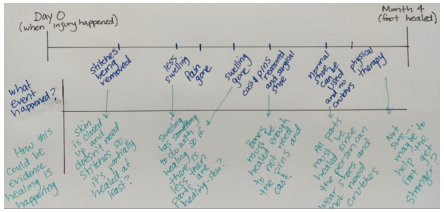
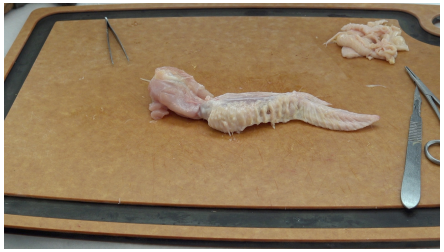
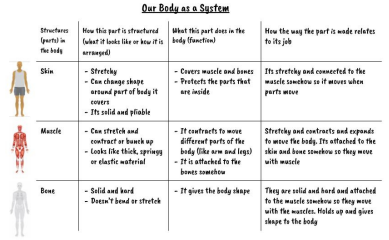
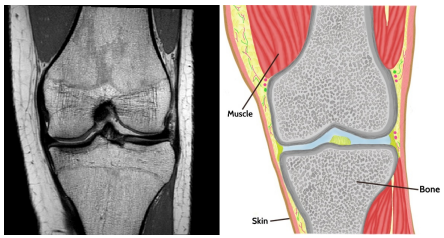
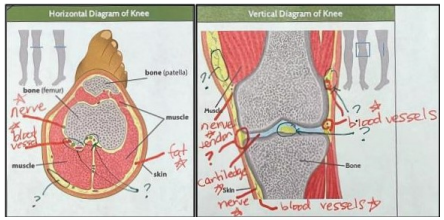
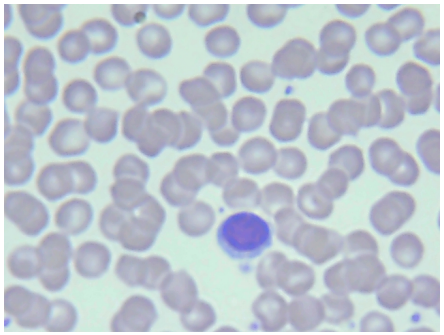
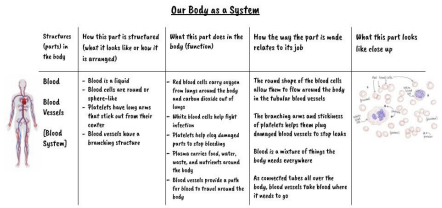
# UNIT STORYLINE

**How students will engage with each of the phenomena**

HANDS-ON/ LAB ACTIVITIES | VIDEOS OR IMAGES | DATA SETS | READINGS | COMPUTER INTERACTIVES

## Unit Question: How do living things heal?

| Lesson Question | Phenomena or Design Problem | What we do and figure out | How we represent it |
|---|---|---|---|
| **LESSON 1**<br>4 days<br>**What happened in the student's foot so they could walk again?**<br>Anchoring Phenomenon |  <br>*A middle school student injured his foot and could not walk. Over the next 4 months, the foot healed and the student could walk again.* | We share our experiences moving our bodies and times when we were unable to. We read doctor's notes and see images of an injury. We create a timeline of important events that show evidence of healing. We develop models to show how the parts of the foot work together so the patient can walk again. We brainstorm related phenomena of other times we have seen healing in humans and other living things. We figure out these things:<br>• A student who was previously able to walk was injured in an accident and could no longer walk.<br>• Some of the injured parts of the foot needed outside supports during the healing process.<br>• Over time, the injured parts of the foot were able to heal; some took longer than others.<br>• The injury caused gaps between the damaged structures in the foot. |  |
| ⇓ **Navigation to Next Lesson:** We want to know more about how parts of the foot work in an uninjured foot before we can figure out why they are not working in an injured foot. | | | |
| **LESSON 2**<br>2 days<br>**What do our bones, skin, and muscles do for us?**<br>Investigation |  <br>*A chicken wing shows the interactions between skin, muscle, and bone during movement. When the bone in the wing is damaged and broken, it cannot function the same as in an uninjured wing.* | We investigate the parts that make up a chicken wing and how they work together when moving by watching a video of the dissection of its skin, muscle, and bone. We map the parts of the chicken wing to the parts of the human foot to make sense of how these parts work together in similar ways in each. Then, we revise the investigation to figure out how function can be affected because of an injury. We figure out these things:<br>• Skin is attached to the muscle underneath it, and the muscle is attached to bones.<br>• Bones move when the muscles attached to them move.<br>• The muscles and bones are both parts of the wing system (or foot system) and interact for the wing (or foot) to move.<br>• When one part of the system is broken or injured, the whole system is affected and can't function the way it used to. |  |
| ⇓ **Navigation to Next Lesson:** We want to look more closely at the different parts of the foot to figure out more about how they interact so we can figure what happens for them to heal. | | | |

| Lesson Question | Phenomena or Design Problem | What we do and figure out | How we represent it |
|---|---|---|---|
| **LESSON 3**<br>1 day<br>**How can medical images and diagrams help us figure out more about the structures in our body?**<br>Investigation |  <br>*Medical images and scientific diagrams can be cross-referenced to identify structures within the body.* | We decide we need to see the different structures inside a body. We observe different types of medical images of a body. We analyze various scientific diagrams to help us interpret the different structures within the images we observed. We figure out that<br>• There are blood vessels in the different parts of the bone, muscle, and skin.<br>• There are nerves that run through the layers of the skin, the muscle, and the bone. |  |
| ⇓ **Navigation to Next Lesson:** We figured out that the skin, muscles, and bone in our body are very similar to the ones we observed in the chicken wing we looked at in the previous lesson. We also noticed that when we looked closer at these parts, there were other parts, like blood vessels and nerves, and we wonder what their role is inside the body. | | | |
| **LESSON 4**<br>3 days<br>**Why is there blood in all of these places in the body?**<br>Investigation |  <br>*A blood sample that looks homogenous when newly drawn separates into distinct layers after being left to stand. When viewed with a microscope, blood smears from humans and other mammals contain three different round components.* | We view an image of blood vessels to determine that blood circulates everywhere in the body, and we notice that blood in a test tube settles into layers. We use microscopes to investigate human and mammal blood on pre-prepared slides, observing that blood is composed of several different smaller structures. We read an article to make sense of the patterns we saw, considering how the structures of the blood and its components support their functions in the body. We figure out:<br>• As a whole, the blood's function is to travel around the body carrying the things the body needs.<br>• The blood's flowy liquid nature (structure) allows it to perform its function.<br>• Blood vessels in a body help blood get to where it needs to go throughout the body.<br>• Blood is composed of a mixture of components that we cannot see without a microscope.<br>• Blood is made of red blood cells, white blood cells, platelets, and blood plasma.<br>• The structure of blood cells relates to their function: their round shape helps them travel easily through the tubular blood vessels.<br>• Platelets' structure relates to their function: their branching arms and stickiness help them plug damaged parts of the blood vessels to stop leaks. |  |
| ⇓ **Navigation to Next Lesson:** We figured out that blood and blood vessels run throughout the body to bring the body things it needs, and blood has microscopic structures that support its functions. Like blood vessels, we also saw nerves in skin, muscle, and bone, and we wonder why there are nerves all over the body, too. | | | |

| Lesson Question | Phenomena or Design Problem | What we do and figure out | How we represent it |
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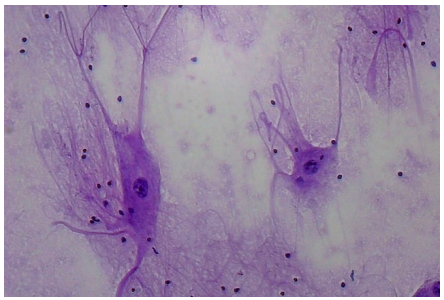
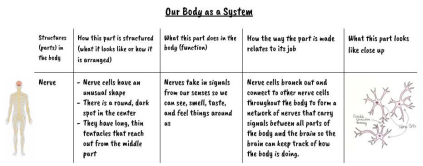
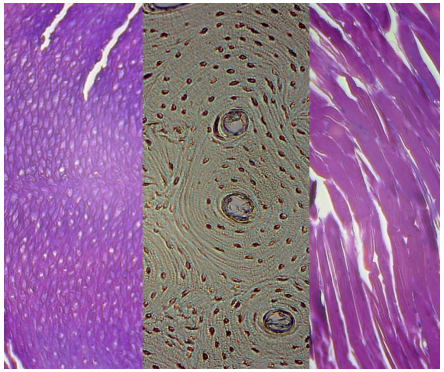
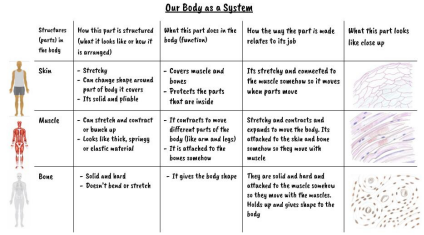
| **LESSON 5**<br>2 days<br>**What do nerves do, and why are they in different parts of the body?**<br>Investigation |  <br>*Nerve cells branch out all over the body to create a system that allows signals to travel throughout the body, including to and from the brain.* | Nerves, like blood vessels, are found throughout the body. We investigate nerves under a microscope and we notice that nerves have a unique and intricate structure. We read about nerves and learn that the nerve cell's structure suits its function. We engage in a few quick experiences that help us understand the role that nerves play in our bodies. Then we revisit the foot injury and think about how we can leverage what we now know about the function of nerves to better understand how the foot works and the healing process of the skin, muscles, and bones affected by the injury to the foot. We figure out:<br>• Nerve cells have a very unique structure--they have long, thin "branches" or "tentacles" extending from a central portion.<br>• Nerve cells branch out and connect to other nerve cells, forming a network of nerves that carry signals between all parts of the body and the brain.<br>• The structure of nerve cells is perfectly suited for their function--they branch out and connect with all parts of the body so that they can carry signals back and forth between the body and the brain. |  |

⇓ **Navigation to Next Lesson:** We figured out that the structure of nerve cells is perfectly suited for the function that they carry out, but there is more that we need to figure out about the role of nerves in healing.

| Lesson Question | Phenomena or Design Problem | What we do and figure out | How we represent it |
|---|---|---|---|
| **LESSON 6**<br>1 day<br>**What will we see if we look at skin, bone, and muscle with the microscope, too?**<br>Investigation |  <br>*Slides of human skin, bone, and muscle samples look different when viewed with a microscope, but each is composed of smaller structures arranged in repeating patterns.* | We investigate pre-prepared slides of bone, skin, and muscle and then use our observational data to come to consensus around how cells' unique structures support their functions in the body. We figure out:<br>• Bone, muscle, and skin are made up of repeating patterns of microscopic structures called cells, and groups of these cells form tissues.<br>• Cells that make up different tissues are structured differently, depending on their function in the body.<br>• Structure is the characteristic of something (the shape or way it's made or arranged) that supports its function. |  |

⇓ **Navigation to Next Lesson:** Now that we have figured out what the different parts of the foot system are made of when they're functioning correctly, we will go back to our timeline and capture what we have figured out. What else do we need to know about the foot to explain how it heals?

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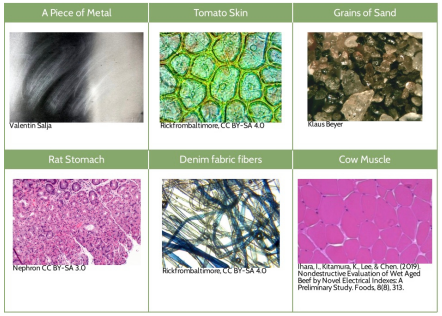
|---|---|---|---|
| **LESSON 7**<br>1 day<br>**Are all things made of cells?**<br>Putting Pieces Together |  <br>*We analyze multiple microscopic images of some living and non-living things as data to determine whether they are all made of cells.* | This lesson marks the end of the first lesson set. Students take an individual assessment where they plan an investigation to collect data to determine if other things are made of cells. They analyze microscopic images of living and non-living things as data to look for evidence of cells. They use these data to argue from evidence that parts of living (or formerly living) things are made of cells--not things that were never living are not made of cells. We figure out:<br>• Microscopic samples from living things that we analyze are made of cells.<br>• Microscopic samples from things that were never living are not made of cells. | |

⇓ **Navigation to Next Lesson:** We figured out that not all things are made of cells but the parts of the things we looked at that were once living are made of cells. Now we wonder, What happens to these cells when an injury occurs?

| Lesson Question | Phenomena or Design Problem | What we do and figure out | How we represent it |
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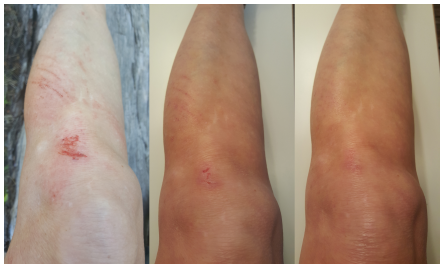
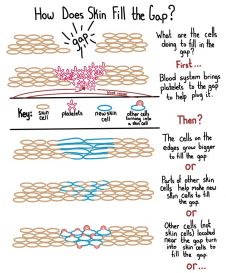
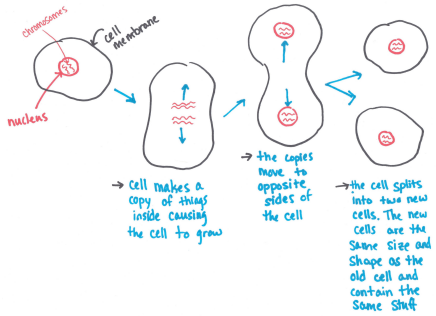
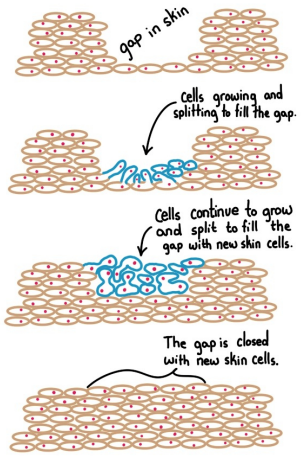
| **LESSON 8**<br>1 day<br>**What happened as the skin on top of the foot healed?**<br>Problematizing, Investigation |  <br>*A time-lapse video of skin healing after a bike crash shows the formation of new skin over time.* | We revisit the healing timeline and Driving Question Board to connect what questions we have answered, like what the foot is made of and how these parts work together to help us function. We revise our definition of *healing* to include that healing must involve filling in the gaps in the injury with cells, but we do not know how. We observe a time-lapse video of a skin wound healing to gather more information about what must be happening in the healing process. We revise our model to specifically focus on and predict what happens with cells for skin to heal. We figure this out:<br>• New skin (which is made of cells) forms as the site of the injury gets smaller and smaller. |  |

⇓ **Navigation to Next Lesson:** We figure out that as a skin wound heals, the opening in the skin gets smaller and smaller, and there is new skin where there was not skin before. We wonder how the cells that make up the skin fill the gap.

| Lesson Question | Phenomena or Design Problem | What we do and figure out | How we represent it |
|---|---|---|---|
| **LESSON 9**<br>1 day<br>**What is happening at the site of an injury to fill the gap?**<br>Investigation |  <br>*A gap in skin, muscle, or bone is filled in by the formation of new cells from old cells of the same type, but what do cells need in order to make more cells?* | We analyze a video and microscopic images of cells splitting and growing in different organisms. By observing this process at different spatial (zoomed-in/out video and images) and time scales (full/half-speed video), we make sense of how our body fills a gap at the site of an injury, such as broken skin or bone. We figure out these things:<br>• New cells come from old cells, which grow and split through a repeated and nonrandom process.<br>• When cells grow and split, they make new cells of the same type (e.g., skin cells make new skin cells and bone cells make new bone cells).<br>• A gap in the skin, muscle, or bone is filled by new cells as a result of cells growing and splitting. |  |

⇓ **Navigation to Next Lesson:** Because our body fills a cut in the skin or a break in the bone by making new cells, we want to know what the cells require to do this. We know that our body requires food and energy to grow, so we wonder if cells need something similar to split and grow.

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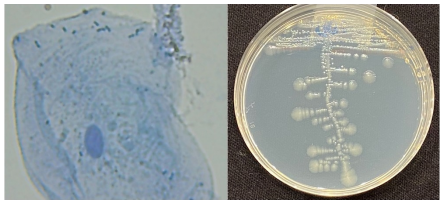
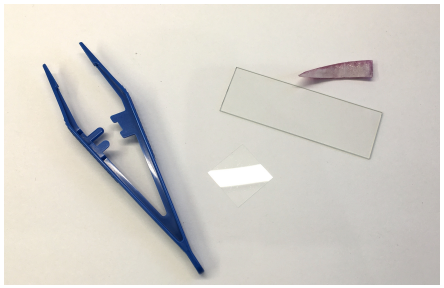
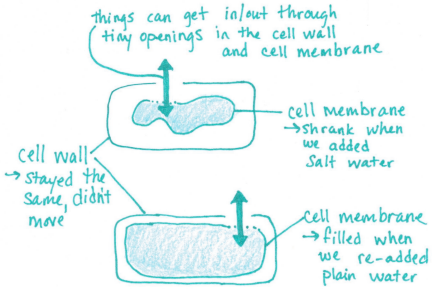
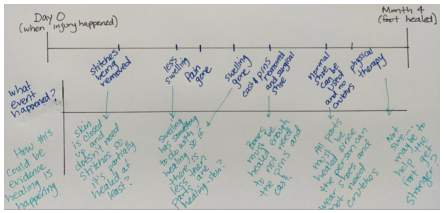
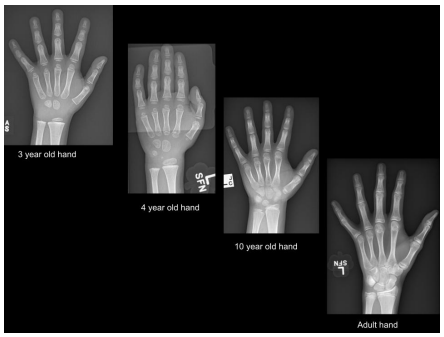
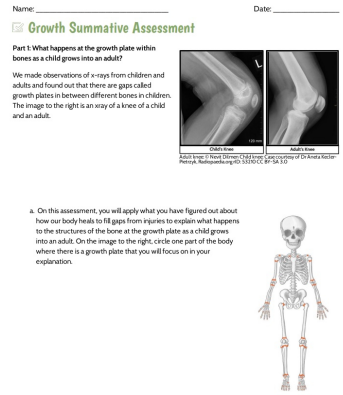
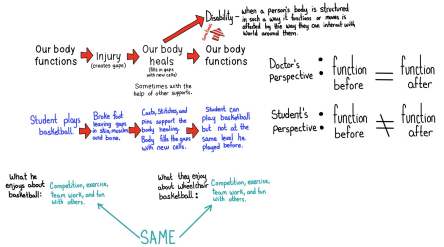
| **LESSON 10**<br>2 days<br>**What do cells need to grow and make more of themselves?**<br>Investigation |  <br>*Bacteria, an organism made of one cell, make more of themselves when given nutrients. The more nutrients, the more the bacteria cells make.* | We recall what we (humans) need to grow and wonder if cells also need the same things to grow, since they are living, too. Since we can't easily study cells from our bodies, we investigate single-celled organisms. We look at data from a scientist, who grew bacteria on agar plates with different nutrient levels. We analyze the data and notice that the quantities of bacteria made increased with increasing nutrient levels. We read about other unicellular organisms and figure out that they are living things that need food to make more of themselves. We figure out:<br>• Cells need food to make more cells.<br>• More cells grow when they have more food around them.<br>• There are single-celled (unicellular) and many-celled (multicellular) living things.<br>• Cells are living things.<br>• All living things are made of cells. | |

⇓ **Navigation to Next Lesson:** We figured out that living things can be made of one or many cells and those cells need food to grow, like humans. We wonder how those cells get what they need in order to make new cells.

| Lesson Question | Phenomena or Design Problem | What we do and figure out | How we represent it |
|---|---|---|---|
| **LESSON 11**<br>1 day<br>**How do cells get what they need to grow?**<br>Investigation |  <br>*Onion cell membranes shrink and expand in the presence of saltwater and plain water, respectively.* | We observe onion cells using microscopes. We add saltwater, then plain water, to the onion skin and observe changes in the cells. We use our observations to explain how plant cells let water out of and into the cell. We figure out:<br>• Plant cells have a cell wall and a cell membrane.<br>• The cell wall is a structure that is unique to plants and helps the cell maintain its shape.<br>• The cell membrane and cell wall act as a barrier and allow things the cell needs (food, nutrients, etc.) into and out of the cell. |  |
| ⇓ **Navigation to Next Lesson:** We think we have enough information to explain healing--let's do that, and revisit our DQB to see what we're still wondering about. | | | |
| **LESSON 12**<br>2 days<br>**How do the structures and systems in the body work together to heal the injury?**<br>Putting Pieces Together |  <br>*Systems in the body interact and work together for the body to be able to heal from injuries.* | We revisit the timeline of healing from Lesson 1 and develop explanations for how healing happens based on each event we had listed. We come to consensus about how the healing in the foot happened, developing a list of key science ideas. We use what we have figured out about healing so far to see if we can explain how the systems in our body interact to support the healing process. We figure out:<br>• The body reacts to an injury by swelling, which increases blood flow and brings extra fluid to injured tissue to help it heal.<br>• The healing process for the foot is similar to how other body parts and other living things heal as well. | |
| ⇓ **Navigation to Next Lesson:** We know that the systems and structures in the body work together to heal injuries, but how is this similar or different from growing? | | | |

| Lesson Question | Phenomena or Design Problem | What we do and figure out | How we represent it |
|---|---|---|---|
| **LESSON 13**<br>1 day<br>**How is the process of growing similar to healing?**<br>Putting Pieces Together |  <br>*Children have smaller bones than adults and have growth plates in bones that fill in over time and become bone.* | We apply what we have figured out about healing to explain a related phenomenon, growth. We revisit the Driving Question Board and discuss all of our questions that we have now answered, which leads us to revise our main question to include growth. We reflect on and celebrate our experiences in this unit and this year of OpenSciEd science. We figure out:<br>• Children have growth plates in their skeletons which are gaps between their bones.<br>• Growth in humans is similar to healing.<br>  • Cells fill a gap in each tissue/body part.<br>  • The same structures and systems that are needed to heal are needed to grow. |  |
| ⇓ **Navigation to Next Lesson:** We figured out that human growth is similar to healing. We wonder if we can investigate other living things to see how they heal and grow. | | | |
| **LESSON 14**<br>3 days<br>**How can shifting our perceptions of ability and disability allow us to be more thoughtful about how we make our environments more accessible?**<br>Investigation |  <br>Created by Susanne Koefoed in 1968<br>  <br>Created by the Accessible Icon Project in 2010<br>*People with different disabilities may have different ways of functioning but everyone has needs and our world should be accessible by all.* | We revise our definition of healing to include thinking about the impacts on the way our body functions. Then we consider how we are still able to achieve our goals even when the way our body functions changes. We read and hear about five stories from people with disabilities, the challenges they face, as well as their perception of their disability. We brainstorm ways to adapt and redesign our environment in order to make it more accessible to people with disabilities. We figure out:<br>• A person could be healed, but that part of the body may have a different function than before.<br>• Some disabilities are temporary and some are permanent.<br>• Some disabilities are visible and some are invisible.<br>• Many disabled people count disability as an important part of their identity. It is something to celebrate and take pride in.<br>• It's important for environments to be designed to be more accessible for all people. |  |

**LESSONS 1-14**
25 days total