept is not explicitly aligned with 4-LS1-1.*

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 about the structures of vertebrates and invertebrates that aid in movement, a necessary part of survival for animals.*

Lesson Sequence Learning Targets

- I can explain, through an explanatory model, how structures work together as a system to allow an animal to move.
- I can critique my partner's explanatory model and provide kind, helpful, and specific feedback.

Ongoing Assessment

- Scientists Meeting: Building Understanding
- Student science notebook: Structures for Movement entry
  - Explanatory model of earthworm
  - Explanatory model of a chicken wing

Agenda

Total Time: 2.5 hours of instruction

Section 1

1. **Opening**
   - A. Scientists Meeting: Building Understanding (15 minutes)
   - B. Reviewing Learning Targets (5 minutes)
2. **Obtaining Information (Invertebrates)**
   - A. Conducting an Earthworm Observation (10 minutes)
   - B. Video Study: Invertebrate Movement (15 minutes)
3. **Developing a Model**
   - A. Creating an Earthworm Explanatory Model (30 minutes)

Section 2

1. **Obtaining Information (Vertebrates)**
   - A. Dissecting a Chicken Wing (30 minutes)
2. **Developing a Model**
   - A. Creating a Chicken Wing Explanatory Model (30 minutes)
   - B. Synthesizing Information (15 minutes)

Optional Extension: Human Musculoskeletal System

Teaching Notes

Purpose of lesson sequence and alignment with NGSS standards:

- Students continue to build understanding of structure and function (a Disciplinary Core Idea and a Crosscutting Concept). In this lesson, they look at the structures for locomotion in both vertebrates (such as bones and muscles) and invertebrates (such as muscle segments and bristles).
- In Section 1, students observe earthworms to stimulate thinking about the locomotion structures of invertebrates. They continue to build capacity around developing explanatory models (a Science and Engineering Practice) and use a peer critique protocol to revise and improve their model.
- In Section 2, students dissect chicken wings to identify the structures that vertebrates use for locomotion. Building on their learning in Lesson Sequence 4 about sensory structures and the nervous system, students learn about how the nervous system and structures for locomotion work together as a system (a Crosscutting Concept) to help organisms move. They develop an explanatory model of a chicken wing to explain their learning.
- After the chicken wing dissection, sterilize the scissors by either running them through a dishwasher or handwash them with hot water and soap.

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

- Similar to the learning in Lesson Sequence 3 and 4, students continue to study the specialized structures of animals that allow the animals to survive. As they study the structures and their function, students gather options for the fictional animal they will design for the performance task. Students also continue to build capacity around identifying systems and creating models.

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. Because "flight" is one of those defense mechanisms, help students identify the sensory and muscular structures animals use to avoid being eaten.
- Students use the Praise, Question, Suggestion protocol in the Language Arts module.
- The Scientists Meeting in Section 1 provides 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 different body parts act in isolation, but through studying the way invertebrates move in Section 1, and the way vertebrates move in Section 2, students will come to understand that body parts in both types of animals work together to allow the animal to move.

Possible broader connections:

- Connect to other sciences by thinking about how we find systems in many domains of science, such as solar systems, ecosystems, and body systems. Consider what kinds of models

students may be familiar with that are used to study those systems—For example, replicas of solar systems, diagrams of food webs in ecosystems, and diagrams of body systems.

- Consider letting students make up a song about muscles, bones, tendons, and nerves to the tune of "Dry Bones (Dem Bones)."

Areas where students may need additional support:

- Not all students will consider dissection an exciting procedure. Consider allowing students who do not want to participate in the dissection to participate in other ways, such as taking notes for the class. Consider taking a survey beforehand to understand your students' perceptions of and feelings about dissection.
- Students may need additional support and prompting to thoroughly wash and clean their dissection area and hands after the chicken wing dissection.
- For students who need support with auditory processing or ELL students: Consider providing running notes or outlines of the videos.

Down the road:

- In Lesson Sequence 7, students will begin examining the specialized structures of plants. Gather a variety of plant parts for Section 1. Consider obtaining live plants (including prickly pear cactus, diamond leaf willow, and coneflower) from a local or online plant nursery for student observation in Section 3.
- Continue to care for the grass and radish plants seeded in preparation for Lesson Sequence 8. Refer to the Grade 4 Life Science Module Overview for additional information.
- Students will develop explanatory models again in Lesson Sequences 7 and 9, and will be asked to demonstrate their ability to do so on the performance task. Consider how much support to give students so they can be successful in developing this skill.
- In Lesson Sequence 11, students will use the Praise, Question, Suggestion protocol again as they complete the performance task. Consider if your students need additional practice with peer critique.

In advance:

- Read each section and complete the Preparing to Teach: Self-Coaching Guide.
- Gather materials for chicken wing dissection. Consider how students will quickly and safely wash their hands, dissection area, and tools.
- Prepare:
  - Technology necessary to play "How Animals Move" <https://vimeo.com/41446127>
  - Technology necessary to play the chicken wing dissection video <https://eleducation.org/resources/life-science-chicken-wing-dissection>
  - Technology necessary to play "The Science of a Cheetah's Speed" <https://www.youtube.com/watch?v=icFMTB0Pi0g>
  - Earthworm investigation stations (Use the same earthworm pairings from Lesson Sequence 3)
- Review the Praise, Question, Suggestion protocol (see Classroom Protocols pack on Curriculum.ELeducation.org).

- Post: Norms of a Scientists Meeting, lesson sequence learning targets, Scientists Do These Things anchor chart, Concepts Scientists Think About anchor chart, Animals Structures and Functions anchor chart.

Optional extensions:

- *Human Musculoskeletal System:* Consider allowing students to explore their own structure for movement by using explanatory models of the human musculoskeletal system. They might use this human musculoskeletal diagram to compare their own relationships to environmental stimuli and responses to movement

Vocabulary

immobile: not moving
burrowing: digging into something
invertebrate: an animal without a backbone
explanatory model: a drawing explaining how something works
vertebrate: an animal with a backbone
musculoskeletal system: the bones of the skeletal system working with the muscles and tendons of the muscular system

Materials

General Materials:

- ☑ Student science notebook (From Lesson Sequence 1; one per student)
  - — Structures for Movement entry (Page 26 of student science notebook)
  - — Animal Structures and Functions anchor chart entry (Page 2)
- ☑ Norms of a Scientists Meeting anchor chart (Begun in Lesson Sequence 1)
- ☑ Life Science Module guiding question (From Lesson Sequence 1; one to display)
- ☑ Handling Live Animals in the Classroom (From Lesson Sequence 3; for teacher reference)
- ☑ "How Animals Move" (Video; play in its entirety; see Teaching Notes)
- ☑ Invertebrate Movement (For teacher reference)
- ☑ Scientists Do These Things anchor chart (Begun in Lesson Sequence 2; added to in Section 2)
- ☑ Chicken wing dissection video (Play in its entirety; see Teaching Notes)
- ☑ "The Science of a Cheetah's Speed" (Video; play in its entirety; see Teaching Notes)
- ☑ Concepts Scientists Think About anchor chart (Begun in Lesson Sequence 2; added to in Section 2)
- ☑ Animal Structures and Functions anchor chart (Begun in Lesson Sequence 3; added to in Section 2)

Science-Specific Materials:

- ☑ Materials for earthworm observation (One set for every two students; used in Section 2)
  - — Gloves
  - — Earthworms (One for every two students)
  - — Wet paper towel

- — Tray/observation plate
- — Magnifying glass (Two)

☑ Materials for guided chicken wing dissection (One set for every student; used in Section 3)

- — Chicken wing
- — Gloves
- — Safety goggles (Optional)
- — Dissecting kit or scissors
- — Tray/plate
- — Materials to clean (Soapy water, disinfecting wipes, sinks to wash hands, etc.)

Section 1: Opening

A. 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 their attention to the **Norms of a Scientists Meeting anchor chart** [(1)]:
  - — 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 Life Science Module guiding question [(2)]:
  - — "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?"
- Remind students that they have been studying how the structures of plants and animals function as a system to help those organisms survive, so they are building their knowledge in order to be able to answer the Life Science Module guiding question.
- Invite students to use the information and ideas recorded in their student science notebook to answer the following questions:

  "What structures of animals do you understand that help an animal survive? How do these structures support survival?" (Students should name at least mouthparts and sensing structures.)

  "How do different structures work together?" (Responses will vary. Students should begin to link function with structures.)

  "Are there structures that support survival in a particular habitat? How?" (Response will vary, but students should link structures that make sense in a particular habitat—for example, a proboscis where there are flowers, flat teeth where there is plant matter, big eyes where animals may live nocturnally because of the heat.)
- Draw other students into the conversation by asking:

  "Who can add to this idea?"

  "Explain what X said in your own words."

- After a few minutes of clarifying student understanding, assure students they will learn more information to help them answer the guiding question.
- Explain that in this lesson sequence, they will explore the structures that *invertebrates* (animals without a backbone, such as spiders, insects, crabs, and jellyfish) and *vertebrates* (animals with backbones, such as mammals, fish, birds and reptiles) use to move [3].
- Gather students' initial ideas about structures for movement by asking questions. Invite students to turn and talk with an elbow partner before calling on pairs to share out [4] [5] [6] [7]:

  "What structures do you have in your body that allow you to move?" (Muscles)

  "How do those structures work together?" (Students may not realize how bones and muscles work together.)

  "How do other animals use their bones and muscles to move?" (Cheetahs run; frogs jump.)

  "Think about invertebrates, such as insects. How do they move?" (They crawl or wiggle.)

  "What is the difference between a* vertebrate *and an* invertebrate*?" (Students may not know that vertebrates have a backbone. Do not define these terms yet.)

  "Why is a backbone important?" (It holds you up straight and supports you.)

  "Why do animals move?" (To find a mate, to find food, to find water, or to find shelter.)

  "What other questions do you have about animals and the way they move?"

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

  "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."

- Finally, explain that movement is a behavior that helps animals survive well. Animals have lots of stimuli in their environment or internally, like hunger or thirst, that stimulate the animals to move. Movement is necessary for most animals to survive well.
- Ask students to return to their seats.

Preparing to Teach: Self-Coaching Guide

1. A Scientists Meeting is different from a regular group discussion. What group norms will I emphasize?
2. At this point, what do I hope my students can answer about the guiding question?
   - Specific examples of structures
   - Specific examples of structures working together as a system
   - Link ecosystem characteristics to animal structures, e.g., sharp teeth in the desert because there aren't as many plants available for food
3. Do my students understand the difference between vertebrates and invertebrates?
4. During this exercise, I'm not looking for the "right" answers. I'm seeing what my students already know and trying to uncover misconceptions.

5. What follow-up questions can I ask to clarify what students know at this point? (Consider: "Have you ever seen ...?")
6. What kinds of ideas do students already have about an animal's ability to move?
7. What student responses will indicate misconceptions?

B. Reviewing Learning Targets (5 minutes)

- Direct students' attention to the posted lesson sequence learning targets.
- Read them aloud as students follow along, reading silently in their heads:
  - ***"I can explain, through an explanatory model, how structures work together as a system to allow an animal to move."***
  - ***"I can critique my partner's explanatory model and provide kind, helpful, and specific feedback."***
- Invite students to open their student science notebooks to the **Structures for Movement entry**.
- Ask them to put their finger on the following question:
  - "How do the external and internal structures of animals work together as a system to help the animals move?"
- Explain to students that through this lesson sequence they will explore how invertebrates and vertebrates move, and create an explanatory model to give evidence to their thinking. Say something like: "You will be exploring how invertebrates move by observing an earthworm and watching a short video. You will also be exploring how vertebrates move by dissecting a chicken wing, and watching another short video about the structures that vertebrates use to move. At the end of the lesson sequence, you will create an explanatory model to show how structures work together to allow an animal to move." (1)
- Invite students to capture their ideas about the learning targets and the focusing question in the "Opening" section of their notebook.

Preparing to Teach: Self-Coaching Guide

1. Will I introduce both tasks, the invertebrate and vertebrate studies, at the same time, or separate them at the time of the task?

Section 1: Obtaining Information (Invertebrates)

A. Conducting an Earthworm Observation (10 minutes)

- Remind students of the importance of handling the earthworms respectfully. Refer to **Handling Live Animals in the Classroom (for teacher reference)** as necessary.
- Explain to students that later in the lesson sequence they will create an explanatory model of how an earthworm moves. Before they can create a model of something, however, they need to observe it closely.
- Ask students to take their student science notebooks and move to sit with their earthworm partner from Lesson Sequences 3 and 4.
- Distribute the **materials for earthworm observation** (1) (2).

- Tell students they are going to observe their earthworm for a total of 2 minutes—1 minute each. As they are observing their earthworm, ask them to consider the following:

  "As you watch the earthworm move, what different structures do you see? "(Hairs on the body, segments contracting and stretching out, the tip of the earthworm "searching")

- Circulate to support students as they observe and share with their partners. Stimulate student thinking by pointing to a part of the body and asking:

  "What is this part of the body doing?"

- Refocus the whole class. Tell students to gently turn the worm over onto its backside using the tip of their pencil eraser.
- Tell students they are going to observe their earthworm again for a total of 2 minutes—1 minute each.
- Direct students to put their magnifying glasses down and open their student science notebooks to the Structure for Movement entry, and draw the earthworm under the section titled "Obtaining Information: Invertebrate Movement." Encourage students to draw every detail (segments, hairs, etc.), and let them know that they will be using this drawing to create their explanatory model later in the lesson sequence [(3) (4)].
- After 5 minutes, ask students to return all materials to their proper place and return to their seats.

Preparing to Teach: Self-Coaching Guide

1. When will I prepare the materials for the earthworm observation? Will students create observation trays with wet paper towels, or will I prepare those materials?
2. How will I distribute the earthworm materials to students?
3. Do I need to offer more support around diagraming? Remind students that there is a diagram of the earthworm's nervous system in their science notebook.
4. Although I don't expect my students to use scientific language to describe the different parts of the earthworm, would my students benefit from seeing a labeled diagram that uses scientific language, as an introduction to this kind of language?

B. Video Study: Invertebrate Movement (15 minutes)

- Refocus your whole group of students. Remind them that an invertebrate is an animal without a backbone. Insects, spiders, and worms are all common invertebrates.
- Tell students that they are going to watch a video to learn more about the diverse ways invertebrates can move, and to get some ideas for the fictional animal they will create for the performance task.
- Ask students to put their finger on the chart labeled "How Invertebrates Move" in the "Obtaining Information" section of the Structures for Movement entry in their science notebooks. Draw students' attention to the fact that there are seven ways in which invertebrates move: walking, jumping, being *immobile*, *burrowing*, swimming, wriggling, and flying.
- Explain that as they watch the video, they should pay attention to the names of structures invertebrates use to move. Tell them you will pause the video as it plays so that they can take notes in the Invertebrate Movement chart in their notebooks [(1)].

- Show **"How Animals Move."** Guide students through the video study using **Invertebrate Movement (for teacher reference)**.
- Ask students to return to the drawing of the earthworm from earlier in the lesson sequence.
- Using a total participation technique, invite responses from the group:

  "What is the best word to describe how an earthworm moves?" (Wriggling)
- Tell students to label their earthworm drawing by adding "wriggling" to the top.
- Using a total participation technique, invite responses from the group:

  "What structures does the earthworm use to wriggle?" (Segments, hairs, muscles)

Preparing to Teach: Self-Coaching Guide

1. How and when will I prepare technology for the viewing of this video?

Section 1: Developing a Model

A. Creating an Earthworm Explanatory Model (30 minutes)

- Direct students' attention to the posted **Scientists Do These Things anchor chart** and remind them that they have been working with different kinds of models in the Life Science Module.
- Using the anchor chart, remind students that models can be a drawing, diagram, physical replica, or simulation [1].
- Direct their attention back to their earthworm drawing from earlier in the lesson sequence and read the information on the left-hand side of the notebook:
  - Explanatory model: A drawing that shows how something works
  - Explanatory models have:

1. Labels with lines pointing to the structures
2. Explanations for how the structures work together to allow the earthworm to move

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

  "Is our drawing an explanatory model, according to these requirements?" (No, it is only a drawing of an earthworm.)

  "What did we add to the earthworm's nervous system diagram in Lesson Sequence 4 to explain how the different components worked?" (Arrows and explanations)

  "What do we need to add to our drawing to make it an explanatory model?" (Labels with arrows; explanation of how the parts work together)
- Invite students to Think-Pair-Share:

  "What labels might you add to your earthworm drawing?" (End of earthworm, top, bottom, middle, segment, hairs)

  "What should connect the label to the structure?" (A line that points from the label to the structure indicated)
- Ask students to label their earthworm drawing.

- Give them 5 minutes to write explanations beside the drawing about how the different structures work together to explain how the earthworm moves.
- After 5 minutes, tell students they are going to use the Praise, Question, Suggestion protocol to provide their classmates with feedback that will help them improve their explanatory models. 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 [(2)].
- Arrange students in pairs.
- Encourage them to use the list of necessary components for explanatory models in their student science notebooks when giving their partner feedback.
- Model the protocol with a student for the whole group if necessary before releasing students to begin.
- Ask students to begin the protocol.
- After they have given and received feedback, ask students to thank their partner and return to their seats.
- Provide students with time to improve their explanatory model based on their partner's feedback.
- Give students specific and positive feedback on their ability to use their partner's feedback to improve their drawing. (Example: "I am impressed with your ability to receive and readily implement feedback from your classmates.")

Preparing to Teach: Self-Coaching Guide

1. What experience do my students have with drawing scientific diagrams or models? What additional support might they need?
2. What experience do my students have with peer critique?

Section 2: Obtaining Information (Vertebrates)

A. Dissecting a Chicken Wing (30 minutes)

- Focus the whole group of students. Explain that they have been studying how invertebrates move, and now they are going to shift their attention to consider how vertebrates move [(1)].
- Clarify the term *vertebrate*. Using a total participation technique, invite responses from the group:

  "How might an animal with a backbone and bones on the inside move differently from an earthworm?"

  "What structures might it use?"
- Explain to students that they will dissect a chicken wing to see the structures vertebrates use. To do that, they will watch a video of a chicken wing dissection, and follow the directions according to the video [(2)].
- Remind students of the norms and expectations for the chicken wing dissection. Review and model as necessary. Specifically, explain:

  "Dissecting is a special procedure that scientists do to see internal structures. It's very

important that you listen carefully and watch how to dissect the chicken wing, so that you can see the important structures that vertebrates have to help them move."

- Distribute the **materials for guided chicken wing dissection** [(3)].
- Show the **chicken wing dissection video**. Guide students through the video and dissection process using the video as reference.
- Invite students to dispose of necessary materials, return other materials to their proper place, thoroughly clean their workspace with disinfecting spray, and return to their seats [(4)].
- Give students specific and positive feedback on their ability to dissect a chicken wing. (Example: "I am impressed with your ability to listen closely during such an important multi-step procedure.")

Preparing to Teach: Self-Coaching Guide

1. Consider whether it would be beneficial to revisit the lesson sequence learning targets, given how spread out the lesson sequence has become.
2. Now that I have previewed the video, what expectations and norms do I want to reiterate? What will students need to do to prepare their workspace so that other materials, such as pencils, papers, and books, are not coming into contact with the wing? (Consider stating the directions given at the beginning of the video.)
3. How will I safely and efficiently distribute the materials for the guided chicken wing dissection?
4. How will I organize the classroom to dispose of materials at the end of the dissection and clean the workspaces?

Section 2: Developing a Model

B. Creating a Chicken Wing Explanatory Model (30 minutes)

- Remind students that they've seen the structures—the bones, tendons, muscles, and nerves—that help a vertebrate move. Now they're going to see how those structures work together to perform their function: helping an animal move.
- Tell students that they are going to watch a short video of a cheetah moving. As they watch, they should pay attention to the structures that help the cheetah move and how the structures work together [(1)].
- Show clip from **"The Science of a Cheetah's Speed."**
- Ask students:

  "What is the gist of this video?" (Cheetahs are perfectly suited for running. They have muscles and bones that work together to help the animal be very fast.)
- Ask students to open their student science notebooks to the Structures for Movement entry and find the "Vertebrate Movement" section.
- Tell students they will watch the cheetah video a second time. This time, they should take notes in the "Vertebrate Movement" section about the structures the cheetah has, and the way they work together.

- Show clip from "The Science of a Cheetah's Speed" again.
- Invite volunteers to share out structures they noted and how they worked together.
- If not already named, ask students:

  "How does the spine of a cheetah work together with the leg muscles to help the cheetah run fast?" (It coils like a spring and helps the cheetah have a very large stride. The leg muscles help the cheetah have explosive movements.)

  "How does the lightweight skull with large nasal holes work with the rest of the body to help the cheetah catch and hold its prey?" (The lightweight skull helps the cheetah keep its eyes on the prey as it runs, and the large nasal opening helps the cheetah breathe after it has caught the prey, and it wants to hold it with its teeth and jaw muscles.)
- Tell students that, like the cheetah, the bones and muscles of all vertebrates work together as a system. They will now think about how the muscles of a chicken wing work with the bones of the chicken wing to help the wing move.
- Tell students to find the "Explanatory Model of a Chicken Wing" section under the Structures for Movement entry in their student science notebook.
- Emphasize the shape of the bone for students. Guide students to ensure they are viewing the chicken wing correctly:

  "Put your finger on the place where the wing tip was."

  "Put your finger on the middle section where you examined the bone, muscles, and tendons together."
- Circulate to spot-check students understanding.
- Using a total participation technique, invite responses from the group:

  "Is this diagram of the wing an explanatory model of the chicken wing?" (No)

  "If we wanted this diagram to explain the structures of the chicken wing that function together to enable the wing to move, what would we add?" (The structures—muscles, tendons, nerves—and labels for the structures and arrows that show how the structures work together.)
- Post the following directions on the board for turning this diagram into an explanatory model, and read through these directions with students. Answer clarifying questions [(2)].
  - Draw in the muscles, tendons, and nerves that you observed in the dissection.
  - Label the structures.
  - Draw arrows and explanations to show how the structures work together to enable the chicken wing to move.
- Circulate to support students as they work [(3)].
- After 10 minutes, refocus the whole class.
- Refer to the Scientists Do These Things anchor chart and add:
  - "Explanatory model of a chicken wing"
- All important parts of the system are labeled
- Explain how the parts work together
- Reading from the anchor chart, tell students that there is another feature about a model, and it is:

  - "A model has limitations because it is used to study one part of a system or object while not paying attention to other parts."
- Ask:

  "What parts of a chicken or earthworm are not included on the explanatory model that you created?" (Mouthparts, sensing structures, etc.)
- Ask:

  "Why do you think it is important that we include certain parts on models and ignore the other parts?" (Because it helps us pay close attention to the structures used to move; including all the parts might be confusing.)
- Add to the anchor chart under "Explanatory Model of a Chicken Wing"
- Does not show parts that are not important to movement (Example: doesn't show the mouthparts)

Preparing to Teach: Self-Coaching Guide

1. Now that I have previewed the video, what do I expect my students to say? What questions can I ask to help them see how the parts of the musculoskeletal system work together?
2. Would asking students to use different colored pencils for muscles, tendons, and nerves be helpful? Or are they having trouble managing materials?
3. In what ways can I support students?

   Consider the following:

   - Refer students to their notebook—for example, the notes in the Sensing Structures entry about the nervous system, to help them explain how the nerves work with the bones, muscles, and tendons to support movement.
   - Ask students to turn and talk with a partner about what they are drawing.
   - Ask a student to serve as an exemplar.

B. Synthesizing Information (15 minutes)

- Give students specific and positive feedback on their ability to create two different models. (Example: "I am impressed with your ability to create two explanatory models—one showing the ways in which invertebrates structures work together to support movement and one showing the same for vertebrates.")
- Direct students' attention to the posted **Concepts Scientists Think About anchor chart** and remind them that, once again, they have been thinking like a scientist by studying systems. If necessary, remind them that a system is a group of parts working together.
- Using a total participation technique, invite responses from the group [1]:

  "How are the chicken wing and the earthworm examples of a system?" (They have structures that work together to perform a function: helping the animals move.)
- Explain that there is a specific name for a system of bones and muscles working together. It is the *musculoskeletal system*. Focus on the root words: *muscle* and *skeleton*. Explain that the musculoskeletal system is the muscles and skeleton working together as one large system.

- Write "musculoskeletal system" as an example on the Concepts Scientists Think About anchor chart and ask students to title their explanatory model of a chicken wing "Musculoskeletal System."
- Display the **Animal Structures and Functions anchor chart** and tell students they will now capture some of the structures for movement, so they can refer to them when they design their animal in the performance task.
- Model briefly with one of the structures from the lesson sequence [(2)].
- Ask students to turn and talk with an elbow partner [(3)]:

  "What are some more structures that work together to help an animal move? How do they work?" (Responses will vary. Record all valid answers on the anchor chart and refer to the supporting materials for possible responses.)
- Ask one pair to share their thinking; add it to the anchor chart.
- Ask students to turn and talk with an elbow partner:

  "Why is it important that animals have structures for movement?" (It allows them to survive well. They can obtain food and/or not be eaten.)

  "What kind of movement would an animal need in order to survive well in a desert, tundra, or grassland?"

  "Why will your animal need to move? To create shelter? What structures will it have to do that?"

  "What kind of food is available in your ecosystem? How will the animal move to find food?"

  "In what other ways will your animal need to move so that it can survive well?"
- Ask students to turn to the **Animal Structures and Functions anchor chart entry** in their student notebook and add a few structures they may want to use in the performance task.

Preparing to Teach: Self-Coaching Guide

1. How can I encourage students to use the correct terminology?
2. What structure will I model? (Consider an invertebrate structure and function, such as wings to fly. Write: "Movement like flying, structures are lightweight wings, folded under the wing casing. The casing lifts and the wings fold out, catch the air, and lift the bug off the ground to fly away from anything trying to eat it.")
3. How can I use what the students learned from the cheetah video to stimulate thinking?