LESSON 14: How is the process of growing similar to healing?

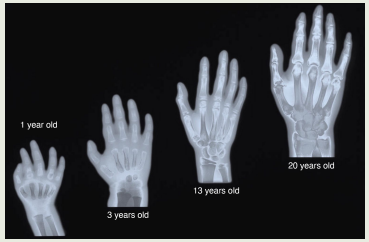
PREVIOUS LESSON

We shared stories of healing and methods of healing from our communities. We explained how techniques that our communities use to support healing do so and shared these with our peers. We made a generalizable model of healing.

THIS LESSON

PUTTING PIECES TOGETHER

2 days



We apply what we have figured out about healing to explain a related phenomenon, growth of body parts and organisms. We revisit the Driving Question Board and discuss all of our questions that we have now answered which leads us to revise our main driving question to include growth. We reflect on and celebrate our experiences in this unit and our year of OpenSciEd science.

NEXT LESSON

In this lesson, we will take on a project to investigate how other living things heal and grow, even when they have different structures and systems than humans. We will identify similar functioning structures in other living things and compare them to the structure in humans. We will communicate the scientific information we found with our peers using a modality of our choice.

BUILDING TOWARD NGSS

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

WHAT STUDENTS WILL DO

14.A Apply science ideas and evidence from classroom investigations to explain a common, real-world phenomenon in which the specialized cells of living things serve particular functions as they work together to interact with each other and other systems to grow.

14.B Identify and ask questions related to healing and growth of living things (patterns) that can be investigated in the future.

WHAT STUDENTS WILL FIGURE OUT

- Children have growth plates in their skeletons which are gaps between their bones.
- The process that occurs when a person grows is similar to healing because
    - cells fill a gap in each tissue/body part as it heals (or grows), and
    - the same structures and systems that are needed to heal are needed to grow.

Lesson 14 • Learning Plan Snapshot

Part	Duration	Summary	Slide	Materials
1	20 min	**DISCUSS HOW THE BONES OF YOUNG CHILDREN ARE DIFFERENT THAN OLDER CHILDREN/ADULTS** Introduce a context for a new phenomenon to investigate using what we have figured out so far about healing.	A-G	Noticings About Bones from Different-aged People poster, markers
2	25 min	**DEMONSTRATE UNDERSTANDING ON AN ASSESSMENT** Students individually apply what they figured out about healing to explain how the growth process may happen in the body.	H	*Growth Summative Assessment*
				End of day 2
3	20 min	**CLOSE OUT OUR DRIVING QUESTION BOARD** Students revisit the DQB to take stock of all the questions we've now answered and revise our driving question.	I-J	5 sticky dots, sticky notes, marker, Driving Question Board
4	5 min	**ADD TO OUR PROGRESS TRACKERS** Allow time for students to update their Progress Trackers.	K	
5	20 min	**CELEBRATE ACCOMPLISHMENTS AND REFLECT ON THE UNIT AND YEAR** Students discuss what was challenging and rewarding about this unit and year.	L	
				End of day 3

Lesson 14 • Materials List

	per student	per group	per class
Lesson materials	• science notebook • *Growth Summative Assessment* • 5 sticky dots • sticky notes • marker		• Noticings About Bones from Different-aged People poster • markers • Driving Question Board

Materials preparation (20 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.

Have chart paper and markers ready to create the poster Noticings About Bones from Different-aged People.

Make sure the DQB is displayed and space is available for the class to gather in a Scientists Circle. Display all previous classroom consensus models and other posters around the room for reference.

Lesson 14 • Where We Are Going and NOT Going

Where We Are Going

This lesson provides a transfer task for assessing students' ability to apply what they have figured out about the process of healing to a new process: growth. In this assessment, students will engage in all three dimensions of the NGSS when analyzing images of x-rays of children's and adults' hands and feet. They will look for patterns of similarities to discover that there are gaps in the bones of children, but not in adults' bones. Then, they explain how growth occurs using what they have figured out about how gaps in injured tissue heal.

This lesson provides an opportunity for students to evaluate the Driving Question Board (DQB). This lesson focuses on finding patterns in questions we are now able to answer related to healing and growth, questions we can partially answer, and those we still have not been able to answer. Through this evaluation of our DQB, we can apply what we have figured out about healing to growth. Then we can expand our investigations of healing and growth to include a greater amount of our related phenomena, in the optional project in Lesson 15. This evaluation of our questions allows us to apply what we've figured out about healing to the growth process of organisms and to many of the related phenomena we've collected.

Where We Are NOT Going

We are not going into detail about the entire process of development from childhood to adulthood. We are only concerned with growth within an individual from the toddler years to physical maturity, specifically focusing on how bones grow during that time. In addition, we will not be comparing the difference in height growth between people which would lead into genetics. Students will investigate genetics in *OpenSciEd Unit 8.5: Why are living things different from one another? (Muscles Unit)*.

We are not naming or explaining cartilage.

LEARNING PLAN for LESSON 14

1 · DISCUSS HOW THE BONES OF YOUNG CHILDREN ARE DIFFERENT THAN OLDER CHILDREN/ADULTS

20 min

MATERIALS: science notebook, Noticings About Bones from Different-aged People poster, markers

Introduce the assessment goal. Display **slide A.** Say, *Up until now we have been working to explain healing. Ideally, we should be able to use and apply what we have figured out so far to explain lots of other related phenomena, beyond those that we initially brainstormed. We don't always know the limitations of the science ideas we have figured out until we try using them to explain a wider range of phenomena. So, today is our chance to test how our model ideas from healing help in explaining a new phenomenon. Today you'll work on an end-of-unit assessment to explain what is happening in a new scenario. This assessment will be an excellent opportunity for you to demonstrate everything you have figured out so far about living things from investigating healing.*

Orient students to the context of the assessment by comparing human bones. Display **slide B.** Say, *Before you start the individual portion of the assessment, let's start by thinking about how we can use our ideas about how bones healed to explain what's going on in this other situation.*

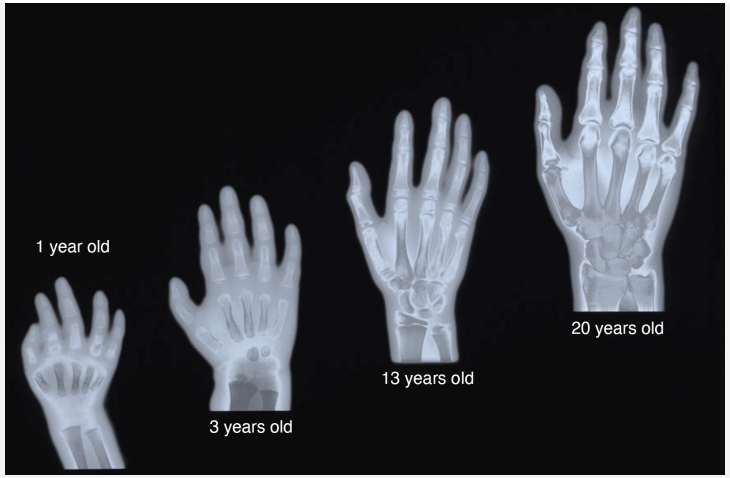
Suggested prompt	Sample student response
In our unit we have been figuring out some things about bones. Think about bones in a young child compared to an adult. How do the bones of an adult compare to the bones of a child?	*Children's bones are smaller than adults' bones.* *Children's bones are growing.* *Adult bones don't grow - most adults stay the same height.* *We learned bones are made of cells and have blood vessels and nerves. So I think the child bones and adult bones are both made of cells.*
Many of you were saying that children are growing and so their bones must be growing too. If you think about how this happens, what are some initial ideas you have about how bones might grow?	*Cells are making more cells.* *Cells need things like food (that is brought by the blood) to make new cells, like how we have to eat healthy foods to grow when we are kids.* *Cells make more cells when we are healing and we think this might be the same for growing.* *Things might be going in and out of the cell.*

Make noticings about x-rays of bones from people of various ages. Display **slide C.** Say, *Let's take a look at some bones in the hands of people of different ages. What are some things you notice? As you share, I will record your noticings on this poster.*

Title the poster, Noticings About Bones from Different-aged People, and record here as students share.

Note: you may need to help orient your students to what the lighter and darker shading on the image represents by pointing out the bones on the images.

See the image on the slide below of an x-ray of hands at different ages.

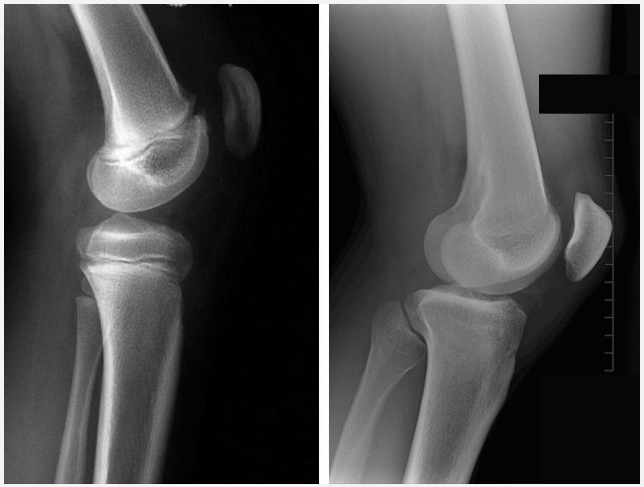


Some possible observations students may share include:

- There seem to be a lot of little bones in the smallest hand.
- It seems like there are places in the little hand that there are no bones where in the adult hand there are bones.
- The bones in the fingers of the second image look too short - there's so much space between them compared to how long and close together the bones are in the adult hand.
- In the third image, it looks like some of the areas between bones have started to fill in with more bone.

Say, *OK, many of you are noticing that there are differences in the bones in an adult and child, particularly that there are smaller bones in the little hands and that there are spaces, or gaps between the bones in the hands of the children. Let's look at another image of an x-ray, this time taken of a child's knee and an adult's knee and see if we notice any of the same patterns between the child and adult bones.*

Project **slide D** which shows the image of the two knee x-rays.



Suggested prompt	Sample student response
What similarities and differences do you notice between the hand images and these knee images?	*Bones in the child are smaller in size for the hand and the knee.* *The bones in the adult are bigger and look like they would be longer too in both the hand and the knee.* *There seems to be more of a space in the knee of the child than the adult, but the space isn't as easy to notice as it was in the hand.* *The two bones that meet where the knee bends look cracked or separated at the ends, but the adult bones don't seem to have that gap near the ends. Looking back at the hand images, I can see similar gaps or separations at the ends of some of the finger bones in the third-largest hand, but the adult hand does not have those either.* *There are more bones in the hand than the knee, at least the part we see.*

Say, *OK in both of the child's x-rays, we are noticing there are spaces or gaps.*

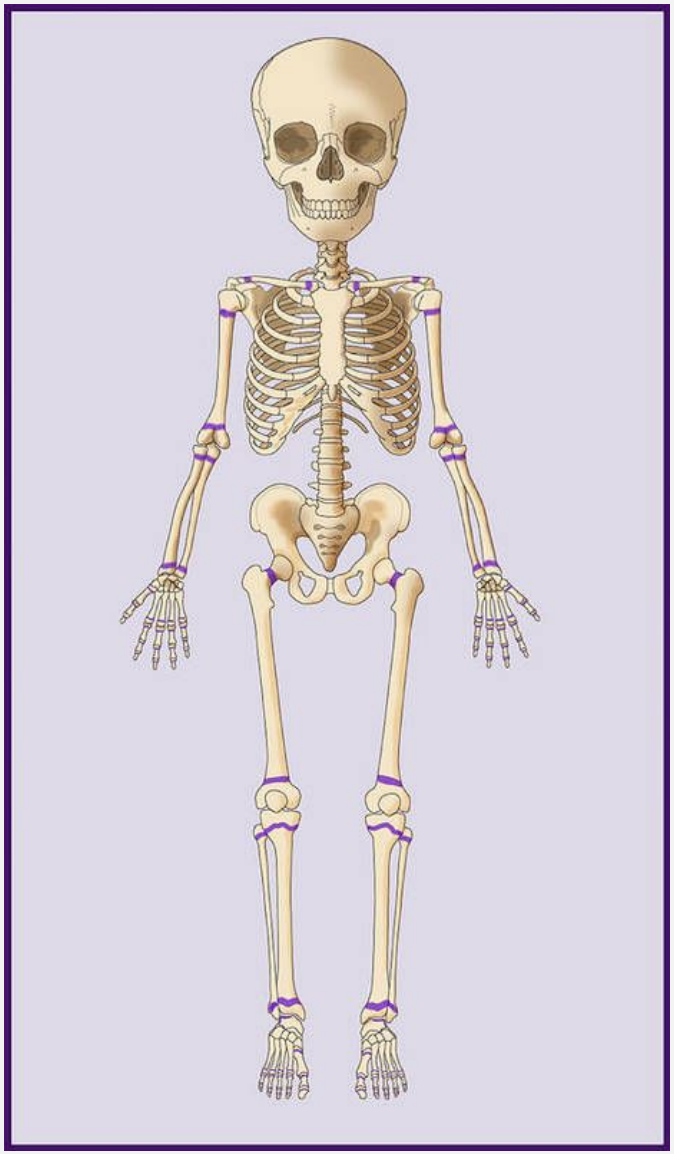
ADDITIONAL GUIDANCE	If kids push back that they think it is just empty space between the growth plates, then problematize this comment by referring to the x-rays and asking what they notice about the gaps. They will likely say that it appears foggy or hazy and not just clear. If there is still hazy stuff there, we are pretty sure it isn't just open space.

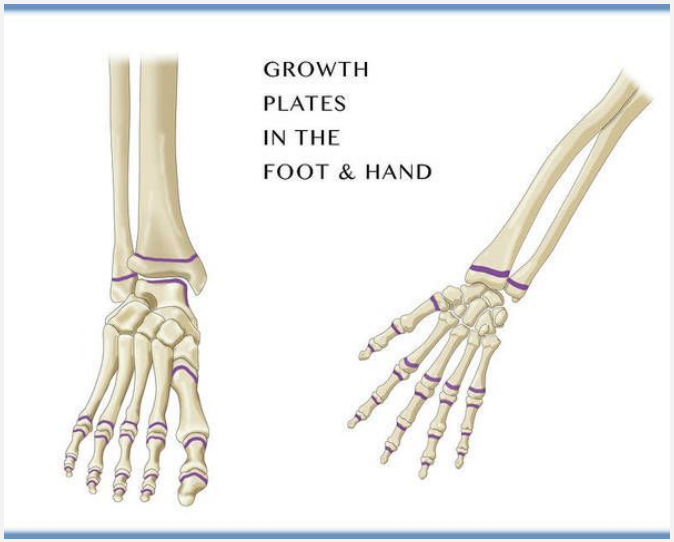
Name growth plates. Display **slide E.** Say, *These spaces in the bones of children are called growth plates. We noticed on the x-ray that they're showing up as gaps, so it's not bone, but when we looked at the adult x-rays there was bone there without any gaps. So something must be happening in these gaps as children grow into adults.*

Make predictions about growth plates. Display **slide F.** Say, *Write two predictions in your notebook to answer these questions.*

- What happens in those spaces at the growth plates?
- Where else in the body, besides the hand or knee, do you think we would find these spaces (growth plates)?

Examine an image of growth plates throughout the body. Display **slide G.** Say, *It is hard to get an x-ray of growth plates for the whole body, so medical professionals make these scientific drawings based on x-rays of the body parts. Let's look at an image on the slide that shows all the places in the body that growth plates are located.*





Suggested prompt	Sample student response
What do you notice about where the growth plates are found?	*Growth plates are everywhere in a baby/child.* *We see growth plates at the ends of the longer bones, but it looks like most bones have a growth plate in the baby.*
Think back to the x-rays we saw. What do you think we would see on an x-ray where we see purple lines in the diagrams?	*There would be a gap between the bones at all of those places.*
What do you think happens at these growth plates between the time someone is a baby until they are an adult?	*Somehow they close up.* *Yeah it seems like the bones must grow because we know people get bigger or taller than when they are born.*
What do we think needs to happen for the bone to grow?	*We think for bones to grow, they need to make more cells.* *We figured out bones are made of cells so maybe more need to be made.*

Summarize, *So we looked at growth plates in children as a class and we saw there was a gap between bones at the growth plate. It sounds like we think that for bones to grow, they need to make more cells. We also noticed that growth plates are everywhere in a baby or small child. Let's see if we can use what we have figured out about healing and what we notice and wonder about growth plates to explain the processes that might be happening at the growth plates.*

2 · DEMONSTRATE UNDERSTANDING ON AN ASSESSMENT

25 min

MATERIALS: science notebook, *Growth Summative Assessment*

Provide time for students to work on *Growth Summative Assessment* individually. Display **slide H.** Distribute one copy of *Growth Summative Assessment* to each student. This assessment will take students the remainder of the class period to complete. Once completed, students should turn in their assessment to you for feedback. Note to students that they have a choice in modality for sharing their answers, which include written or pictorial or a combination of the two.✱

ASSESSMENT OPPORTUNITY

Building towards: 14.A Apply science ideas and evidence from classroom investigations to explain a common, real-world phenomenon in which the specialized cells of living things serve particular functions as they work together to interact with each other and other systems to grow.

What to look for: This assessment is a transfer task to give students an opportunity to use the three dimensions to make sense of a new scenario. For specific scoring guidance see *Scoring Guidance: Growth Summative Assessment*. Allow students to choose how to share their understanding through written response, pictorial response, or a combination of both.

What to do: This is meant to be a summative assessment task for the unit, and it gives you a grading opportunity. The task includes a scoring guide located in *Scoring Guidance: Growth Summative Assessment*. Scoring guides are meant to highlight important ideas students should include in their responses. If students share these ideas elsewhere in the assessment, it is up to you to decide if that understanding is sufficiently demonstrated.

✱ ATTENDING TO EQUITY

Universal Design for Learning: This assessment encourages students to demonstrate their understanding of key skills and concepts from the unit so far through multiple modalities. Some students may benefit from using multiple modalities of *expression* to show their thinking for any or all of the questions on this assessment. You may consider allowing some students to present their answers verbally with you or another student acting as a scribe to record their thinking on paper. Other students may benefit from using gestures rather than images to describe parts of explanations. Some students might also benefit from using manipulatives to represent parts of the system and to support a written or verbal explanation of what's happening in each part of their explanation. In each case, encouraging students to use multiple modalities to show their thinking creates a clear, accessible, and equitable pathway for all students to demonstrate proficiency.

End of day 2

3 · CLOSE OUT OUR DRIVING QUESTION BOARD

20 min

MATERIALS: 5 sticky dots, sticky notes, marker, Driving Question Board

Gather at the DQB and mark questions that students think we have answered. Present **slide I** and have students place sticky dots on the class DQB next to the questions that they think we have made progress on.✱

ALTERNATE ACTIVITY

Another option for evaluating DQB questions is to have students work either individually or in pairs to answer the questions they posed. This can be done similarly to what they did in Lessons 5 and 8 by asking them to write their questions on a sheet of paper and answer the questions in words and/or pictures. To help students feel like they made progress answering their own questions, create a focus on the questions that we have not answered, but now feel we could (or partially could) using the ideas we have developed.

As another option, some teachers may start a Wonder board to house questions that have not yet been answered, but students are still interested in pursuing. These questions are available for students to pursue independently or as time allows.

Look for patterns using the sticky dots. In the Scientists Circle, ask the class to focus on the questions that have the most sticky dots.

Discuss as a class the questions the class can now answer. Present **slide J** if desired. Have the class discuss the answers to these questions as a group. If you have space, you might make a Take Aways poster to record the class's answers. ✱
Prompts on the slide:

- Which questions have we made the most progress on?
- What have we figured out?
- What new questions do we have?

To begin to close out the discussion, pose the main driving question, *How do living things heal?* Elicit students' new ideas to this question.

Add growth to the DQB. Say, *We have answered so many questions about healing. However, when we considered growth plates, we found that we could explain growth by using many of the same science ideas we used to explain healing.*

Suggested prompt	Sample student response
Do you think any of these DQB questions and answers could also be related to growth?	*Yes!*
Which questions on our DQB do you think are related to growth?	*Answers will vary.* *Why do kids have more broken bones than adults?* *How do lizards regrow their tails?*
Do you think we could add "growth" to our main driving question and some of our questions would still apply? Explain why you think so.	*The process that occurs when a person grows is similar to healing.* *Cells fill a gap in each tissue/body part as it heals.* *The same structures and systems that are needed to heal are needed to grow.*

Update the main driving question on the poster to read "How do living things heal and grow?" Give students time to write 1-2 new questions. Encourage students to write down questions about growth and/or new questions that came up about phenomena they have observed in the world and want to explain. Have students post their questions to the DQB.

✱ SUPPORTING STUDENTS IN ENGAGING IN ASKING QUESTIONS AND DEFINING PROBLEMS

Revisiting the DQB at the end of the unit helps students see the progress they have made toward answering the questions that were important to them at the onset of the unit. At that time, students asked questions "that required sufficient and appropriate evidence to answer." Through investigations and individual and whole-group sensemaking, they can now answer many of their initial questions. This final visit to the DQB also allows students to see how their work toward a shared learning goal can help them figure out the anchor phenomenon and also explain other phenomena in the world.

✱ ATTENDING TO EQUITY

It is important to revisit the DQB to ensure students feel as though their questions are valued and recognized. While not all questions will have been addressed (it's more likely that 50–75 percent will be at least partially answered), this helps students see that they have done hard work to help answer many of their own questions.

If needed, have students start new clusters of questions based on the phenomena and/or questions that are most closely related.

Ask students to share their questions and how they may go about answering those questions on their own, and/or as part of their science learning in the future.

ASSESSMENT OPPORTUNITY

Building towards: 14.B Identify and ask questions related to healing and growth of living things (patterns) that can be investigated in the future.

What to look for:

- We can clearly answer some of the questions through ideas learned throughout the unit.
- Some questions we can partially answer with some of our ideas learned, but others require more information and/or evidence in order to answer them fully.

What to do: If students struggle to answer questions from the DQB, place them in partners or small groups with one question or cluster of similar questions assigned to the group. Have them first 1) locate where the questions most closely relate to the class' consensus models from Lesson 7 or Lesson 12, and then 2) examine their science notebooks and other documents to search for evidence that could answer or partially answer the question(s). Ask the group to co-construct, in writing or orally, an explanation to the question(s) using evidence from their previous work. Remind students that a good explanation is a how or why causal account that can be supported with evidence.

4 · ADD TO OUR PROGRESS TRACKERS

5 min

MATERIALS: science notebook

Update Progress Trackers in science notebooks. Display **slide K**. Direct students to the Progress Tracker section of their notebooks (landscape orientation) and have them add rows for what we've figured out about growth. Have students update the third column heading to include growing. Remind students that this tracker is their space to process and record their thoughts while we're working to figure out how an injury can heal and living things can grow. (This a moment for formative assessment but not for scoring or grading.) Give students about 5 minutes to update their trackers. See the sample student responses shown below.

Question	What we figured out in words/pictures	This makes me think or wonder about healing and growing...
How is the process of growing similar to healing?	• Children have growth plates in their skeletons which are gaps in their bones. • The process that occurs when a person grows is similar to healing. • Cells fill a gap in each tissue/body part as it heals. • The same structures and systems that are needed to heal are needed to grow.	I think healing is a type of growth. I wonder if other living things with different types of structures heal and grow similar to humans.

5 · CELEBRATE ACCOMPLISHMENTS AND REFLECT ON THE UNIT AND YEAR

20 min

MATERIALS: science notebook

ADDITIONAL GUIDANCE	If you are able to complete Lesson 15, skip the reflection at this time and have students do it after they complete their Lesson 15 projects.

Celebrate the class's accomplishments. Say, *We have come so far since we first explored the case of how the student's foot could heal! We should be very proud of what we have accomplished, not just in this unit, but throughout this whole year of science!*

Have students reflect individually on their experiences. Project **slide L**. Give students 10 minutes on their own to answer these questions in their science notebooks.

- What was the most challenging for you in this unit? This year?
- What was the most rewarding for you in this unit? This year?
- Think about how you engaged in sensemaking discussions with classmates. How would you want to engage in those experiences next year?
    - What would you do the same?
    - What would you do differently?

Share unit and year-long reflections with the class. Bring students together in a whole-group discussion and ask them each to share one part of their reflection on the unit and year.

ADDITIONAL GUIDANCE	This curriculum and unit asks students to do sensemaking that is very difficult but potentially very rewarding. Taking time to reflect upon this challenging work allows students to think about what works well for them as learners. Consider giving students more time to answer these questions if needed.