LESSON 2: What do our bones, skin, and muscles do for us?

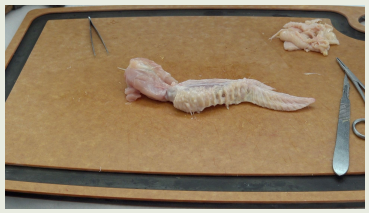
PREVIOUS LESSON

We shared experiences when we could move our bodies and not move our bodies. We read doctors notes, analyzed injury images, and created a timeline of evidence of healing. We developed models explaining how parts of the foot work together, allowing the patient to walk again. We generated a list of related phenomena, a Driving Question Board (DQB), and possible investigation ideas.

THIS LESSON

INVESTIGATION

2 days



We investigate how skin, muscle, and bone work together when moving by watching a video of the dissection of a chicken wing. We map the parts of the chicken wing to the parts of the foot to make sense of how these parts work together in similar ways. Then, we revise the investigation to figure out how injuries can affect the wing's function.

NEXT LESSON

We observe images and cross sections of the leg and foot to analyze the structures inside the body. We notice that there are some structures we can't identify so we look at close-up diagrams of the skin, muscle, and bone. We discover that blood vessels and nerves are found throughout the skin, muscles, and bone.

BUILDING TOWARD NGSS

MS-LS1-1, MS-LS1-2, MS-LS1-3*, MS-LS1-8*

WHAT STUDENTS WILL DO

2.A Analyze and interpret data to highlight the interactions between subsystems (skin, muscle, bone) within the larger system (foot or wing).

2.B Revise the experimental design and conduct an investigation to predict the change in function of the chicken wing (effect) when injured (cause).

WHAT STUDENTS WILL FIGURE OUT

- Skin is attached to the muscle underneath it and the muscle is attached to bones.
- Bones move when the muscles attached to them move.
- The muscles and bones are both parts of the wing (or foot) system and interact for the wing (or foot) to move.
- When one part of the system is broken or injured, the whole system is affected and can't function the way it used to.

Lesson 2 • Learning Plan Snapshot

Part	Duration	Summary	Slide	Materials
1	5 min	**NAVIGATION** Observe how our foot moves and figure out how to investigate the foot's structures using a chicken wing.	A-C	computer, projector
2	20 min	**INVESTIGATE SKIN, MUSCLES, AND BONES IN A CHICKEN WING** Watch a video of a chicken wing being dissected to see what is inside and how those parts work together for the wing to move.	D-G	computer, projector, Investigate Skin, Muscles, and Bones in a Chicken Wing
3	10 min	**MAP THE CHICKEN WING STRUCTURES TO THE FOOT MODEL** Use a mapping tool to analyze how parts of a chicken wing could represent similar parts in the human foot.	H	*Mapping the Chicken Wing to the Human Foot*, computer, projector
4	5 min	**REVISE OUR PARTS OF THE FOOT POSTER** Revisit and revise the parts of the foot poster to include what we have figured out about the structures and functions of muscles, bones, and skin.		Parts of the Foot poster from Lesson 1
5	5 min	**BRAINSTORM HOW TO REVISE THE INVESTIGATION** Now that we have figured out how the parts of the chicken wing work together, we brainstorm how we could revise the investigation to see how injuries affect the chicken wing's function.	I-J	*Mapping the Chicken Wing to the Human Foot*, tape
				End of day 1
6	3 min	**NAVIGATION** Partners share predictions about how an injury to the skin, muscle, or bone would affect the wing's function.	K	
7	15 min	**INVESTIGATE SKIN, MUSCLES, AND BONES IN AN INJURED CHICKEN WING** Watch a video of a chicken wing being injured and dissected to see what parts are damaged and how this affects the way they work together for the wing to move.	L-M	computer, projector, Investigate Skin, Muscles, And Bones In An Injured Chicken Wing
8	5 min	**COMPARE THE INJURED WING TO THE INJURED FOOT** Discuss how the parts of the chicken wing compare to the parts in the foot and how using the chicken wing can help us figure out more about how the foot works.	N	*Mapping the Chicken Wing to the Human Foot*, How is the injured chicken wing similar and different from the injured human foot? poster
9	10 min	**BUILDING UNDERSTANDINGS DISCUSSION TO BEGIN THINKING ABOUT A BODY AS A SYSTEM** Facilitate a Building Understandings Discussion to review their prior use of systems and system models, and begin thinking about the body as a system of subsystems.	O-P	*Mapping the Chicken Wing to the Human Foot*, Parts of a Body poster
10	12 min	**CREATE PROGRESS TRACKER FOR THE UNIT** Set up a new three-column Progress Tracker and record what we have figured out about skin, muscles, and bones and what they do. Reflect on what we want to figure out next.	Q	Progress Tracker
				End of day 2

Lesson 2 • Materials List

	per student	per group	per class
Investigate Skin, Muscles, and Bones in a Chicken Wing materials			• Intact Chicken Wing video at https://www.teachersopensciedfieldtest.org/healing
Investigate Skin, Muscles, And Bones In An Injured Chicken Wing materials			• Injured Chicken Wing video at https://www.teachersopensciedfieldtest.org/healing
Lesson materials	• science notebook • *Mapping the Chicken Wing to the Human Foot* • tape • Progress Tracker		• computer • projector • Parts of the Foot poster from Lesson 1 • How is the injured chicken wing similar and different from the injured human foot? poster • Parts of a Body poster

Materials preparation (minutes)

Review teacher guide, slides, and teacher references or keys (if applicable).

Make copies of handouts and ensure sufficient copies of student references, readings, and procedures are available.

Be sure you have materials ready to add the following word to the Word Wall: **function**. Do not post this word on the wall until after your class has developed a shared understanding of its meaning. This will be done during day 1 of this lesson.

See *Teacher instructions for chicken wing dissections* if you would like to demonstrate this investigation yourself rather than using the video.

Before the lesson, watch the *Intact Chicken Wing* video *at* https://www.teachersopensciedfieldtest.org/healing and the *Injured Chicken Wing* video at https://www.teachersopensciedfieldtest.org/healing .

Be prepared to play the *Intact Chicken Wing* video *at* https://www.teachersopensciedfieldtest.org/healing on day 1 and the *Injured Chicken Wing* video at https://www.teachersopensciedfieldtest.org/healing on day 2, and pause the video at designated places so students can discuss what they're seeing.

Lesson 2 • Where We Are Going and NOT Going

Where We Are Going

From earlier grades, students already have figured out that animals have internal and external structures that help the animal to function (move, grow, survive, and reproduce) (4-LS-1). In this lesson, we want to use this knowledge to press students to think about and figure out how these internal and external structures interact and work together for the body to move (function). By removing the skin of a chicken wing and taking a closer look at some of the internal structures (muscles and bones), students observe how the two structures work together when the wing is moved. Students extrapolate what they figure out to consider how these structures work together in a human foot. In this lesson, we will focus on how the bones, skin, and muscles work together in a chicken wing and human foot.

Where We Are NOT Going

Although there are other parts or structures that affect how the chicken wing (and human foot) move, this lesson only focuses on the role of the muscles, skin, and bones because those parts were identified as part of the evidence when describing the injury from Lesson 1 (e.g., doctor's notes, x-ray and images). Because there is nothing mentioned in the doctor's notes about tendons, ligaments or joints being injured and needing to be healed, we are not going to include these structures in this investigation. In addition, the joint of the injured foot we look at in Lesson 1 is not impacted. Therefore, we are not going to focus on how joints work in this lesson.

LEARNING PLAN for LESSON 2

1 · NAVIGATION

5 min

MATERIALS: computer, projector

Brainstorm how the different parts of the foot work together. Display **slide A.** Say, *Last class we analyzed a case where a person couldn't use their foot to walk after an injury.*

At the end of the last period we looked at our questions and our investigation ideas, and we made an argument that investigating how the different parts of our body function might help us make progress on our questions. What was our rationale for that?

Sample student responses:

- If we figure out how these different parts function or work, maybe we can figure out why the student couldn't walk on his foot.

Let's begin by figuring out a little bit about how different parts of our body function or work together.

Suggested prompt	Sample student response
If you look at and feel your foot, or your calf or your hand or your forearm, what can you feel or see?	*I can see skin.* *I feel my bones in my foot or the front of my calf.* *If I push a little bit, I can feel bones in my fingers, in my hand, and in my arm.* *The back of my calf feels less hard than the front. I can feel there is muscle or stuff inside there.* *My forearm feels like there is muscle or stuff inside. I can feel my bone if I press a little.*

Say, *Cool. So it seems like there are these different structures (muscles, bones and skin) in our arms and feet. As we continue to explore, feel free to use either or both of these body parts, or limbs as you think about how these parts work together or interact.*

Suggested prompt	Sample student response
Okay, so you can feel your bones and maybe your muscles, but we can only see our skin. Now move your foot up and down or back and forth, or move your hand up and down or side to side. What can you feel when you do this?	*I can see and feel my calf get tighter and less tight as I move my foot.* *The front of my calf, or shin, also gets tighter or less tight as I move my foot up and down.* *I can see my skin shift or stretch in different ways when I move my foot or my hand.* *I can see and feel the skin shift and get more or less tight in my arm as I move my hand up and down.*

Suggested prompt	Sample student response
Can anyone feel anything different with their bone when they move their foot or hand?	*Not really, but I can feel and see that my ankle area looks a little different when I flex and unflex my foot.* *No... but when I move my hand or fingers, they take a different shape when they bend or extend. When I extend my fingers, they are all straight, but when I bend them, they have a hook shape. Does that mean the bone bends too?*

Discuss how looking at muscle and bone can help us and a way to do so. Display **slide B.** Say, *So we can see that our skin changes when we move our foot or hand or arm around, but we can't see what is happening to the muscles or bones in our foot or hand or arm. If we can figure out what is happening with our muscles and bones when we move our foot, how might that help us figure out why the person with the injured foot couldn't walk on his foot? Turn and talk with a neighbor about this question.*

Some sample student responses:

- Maybe if we know how they work together when not injured, then we can figure out how they function differently when they are injured.

Say, *So if we want to see how these parts of the foot or arm or hand work together, it seems like we would want to be able to see inside the foot, arm or hand as it moves. Although we can't look inside a human body part, there are other things that have muscles, skin, and bones that we might be able to use to figure out more about how they interact and work together.*

Display **slide C**. Use the prompts in the following table to ask students how we could use a chicken wing to help us figure out what is going inside of our body.

ADDITIONAL GUIDANCE

There are two investigations students will watch to collect data about how different parts of a chicken wing work together in order to move. Students will be encouraged to think about the muscles, bones, and skin of the chicken wing, how they work together for the wing to move, and how this relates to the way these parts work in our body for our limbs to move. If you have students who do not feel comfortable watching the chicken wing dissection, you may need to provide them a space to sit outside of the classroom during this time. If they don't watch the dissection to see how different muscles affect the movement of the chicken wing, you might ask them to record what they notice about their own arm or leg when they flex one muscle, like the bicep or the tricep. Then ask them to compare their noticings with a partner in the classroom.

Suggested prompt	Sample student response
What if we were to use a chicken wing to try to figure out how these parts work together? How might this help us eventually figure out how our foot works?	*Accept all responses.* *Students may mention chickens also have skin and bones, so maybe we can figure something out about these two parts with the chicken wing.*
How could looking more closely at the parts of the chicken wing and examining how they interact help us figure out more about our foot?	*If we can look under the skin, then we might be able to see what is under there and how it moves or functions.*

2 · INVESTIGATE SKIN, MUSCLES, AND BONES IN A CHICKEN WING

20 min

MATERIALS: Investigate Skin, Muscles, and Bones in a Chicken Wing, science notebook, computer, projector

ADDITIONAL GUIDANCE

If you prefer to dissect an actual chicken wing in class, refer to *Teacher instructions for chicken wing dissections* for a list of materials needed and step-by-step instructions. It is highly recommended that you use a document camera, if available, to clearly project the wing as you dissect it so students can observe the needed details. Note that carefully removing the skin so as not to damage the muscle tissue can be time consuming, extending the investigation time beyond 20 minutes. Be sure to try this on your own prior to conducting the dissection during class.

Orient the students to the chicken wing dissection. Display **slide D.** Say, *We are going to watch a video of a chicken wing dissection to see if we can take a closer look at how the muscle and bone interact. Let's think about how what we're looking at compares to the human body. Look at the image on the slide. How does the chicken wing resemble a human arm? What parts look similar?*

Conduct a brief discussion comparing what we're seeing on the chicken wing to the human body, relating and pointing to different parts of your arm that correspond to the chicken wing:

- Upper arm muscles (biceps, triceps) and bone
- Elbow joint that bends
- Forearm with 2 smaller bones
- Hand corresponding to wing tip

As the class discusses these comparisons and structures, if the slide is projected onto a whiteboard, it might be helpful to have students come up and point to the structure(s) they think are similar in the two images.

ADDITIONAL GUIDANCE

Before observing the dissection of the chicken wing, take a couple minutes to compare the human arm to the chicken wing here to support students in thinking about how we can use what we figure out about the wing to understand our own bodies. This will be helpful in supporting the idea of using a chicken wing to make sense of what is going on inside a human. Specifically, students will see in the video different muscles being moved one way and how it affects the movement in other parts of the wing. Most students will probably have heard of the bicep and tricep muscles in a human arm from what they learn in their physical education courses and/or health class. Using these terms to describe these parts of the human arm ***and*** chicken wing will help when sharing observations of the chicken wing dissection. In addition, some of your students might bring up other structures that might be similar in both images that they are familiar with, such as the humerus bone or the ulna bone. At this point it is okay to make space for them to share these ideas, but there is no need to press for naming any structures beyond the bicep and tricep.

Display **slide E.** Say, *To prepare to collect data of these different parts, let's set up a notebook page. Title it "Chicken Wing Dissection" and then make a t-chart. Title the left column of your t-chart "Part of the chicken." Title the right column "Observations."*

ADDITIONAL GUIDANCE	Since we are using another organism that used to be living in our classroom to make sense of how our body works, it will be important to have a conversation with your students about the need to be respectful and serious when making our observations. We are fortunate enough that we can use this organism in the science classroom to figure out more about how parts of different body systems work. In addition, the researchers who made the video for us made sure the chicken wings used in the video were then used as nourishment. If you have students who are vegetarian and/or cannot handle seeing this dissection, reference the previous guidance for some suggestions of how to support them.

Prepare to watch the dissection. Display **slide F** and watch the *Intact Chicken Wing Video* https://www.teachersopensciedfieldtest.org/healing , pausing for about 30 seconds when the video shows a prompt. Be prepared to pause the video at the following times: 0:35, 1:53, and 3:35. Tell students to record the timestamp of the video in case they want to watch it again, and then give students more time as needed to record their thoughts. Additionally, there is some guidance in the video, but you may need to note with your students that the researcher is alternately *pulling* on the bicep muscle and then pulling on the tricep muscle; the researcher does not *push* on either muscle intentionally.

The prompts in the video may have the following student observations:

Video prompts	Sample student responses
What do you notice about the appearance of the skin on the front and back of the chicken wing? *(pause at 0:35)*	*The skin on the front looks thicker than the skin on the back.* *The skin on the underside is a little more see through. I can see the muscle and bone.*
What do you notice about the skin? *(pause at 1:53)*	*It seems like it's connected to the muscle underneath.* *There's some stretchy connected material under it.*
What do you notice about the bones and muscles in the skinned wing? *(pause at 3:35)*	*One muscle bent the wing one way. The other muscle straightened the wing out.* *The bones were inside/underneath the muscles.* *The bones moved when the muscles moved.*
Compared to when the skin was on the wing, how would you describe the wing's motion after the skin was removed? *(pause at 3:35)*	*The wing could move faster and more freely when the skin was gone.* *The wing stretched farther out when the skin was removed.*

Display **slide G and have students write down any further observations and questions they have.** This slide contains an image of the whole chicken wing, the skinned wing, and the wing with most of the muscles removed. Students may have questions and observations about the size and shape of the muscles and bones, and you may need to return to the human arm comparison on **slide D**.

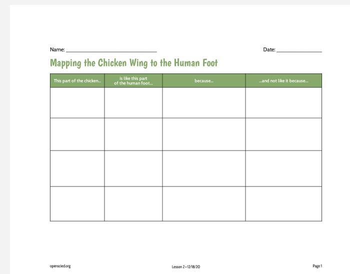
3 · MAP THE CHICKEN WING STRUCTURES TO THE FOOT MODEL

10 min

MATERIALS: science notebook, *Mapping the Chicken Wing to the Human Foot*, computer, projector

Make sense of how the chicken wing relates to the human foot by mapping the different parts. Say, *We figured out a lot about how the parts of the chicken wing work together for the wing to move, but a chicken wing isn't a human foot. How can we use what we observed to figure out more about how the human foot works? Let's use a mapping tool to think through how this could help us.*

Hand out a copy of *Mapping the Chicken Wing to the Human Foot* to each student. Display **slide H.** Facilitate a discussion to decide how to map the different parts of the chicken wing to the human foot. Tell students not to tape this in their notebooks at this time. Remind students they used a similar mapping tool in *Everest Unit* to consider how a demo with dye in water helped us better understand what happens within the earth's mantle and again in *Tsunami Unit* to consider how different models helped us visualize what happens during a tsunami. Talk through the different columns and what we will be recording in each box. As you facilitate this discussion, it will be helpful to record what the class agrees upon. Project **slide H** onto a whiteboard and record what the class agrees upon.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Mapping the Chicken Wing to the Human Foot

This part of the chicken...	is like this part of the human foot...	because...	...and not like it because...

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ADDITIONAL GUIDANCE

If you cannot project the slide onto a whiteboard, but you have a document camera, you can print off an extra copy of the handout and fill it in as students share. If neither of these options are available, this table could be replicated onto poster paper. It will be important to record what the class agrees on in a public way. Handout *Mapping the Chicken Wing to the Human Foot* has more rows than are needed for the skin, muscles and bones. Feel free to use the other row(s) for another part if students suggest it, and/or assure them that they may not need them all.

Ask the students what part of the chicken wing we should begin with in our mapping tool. Although the description below starts with mapping the skin, the order your class chooses does not matter.

Ask the class, *What parts of the human foot do we want to collect more data about from this investigation besides the skin? What other parts of the foot from the case we looked at in the first lesson do we want to figure out more about from the chicken wing investigation?*

Students should say the muscle and the bone. Say, *Record these parts in the boxes in the second column of your handout, one part per box. Take a couple of minutes with a partner and fill in these rows.*

Ask for volunteers to share and add to the class table. An example of how the table might look filled in can be found below:

This part of the chicken...	is like this part of the human foot...	because...	...and not like it because...
chicken skin	skin	It moves and stretches as the wing moves just like our skin moves and stretches when our foot or other limb moves. It covers everything in our body like the skin covered all the parts of the chicken wing.	It looks a little different in color, like paler and a little pinkish. It seems thicker and tougher than human skin. The chicken skin has lines or pock marks on the skin and humans do not. Human skin has smaller divots or pores.
chicken muscle (or the meat part)	muscle	It contracts and extends, causing different parts of the wing to move, like when a foot flexes or extends.	A wing is not a foot, so the types of muscle might be different.
chicken bone	bone	The bones move when the muscles move in both the foot and the wing.	The bones in the wing seem to be shaped differently than the bones in the foot.

ASSESSMENT OPPORTUNITY	**Building towards: 2.A** Analyze and interpret data to highlight the interactions between subsystems (skin, muscle, bone) within the larger system (foot or wing). **What to look for**: Students will analyze a demonstration dissection of a chicken wing to make sense of how the different parts of the wing work together for the wing to move. Specifically, they will focus on how the skin, muscles, and bones work together. These observations focus on interactions between these three parts at a level that they can see in the video with their eyes. This is not intended to be a deep investigation into how these parts work together or attach to one another, nor should students need to name the muscles or bones in this area of the body. Instead, we want students to be thinking about how these parts function together. Using their recorded observations, they will compare chicken parts with analogous human parts to make inferences about how the parts within the foot work together for it to move. After observing the chicken dissection, listen for students to identify the following comparisons and connections about how the parts of the foot help the foot move: • The skin on the foot stretches and moves as the foot moves up and down or back and forth, like the chicken skin moved and stretched as the chicken wing moved. • The skin is attached to the muscle below it, which allows the skin to move when the muscles move too. • When the researcher pulls on the muscles in the upper part (upper arm) of the chicken wing, the lower part (forearm) of the wing moves. For that to happen, the muscles in the upper part must be connected to the lower part. • The muscles in the chicken wing must be attached to the bones because when the muscles are moved, the bones that are attached to them move also. • When the biceps on the upper arm are pulled one way, the triceps on the opposite side of the upper arm extend and straighten out. This made the wing be able to flex and extend. • We think the muscles and bones in the human foot work in similar ways to the chicken wing because when the muscles move, the bones in the foot also move. **What to do**: Students watch this chicken wing dissection as a class to look closer at the different parts. Some students may struggle with recording observations while watching. Make these videos available to students to watch on their own outside of class multiple times, so that they have enough time to make sense of how the different parts look, move, and interact. Another option, if the technology is available in your classroom, is to watch the video as a class once together, and then have students play it again in small groups on devices to make their observations. If time is available and you have the materials, use *Teacher instructions for chicken wing dissections* to conduct a live demonstration and invite students to gather around and make their observations.

Say, *Would you say this dissection of an organism that isn't a human, a chicken, is an appropriate and useful model to use as we try to figure out aspects of how the parts of the foot in a human work together?* Students should suggest something like:

- This model is mostly helpful. A chicken wing is different from a human foot, but since a chicken wing and human foot have muscles, skin, and bones, we are able to figure out a lot about how these parts work together in the chicken wing, and we think it is probably pretty similar in the human foot from Lesson 1.
- We saw that the human arm and the chicken wing have similar parts (or structures) and the foot had muscles and bones that were injured, so it seems like there might be similar movement or function in the foot.

ADDITIONAL GUIDANCE	It might not be obvious to students that the wing is a model for explaining the foot system. You might need to provide some guidance to talk first about how this is a model: 1) What question were we trying to answer? 2) How did we use this wing to help us to answer the question? We manipulated various things to explore how things worked and to help us reason about how the parts of the human foot worked.

4 · REVISE OUR PARTS OF THE FOOT POSTER

5 min

MATERIALS: science notebook, Parts of the Foot poster from Lesson 1

Bring the *Parts of the Foot* poster to a space where all the students can see it. Conduct a discussion relating what we've learned about the chicken wing parts (structures) to the parts of the foot. To start out, say, *We have figured some things out about skin, muscles, and bones in a chicken wing and how they relate to structures in the human body. Let's capture some of these ideas by adding them to our Parts of the Foot poster. Let's think about what data we collected about how these parts (or structures) looked and behaved (or functioned) for the wing to move. We made this poster in Lesson 1 when we were only looking at the injured foot. Now, we have some additional information from the chicken wing that could help us figure some things out. Should we revise anything from the poster to reflect that we are not only looking at a foot anymore? What are some ideas for how we could revise this? Does anyone have ideas about how to change this to better fit what we've figured out?*

Say, *Okay. On our poster let's capture what we have observed about these parts or structures and how they work or function.* Pause to add the word "structure" above the parts listed and add a column with the title "The Job in the Body" (function). At this point cross off "the foot" and write in "a body" in the title of the poster to capture this idea that what we are figuring out applies to more than just the foot.

Continue the discussion asking students what the job, or function, is for each of the parts and when the class has agreed on this, add it to the chart. Below are some examples of what students might say for each of the body parts:

Skin

- *It covers the muscles and the bones.*
- *It protects the parts that are inside.*

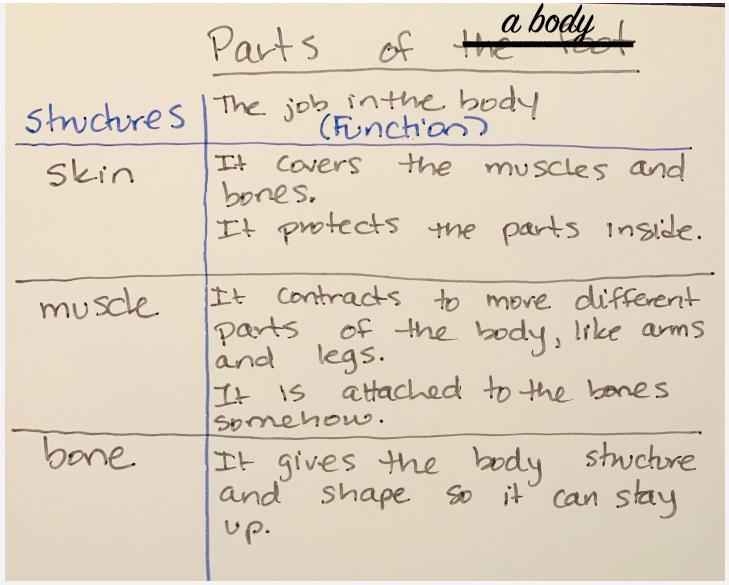
Muscle

- *It contracts to move different parts of the body, like arms and legs.*
- *It is attached to the bones somehow.*

Bone

- *It gives the body structure and shape so it can stay up.*

An example Parts of the Body poster can be found on the following page:



Parts of ~~the test~~ a body

Structures	The job in the body (Function)
skin	It covers the muscles and bones. It protects the parts inside.
muscle	It contracts to move different parts of the body, like arms and legs. It is attached to the bones somehow.
bone	It gives the body structure and shape so it can stay up.

Be sure to leave space on the right hand side of the poster to make a third column. During day 2 we will be adding another column for how each structure relates to its function.

Add "function" to our Word Wall. Your definition might be something like "job of the part (in the body)." Say, *We've really made some progress in our understanding of the word function. Could someone tell us what our definition of function is so that we can add it to our Word Wall?*

Function: job of the part (in the body)

ADDITIONAL GUIDANCE

Throughout this unit we will be using the term *structure* and *function* to refer to both DCIs and CCCs. We will be investigating different part(s) of living things and how they work (CCC) ***and*** the structures (cells and cell parts) found within these parts and the function these structures serve for the part of the body they make up (DCI). In this lesson, we will begin using the word structure to refer to the macroscopic structures of the skin, bone, and muscles, and we will use function to refer to what we figure out about the job this part does for a limb in a living organism. Though we will begin using the term function in this lesson, we are not going to add this word to the Word Wall until Lesson 6. Before we add this term to the Word Wall we will earn it by:

- Analyzing cross sections of different parts of the body to figure out that common structures in these body parts include blood vessels and nerves (Lesson 3).
- Looking at a blood sample under the microscope and finding small structures called blood cells and noticing arm-like structures on the platelets. We also use structure to discuss the shape of the cells, i.e. blood cells are round and that structure supports their function of moving around the body (Lesson 4).
- Looking at a sample of nerves under the microscope and finding small branch-like structures called nerve cells (Lesson 5).
- Looking at samples of bones, skin, and muscles under the microscope and finding these too have structures called cells and that these cells have structures that support their functions (Lesson 6).

5 · BRAINSTORM HOW TO REVISE THE INVESTIGATION

5 min

MATERIALS: science notebook, *Mapping the Chicken Wing to the Human Foot*, tape

Brainstorm how we could try the dissection again to see how an injured chicken wing functions. Display **slide I.** Ask students, *Okay, so now we have some data from this investigation about how muscles and bones work together for a limb or extremity (like the chicken wing or human foot) to move. In Lesson 1, the parts of the person's foot were injured and needed to heal before he could walk again. How could we revise the chicken wing dissection to figure out more about how the injury affected the different parts of the foot and prevented him from being able to walk?*

Some sample students responses:

- *We could use a chicken leg and foot instead of a wing.*
- *We could drop a weight on the chicken wing like what happened to the foot.*
- *We could cut the skin and muscle to show it broken open like the foot.*
- *We could use some heavy metal object to simulate the same type of injury.*

Elicit ideas about how to investigate the chicken wing next. Show **slide J.** Have students record their ideas in their notebooks. Students will use their answers to navigate to the next investigation and prepare them to watch for changes to the chicken wing's function.✱

Say, *In the foot injury, the bone, the skin, and muscles were impacted when the person dropped the weight on their foot. In our next class we will revise the investigation to include an injury and analyze data to help us understand how the injuries prevented the person from being able to walk. Turn to the next page in your notebook and use what you have recorded on Mapping the Chicken Wing to the Human Foot and the Parts of a Body poster to explain how an injury to one of the body parts or structures could affect the chicken wing's function. You can use words and/or pictures to capture your predictions.*

Say, *When you are finished, please make sure you have taped Mapping the Chicken Wing to the Human Foot into your notebook. At the beginning of our next class be ready to share your predictions.*

✱ ATTENDING TO EQUITY

Universal Design for Learning: The goal in this moment is two-fold: (1) to support *engagement* by optimizing choice of how they would proceed with the investigation, and (2) to allow students to *express* their ideas using multiple modalities supports student ownership of their learning by giving students choice, access, and control in navigating their own understanding around the science ideas. All versions of responses can productively contribute to the next day's discussion.

End of day 1

6 · NAVIGATION

3 min

MATERIALS: science notebook

Discuss your predictions from last class with a partner. Display **slide K** and direct students to turn and talk with a partner about their predictions of how the function of the wing would be affected if one of the parts of the wing was injured. Ask students to share any pictures they drew in their science notebook with each other.

Have one or two students briefly share out predictions with the whole class, making sure not to indicate whether any of the stated predictions will describe what's going to happen. Say, *The researcher revisited their investigation, damaging part of the wing. We're going to make observations of the researcher's investigation to see whether our predictions about damaged structures are accurate and if we notice anything else that we hadn't thought of before.*

ASSESSMENT OPPORTUNITY

Building towards: 2.B Revise the experimental design to predict the change in function of the chicken wing (effect) under various conditions (cause) and conduct the investigation.

What to look for:
At the end of day 1, the class will be brainstorming ideas for how to revise the dissection investigation to figure out more about how the injury to the person's foot affected different parts of the foot and prevented the student from being able to walk. Look for the verbal sharing of ideas around injuring the wing in a way that is similar to how the foot in Lesson 1 was injured, such as dropping a heavy weight on it.

At the end of day 1 students will record predictions about how an injury to one part of the wing will affect its function in their notebooks. At the beginning of day 2, students will share those predictions with a partner and then the class. Look for ideas that include a change in the wing's function as a result of injury to the part, as in the following examples:

- If the muscles are broken, the wing might not be able to move at all.
- When the bone is broken, the muscles can still move, but not in the same way.
- If only the skin is cut, the wing will probably still be able to move and it may move even more since the skin would be less able to hold it back.

What to do:
If students are struggling to come up with ideas around mimicking an injury that is in a manner similar to how the foot was injured on day 1, ask them to revisit *Mapping the Chicken Wing to the Human Foot* and think of additional ways that the chicken wing in the video differs from the foot in Lesson 1. Ask them to recall what happened to the foot in Lesson 1 that caused the person's inability to walk.

Look at students' notebooks after day 1 and read through their predictions. Listen to partner groups as they share their predictions on day 2. If students are struggling to make cogent predictions, ask them questions such as:

- If the bone is broken in the wing, like the bone was broken in the foot, what do you think will be similar or different about the wing's ability to move?
- If the muscle is impacted and torn somehow, do you think the wing will be able to move in the same way? Why?

7 · INVESTIGATE SKIN, MUSCLES, AND BONES IN AN INJURED CHICKEN WING

15 min

MATERIALS: Investigate Skin, Muscles, And Bones In An Injured Chicken Wing, science notebook, computer, projector

Orient the students to the chicken wing dissection. Display **slide L.** Say, *To see how an injury affects the parts of a chicken wing and its movement, we are going to make observations again of a chicken wing. In the beginning of the video, you will see the wing is being damaged in a way that is similar to the injury to the foot from Lesson 1. As you watch the video, think about how the structures are affected by the injury and how it will alter, if at all, the wing's function. As we did last class, we will pause the video at various times to record our observations. To prepare to collect this evidence, let's set up a new notebook page. Title it "Injured Chicken Wing Dissection." Then make a t-chart like the one we created last class. Your page should look like this:*

Part of the chicken	*Observations*

Display slide M and watch the *Injured Chicken Wing video* at https://www.teachersopensciedfieldtest.org/healing , pausing for about 30 seconds when the video shows a prompt. Be prepared to pause the video at the following times: 0:34, 1:50, 3:12, 3:34, and 4:10. Give students more time as needed to record their thoughts.

In the *Injured Chicken Wing video* at https://www.teachersopensciedfieldtest.org/healing , the humerus bone of the chicken wing is broken by placing the curved end of a pry bar on the upper arm and striking the other end of the pry bar with a hammer to mimic the force of a weight dropping on a foot. The striking of the pry bar with a hammer is not visible in the video so you may have to explain this to students. In addition, this approach was taken to focus the force on the bone so it would break in a controlled manner.

The right-hand image in https://www.teachersopensciedfieldtest.org/healing at 3:34 is a pseudo cross-sectional view to show what is inside the bone shown to the left. Explain the differences in these two images if students are confused.

The prompts in the video may have the following student observations:

Video prompts	Sample student responses
What parts of the wing, if any, do you think were damaged by the impact? *(pause at 0:34)*	*It seems like the bone broke since the wing moved up while it was being hit.* *The orange bar might have damaged the skin?* *It's hard to tell if muscles were damaged.*
What do you notice about the motion of the injured wing? *(pause at 1:50)*	*When hands on either end move it, the elbow joint starts to bend off-center.* *It's hard to see a difference when the muscles are pulled.*
What do you notice about the bones and muscles in the injured wing? *(pause at 3:12)*	*One of the muscles near where it was hit seems to be looser near the elbow.* *I think I saw a broken bone!*
What do you notice about the motion of the injured wing when the skin is removed? *(pause at 3:12)*	*The wing was flopping around a lot beyond just the elbow bend, it was flopping to either side.* *It looked like the muscle was also split or opened up from the injury.* *Like with the uninjured wing, it stretched farther out and moved more when the skin was removed.*
What do you notice about the injured wing? *(pause at 3:34)*	*The bone is definitely broken!* *The inside of the bone has red, mushy looking stuff.* *The muscle seems damaged near the bone break.*

Video prompts	Sample student responses
When looking at the uninjured and injured wings side by side, do you notice any additional differences? (pause at 4:10)	*Compared to the uninjured wing, the injured wing moves around in more directions, more out of control.*

8 · COMPARE THE INJURED WING TO THE INJURED FOOT

5 min

MATERIALS: science notebook, *Mapping the Chicken Wing to the Human Foot*, How is the injured chicken wing similar and different from the injured human foot? poster

Facilitate a brief Building Understandings Discussion. Display **slide N.** Say, *During the last two classes, we used a chicken wing as a model to figure out how the parts of the foot work together for the person to be able to walk and how the injury affected the foot's function. Let's take a couple of minutes to make sense of what we have figured out about how an injury can affect a body part's function and what we still need to figure out. Talk with an elbow partner about the question on the slide:*

- *Compare the injured chicken wing to the injured foot.*
- *Was there anything from our timeline or from the doctor's notes that we didn't see in the injured chicken wing? Look back in your notebook at the doctor's notes if needed.*
- *Be ready to share.*

Prepare a poster paper and title it, "How is the injured chicken wing similar and different from the injured human foot?" Use the suggested prompts below to facilitate this discussion and record students' ideas on the poster.✱

Suggested prompt	Sample student response
What were some things that were similar between the injured chicken wing and the injured human foot?	*Both had a broken bone.* *Both had muscle that was damaged or torn.* *Both could not function the same way it could before it was injured - the person couldn't walk on their foot and the chicken wing didn't extend and contract the same.*
What were some things that were different between the injured chicken wing and the injured human foot?	*The foot has dried blood on it, whereas the chicken wing didn't have any visible blood near the injury.* *The human foot was still living, whereas the chicken wing was not.* *There was swelling on the foot when the injury happened and lasted for a little while, but the chicken wing didn't swell.* *The human foot needed pins, a cast, and stitches so it could heal while the chicken wing is not going to heal even if it had these things because it is no longer living.*

Say, *So it seems like we were able to figure out a few things about how parts of a foot or arm (or wing) interact for that limb to move, or function from these investigations. So though the chicken wing helped us figure some things out, there are some limitations to using it as a model for the injured foot. Looking at the things we have recorded on this poster, what are some of these limitations?*

✱ SUPPORTING STUDENTS IN DEVELOPING AND USING SYSTEMS AND SYSTEM MODELS

In this lesson, students use a chicken wing as a model to develop ideas to explain how parts of a human foot work and how injuries affect the human foot's function. This model has limitations, as the wing is no longer part of a living organism. Thus, there are things missing after injuring the chicken wing, such as the presence of blood or swelling, that were present with the injured foot. Students will reflect on how the chicken wing is limited in how it can help us figure out how parts of living things heal.

Some possible student responses:

- *The chicken wing isn't part of the chicken anymore. So we can't see how it functions when the chicken is living.*
- *Though we are just trying to figure out how the foot healed, it is still part of a body so there must be more parts that are important for it to heal than just the muscles, skin, and bones.*
- *The chicken wing helps us see how the muscles, bones, and skin move and work together, but because it wasn't living anymore there wasn't any visible blood, so we couldn't see why or how blood is affected or part of an injury.*
- *The chicken wing didn't swell up like the foot did, so we couldn't figure out anything about swelling or why it happens.*
- *The chicken wing didn't have anything added to it to help it heal.*
- *The chicken wing won't heal because it is not living or part of a chicken anymore.*

Say, *Although the chicken wing as a model helps us figure out a few things about how these different parts work, we still have a lot of questions to answer.*

9 · BUILDING UNDERSTANDINGS DISCUSSION TO BEGIN THINKING ABOUT A BODY AS A SYSTEM

10 min

MATERIALS: science notebook, *Mapping the Chicken Wing to the Human Foot*, Parts of a Body poster

Facilitate a Building Understandings Discussion. Be sure students can see the *Parts of a Body* poster. Display **slide O.** Say, *In many of our units, we've broken down complex phenomena into various systems or subsystems that interrelate with one another to give rise to a phenomenon. Let's think back to some of our earlier units that we studied this year. In the Cup Design Unit for example, when we were trying to figure out how to keep a drink cold longer, we studied the different parts of the cup system to figure how a cup keeps a drink cold and in Storms Unit when we were trying to figure out why there are different types of precipitation events, we figured out what the different parts of the weather system are and how they interact.*

Use the prompt response suggestions below to press students to consider how systems could be a useful lens for examining this new phenomenon of injury and healing.

Suggested prompt	Sample student response
In the Cup Design Unit, when we were trying to figure out how to keep our drink cold longer, we analyzed different cup systems. What were some of the parts of the cup system?	*The cup system was made up of the wall of the cup, the lid of the cup, the material of the cup and possibly a straw.*
What system and subsystems did we figure out about in Storms Unit?	*We figured out that weather is affected by heat from the sun heating the ground which then heats the air. So the sun would be a sub-system and the ground and the air would also be sub-systems. Water vapor was also part of this system.*

Say, *Great, okay. So do you think we could think of the body as a system? Turn and talk with a partner about the questions on **slide P**:*

- *Is the body a system?*
- *What would be some parts of the body if it is a system?*

Suggested prompt	Sample student response
Can we think of the body as a system?	*Yes!*
So if the body is a system, what are some parts of the body system?	*The muscles could be one part.* *The bones.* *The skin.*
And we saw in the dissection videos that these parts do interact and work together. What about the foot? How is it related to the body system?	*The foot is part of the whole body.* *Yeah and it has muscles, bones and skin, so maybe it is like a subsystem of the body.*
What have we figured out about how these different parts of the foot system, or body system work together?	*We figured out that the muscles help the limbs move and that the bones are attached somehow to the muscles, so they move when the muscles move.*
And, what did we figure out about what happens to the foot system if one part is impacted or damaged?	*We figured out the parts work together for the foot to be able to walk, so if one part is damaged, then the whole foot is impacted.*

KEY IDEAS

Purpose:

- Review how systems thinking was used in prior units to make sense of complex phenomena by breaking larger systems down into smaller subsystems.
- Identify the body as a larger system consisting of distinct interacting subsystems (skin, muscle, bone).

Listen for these ideas:

- The function of the whole foot changes when one part of the foot is injured, like when a bone is broken.
- Each part of the foot has a specific function.
- The parts of the foot interact to make the foot function (move).
- In the Cup Unit, the cup was the system we looked at. We broke it down into parts (the lid, the material, etc.) and investigated the interactions between those parts.
- In the Storms Unit, the water cycle was the system we worked with.
- In this investigation, we looked at a part of the chicken (the wing) and saw that it was made up of other parts (skin, bone, muscle). From Lesson 1, we know that the injured foot also had skin, muscle, and bone, and the foot is a part of our body. So maybe the big system we are working with is the body.

Orient the class back to our *Parts of a Body* poster. Say, *In our last class, we retitled this poster to read Parts of a Body and we identified the function of the parts that we had listed. Now that we are thinking of the body as a system made up of subsystems, let's keep track of this by adding (system) after the word body in the title.* Add "a system" after the title Parts of a Body, on the poster.

Say, *Let's add to our poster what we have figured out so far about how the different structures, or parts, relate to the function, or job, of that body part. What about each part makes it particularly useful or necessary to its function?*

After the class has come to agreement that we're looking at more than just a foot at this point in time, cross out "the Foot" in the title and replace it with "a Body." It is possible your class may want to change the title to Parts of the foot and the chicken wing. Press them to consider, if we are using what we have seen with these parts in the chicken wing to figure out what happens in a human body, is it possible we could look at muscles, bones, and skin in another animal and we would see similar structures and functions?

Add a new column to the right of the "function" column and label it "Structure relates to Function..." and facilitate a discussion by asking students how each structure is related to its function for each part (skin, muscle, bone). When the class agrees about a relationship, add it to the chart.

Below are some examples of what students might say for each of the body parts (or structures):

Skin

- *Connected to the muscle with a thin layer.*
- *Stretchy.*
- *Moves with the part it's attached to.*

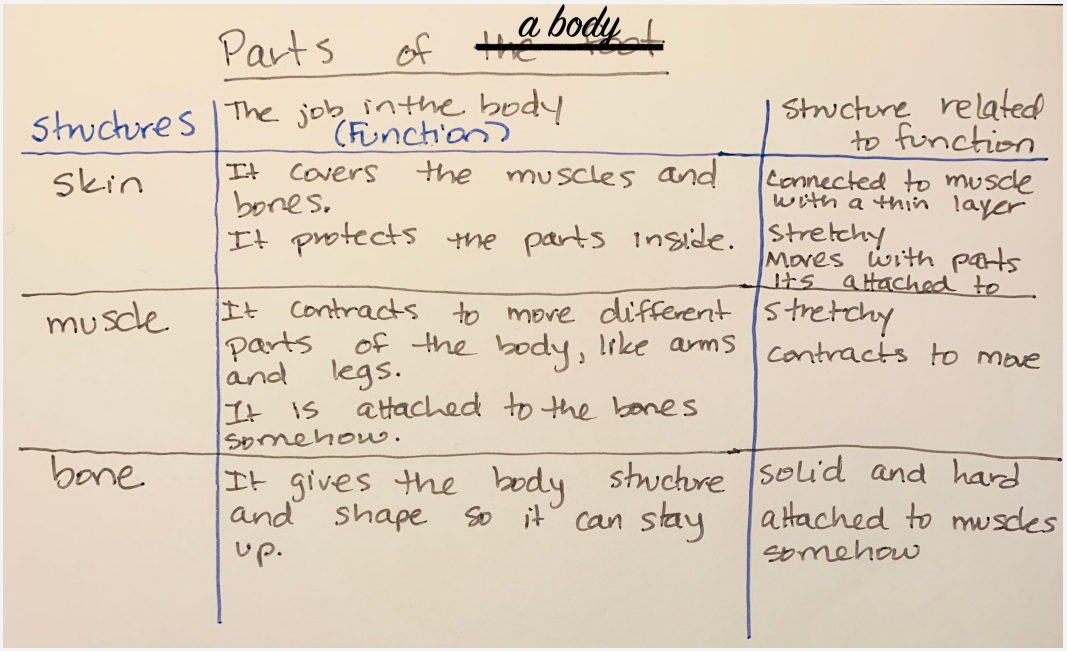
Muscle

- *Stretchy.*
- *Is attached somehow to the skin and the bone so it is able to move those parts when it moves.*

Bone

- *Solid and hard.*
- *Attached to muscles somehow and moves when the attached muscles move.*
- *Holds up/gives shape to the whole body.*
- *Makes the whole system not like jelly/wobbly.*

An example of this revised poster is included here:



Parts of ~~the foot~~ a body

Structures	The job in the body (Function)	Structure related to function
skin	It covers the muscles and bones. It protects the parts inside.	Connected to muscle with a thin layer Stretchy Moves with parts it's attached to
muscle	It contracts to move different parts of the body, like arms and legs. It is attached to the bones somehow.	Stretchy Contracts to move
bone	It gives the body structure and shape so it can stay up.	solid and hard attached to muscles somehow

10 · CREATE PROGRESS TRACKER FOR THE UNIT

12 min

MATERIALS: science notebook, Progress Tracker

Help students recall what they have figured out by using the Progress Tracker. Introduce the Progress Tracker. Present **slide Q**. Have students draw a three-column chart in ***landscape orientation*** directly in their science notebooks in the section set aside for Progress Trackers. Explain that as we investigate healing and how it happens, we are going to keep track of how our model changes and develops over time in our Progress Tracker.

Say, *Just as in other units this year, we will use this tool to help us keep track of ideas we figure out from each lesson. In the "What we figured out in words/pictures" you can draw pictures or write in words, bullet points, or whatever way is most meaningful for you. The "This makes me think or wonder about healing...." column helps us think about the big picture of how healing happens as we figure out new things or what questions we might have that we want to learn more about. Initially, we may have more questions in this section or partial ideas, but that is okay because questions help us figure out what we still need to know. Individually take 3 minutes to think about what you figured out from our last classes. You can draw from anything we've done so far.*

By using a landscape orientation and having no structured box, students can take up a lot of space or a little space on their Progress Trackers. Whenever a student is done writing, they can draw a line after their work to make space for the next time a teacher instructs them to write in their Tracker.✱

Question	What we figured out in words/pictures	This makes me think or wonder about healing...
What do our skin, muscles, and bones do?	• Muscles help us move our body parts • Bones move when the muscles attached to them move • Skin is stretchy and covers our bones and muscles, protecting them • Skin is connected to muscle	When the foot is injured, the muscles and bones aren't working properly, and they can't move very well. But what needs to happen so it can function again? When one part of the system is broken or injured, the whole system is affected and can't function the way it used to. How do skin, muscle, and bone become functional again?? Do the structures heal all at the same time?

Reflect on what we want to figure out next. Say, *It seems like we can only learn so much from examining the chicken wing, but we need to know more about these body parts so that we can learn more about what is needed for the foot to heal. We saw the skin is attached to the muscle and the muscle is attached to the bone and because of this, all these parts move together, but what else is part of the foot or chicken wing system? Next class, let's see if we can look at these parts of the foot system in a new way to see if we can figure out more about how these parts interact with each other.*

✱ ATTENDING TO EQUITY

This example Progress Tracker serves as teacher guidance for what students might say at various points throughout the unit. However, some students may say more and others may say less. It is important that what the students write in the three-column tracker reflects their own thinking at that particular moment in time. This is an opportunity for students to express their understanding and reasoning in their own way. Encourage students to express what they've learned using a mode that makes sense for them. For some emergent multilingual students, encourage them to use this space to make sense in the language that they feel most comfortable using. The individual Progress Tracker is a space for students to be creative and to synthesize learning in their own words. It is not supposed to follow a prescriptive plan or structure and should be a low-stakes opportunity for students' to make sense of what they are learning without the worry and anxiety that comes with knowing their work will be graded. Use the Progress Tracker for formative assessment only.