Lesson 1: What happened in the student's foot so they could walk again?

Previous Lesson *There is no previous lesson.*

This Lesson

Anchoring Phenomenon

4 days

We share experiences of moving our bodies and also times when we were unable to. We read doctor's notes about an injured patient and see images of his foot injury and the healing process. We create a timeline of important events that show evidence of healing. We develop models to explain how parts of the foot work together to allow the patient to walk. We brainstorm related phenomena of other times we have seen healing in humans and other living things. We develop questions for our Driving Question Board (DQB) and ideas for possible investigations to answer these questions.

Next Lesson *We will investigate how the parts of a chicken wing work together when moving. We will map the parts of the chicken wing to the parts of the human foot to compare how they function together. We will revise the investigation to figure out how the wing's function is affected due to an injury.*

BUILDING TOWARD NGSS

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

What students will do

1.A Obtain information from images and doctor's notes to identify patterns between the relationship of important events (effect) and the evidence of interacting subsystems healing (cause).

1.B Develop an initial model of the healing process that occurs within and between multiple interacting systems and subsystems and restores the foot's function.

1.C Ask questions that arise from observations of injuries to multiple subsystems that result in the loss of function of the foot (larger complex system).

What students will figure out

- A student who was previously able to walk was injured in an accident and could no longer walk.
- More than one part of the patient's foot was injured in the same accident.
- Some of the injured parts of the foot needed outside supports during the healing process.
- Over time, the injured parts of the foot were able to heal; some took longer than others.

- The injury caused gaps between the damaged structures in the foot.

Lesson 1 • Learning Plan Snapshot

Part	Duration	Summary	Slide	Materials
1	10 min	**NAVIGATION** Share about experiences when students were moving their bodies and times when they were unable to.	A-B	
2	15 min	**EXPLORE AN INTERESTING PHENOMENON** Introduce a similar phenomenon to notice and wonder about--a middle school student injured in PE and his journey to recovery.	C-F	*Emergency Room Report*, *Post-Operation Report*, *Recovery Reports*, chart paper, marker
3	10 min	**RECORD EVIDENCE FOR HEALING** Co-construct a definition of what it means to heal, and identify events in the injured foot's healing process.	G-H	*Recovery Reports*, *Evidence for Healing*, sticky note, marker, tape, Word Wall poster, chart paper
4	10 min	**CREATE A TIMELINE FOR HEALING** Facilitate a Building Understandings Discussion to organize our ideas about important events in the healing process that provide evidence that the foot is healing.	I	Healing Timeline poster, markers, sticky notes
				End of day 1
5	3 min	**NAVIGATION** Revisit the Healing Timeline to recall the parts of the foot impacted by the injury.	J	Healing Timeline poster, markers
6	10 min	**DEVELOP AN INITIAL MODEL OF HEALING** Students individually develop models of the injured and healed foot to explain what they think happens during the healing process.	K	*Healing Initial Model*
7	5 min	**REVISIT CLASSROOM NORMS/COMMUNITY AGREEMENTS** Review the classroom norms and set expectations for students' work together on a consensus model. Prompt students to pick one norm to focus on for today.	L-M	Classroom Norms poster or slide
8	5 min	**COMPARE INITIAL MODELS** Students work in partners to compare their initial models and record similarities and differences.	N	*Healing Initial Model*, chart paper, markers
9	20 min	**DEVELOP AN INITIAL CONSENSUS MODEL OF HEALING** Facilitate a Consensus Discussion to develop the class's initial consensus model of healing.	O	Healing Timeline poster, markers, 2 copies of *Printouts of the Foot*, tape, chart paper,

				Communicating in Scientific Ways poster or handout
10	2 min	**PREPARE FOR HOME LEARNING ABOUT RELATED PHENOMENA** Give students their home learning assignment to gather stories of related phenomena similar to the healing case we have been working with/observing/examining"	P	*Healing Phenomena Stories*
				End of day 2
11	30 min	**EXPLORE DIFFERENT ASPECTS OF VISIBLE AND INVISIBLE DISABILITY** Create lists of different ways people complete everyday tasks. Describe adaptive equipment that can assist in daily tasks. Revise the class definition of healing.	Q-BB	*Healing Phenomena Stories*, markers, Word Wall poster
12	10 min	**SHARE RELATED PHENOMENA OF HEALING** Record students' ideas of related phenomena and experiences they have had, either like those in the doctor's notes or any other phenomena that they think might have happened due to similar causes.	CC-DD	*Healing Phenomena Stories*, chart paper, markers
13	5 min	**DEVELOP QUESTIONS FOR THE DRIVING QUESTION BOARD** Students develop questions individually for the DQB.	EE	sticky notes, marker, Noticings and Wonderings – Post Operation poster, How Does the Foot Heal over Time? poster, Related Phenomenon poster
				End of day 3
14	30 min	**BUILD OUR DRIVING QUESTION BOARD** Convene a Scientists Circle to construct a DQB about what is causing the phenomena students have been observing and working with over the previous days of this lesson.	FF	sticky notes with questions, sticky notes, larger sticky notes (to label cluster or categories of questions) tape, chart paper, markers
15	10 min	**GENERATE IDEAS FOR FUTURE INVESTIGATIONS** Elicit students' ideas for future investigations that could help us answer our questions. Make a public record of these ideas as they are shared with the class.	GG-HH	chart paper, markers
16	5 min	**NAVIGATION** Discuss where we are headed next to investigate this phenomenon.	II	
				End of day 4

Lesson 1 • Materials List

	per student	per group	per class
Lesson materials	• science notebook • *Emergency Room Report* • *Post-Operation Report* • *Recovery Reports* • *Evidence for Healing* • sticky note • marker • *Healing Initial Model* • *Healing Phenomena Stories* • sticky notes • sticky notes with questions	• tape	• chart paper • marker • Word Wall poster • Healing Timeline poster • markers • sticky notes • Classroom Norms poster or slide • 2 copies of *Printouts of the Foot* • tape • Communicating in Scientific Ways poster or handout • Noticings and Wonderings – Post Operation poster • How Does the Foot Heal over Time? poster • Related Phenomenon poster • larger sticky notes (to label cluster or categories of questions) tape

Materials preparation (30 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.

Review the *Disability and Inclusion Awareness* reference before teaching the lesson and send the *Pre-Unit Letter Home* to students' parents/guardians.

Prepare chart paper to make the following posters:

- Noticings and Wonderings about the Injury

- Noticings and Wonderings Post-Operation
- What Do We Mean by Healing?
- Word Wall
- Healing Timeline: Prepare 2 large pieces of chart paper for the timeline (see image of sample timeline in teacher guide corresponding with slide I). Create the timeline on the bottom two-thirds of the chart, leaving room for foot diagrams to be taped above it. On the left end of the timeline, write "When Injury Happened". On the right end of the timeline, write "Foot Healed". Just above the line, evenly spaced, write "Recovery Report 1", "Recovery Report 2", "Recovery Report 3", and "Recovery Report 4".
- How Does the Foot Heal over Time? (initial consensus model):
    - On a separate sheet of paper, write the question "How Does the Foot Heal over Time?" Be ready to place this paper above the initial consensus model as a title.
    - The initial consensus model will consist of annotated diagrams of the injured foot and healed foot above the Healing Timeline, with the question "How Does the Foot Heal Over Time?" above it.
    - Print two large copies of *Printouts of the Foot*. Tape one of these on each side of the chart paper above the Healing Timeline.
- Related Phenomena
- Driving Question Board
- Ideas for Future Investigations and Data We Need

Determine where to set up the DQB and posters so students can gather around them. If you have not already done so, make and post a Classroom Norms poster near your DQB space.

Be sure you have a blank piece of paper or sticky note ready to add *healing* to the Word Wall. Do not post this word on the wall until after your class has developed a shared understanding of its meaning.

Lesson 1 • Where We Are Going and NOT Going

Where We Are Going

Students begin this lesson by considering a phenomenon directly connected to their personal experience: a time when a part of their body was hurt or injured, which prevented them from being able to do a favorite activity for a short or long period. They are next presented with a case study of a middle school student's multisystem foot injury, and they follow his healing journey by analyzing doctor's notes and images.

In this lesson, students develop an initial definition for the word *healing* based on their prior experiences. Over the course of the unit, the definition is expanded and revised as students figure out more about the structure and function of different body parts and whether functions return to their original state prior to injury. Students explore different ways in which individuals experience or accomplish daily tasks. They begin to develop social-emotional skills around how people may have different abilities than themselves; they learn that sometimes these abilities are a result of an injury, but that it doesn't mean the person isn't healed or otherwise healthy. Although this unit builds off the systems thinking developed in other units, this is the first life science unit in OpenSciEd that considers living body systems.

As injury sometimes results in disability, this unit introduces students to the concept of disability as a natural and expected part of human diversity. The language in this unit reflects the idea that disability is neutral: neither tragic nor bad, nor inspirational. More information about disability to support teachers' instruction is given in *Disability and Inclusion Awareness*.

Where We Are NOT Going

This unit focuses on how the parts of the body work together as a system to function (move, grow, and the like) and restore function (heal), and how macro- and microlevel structures (and their corresponding functions) are involved in both. In this lesson, students begin this exploration by analyzing a case study of a middle school student who broke his foot.

It is **not** necessary for students to consider what is happening at the microscopic level in Lesson 1. They remain at the macroscopic level in the first three lessons and consider the parts of the foot from different perspectives, orientations, and interactions. In Lesson 4, students shift to microscopic exploration as they examine microscopic images or slides of different parts of the body. Motivation for this shift is built into the storyline toward the end of Lesson 3.

This unit does not explore the mechanisms of the immune system, or the body's immune response to injury, in any greater detail than identifying the different components of blood (in Lesson 4). Additionally, though Lesson 1 presents data indicating that different parts or systems of the body heal at different rates (i.e., skin heals faster than bone, which heals faster than nerves), the differential lifespan of various cells is not addressed until Lesson 10.

Finally, Lesson 1 does not focus on how the injury occurred, nor on the patient's surgical procedure or external supports (cast, pins). These are merely shared so students can deduce what parts of the foot were injured and how the injury affected the foot's function, and to help analyze data that could be evidence of healing over time.

LEARNING PLAN for LESSON 1

1 · NAVIGATION

10 min

MATERIALS: science notebook

Elicit students' experiences of moving their bodies. Display **slide A**. Begin by asking students to stop and jot in their notebooks about their favorite activities that involve moving their body, and what parts of their body they use in that activity. **Slide A** is meant to elicit an array of movement experiences from students with diverse backgrounds. Take the opportunity to localize this phenomenon by revising the slide with images of activities in which your students may have more interest✱. However, be mindful to include students with different abilities and interests.✱

After giving students a couple of minutes to write and process their ideas, have them share out with the class. Use the prompts below to guide the discussion.

Suggested prompt	Sample student response	Follow-up question
What is your favorite activity that involves moving your body?	*Accept all answers. For example:* *Dancing* *Riding a bike* *Painting* *Playing video games* *Jumping on a trampoline* *Climbing a tree* *Yoga*	*What are some of your daily activities that involve moving your body?*
What parts of your body do you use when doing this activity?	*Accept all answers related to parts of the body. For example:* *Hands* *Feet* *Arms* *Leg(s)* *Head* *Eyes* *Nose and mouth*	*How is this body part useful for supporting the activity?*

✱ ATTENDING TO EQUITY

When selecting images to include in **slide A**, be sure that individuals with disabilities are represented. This will help students understand that disability is an aspect of human diversity and that individuals with disabilities have a range of interests and participate in a variety of activities.

✱ ATTENDING TO EQUITY

Supporting Emergent Multilingual Students: A science notebook gives students a space in which to reflect and communicate their developing understandings about science ideas and to track changes in those understanding. Encourage students to record their ideas using linguistic (written words) and nonlinguistic modes (photographs, drawings, tables, graphs, mathematical equations, measurements). This is especially important for emerging multilingual students because making connections between written words and nonlinguistic representations helps students generate richer explanations of scientific phenomena.

*Are there other parts of your body that we **can't** see that support you doing this activity?*	*Accept responses that are internal body structures. For example:* *Muscles* *Bones* *Joints* *Tendons* *Ligaments* *Brain* *Heart* *Core or abs* *Lungs*	*How are these body parts that we can't see useful for supporting the activity?*
How do these body parts work together to do your activity?	*Accept all answers. For example:* *When I dance, I use my core and my arms and my feet to move around. I use my mouth, nose, and lungs to breath, and my eyes to see where I am moving.*	*Can anyone else think of how other body parts might be helpful for _____'s activity?*

SCIENCE NOTEBOOK

This is the unit's first use of the science notebook. You may need time to organize a new section. How to set it up varies depending on how you've structured the components of your notebooks, such as the table of contents and how to note the start of a new unit. It is recommended to have students do the following:

- Reserve a blank page at the start of the unit for writing the unit question on day 3 of this lesson.
- After the title page, reserve 2 pages (4 pages front-to-back) for the table of contents (unless all tables of contents are at the front of the notebook).
- Reserve 10 pages (20 pages front-to-back) for the Progress Tracker pages.
- After the Progress Tracker pages, begin numbering pages (start with 1) so everyone begins the unit's first investigation on the same page number.

Remind students that the notebook is their tool for recording their observations, evidence, and ideas to share with the classroom community. They should see it as a space to brainstorm and record their thinking, as well as a place to show how their thinking changes as they learn more.

ADDITIONAL GUIDANCE	In this unit, the Progress Tracker uses a 3-column format. Similar to previous units, students record the lesson question in the first column and explain what they figured out in the second column. The third column extends their thinking by connecting what they figured out to the concept of healing. Unlike in previous units, the third column also supports students in generating further questions that can be added to the DQB and inform or motivate future investigations.

ADDITIONAL GUIDANCE	Be mindful that sharing or hearing stories of past injuries can bring up past or recurring trauma for students. It is advised to send home communication to parents, letting them know the subject of the lesson in advance so they can let you know of any topics that may be sensitive for students. There is a *Pre-Unit Letter Home* provided that can be edited and sent home to parents. We also recommend seeking the assistance of a school psychologist, social worker, mental health specialist, or counselor to support discussions that may be challenging for some students.

Elicit students' experiences of being unable to do an activity. ✱ ✱ Display **slide B**. Using the slide and the prompts below, have students share out about times when something made them unable to use part of their body. Ask follow-up questions to push them to think more deeply about what was happening inside their body during that time, and whether other body parts were impacted, even if not directly affected by the injury.

Suggested prompt	Sample student response
Why was your body not physically able to do this activity?	*Accept all answers. For example:* *I broke my leg.* *I sprained my ankle.* *I had stitches.* *My finger was swollen.* *It hurt too much.*
How long was it before you could do this activity again?	*Accept all answers. For example:* *Days* *Weeks* *Months* *Never*

✱ STRATEGIES FOR THIS INITIAL IDEAS DISCUSSION

Middle school students are learning a lot about science, but it is important to honor the fact that they are already experts in their own experiences and that these are legitimate ways of knowing about the world. During this discussion, validate and encourage students as they share meaningful observations from their own lives by saying things like, *That is very perceptive, has anybody else noticed that?*

✱ ATTENDING TO EQUITY

What were some things you had to do so your body could heal and you could do the activity again?	*Accept all answers. For example:* *I had to rest.* *I healed.* *I had to do certain exercises or stretches.*

Ask, *When your body was able to do the activity again, were you able to do it in the same way you could before the injury, or was there anything different about how you could engage in this activity?* Have students talk about this briefly with an elbow partner.

Let a few students share out their experiences. Here are some possible student responses:

- I couldn't lift as much for a long time.
- I was slower.
- I still hurt a little bit.
- I had to wear a brace.

ADDITIONAL GUIDANCE

Connections to Me and My Community: Inclusion
As students are sharing their experiences, be mindful of ability-diversity. Disabled students may experience injury and healing in different ways than their non-disabled peers, so it is important to welcome and honor all experiences. Listen for language that construes disability in a negative light; remind students that individuals who become disabled after an injury learn to adapt to their body's new way of functioning and are able to complete the daily tasks of life, if a little differently. It is important that students understand that disabled individuals often take a great deal of pride in their disability and consider it a key part of their identity.

Supporting Emergent Multilingual Students: For students who are learning English or who need support following a class discussion, it can be helpful to use gestures in addition to talking. For example, as students describe their injuries, have them point to the body part and move their body to describe what they were unable to do. Keep in mind that you may have students with current injuries. Ask them to explain what they can't currently do with their body. As appropriate, revoice what is shared while demonstrating the described actions with your own body.

2 · EXPLORE AN INTERESTING PHENOMENON

15 min

MATERIALS: science notebook, *Emergency Room Report*, *Post-Operation Report*, *Recovery Reports*, chart paper, marker

Introduce the phenomenon. Display **slide C**. *Say, I am going to tell you the story of a middle school student. Today, this student can walk, run, and jump! However, a while ago, he had an injury that prevented him from being able to do these things. He dropped a heavy weight on his foot during PE class. After this happened, he was not able to stand, walk, or run and had lots of pain.*

Use the prompts below to elicit experiences and ideas about what happened from student volunteers.✱ Accept all responses.

- *Have you ever experienced something like this where you dropped something on your foot or another part of your body?*
- *Why do you think he was not able to do these activities with his body after the injury?*

✱ SUPPORTING STUDENTS IN ENGAGING IN ASKING QUESTIONS AND DEFINING PROBLEMS

Initial questions about a phenomenon are intended to clarify what information is known and not known; there are often more

- *What happened in his body to allow him to get back to these activities?*
- *What are you wondering about with his injury and journey to recovery?*

Say, *I had lots of questions as well. Let's take a look at some of the notes his doctor took along the way. We are going to notice and wonder about several time points, including when the patient was injured and during his recovery. Once we have all had a chance to record our noticings and wonderings, we will share our ideas as a class.*

Notice and wonder about the injury. Display **slide D**. Distribute the *Emergency Room Report* to each student. Tell students to read, annotate, and mark up their handout. If they ask what the word *metatarsal* refers to, ask them what they think that is based on what they read in the report. They should say that because it says two metatarsals are broken, and the x-ray shows two broken bones, metatarsals are two of the bones in the foot. After 2 minutes, bring the class together to share out what they noticed and wondered. Record this on a piece of chart paper titled "Noticings and Wonderings about the Injury".

Notice and wonder about what was done to the foot. Display **slide E**. Distribute the *Post-Operation Report* to each student. Have students read, annotate, and mark up their handout as before. After 2 minutes, bring the class together to share out what they noticed and wondered. Record this on a piece of chart paper titled "Noticings and Wonderings--Post Operation".

ADDITIONAL GUIDANCE	The images on the *Post-Operation Report* could be traumatic for some students. Please use at your discretion. They are purposely not on the slide and are printed in black and white to make them less shocking. Please discuss the unit topic with a school social worker, psychologist, mental health specialist, or counselor, and send the *Pre-Unit Letter Home* to students' parents/guardians before starting the unit.

Notice and wonder about the foot's recovery process. Display **slide F**. Distribute the *Recovery Reports*. Give students 4 minutes to read, annotate, and mark up their handout for noticings and wonderings about steps in the healing process over time. After 4 minutes, bring the class together to share. You don't need to make a record for the whole class, as you will use some of these noticings in the next activity.

ADDITIONAL GUIDANCE	The term *gap*, or "distance between bones at the fracture sites," is used throughout the *Emergency Room Report*, *Post-Operation Report*, and *Recovery Reports*. This intentionally seeds the idea that gaps, or empty spaces where cells once existed, are created by the injury and need to be filled in during the healing process. It's important for students to consider this gap at this point in Lesson 1. However, it's not essential for them to think about cells yet, or to know that cells are involved in healing. In Lesson 1, **there is only evidence that a gap exists due to injury**, with no evidence yet that cells are involved. Evidence for cells comes later.

ALTERNATE	**Jigsawing the Hospital and Doctor's Reports**

questions than answers when scientists begin their investigations. Develop a safe and supportive space for students' uncertainty, and focus on the need to ask and answer questions in order to address the uncertainty that may require the entire unit to resolve.

ACTIVITY

Rather than have students share out noticings and wondering with the class after each handout, you might consider jigsawing this activity in the following way:

1. Provide a packet containing all three handouts for each student.
2. Prompt students to skim all three handouts in chronological order.
3. Assign groups of students to focus their noticings and wonderings on only one handout or report (the third handout contains four short recovery reports--these can be further jigsawed so groups focus on only one or two).
4. Be sure to assign at least one group to each resource--multiple groups looking at each resource is preferable, as this ensures the essential details from each report are captured.
5. After groups record their noticings and wonderings on their handouts, facilitate a class share out in which groups discuss their assigned resource.

If students struggle to make sense of the reports, consider reading and annotating the first handout as a class, then allow groups to read and annotate the rest. You might instruct them to annotate the reports in these ways:

- *Underline things you notice or that grab your attention.*
- *Circle things you wonder about.*
- *Add question marks to places where you are unsure of the information.*

Note: If the resources are jigsawed in this activity, be sure all assigned resources carry over into the next activity, when students look for and record evidence of healing. It may be easier and more efficient for students to continue examining the same resource in the next activity.

3 · RECORD EVIDENCE FOR HEALING

10 min

MATERIALS: science notebook, *Recovery Reports*, *Evidence for Healing*, sticky note, marker, tape, Word Wall poster, chart paper

Co-construct a definition of healing. ✱ Display **slide G**. *Say, I keep hearing you use the word "healing," and we saw this word in the doctor's notes to describe what happened to the student's foot over time. What do we mean by that? Grab a sticky note and write your ideas about what you think healing is.*

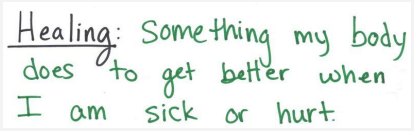
✱ ATTENDING TO EQUITY

The term *healed* can have a loaded meaning in the English language. In this unit, we use it to refer to the biological process that takes

Title a piece of chart paper "What Do We Mean by Healing?" and have students post their sticky notes on it. Instruct students to read through other sticky notes after posting their own. As they post, read some of their responses aloud. Once all students are seated, use the prompts below to facilitate a discussion around what they think it means to heal.

Suggested prompt	Sample student response	Follow-up question
Are there any other words in English or other languages that we also use to mean "healed" or "healing"?	*Accept all relevant answers. For example:* *Repair* *Recovered* *Restored* *Mended* *Cure* *Curar or sanar (Spanish)*	*So, when we use these words, do they mean the same thing as when we use the word "heal"?*
Can someone explain to me what we think it means to heal?	*Fixing the broken parts.* *The process that happens when your body puts itself back together.* *When gaps in your body get filled in--like between broken bones or cut skin.* *How the body fixes itself.* *What happens in the body when it fixes the parts that are injured or hurt.*	*Can you say more about why you think that?* *What is evidence of healing from your own experiences?*

Add *healing* and the co-constructed definition to the Word Wall. Your definition might be something like "the body trying to return to doing the things it was able to do before." ✱ Remind students that the Word Wall is a place to record our growing understanding of the word, and we will come back to it frequently to add more words or revise our definitions based on what we figure out in class.



ALTERNATE ACTIVITY

If you have enough space in your classroom, consider displaying the What Do We Mean by Healing? poster throughout the unit and post your healing definition there. The definition will be developed at this moment in place in the body in response to an injury. Sometimes injuries result in permanent disability after the body's biological healing process has concluded. A person who becomes disabled as a result of an injury is no less healed than a person whose body fully returns to prior functionality.

✱ ATTENDING TO EQUITY

Supporting Emergent Multilingual Students: When developing new vocabulary, strategies that may benefit emergent multilingual learners are to use student-friendly definitions, make connections to cognate words when possible, and include a visual representation of the word. Use these strategies throughout the unit for both "words we earn" and "words we encounter."

✱ ATTENDING TO EQUITY

Supporting Emergent Multilingual Students: When students are tasked with expressing their ideas, allow them to do so through linguistic (oral and written language) and nonlinguistic (drawings, graphs, symbols, gestures) modes. For example, for a student who is having trouble articulating evidence from the images and doctor's report, you might suggest sketching a picture on the handout. Providing emerging multilingual students with such opportunities allows them to use all their resources to express meaning.

Lesson 1, revised later in Lesson 1, and revised again in Lessons 8 and 14. Using the poster rather than a typical Word Wall entry gives you space to document each revision as your class deepens their understanding. If you choose to post your definition on the poster, you can start the Word Wall in Lesson 2 rather than now.

Record important events that could be evidence of healing.✱ Display **slide H**. Distribute *Evidence for Healing* to each student and have them tape it into their science notebook.

Assign each pair of students one of the four recovery reports in *Recovery Reports*. Pairs will review their assigned report and work together to record clues they notice that could be indicators that the foot was healing. Explain that some clues will be the doctor's observations about what is happening with the patient's body, both externally (such as the skin closing where the stitches were) and internally (such as reduced swelling or the image on an x-ray). Other clues will be the doctor's actions in caring for the patient, such as removing stitches.

As you listen to students discuss with their partners, push them to think about how each clue is supported by evidence of something happening related to healing in the body. After each pair has completed the *Evidence for Healing* handout for their assigned recovery report, ask all pairs to share out with the class. The clues from all four reports will be combined in the next activity to make a timeline of the healing process.

ASSESSMENT OPPORTUNITY

Building towards: 1.A Obtain information from images and doctor's notes to identify patterns between the relationship of important events (effect) and the evidence of interacting subsystems healing (cause).

What to look/listen for: During the discussion, listen for students who are using doctor's notes and images, such as stitches being removed or the cast coming off, to describe evidence of part of the system healing.

What to do: If students struggle to identify events or evidence, ask them to compare the *Emergency Room Report* with the *Post-Operation Report* and the *Recovery Reports*. Ask what was different about the foot, what was done to the foot, or what activities the injured student was able to do over time. Prompt them to find evidence that healing was happening in the body and to describe what happened that led to the milestone.

4 · CREATE A TIMELINE FOR HEALING

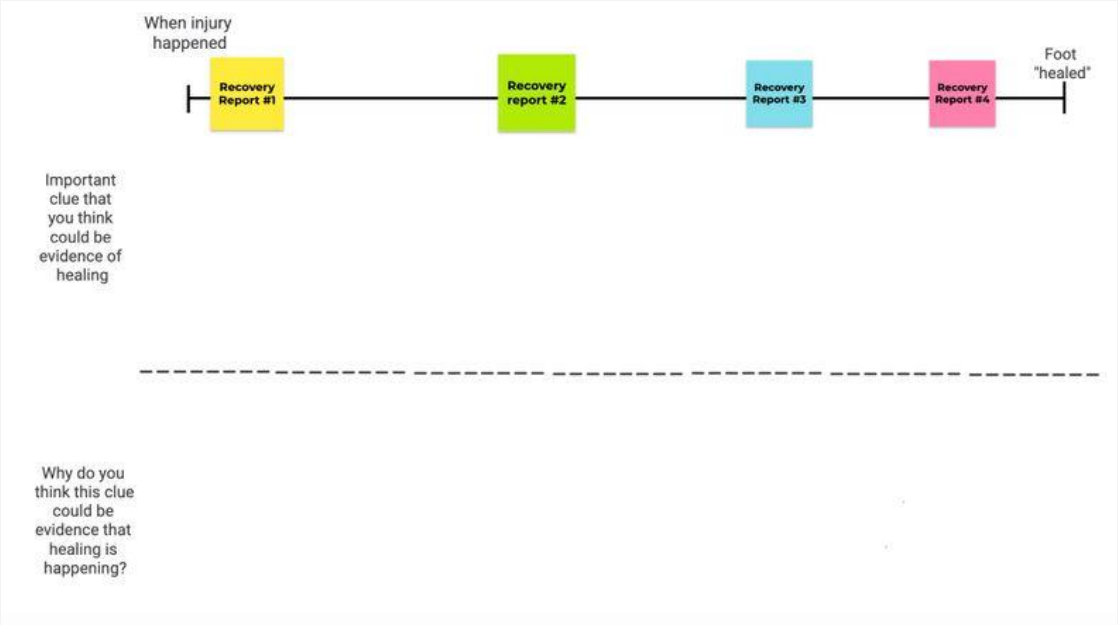
10 min

MATERIALS: science notebook, Healing Timeline poster, markers, sticky notes

Create a timeline of the foot's healing process. Display **slide I**. Gather students in a Scientists Circle. Begin discussing Recovery Report #1. Ask a student from each partner pair that was assigned this report to share a clue that healing occurred from their *Evidence for Healing*

✱ SUPPORTING STUDENTS IN DEVELOPING AND USING SCALE,

handout. As students share, record the clue on a sticky note in large, bold writing. Next, ask them and/or the class to explain the evidence supporting how the clue is an indicator for healing happening in the body. Record that evidence on the sticky note using a different color sticky note (if available) or using a different color marker on the same sticky note. Affix the sticky note(s) onto the Healing Timeline under Recovery Report #1.

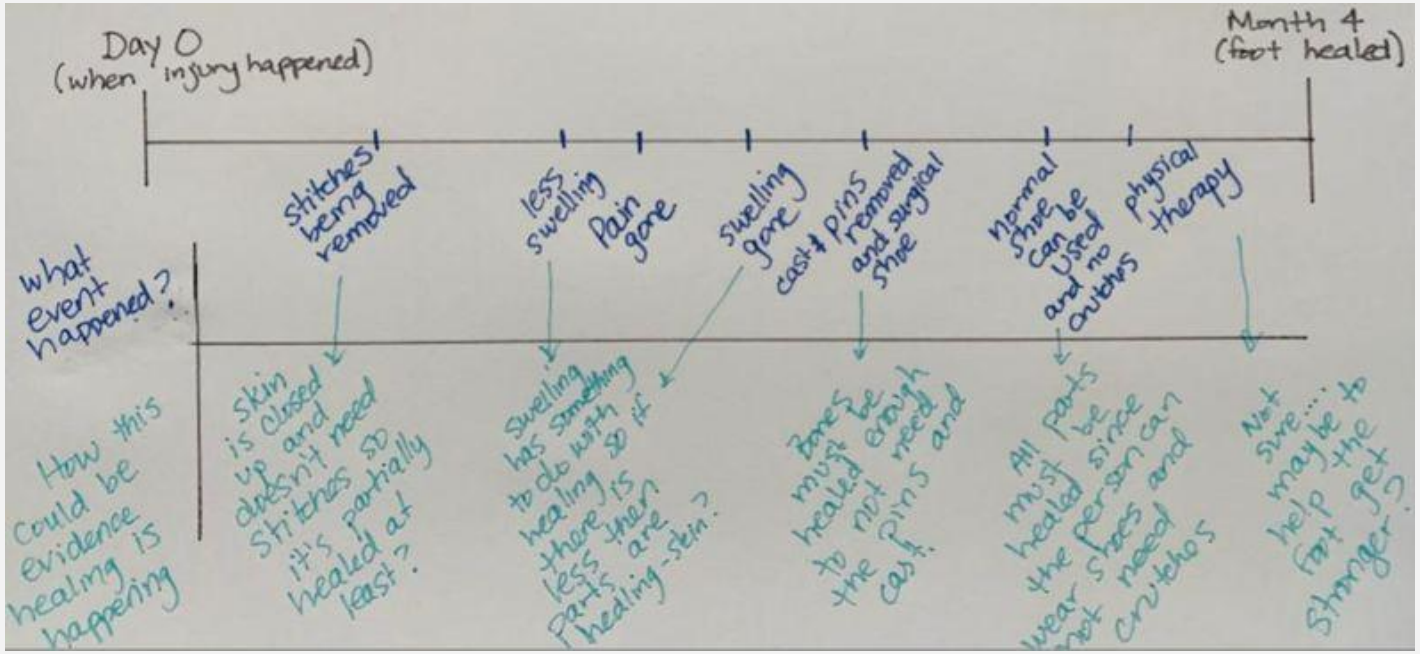


Continue until the timeline contains all the clues with evidence for Recovery Report #1. Then repeat this process for Reports #2-4.✱

See a suggested way to set up your timeline below.

PROPORTION, AND QUANTITY

Creating a timeline in this first lesson helps to map out the sequential events in the foot's healing process. Over the course of the unit, students realize that different parts of the body take differing amounts of time to heal. In addition, they figure out what is happening at a microscopic scale during the healing process for each of these body parts. Students begin to connect the crosscutting concept of Scale, Proportion, and Quantity in regard to time and scale, and continue to develop this concept throughout the unit through additional investigations, models they develop, and explanations they construct.



ADDITIONAL GUIDANCE	Make sure to leave the top two-thirds of the Healing Timeline poster open to build the class consensus model on day 2. When you make the consensus model, you will print out two copies of *Printouts of the Foot* and tape them above the timeline along with the question for the model, "How Does the Foot Heal over Time?"

Include on your timeline only the clues we have evidence for--the timeline should not include every note on the reports. If students feel adamant that an event from the report needs to be included but you feel that the evidence is insufficient, you might choose to include it with a question mark. See some suggested events and evidence on the following page.

	Recovery Report #1	Recovery Report #2	Recovery Report #3	Recovery Report #4
Skin	***Stitches removed*** *- The stitches were removed, so the skin must be closed up enough that the stitches aren't needed.*	***Skin closed*** *- No more opening in the skin, so it is healed.*		

Bones	***X-ray shows bones lined up*** *- If the bones are lined up, it seems they are on the way to healing and functioning.*	***Pins removed*** *- Bones are lined up, so they are on the way to healing and functioning.* ***Cast removed and post-op shoe used*** *- This must mean the bone is stronger and healed.* ***X-ray image*** *- It is hard to see the fracture site - if we can't see the break anymore, it's probably healing.*	***Bones lined up*** *- Fracture lines are harder to see, so the bone has been put back together somehow.*	***Fracture no longer visible*** *- If the fracture can't be seen, then the bone must be back together again.*
Muscles			***More range of motion*** *- The foot can move more, which might also be related to swelling and that it has healed more.*	***Improved range of motion*** *- The foot can move even more, which is a sign of healing.*
Blood			***Adequate blood flow*** *- This wasn't mentioned before, but we saw it bleed when injured, so the amount of blood flow in the area must be important.*	***Strong blood flow*** *- Maybe because some blood got out of the body, the blood had to somehow come back, and now it is "strong" where before it was just "adequate."*
Swelling	***Swelling went down*** *- The swelling began when the injury happened, so the swelling going down seems to indicate that the area is less injured.*	***Minimal swelling*** *- Not sure what swelling does, but it is mentioned in almost all the notes, so it must be a clue of healing if the doctor was paying such careful attention to it.*	***Minimal swelling*** *- Not sure what swelling does, but it is mentioned in almost all the notes, so it must be a clue of healing.*	***No swelling*** *- There isn't any swelling anymore, so the foot must be healed and whatever the swelling did for the injury isn't needed.*

To ensure all evidence of healing is included on the timeline, use prompts such as these:

- *Take a moment and look back at the recovery report you analyzed. Do we have every clue with evidence from that report up on our timeline?*
- *Are there any other clues from our recovery reports that we want to make sure are included on our timeline?*
- *Are we missing any pieces of the progression for any types of events, like changes in swelling and so forth?*

ADDITIONAL GUIDANCE	The table above shows the key clues and evidence you will likely collect on your timeline. Note that the exact words your students use will likely be slightly different, and that is OK. The gist of the timeline is that healing takes time and not everything heals at the same rate. If students suggest adding a clue that is not one of these key clues, ask how it is evidence of healing. For example, if students suggest an important clue is that the patient could wiggle his toes, you might push back by referring to the *Post-Operation Report* and ask, *How is the wiggling toes evidence of healing happening? Do we know if he could wiggle his toes before surgery? It could be something, but we don't know.*

Navigation. Say, *Now that we have captured the different clues we think are part of the healing process, in our next class we'll try to figure out what is happening within the body that could explain these events.*

End of day 1

5 · NAVIGATION

3 min

MATERIALS: science notebook, Healing Timeline poster, markers

Revisit the timeline for healing. Display **slide J**. Walk over to the timeline and ask students to remind you about the parts of the foot that were impacted by the injury and needed to heal. List those parts (skin, bone, muscle) on the side of the Healing Timeline poster or highlight them. This is an important move to support students in developing their models in the next step. Say, *It is important for us to remember what parts were damaged and needed to heal so we can explain what happens during the healing process so the student was able to use his foot again to walk, run, jump, and dance.*

ADDITIONAL GUIDANCE	In helping students list the parts of the foot that were impacted by the injury, you do not need to press them to think beyond the large parts (bone, skin, and muscle). In subsequent lessons, they investigate more about these parts, including how they interact to allow a body part to function (Lesson 2); common structures found in bone, muscle, and skin (blood vessels and nerves, in Lesson 3); components of blood (Lesson 4); components of nerves (Lesson 5); and components of skin, muscle, and nerves (Lesson 6). At this point, students only need to understand that several structures inside the foot were impacted. If students suggest that nerves or blood (or blood vessels) were also impacted and need to heal, you might add them to the Healing Timeline with question marks, indicating that our evidence for the healing of those parts is less conclusive than our evidence concerning the bones, skin, and muscle.

After students share out about the parts of the foot we are looking at to explain its healing, say, *We just identified that in order for the foot to have healed so the student can start doing activities again, its bone, skin, and muscle need to be repaired. Let's start thinking about what is happening with these different parts and the interactions between them during the healing process.*

6 · DEVELOP AN INITIAL MODEL OF HEALING

10 min

MATERIALS: science notebook, *Healing Initial Model*

Develop an initial model of the student's healing process. Say, *Let's try to develop a model to explain "What happens during the healing process so the student was able to use his foot again to walk, run, jump, and dance?"* Display **slide K.** ✱

Distribute a copy of *Healing Initial Model* to each student. Tell students to put their name on their handout but not to add it to their notebooks yet, as you want to collect it at the end of class to get a sense of what they are thinking. Remind them that models allow us to view a system from different perspectives and scales. Ask students to recall moments from previous units where it was useful to look at something from a different perspective or scale; see the prompt below.

Suggested prompt	Sample student response
Does anyone remember how looking at something from a different perspective helped us figure more things out in an earlier unit?	*Yeah! Like in the Everest Unit, when we moved from the top-down view to the side view of Earth's crust, we could see that earthquakes occurred at different depths.* *I think in the Tsunami Unit, we looked at different wave models because each one had certain strengths and limitations, but when examined together we could figure out more. Sometimes we can understand more by looking at different perspectives at the same time.*

Explain that we can draw the foot from various angles to examine it externally, but we can also think about what we might see under the skin and inside the foot, thanks to the x-rays in the reports. Regarding scale, we can zoom in to the site of the injury to help us better understand what we cannot normally see under the skin, and how these normally invisible changes might affect the whole foot. ✱✱

At the end, have students hand in *Healing Initial Model* as a formative assessment.

✱ SUPPORTING STUDENTS IN ENGAGING IN DEVELOPING AND USING MODELS

Remind students that in this classroom, a *model* is a picture and/or description that helps us explain something that happens in the world. As in previous OpenSciEd units, such models should try to do more than just show what we can see; they should also try to represent any unobservable mechanisms and interactions that we think might be at work in the system to explain what we observe happening. Also, remind students that it's OK if they don't know the "right" answer when drawing models. At this stage, there are no "correct" ideas or questions--all are welcome. The goal of making an initial model is to make their thinking visible to others. Have students try to put any ideas down on paper using labels, pictures, symbols, and/or words.

✱ ATTENDING TO EQUITY

Supporting Universal Design for Learning: In this unit, Developing and Using Models is a focal SEP. Therefore, numerous scaffolds

ASSESSMENT OPPORTUNITY

Building towards: 1.B Develop an initial model of the healing process within and between multiple interacting systems and subsystems that restores the foot's function.

What to look for/listen for: Students' first models on *Healing Initial Model* are more representative of what they see happening with the foot at a macroscopic level. As the handout suggests using close-up diagrams, and because students have practiced using them in previous 6th-grade units, you may notice some students adding these diagrams to their models to show what is happening under the skin (for example, that parts of the bone and muscle may no longer be connected underneath the broken skin). However, it's not necessary for students to include cells or microscopic interactions at this time. Later in the unit, they investigate the structure and function of each part at the cellular level. Also, they are likely to suggest using a microscope to examine the injury at the microscopic level later in this lesson, during the Generate Ideas for Future Investigations activity. We want to be sure that students motivate the need to explore this phenomenon at different scales.

ASSESSMENT OPPORTUNITY

Continued from previous page...

Look for inclusion of parts or interactions within the foot system that explain how the foot heals, aside from any aid from external processes or factors such as a cast or pins. Look for the following elements across their models and explanations to see if they bring these ideas to the table with the prompts for the task as written:

- Parts of the foot (system): bone, skin, muscle
    - Might also include: blood and nerves
- How the parts of the foot (system) worked together (interacted) to heal so the student could walk

What to do: If students need support in choosing what to put in their models, refer them back to the Healing Timeline we developed as a class. Ask what they think might be happening with each part of the foot between when the injury happened until the student could walk again. Ask what was different in the parts of the foot right after the injury and after it was healed.

Students might include parts of the foot without representing how the parts interact or work together. If you notice this, remind them that we can also think about what's going on inside the foot and underneath the skin because x-rays allow us to see some internal structures. Prompt them to include how the parts were interacting during the events in the Healing Timeline, and what we might see if we could look inside the foot at these interactions.

exist to support this practice in the context of cells and healing. If you believe your students are ready to proceed with less support, we recommend first removing scaffolding related to practices that are not focal in this unit. For example, analyzing and interpreting data is likely a familiar practice, as students have engaged with it in previous units. Therefore, consider asking them to use their own methods to note similarities and differences when comparing images, or to organize and present evidence for a phenomenon, without offering them supplemental data tables, graphic organizers, or handouts (often provided throughout this unit). However, take caution when removing scaffolding, as it is designed to ensure greater access and to help remove barriers to understanding complex phenomena.

✱ SUPPORTING STUDENTS IN DEVELOPING AND USING SYSTEMS AND SYSTEM MODELS

Systems and Systems Models is a focal crosscutting concept for this unit. A *system* is an organized group of related objects or components. Here we refer to the different structures of the foot that are injured as "parts." Scientists use models to understand and predict the behavior of systems. The first step in modeling a system is to set its boundary, and then to figure out the important parts. This allows scientists to study how the parts within a system interact to produce specific results. Help students set up their initial models as systems models by

Healing Initial Model handouts can be collected (at the end of the class) and used as a formative pre-assessment. They can help identify what science ideas students are bringing into this unit and where students are in their development of the practice of modeling.

identifying the important parts of each system and thinking about how those parts work together (interact).

7 · REVISIT CLASSROOM NORMS/COMMUNITY AGREEMENTS

5 min

MATERIALS: science notebook, Classroom Norms poster or slide

Revisit classroom norms established in previous units. ✱ Display **slide L**. Take this opportunity to remind the class how we listen to one another, press on one another's ideas, and ask questions of one another. Note that it's OK to disagree with ideas but it's important to be respectful.

Mention that it will be particularly important for us to be mindful of language we use when describing individual people's bodies, experiences, and differences. Say, *Let's take a look back at our norms to see which one will help us most to create a classroom culture where we can share different experiences openly, make each other feel safe, and respect everyone's personal experiences.*

You can use **slide M** to remind students of the Classroom Norms (if you have developed your own set of norms, replace this slide with your norms). Ask students to choose one norm to personally work on for the rest of the class period.

ADDITIONAL GUIDANCE

Establishing norms is an important focus early in the school year. This brief reminder about norms assumes that your classroom norms have already been established in a previous unit. For more information about OpenSciEd norms and how to establish them in your classroom, refer to the *OpenSciEd Teacher Handbook*.

✱ ATTENDING TO EQUITY

Supporting Universal Design for Learning: Use classroom norms to support *engagement* by fostering an equitable learning community that promotes trusting and caring relationships. The norms should reinforce to students the value of (1) the diversity of thought among all classroom community members in pushing our learning forward and (2) providing a safe learning environment that ensures fair participation. In addition, classroom norms should interrupt cultural norms or stereotypes that could make science experiences feel uncomfortable for some students (e.g., someone may feel they are not intelligent enough to think like a scientist or may be unable or unconfident with sharing their thinking).

8 · COMPARE INITIAL MODELS

5 min

MATERIALS: science notebook, *Healing Initial Model*, chart paper, markers

Share initial models of the foot's healing process. Show **slide N**. Tell students to make a table in their notebook to record similarities and differences, titled "Comparing Our Models." ✱

Explain that they will now work with an elbow partner to compare initial models. Each student will talk about their own model for 1 minute. Then, in their table, they will record similarities and differences they notice about the ideas represented. Students should be prepared to share their own or their partner's ideas with the class.

✱ ATTENDING TO EQUITY

Supporting Universal Design for Learning: It is important to create opportunities to support student *engagement* in meaningful, accountable talk by emphasizing socially safe activity structures, such as conducting small group or partner work before a class discussion. This is especially beneficial to emergent multilingual students. Partner talk or small group talk gives students an opportunity to share their ideas with one or two peers before "going public" with the whole class.

9 · DEVELOP AN INITIAL CONSENSUS MODEL OF HEALING

20 min

MATERIALS: science notebook, Healing Timeline poster, markers, 2 copies of *Printouts of the Foot*, tape, chart paper, Communicating in Scientific Ways poster or handout

Form a Scientists Circle. Ask students to assemble their chairs in a circle and bring their science notebooks and something to write with. Students will remain in the circle for the remainder of class. Ideally, they should be able to see the slide and the Healing Timeline and have access to chart paper, but if that is not possible, use only the chart paper, which is where the more critical sensemaking will occur.

SCIENTISTS CIRCLE

If this is your first time forming a Scientists Circle, you will need longer than 15 minutes to coordinate it. If your class is familiar with it from previous units, the movement in and out of the circle should happen fairly quickly. Setting up the norms and logistics for forming, equitably participating in, and breaking down that space is important to do if this is your first time. A Scientists Circle includes these important features:

- students sitting so they face one another to build a sense of shared mission and a community of learners working together
- celebrating progress toward answering students' questions and developing more-complete explanations of phenomena
- focusing on where students need to go next and how they might go about the next steps in their work

✱ ATTENDING TO EQUITY

Supporting Emergent Multilingual Students: Scaffolds such as sentence starters can model and facilitate particular oral or written language production skills such as formulating questions, hypotheses, explanations, or arguments based on evidence (see Communicating in Scientific Ways poster). Such scaffolds may be of particular benefit for emerging multilingual students to help them develop language skills to write or communicate their ideas to peers. It is important that scaffolds be used purposefully and **removed when no longer needed**.

✱ STRATEGIES FOR THIS

Returning to this Scientists Circle throughout the unit to take stock of what we have figured out and where we need to go next is an important tool in helping the class take on greater agency in steering the direction of their learning. This circle also helps build a sense of pride in their work. You may want to inform students that professional scientists also collaborate with one another to brainstorm, discuss, and review their work.

Revisit the Communicating in Scientific Ways sentence starters. ✱ Make certain a Communicating in Scientific Ways poster or handout is visible. Emphasize that each individual has contributions to make to their community of learners. Ask students which sentence starters (see examples below) they might want to use to help them talk to one another.

Say, *To help you explain an idea, claim, prediction, or model to explain your data and observations, you could say:*

- *My idea is ...*
- *I think that ...*
- *We could draw it this way ... to show ...*

Say, *To help you give evidence for your idea or claim:*

- *My evidence is ...*
- *The reason I think that this evidence supports this is ...*

Other examples of sentence starters could come from (1) listening to others' ideas and asking clarifying questions, (2) agreeing or disagreeing with others' ideas, and (3) adding onto others' ideas.

Initiate a Consensus Discussion. Tell students that the class is now ready to have a Consensus Discussion. ✱ Say, *Remember, the goal of this discussion is to figure out areas of agreement and disagreement in our initial models. Knowing where we agree and disagree will help us figure out what is happening in the healing foot phenomenon. We also want to practice using our norms.*

ADDITIONAL GUIDANCE

Build the consensus model on the Healing Timeline poster. Print out two copies of *Printouts of the Foot* and tape one foot diagram above the right and left sides of the timeline. Add drawings and annotations for the consensus model to each foot and, if prompted by students, you can add more feet in between to show how the healing process progresses. Refer to this consensus model and Healing Timeline jointly as the How Does the Foot Heal over Time? poster.

Capture similarities and differences in students' initial models. Display **slide O**. Use prompts such as those on **slide O** to develop an initial consensus model. ✱

CONSENSUS DISCUSSION

Because this is our initial consensus model, we want to capture our competing ideas. For example, what is happening in the space, or gap, created after the bone and skin separated, as the foot heals? How is each part of the foot connected, allowing it to function when uninjured but not function immediately after the injury?

Use question marks in the consensus model to show where we have some different ideas or uncertainty. Be careful not to favorably respond to any one idea over others so as not to give away what might be going on in the phenomenon. The class can revisit and evaluate their initial competing ideas as they gather more evidence throughout the unit.

✱ ATTENDING TO EQUITY

Supporting Universal Design for Learning: Use *representations* like color coding and/or letter or number coding to foreground parts of the model. Create a key to track the coding you use. Although color coding is a useful way to quickly reference the parts of the model, letter or number coding helps ensure accessibility for any student who may be color blind. If color coding is used, consider a palette of orange, blue, black, and/or dark brown.

KEY IDEAS

Purpose of the discussion:

- Develop an initial class consensus model to capture the ideas we agree and disagree on, or are more uncertain about, to explain what happened as the foot went from being injured with nonfunctioning parts to being healed and able to walk again.
- This initial model lays the groundwork for what students want to figure out about what is going on with the structures of the foot and their function, and also supports and encourages them to look closer at how the parts of the foot interact and work together as a complex system for both healing and walking.

KEY IDEAS

Continued from previous page...

Listen for these ideas:

- Possible areas of agreement:
    - Many parts of the foot were involved in the injury:
        - skin, bone, muscle
        - Students may also add nerves, blood, and the like, especially if focusing on what's happening under the skin (e.g., blood must be inside the foot because it came out when the skin was cut open, nerves might be under the skin in this part of the foot because the student lost feeling).
    - There is a break/cut/opening between the skin and bone.
    - There is swelling.
    - Something happens to stop the bleeding.
    - The foot is not working and the bone/skin/muscle has to come back together (filling the gap) before it can work again.
- Possible areas of disagreement/controversy:
    - What is happening in the gaps, or spaces, that form due to the break/cut/opening in the bone and skin as the foot heals?
    - How are the parts of the foot working together?
    - Where is the new skin/bone/muscle coming from?

Note: **We don't have evidence to support that cells are present** using information solely from the doctor's reports. If students bring up the idea of cells in their zoom-in drawings, be sure to ask for evidence of where

they see this. Though there is none at this point, if more than one student brings up cells, you might write this idea at the side of the model with a question mark. It can be revisited during Lesson 4 when there is clearer motivation to make microscopic observations of the structures inside the foot.

Consider using a round-robin format to give every student a chance to either share something they wrote in their own model or comment respectfully on something someone else has shared. As students share out, use their ideas to draw an initial consensus model on the printouts of the feet above the timeline.

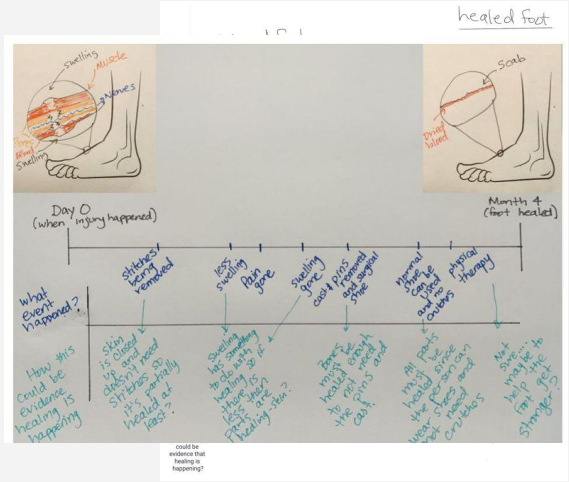
Work through the locations in the model in this strategic order by starting with the healed foot and/or an uninjured foot, using the prompts below.

Suggested prompt	Sample student response	Follow-up question
Let's start by modeling the healed/uninjured foot. What parts, or structures, should we include on the healed/uninjured foot?	*Skin, bone, muscle* *(Students might also add blood and nerves.)*	*Are there any other parts of the foot or body we might need to include?*
If we could see inside the foot, what would we see?	*We would see the bone.* *We would see the muscle.* *There should be blood inside the foot.* *The skin would not be opened up anymore, but it might have a scar.*	*What about the skin? Does the skin count as something "inside the foot"?*
How would we represent each of these parts of the foot in our model?	*I think the skin should be closer to the outline of the foot, then the muscle, and the bone on the inside. It feels like the bone is more inside than the skin or muscle.* *Maybe the skin could be made to look like a thin layer, because it seems really easy to break this layer and for blood to come out.*	*Great! Let's write that down as something we want to know about, and we can leave it as a question mark in our model.*

	Maybe the bones could look thicker, because they are hard and difficult to break--otherwise we would probably break our bones more often.	
How do these parts look different on the injured foot right after the injury occured? *Note: The three parts of the foot that should be represented on the consensus model are skin, bone, and muscle. Feel free to include other parts the class agrees upon and any parts there might be disagreement or questions about. For example, some students may mention nerves, so your model might include nerves with a question mark.*	*The skin was opened up from the injury, and there was dried blood on the skin.* *The x-rays showed two of the bones in the foot were broken and crooked (not lined up anymore).* *There was lots of swelling, so maybe the skin is puffy or something happened to the muscle in the foot.* *The muscle was stitched back together, but we don't really know how it looked.* *There was dried blood on the skin of the foot, so blood must have come out of the foot.*	*If we were to zoom in on the injured and healed/uninjured foot, do you think we would see anything different than with just our eyes?*
What did you notice was common in how other people represented the different parts of the foot and their interactions in the injured foot compared to the healed/uninjured foot?	*We had gaps/holes/breaks between the bone/skin/muscle in the injured foot, but they were connected in the healed/uninjured foot.*	*Is this something everyone showed?*
OK, we have a model for the foot right after the injury and a model for the foot when it's fully healed. If we could see what happens over the 4 months it took for this person's foot to heal, what do you think we would see during the healing process?	*We saw swelling, and then it went down, but we don't really know why.* *We would see the skin growing back together or closing up somehow.* *We might see a scab or scar on the skin.* *We would see the bone lined back up, and the crack in the bone would be filled in.*	*What do you think was happening inside the body to cause those events?*

	We would see something happening with the muscle that was opened up, growing back so it was together, but we don't really know how.	
Were there areas where you disagreed with your partners?	*Yes! We didn't agree about what was happening in the gap(s) as the foot healed.* *We know there is blood, but we do not know how it is there or why!* *We are not sure how the nerves are involved.*	*It sounds like we have some questions about what is happening as the foot heals! Write those down in your notebook on the same page where you compared initial models with a partner, and we can come back to them.*

Examples of the How Does the Foot Heal over Time? poster are shown below.



10 · PREPARE FOR HOME LEARNING ABOUT RELATED PHENOMENA

2 min

MATERIALS: *Healing Phenomena Stories*

Present the home learning assignment. ✱ Display **slide P**. The purpose of the home learning is to have students hear about other people's experiences related to healing that were similar to what happened in the healed foot. Distribute the *Healing Phenomena Stories* handout to each student.

Say, *You are going to talk with trusted members of your community and ask them to tell you their stories of healing or stories they have heard from others. Use the question prompts on Healing Phenomena Stories to help you ask questions as they tell their stories.*

✱ ATTENDING TO EQUITY

Framing students' families and communities as legitimate funds of knowledge serves multiple purposes. It can (1) help students feel like they belong in the science classroom by situating their family and community knowledge as productive resources for science, (2) engage students' families in conversations about what is happening in the classroom, and (3) help students make connections between the science classroom and their everyday lives.

End of day 2

11 · EXPLORE DIFFERENT ASPECTS OF VISIBLE AND INVISIBLE DISABILITY

30 min

MATERIALS: *Healing Phenomena Stories*, science notebook, markers, Word Wall poster

Navigation. Display **slide Q**. Have students reflect independently on their responses to the *Healing Phenomena Stories*, but do not ask them to share their ideas of related phenomena with the class yet (that is the next step). Ask, *As you were coming up with examples of healing and other related phenomena in your home learning, did you have any questions about whether or not someone was healed?*

Individually read each prompt on the slide (shown below) and accept all student responses.

- *Did you have any questions about whether or not something counted as "healed"?*
- *Did you have any questions about people whose bodies might work or function differently after their injury?*
- *Did you have any questions about how healing might be similar or different for individuals?*

Set up a chart in the science notebook for brainstorming. Say, *Everyone is different in various ways, and all of us can function to complete the daily tasks of life. Let's explore some of these everyday things and think about the different ways people do them. Open up your notebook and set up a two-column chart.*

Display **slide R**. Have students title the left side of their chart "Task". This is where they will write an aspect of daily life, such as communicating, perceiving/sensing, eating, and moving, as you discuss them. Have them title the right side "How it is completed". Here, they will brainstorm different ways a person could communicate, perceive/sense, eat, and move.

ADDITIONAL GUIDANCE	Avoid using the word *normal* in this discussion. If you want to refer to the ways that non-disabled people complete tasks, state how the task is completed without a qualifier. For example, when describing how non-disabled people see, state simply "with their eyes" rather than "normally." If a student uses the word *normal* during this discussion, ask them what they mean and guide them toward more accurate/precise language.

Prepare to explore differences in how people experience the world. Say, *We'll think about and discuss a few examples of daily tasks to help us explore the wide variety of ways that people complete them. People with and without disability do these things, sometimes with the help of adaptive equipment.*

ADDITIONAL GUIDANCE	The words *disability* and *disabled* carry a great deal of stigma in our society, but they are neutral words associated with the rights and protections provided by laws such as the Americans with Disabilities Act (ADA) and the Individuals with Disabilities Education Act (IDEA). *Disability* is the term preferred by adults who are fighting for disability rights. It's important to note that these words are generally preferred over euphemisms such as "special needs" or "differently abled", which stigmatize that which is different. "Special needs" fell out of fashion when advocates pointed out that there's nothing "special" about needing health care, education, safety, and access to public accommodations.

SUPPORTING STUDENTS IN MAKING CONNECTIONS IN ELA	Many great novels are written for teens and young adults in which the main character has a disability. In most of these, the focus is not the disability but rather the character's everyday life experiences. This is a great opportunity to reach out to your ELA counterpart on your team to share what your students are doing in science class, in case any cross-curricular connections can be made. In addition, you may wish to ask if there are novels or other books they would recommend making available to students during this unit. There is an extensive list of beautifully written novels that will provide students a new way of viewing the challenges faced by people with disabilities, and their common struggles that all students face (such as finding friends). Here are a few: • *Out of My Mind* by Sharon Draper • *Restart,*by Gordan Korman • *Break the Mould* by Sinéad Burke

Explain that for each daily task, students will have 1 minute to brainstorm in their notebook about the ways a person might complete that task. Then they will share out what they wrote. After students share, you will move to the next slide to show images of adaptive equipment that individuals with disabilities may use as they complete that task.

Brainstorm ways people communicate. Display **slide S**. Give students 1 minute to write in their notebook chart about different ways people might communicate.

Share out ways people communicate. Have students share their ideas about different ways people complete the task of communicating. Then display **slide T** to see images of some ways people communicate, including some types of adaptive equipment. Some of these images will be similar to what the students shared. Explain how the adaptive equipment works and ask students if they have any questions.

Adaptive Equipment	Purpose
AAC device	AAC stands for "augmentative and alternative communication." An AAC device is a piece of technology or even an iPad with software (or an app) that contains a variety of words such as verbs, nouns, and adverbs. The person using the device selects the word (or picture) they want, and the device says the word out loud. This can be done by physically touching the buttons or with eye-gaze technology. They can communicate single words, phrases, and even full sentences. An AAC device may be used by individuals who do not use verbal speech or who need language support. Other tools, such as letter boards, can also be used to communicate.
American Sign Language	American Sign Language (ASL) is a complete, natural language that has the same linguistic properties as vocally spoken languages, with grammar that differs from English. ASL is expressed by movements of the hands and face. It is the primary language of many North Americans who are deaf and hard of hearing and is used by many hearing people as well. Source: https://www.nidcd.nih.gov/health/american-sign-language
Gestures	Gestures are woven into the fabric of our daily lives. You may wave, point, beckon, or use your hands when arguing or speaking animatedly, often expressing yourself with gestures without thinking. However, the meaning of some gestures can be very different across cultures. While the "OK" sign, for example, usually conveys a positive message in English-speaking countries, it's considered offensive in countries such as Germany, Russia, and Brazil. So, it's important to be careful of how you use gestures to avoid misinterpretation.
Facial expression	The human face is extremely expressive, able to convey countless emotions without saying a word. And unlike some forms of nonverbal communication, facial expressions are universal. The facial expressions for happiness, sadness, anger, surprise, fear, and disgust are the same across cultures.

Brainstorm ways people perceive the environment. Display **slide U**. Give students 1 minute to write in their chart about different ways that people might see, hear, or understand their surroundings.

Share out ways people perceive the environment. Have students share their ideas about different ways people perceive the environment around them. Then display **slide V** to see images of some ways people might do this, including some adaptive equipment for this purpose.

Some of these images will be similar to what the students shared. Explain how the equipment works and ask students if they have any questions.

Adaptive Equipment	Purpose
Eyeglasses or contact lenses	People who experience nearsightedness, farsightedness, or astigmatism may use eyeglasses or contact lenses to correct their vision.
Magnifier	A magnifier is a tool that makes things appear larger. There are physical handheld magnifying tools as well as digital tools that magnify text on a screen. People with low vision who may not be able to make things out at a typical distance, even with glasses or contact lenses, may benefit from a magnifier.
Cane	People who are blind may not see using their eyes, but they do use tools and other senses to perceive their environment. A cane is a tool that blind people can use to perceive any obstacles or hazards in front of them as they move from place to place.
Hearing aids	Hearing aids are devices used by deaf and hard-of-hearing individuals to regain a portion of hearing by amplifying sound.
Cochlear implants	A cochlear implant is a small electronic device that electrically stimulates the cochlear nerve (nerve for hearing). The implant has external and internal parts. The external part sits behind the ear and picks up sounds with a microphone. It then processes the sound and transmits it to the internal part of the implant.
Braille	Braille is a system of raised bumps that allows blind individuals to read text with their fingers. Braille is a code of language and not a language in itself.
Alerting devices	Alerting devices are assistive devices that connect with doorbells, telephones, and other alarm devices. These devices add a specific alarm based on one's disability. For instance, a deaf individual can have a doorbell that blinks a light instead of making a noise to indicate someone is at the door.

Brainstorm ways people eat. Display **slide W**. Give students 1 minute to write in their chart about different ways people eat.

Share out ways people eat. Have students share their ideas as before. Display **slide X** to see images of adaptive equipment for eating. Some will be similar to what the students shared. Explain how the equipment works and ask students if they have any questions.

Adaptive Equipment	Purpose

G-tube	"G-tube" is a nickname for a gastronomy tube. It is a small tube that goes from the outside of the body directly to the stomach. It's a way to make sure someone gets all the fluid and nutrients they need.
Adaptive plates, bowls, spoons, forks, knives	Adaptive feeding tools like specialized mugs, plates, utensils, and more make it possible for individuals to eat with increased independence. These include things like plate guards, partitioned plates, and weighted utensils to help with tremors or weak grip strength, rocker knives to decrease wrist strain, and many types of cups. Source: https://swallowingdisorderfoundation.com/adaptive-feeding-devices/

Brainstorm ways people move. Display **slide Y**. Give students 1 minute to write in their chart about ways people move around.

Share out ways people move. Have students share their ideas. Display **slide Z** to see images of adaptive equipment. Some will be similar to what the students shared. Explain how the equipment works and ask students if they have any questions.

Adaptive Equipment	Purpose
Wheelchair	A wheelchair is a tool individuals use to move from place to place. People use wheelchairs for many different reasons. Some individuals use a manual wheelchair that is pushed, or they propel the chair themselves using their hands and arms. Power wheelchairs have motors and joysticks and are controlled by switches. Some wheelchair users control their chairs with switches near their heads or by using other body parts. Some people use their wheelchairs exclusively to get around. Other wheelchair users occasionally walk or use other adaptive equipment to move from place to place in addition to using a wheelchair.
Stander	A stander is a piece of equipment that helps muscles and bones stay strong. Typically, individuals who use wheelchairs for all of their movement use a stander for some time during the day to give them a change of position and help keep their bones and muscles from weakening. The person gets into the stander (with or without help) and safety straps are engaged and tightened.
Braces	Braces are worn on different parts of the body that need extra support or positioning.
Prosthetics	Prosthetics are devices that simulate a body part a person may not have, like an arm or a leg. Prosthetics often work similarly to the body part they simulate.
Crutches or walkers	Crutches or walkers are devices used to transfer the body's load from the lower body to the upper body. Crutches and walkers are used when a person's lower body is not completely immobilized, but impaired.

ALTERNATE ACTIVITY

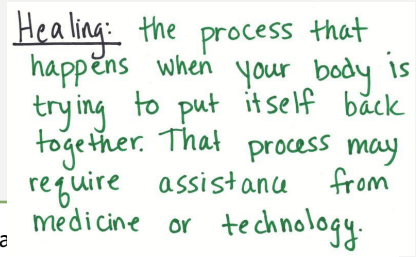
If time permits, hang 4 pieces of chart paper in different places in your classroom. At the top of each piece, write the title "Brainstorm different ways people ..." and complete each title with a different task: communicate, eat, perceive/sense, and move. Have students move around the room in a silent carousel activity in which they each write one idea on each poster. Then you or a student can read each list aloud before you show and discuss the images of adaptive technology for the corresponding daily task.

Synthesize and expand our understanding of healing and body function. Display **slide AA**. Say, *Now that we have expanded our knowledge of the many different ways people complete the daily tasks of life, let's refine our definition of healing.*

Have students begin by doing a Quick Write in their notebook. These prompts are shown on **slide AA**: *I used to think healing was _____. Now I think healing is _____.*

Ask students to share their ideas with a partner and then share out with the class.

Revise the Word Wall's definition of healing. Add a definition similar to this, but created by your class: "Healing is the process that happens when your body is trying to put itself back together. That process may require assistance from medicine or technology."



ADDITIONAL GUIDANCE

It's important to note that there are many homeopathic techniques and fa
arise from indigenous medical practices, which, though largely ignored or devalued by western medicine, are still rooted in medicine. What is commonly referred to as Complementary and Alternative Medicine (CAM) is often chosen for social, cultural, philosophical, and personal factors.

For the purposes of this unit, and in alignment with our call for equity, it's important to listen to and include all forms of medicine or remedies described by students. More importantly, to help value indigenous and traditional medical techniques, consider using the term "complementary" rather than "alternative" when describing them. "Alternative" denotes something unusual, not normal, or outside of accepted practice. "Complementary" signifies something used in conjunction with other medical practice, which is most often the case with illnesses regardless of culture, location, or belief.

Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7425891/

Connect what we have figured out about disability to the related healing phenomena. Display **slide BB**. Say, *Thinking about how we expanded our understanding of the different ways people can function, look back at what you wrote on your home learning handout, Healing Phenomena Stories. Is there anything you would want to change or share differently? How might our revised definition of healing change what you were going to share about related phenomena?*

Here are some sample student responses:

- Healing is more complicated than we thought at first!
- We have more ideas to add to our related phenomena.

12 · SHARE RELATED PHENOMENA OF HEALING

10 min

MATERIALS: science notebook, *Healing Phenomena Stories*, chart paper, markers

Share related phenomena and experiences. Display **slide CC**. Have students take out *Healing Phenomena Stories*. Have several students share with the class. Encourage students to snap their fingers if a phenomenon is mentioned that they also have observed.

Consider using the following prompts to begin this conversation:

- *What other experiences have you or the members of your community had that this students' journey to recovery reminds you of? What parts were impacted? How long did it take to heal?*
- *What other situations might involve similar ways of healing that occurred within the student's body?*
- *When have you ever seen or heard of healing from injuries that affected the ability to sense (smell, feel, taste) something in one's surroundings?*
- *When have you ever seen or heard of other living things, besides humans, healing from an injury?*

Use chart paper titled "Related Phenomena" to record a bulleted list of what students share. After making this list, link it back to the classroom consensus model. Display **slide DD**. Say, *As we refine our model to try to explain what is happening with the student's recovery, let's keep other phenomena in mind too, so we can see if our model can be used to explain any of these as well.*

Ask students to tape *Healing Phenomena Stories* into their science notebooks.

13 · DEVELOP QUESTIONS FOR THE DRIVING QUESTION BOARD

5 min

MATERIALS: sticky notes, marker, science notebook, Noticings and Wonderings – Post Operation poster, How Does the Foot Heal over Time? poster, Related Phenomenon poster

Write initial questions for the DQB. Make sure the Noticings and Wonderings – Post Operation poster, the How Does the Foot Heal over Time? poster, and the Related Phenomenon poster are visible at the front of the room. Present **slide EE**. Say, *We have looked at the foot injury healing, as well as other instances of injuries healing. In thinking about what we could investigate as a class, what kinds of questions do we have about these systems, and the interactions between the parts of these systems that cause them to heal?* Listen for students to suggest questions about other things healing, other body parts healing, what is happening in the different parts of the system where healing is happening, how the parts are connected, and so forth.

Then distribute 3-4 sticky notes and a marker to each student. Ask students to write up to three questions about healing and at least one about other related phenomena. They should write one question per sticky note, big and bold, so they can be clearly seen.

Have students stick their questions temporarily on the inside cover of their science notebook to keep them safe until we share them in the next class period.

ADDITIONAL GUIDANCE	Students may have these kinds of questions: "Why did the skin heal first?" "Why did he need stitches?" "Why did he have pins or a cast?" These questions are valid and acceptable, but to keep the focus on natural phenomena within body systems rather than external supports for healing, remind students to think about what was happening inside the student's body or other living things' bodies.

End of day 3

14 · BUILD OUR DRIVING QUESTION BOARD

30 min

MATERIALS: science notebook, sticky notes with questions, sticky notes, larger sticky notes (to label cluster or categories of questions) tape, chart paper, markers

Gather in a Scientists Circle around the DQB. Project **slide FF**. Put up a piece of chart paper to build the DQB. Instruct students to bring their sticky notes and science notebook, along with a chair, to a Scientists Circle around the DQB. The How Does the Foot Heal over Time? poster and the Related Phenomena poster should be visible.

ADDITIONAL GUIDANCE	The DQB is central to this unit's sensemaking. It can be set up in various ways depending on your classroom resources, use of technology, and number of students. What works for some will not work for others. Most important is that the DQB is visible to students each day and represents "our shared mission." Students will use it to assess what they've figured out and identify next steps. You can choose to have students put their sticky notes directly onto the Healing Timeline or you can make a separate DQB poster.

Post questions to the DQB.✱ Explain how you will create the DQB:

- The first student reads their question aloud to the class and then posts it on the DQB.
- Students who are listening should raise their hand if one of their questions relates to the question that was just read aloud.
- The first student selects the next student whose hand is raised.

- The second student reads their question, says why or how it relates, and posts it near the question it most relates to on the DQB.
- That student selects the next student, who may have a related question or a new question.
- We will continue until everyone has at least one question on the DQB.

If the question is a new question and doesn't fit with any that are already on the board, students should create a new cluster.

 **Organize questions into categories.** Questions will naturally cluster into similar areas. Once students finish sharing, ask them to look at the questions for any additional organization that can be done. Use larger sticky notes to label these clusters. Some clusters that may emerge include: the parts of the foot (bone, skin, muscle, blood, nerves), recovery, things done to the foot after the injury, healing/repair, when things heal or how long it takes, and so forth.

Develop an initial driving question. Point out that many of the questions are connected to how and why certain things happened in the healing process. Suggest that encompassing them under a single driving question could remind us of how the work on any one question is in the service of all our questions. Ask, *Now that we have written our questions, what main driving question should we put at the top of our DQB?*

Feel free to offer slight changes to students' wording or combine questions. For example, if one student suggests, "How do the parts of the foot work together to heal?" and another suggests, "What is happening inside the foot so the student can walk again?" you can say, *I heard one person asking about how the parts of the foot work together and one person asking about what is happening that we can't see. Can someone combine these into a single question?* Once an idea is on the table that meets the criteria and/or looks like the example above, revoice it.

If students struggle to construct a driving question for the unit, propose "How does the foot (or body) heal?" as a single driving question that most of our questions could fit under. Then ask, *Does everyone agree on this for our initial driving question?*

Once the class agrees on one driving question, write it in large letters on a half-piece of chart paper and hang this banner over the top of the entire DQB. Remind students that we can revise this question as we continue to figure out new things in future lessons.

ASSESSMENT OPPORTUNITY

Building towards: 1.C Ask questions that arise from observations of injuries to multiple subsystems resulting in loss of a particular body function to the larger complex system of the foot.

What to look for/listen for: When students generate questions on sticky notes, look to see that they are including questions about multiple parts of the foot or body working together whether to function or to heal. You should also notice that students are asking questions about specific events from the Notice and Wonder–Post Operation poster, the How Does the Foot Heal over Time? poster, and/or the Related Phenomena poster. You may also want to look through student notebooks to see their individual ideas for future investigations to pursue.

What to do: It is important that *all* questions posed be placed on the DQB, whether open-ended or close-ended. As students ask questions, have them reflect on any related phenomena about other living things or important events or evidence in the How Does the Foot Heal over Time? poster that have few or no corresponding questions posted on the DQB. Prompt students to generate more questions in this space so we are motivated to investigate several subsystems of the body and other living things.

ADDITIONAL GUIDANCE

If your DQB is not already in a digital form easily referenced by all students, you will want to type up the questions after your final class develops their DQB, and then share them with students in later lessons. This list will first be used in Lesson 8 and again in several lessons thereafter. Revisiting the DQB questions to see which ones can be answered at different points in the unit can also be an individual activity if students finish other activities early. Having this list in digital form makes it more accessible to students to think through which questions they can answer over time.

15 · GENERATE IDEAS FOR FUTURE INVESTIGATIONS

10 min

MATERIALS: science notebook, chart paper, markers

Stay in the Scientists Circle to brainstorm investigations and data we need. Show **slide GG**. Now that the class has created a DQB, tell students it is time to really dig into the hard work of figuring out what is going on! Have them title a new notebook page as shown in the slide. Ask, *What kind of information or data will we need to be able to figure out what is going on inside our body at these times:*

- *when it is performing a specific function,*
- *when it is injured, and*
- *as it heals?*

Give students about 5 minutes to individually record in their notebooks some ideas for future investigations or data we need. Meanwhile, create a new poster titled "Ideas for Future Investigations and Data We Need." Put this right next to the DQB.

Tell students you are going to record their ideas and you want everyone's ideas to be represented. Have students turn and talk with a partner about their ideas.

Make a class record of these ideas. Display **slide HH**. Have partners share their ideas with the class. Make sure that all partner pairs get to offer at least one idea. Create a class record of these ideas on the new poster. You may also want to prompt students to keep a record in their science notebooks. As they share, underline or add check/tally marks to repeated statements to keep track of common ideas. Emphasize

that we are listing what we think might help us answer our questions, and that we may need to add to this list and update our DQB throughout the unit.

Here are some ideas for possible investigations or data:

- Look more closely at the foot using magnifying glasses.
- Zoom in using microscopes or pictures.
- Look more closely at x-rays.
- Get more information from a doctor or surgeon.
- See more pictures over time of injuries healing.
- Look at some other injuries.

SCIENTISTS CIRCLE

One way to ensure that all student ideas are shared and recorded on the Ideas for Future Investigations and Data We Need poster is to pass a marker to the student nearest you in the circle. Have that student share one idea. Write it on the poster. When you have almost finished writing it, have that student pass the marker to the next student, who then shares an idea. If the idea is on the poster already, the student should say which idea is similar and how it is similar. Underline or put a tally mark next to that idea. In this way, the marker continues to be passed and all students have their thinking represented. Remind students that if they have additional ideas that don't end up on the poster, they should jot them down now; then, after the marker makes it all the way around the circle, they can raise a hand to share.

16 · NAVIGATION

5 min

MATERIALS: None

Prioritize what to investigate first. Display **slide II**. Say, *We have a lot of questions about how the boy's foot healed, and some ideas about what to investigate next. We saw from the doctor's notes that the main parts of his foot that were impacted were the bone, muscle, and skin. If we could look more closely at these three parts, how might this help us with some of our questions? Which of our ideas for investigation involve the bone, muscle, or skin?*

Prompt students to turn and talk with their neighbor. After 2 minutes, ask students to share their responses. Here are some sample student responses:

- Before the injury, all these parts seemed to work together. Maybe by looking at the parts closely, we can see how they are connected, and then figure out why the foot works differently when they're not connected.
- If we can figure out how the bone, muscle, and skin work together for someone to walk, then maybe we can figure out why the boy

couldn't walk when these parts were injured.

- We said that we wanted to use a magnifying glass or microscope to look more closely at the different parts.

Say, *It sounds like in our next class we might want to look more closely at these parts of the foot to figure out more about how they work together for the foot to function.*

Additional Lesson 1 Teacher Guidance

SUPPORTING STUDENTS IN MAKING CONNECTIONS IN ELA

CCSS.ELA-Literacy.RST.6-8.2: Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

On day 1, students gather additional information from doctor's reports and images of an injury, from which they record important events and evidence that those events indicate healing is happening on *Evidence for Healing*, and then add these to a class timeline.

CCSS.ELA-Literacy.SL.6.1.c: Pose and respond to specific questions with elaboration and detail by making comments that contribute to the topic, text, or issue under discussion.

When the class is building the DQB, if a student forgets to explain why or how their question is linked to someone else's, press that student to try to talk through their own thinking. This is a key way to emphasize the importance of listening to and building off of one another's ideas and to help scaffold student thinking.

If students can't figure out which question connects to theirs, encourage them to ask the class for help. After an idea is shared, ask the original presenter if there is agreement and why, and then post the question.

This lesson's activities rely on students communicating and articulating their thinking. One tool that supports classroom discussion is the *Communicating in Scientific Ways* sentence starters. This 1-page document can be blown up and printed as a class poster, printed on 8.5-x-11 paper and posted near students' desks, and/or scaled down and taped into students' science notebooks. Reference the sentence starters and encourage students to use them as they communicate. The sentence starters can be especially useful for helping students engage in scientific talk, particularly students who may feel reluctant to contribute.