LESSON 4: Why is there blood in all of these places in the body?

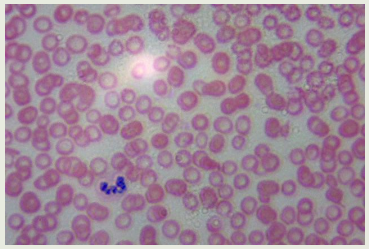
PREVIOUS LESSON

We observed images from scans and tests of the leg and foot as well as cross sections to analyze the structures inside the body. We noticed that there were some structures that we still couldn't identify so we looked at close-up diagrams of the skin, muscle, and bone. From these, we discovered that blood vessels and nerves are found throughout the skin, muscles, and bone.

THIS LESSON

INVESTIGATION

3 days



We view images to determine that blood circulates everywhere in the body through blood vessels and that blood is a mixture of different things. We use microscopes to investigate human and mammal blood on pre-prepared slides. We notice patterns in our observations and establish that blood is composed of several different smaller structures that cannot be seen without a microscope. We read an article to make sense of the patterns we observed, including how the structures of the blood and its components (plasma, red blood cells, white blood cells, and platelets) support their functions in the body.

NEXT LESSON

To understand why nerves are present throughout the cross section of the foot injury, we will observe nerve cells using a microscope. We will read about nerve cells to understand the relationship between structure and function. We will engage in activities to experience how nerves work, then consider how we can leverage what we learn about nerves to better understand healing.

BUILDING TOWARD NGSS

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

WHAT STUDENTS WILL DO

4.A Collect data at different scales to answer scientific questions about the structures and function of blood.
4.B Critically read scientific text to make sense of patterns within structures we observed in the blood related to their function in the body.

WHAT STUDENTS WILL FIGURE OUT

- Blood is composed of a mixture of structures that we cannot see without a microscope.
- Blood is made of red blood cells, white blood cells, platelets and blood plasma.
- The structure of blood cells relates to their function: their round shape helps them travel easily through the tubular blood vessels.
- Blood's function, as a whole, is to travel around the body, carrying different things the body needs.
- The blood's structure (flowy liquid mixture) allows it to perform its function.

Lesson 4 • Learning Plan Snapshot

Part	Duration	Summary	Slide	Materials
1	8 min	**CONSIDER WHERE BLOOD IS IN OUR BODIES** View an image of blood vessels in the human body to determine that blood circulates everywhere in the body. Compare images of blood samples in test tubes to determine that blood is a mixture.	A-E	
2	10 min	**PREPARE TO PRACTICE USING MICROSCOPES** Consider our prior knowledge about lenses, and identify what we need to figure out about using microscopes.	F-J	
3	12 min	**PRACTICE USING MICROSCOPES** Use a microscope to view millimeter graph paper at various objectives and record observations; practice focusing and moving other parts of the microscope slowly and carefully.	K	Investigating Microscopes
4	15 min	**BUILDING UNDERSTANDINGS DISCUSSION ABOUT SCALE** Share what we figured out about using microscopes to see at a microscopic scale; create a class poster for future reference.	L-M	chart paper, markers
				End of day 1
5	10 min	**PREPARE TO INVESTIGATE BLOOD WITH A MICROSCOPE** Consider the human and animal samples we'll observe today (on pre-prepared slides) and set up data tables to record observations.	N-O	
6	15 min	**INVESTIGATE BLOOD WITH A MICROSCOPE** Observe samples of human and other mammal blood to investigate what is in blood, and record observations of structures visible at various objectives.	P-Q	Investigate Blood with a Microscope
7	20 min	**SHARE OBSERVATIONS OF BLOOD** Discuss patterns in observational data with a partner, then with the whole class. Establish that blood is composed of several different smaller structures that cannot be seen without a microscope.	R-U	1 sheet of blank 8.5x11 inch paper, markers
				End of day 2
8	15 min	**READ ABOUT BLOOD** Read an article to find out what structures are in blood and what they do for the body.	V-W	*Guidance for Reading about Blood*, *Reading: What is Blood?* or *What is Blood?* in student editions
9	15 min	**BUILDING UNDERSTANDINGS DISCUSSION ABOUT BLOOD** Use ideas from the article to make sense of the patterns we saw in the blood samples and consider how the structures of the blood and its components support their functions.	X-Y	*Guidance for Reading about Blood*, *Reading: What is Blood?* or *What is Blood?* in student editions, Parts of a Body poster, markers
10	15 min	**UPDATE PROGRESS TRACKER AND REVISIT THE DQB** Reflect on and record what we figured out about blood, how that helps us understand healing, and what questions we have answered (or need to add) on our Driving Question Board.	Z-AA	
				End of day 3

Lesson 4 • Materials List

	per student	per group	per class
Investigating Microscopes materials		• microscope • 2 cm x 4 cm piece of mm graph paper cut from *mm Graph Paper*	
Investigate Blood with a Microscope materials		• microscope • pre-prepared slide of human blood • pre-prepared slide of blood from another mammal • *Procedures for Investigating Blood with a Microscope*	
Lesson materials	• science notebook • *Guidance for Reading about Blood* • *Reading: What is Blood?* or *What is Blood?* in student editions		• chart paper • markers • 1 sheet of blank 8.5x11 inch paper • Parts of a Body poster

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.

In this and future lessons, students use microscopes to look at different samples on pre-prepared slides. The materials (slides, handouts, discussion prompts) all assume your microscopes have a 10x eyepiece lens and 4x, 10x, and 40x objective lenses. If the microscopes your class will be using are different, modify the materials accordingly or call students' attention to the differences.

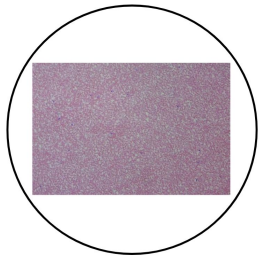
If you do not have microscopes for your class to use, here are some options:

- A partner high school may have microscopes that you could borrow for this unit. Order the slides included in the unit materials list.
- We have included images of what students would see when zooming in on the blood with a microscope in *Microscopic Images of Blood*.
- Access the Virtual Microscope interactive at https://www.teachersopensciedfieldtest.org/healing . From there, copy the link for viewing **blood** and share it with your students so they can access it on their own devices. By sharing this direct link, your students will only have access to the images needed for this lesson.
- If you plan to purchase microscopes for your classroom, they need to be light microscopes to provide enough detail for students to see the small cell structures necessary for sense-making in this unit. Consider purchasing one of the following:
    - standard light microscopes for your class,
    - digital light microscopes that can be used with students' computers, or
    - a single digital light microscope that can be connected to your computer so that you can project different samples for student sense-making as a whole class.

If you don't have access to any microscopes, skip the microscope orientation activities in steps 2, 3, and 4. You may want to make a copy of the "What we can see at microscopic scale" poster in **step 4** to reference the various magnification powers of the microscope. In **step 5**, have students use *Microscopic Images of Blood* to make their observations.

On *Microscopic Images of Blood* and in future lessons where microscopic images are provided, they are labeled as "low," "medium," or "high" magnification. The low magnification was photographed using the 4x objective, medium used the 10x objective, and high used 40x objective, but the total magnification varies depending on how large the images are printed or projected. For the majority of the images printed in this unit, the magnification from the camera-plus-computer setup is about 30x. So, "low" total magnification is about 120x, "medium" is about 300x, and "high" is about 1200x.

Also, the images taken with the microscope camera are rectangular because the camera's sensor is rectangular and does not capture the microscope's entire field of view (see image here). If you worry that your students will be overwhelmed with the task of drawing everything they see in these rectangular images, you may choose to have them draw circles of the same size (tracing a cup or lid would work well) on each image to help them concentrate on just a subset of the data to record in their drawing.



Each lab group will need a 2 cm x 4 cm piece of millimeter graph paper to fit under the slide clips on the microscope stage. Print *mm Graph Paper* or use pre-printed millimeter graph paper.

Depending on availability, you may have one type of non-human mammal blood slides or a few types. If you have multiple types, each group only needs to observe two slides (human blood and one other mammal), but then when students are paired up to share their observations, partner them with someone who observed a different mammal's blood so that they can compare that data.

Be sure you have materials (e.g., blank piece of paper, sticky note, or note card) to add the following words to the Word Wall: **focus, circulatory system**. Do not post these word(s) until your class has developed a shared understanding of their meaning.

Day 1: Investigating Microscopes

- **Group size:** Divide your class by the number of microscopes available.
- **Setup:** Be sure all microscopes have access to an outlet (or other power source for their light).
- **Notes for during the lab:** Students should plug in and/or turn on the microscope. Have students sanitize microscopes between turns.
- **Safety:** There are no safety concerns.
- **Disposal:** Keep all materials for future use.
- **Storage:** Unplug and/or turn off and cover microscopes when not in use to avoid dust.

Day 2: Investigate Blood with a Microscope

- **Group size:** Divide your class by the number of microscopes available.
- **Setup:** Be sure all microscopes have access to an outlet (or other power source for their light). Or, if you are using *Microscopic Images of Blood*, plan how students will access those images (in the Student Edition, and/or printed separately). If you are using the Virtual Microscope interactive, share the link for blood found at https://www.teachersopensciedfieldtest.org/healing .
- **Notes for during the lab:** Be sure that students sanitize microscopes between turns.
- **Safety:** Glass slides are fragile. Have ready an appropriate receptacle to dispose of broken glass as well as a broom and dustpan specifically reserved for cleanup of broken glass. Remind students to handle the slides carefully and ask you for help if one happens to break.
- **Disposal:** Keep all materials for future use.
- **Storage:** Keep slides in their case. Unplug or turn off and cover microscopes when not in use to avoid dust.

Lesson 4 • Where We Are Going and NOT Going

Where We Are Going

Students have considered scale in *OpenSciEd Unit 6.4: How and why does Earth's surface change? (Everest Unit)*. In that unit, they identified patterns in regional and global earthquake data at different spatial (zooming in/out) and temporal (short and longer time periods) scales. The idea of microscopic scale is introduced in this lesson. If your students already have experience using microscopes, make sure you discuss or revisit the idea of microscopic scale when considering how microscopes can help us investigate blood in step 5.

Previously in sixth grade, students have used "zoom-ins" to consider what they cannot see, such as considering differences in particle movement at different temperatures. In this lesson, rather than only modeling non-visible parts and processes, students will use a tool (a microscope) to actually see things at a smaller scale.

Students will use microscopes and/or microscopic images in *OpenSciEd Unit 7.3: How do things inside our bodies work together to make us feel the way we do? (Inside Our Bodies Unit)*, *OpenSciEd Unit 7.4: Where does food come from, and where does it go next? (Maple Syrup Unit)*, and *OpenSciEd Unit 8.5: Why are living things different from one another? (Muscles Unit)*.

This lesson references students' prior knowledge from *OpenSciEd Unit 6.1: Why do we sometimes see different things when looking at the same object? (One-way Mirror Unit)*: lenses refract light and change what we can see. If your class did not read *How do eyeglasses help people see better?* as home learning in Lesson 6 of that unit, you might want them to read it as home learning between days 1 and 2 of this lesson.

If you're using *Microscopic Images of Blood* instead of microscopes, note that the magnification levels are labeled as "low," "medium," or "high" magnification. The low magnification was photographed using the 4x objective, medium used the 10x objective, and high used 40x objective, but the total magnification will vary depending on how large the images are printed or projected. The same labels are used for all images provided in this unit. For the majority of the images printed in this unit, the magnification from the camera-plus-computer setup is about 30x. So, "low" total magnification is about 120x, "medium" is about 300x, and "high" is about 1200x.

Where We Are NOT Going

In this lesson, we will only be naming red and white blood cells rather than cells in general. In Lesson 5, students will identify nerve cells, and then in Lesson 6 they will observe cells in bone, muscle, and skin samples. At that point students will have seen enough examples of cells to add that general term to our Word Wall.

In this lesson, we use the word structure more often as we consider what functions the blood has. We will continue to consider how we're using the word structure and add it to our Word Wall in Lesson 6 when we have determined what we mean by that word (especially as it relates to function).

In this lesson, we will be figuring out what the blood does for the functioning body. This lesson mentions the role of platelets and plasma; other functions of blood and the bloodstream will be investigated in Lesson 12.

The reading about blood includes mention that white blood cells aid the body in responding to disease and infection. However, the immune system itself is beyond grade band and scope of this unit. Therefore, the reading does not go into detail about the white blood cells' role in immune or inflammatory responses.

On day 1, students figure out how to use microscopes and how much the different objectives magnify what they can see. Students will discover for themselves the different parts of the microscope, some of which the teacher will provide names for (but not all). A labeled diagram of a microscope was intentionally left out of this lesson to allow students to explore how the parts work themselves, rather than spending time memorizing specific vocabulary.

LEARNING PLAN for LESSON 4

1 · CONSIDER WHERE BLOOD IS IN OUR BODIES

8 min

MATERIALS: None

Navigate into today's work. Display **slide A.** Say, *Last time we were together, we started wondering about blood and why there were blood vessels found in the muscles, skin and bones. Who can remind us of some of the questions we had about blood?*

Sample student responses include:

- *Is there blood in every part of our bodies?*
- *What does blood do for us?*

ALTERNATE ACTIVITY

The upcoming **slide B** shows a front view and a side view of the blood vessels preserved from a human body for a museum exhibit. If you are concerned that your students will be distracted by the frontal view of the male body, **slide B - Alternate** is provided with only the side view.

Discuss an image of blood vessels. Display **slide B** which shows two photos of the same museum exhibit of blood vessels in a human body. Say, *This image shows many of the blood vessels in a human body. What do you notice?*

Sample student responses include:

- *They go all over! We can see the whole outline or shape of the body with just the blood vessels!*
- *There are so many so close together around the chest area (lungs? stomach?).*
- *It's darker red around the head and fingertips--are there more blood vessels there? Why?*
- *Some are bigger/thicker, while some are smaller/narrower.*

Say, *Last time, we saw that there were blood vessels in different parts of the body. In this image, we see that blood vessels are found all over our body, even in our toes and fingers! All these blood vessels are part of a system of the body called the circulatory system. Why do you think it is called this? What does it mean for something to circulate?*

Sample student responses:

- *Things that circulate move all around.*
- *The blood moves all around our body because there are blood vessels everywhere.*

Ask, *Has anyone ever had a blood test where a doctor takes a sample of blood in a test tube? Let's look at an image of two test tubes of blood and see if we can figure out more about blood.*

Observe and discuss blood samples in test tubes. Display **slide C.** Say, *The sample on the left was just taken from a patient, and the sample on the right was taken from the same patient a few hours later. The tube has been standing still since then. What do you notice?*

Direct students to turn and talk with a partner and then use prompts such as the following to discuss ideas with the class.

✱ ATTENDING TO EQUITY

Universal Design for Learning
To support all students' *perception* of microscopic images in this lesson and throughout the rest of the unit, you might adapt the tools your class is using in a few ways. Students with low vision may be able to see microscopic images on a screen instead of through the eyepiece, so having a USB-connected digital light microscope available might be helpful. Students who are blind should be provided with models or raised-line images so they can participate in the exploration of graph paper and investigation of blood.

Suggested prompt	Sample student response
What do you notice about these blood samples?	*The "fresh" one is all one color, but the "older" one is two different colors.* *It doesn't look as red as I expected.* *The "standing" one has a yellowy-orange layer and a layer that looks maybe even darker than the "new" one. It also might have bubbles around the top?* *The one on the right looks a little bit like salad dressing that my family eats -- the vinegar and oil separate and you have to shake it really well to mix it up again before you put it on your salad. (Optional **slide D** is provided if it's helpful to look at an image of vinegar-and-oil salad dressing.)*
Thanks for describing what you see here. What do you think those observations mean? Why do you think the test tube that has been sitting for a while has two different layers?	*The yellowish stuff is lighter (less dense) and the darker red stuff is heavier (more dense) because it sunk to the bottom.* *There are different things or substances in the blood.* *It seems like blood is a mixture--not all the same stuff throughout.*

Propose using microscopes to observe blood samples. Display **slide E**. Say something like, *How could we figure out what's in the blood? (If we want to be able to observe it more closely, what tool(s) could we use?)*

Sample student responses:

- *We could use a microscope (and possibly a hand lens).*

ADDITIONAL GUIDANCE	If your students suggest using a hand lens to look at the blood up close, have them use hand lenses along with the microscopes when they're looking at the graph paper and the blood samples on slides. Compare the magnification level of the hand lens to that of the microscopes and ask students to record the observational data they make with the hand lens as well.

Say, *So we are thinking that blood is a mixture, but a mixture of what? How could microscopes (and maybe hand lenses) help us figure out what the blood is made of?*✱

Sample student responses include:

- *We can use microscopes to see the blood up close.*
- *We can zoom in on/magnify the blood to be able to see what's in it.*

ALTERNATE ACTIVITY

If you do not have access to microscopes, ask, *How could we figure out what's in the blood? (If we want to be able to observe it more closely, what tool(s) could we use?)* Elicit, *We could use a microscope (and possibly a hand lens).*

Say something like, *Did you know the word microscope is composed of two word roots from Greek that mean "small" and "see?" A microscope is a tool we can use to observe things at a much smaller scale than our eyes alone can see. I have some photos of blood that were taken using a microscope at different magnifications and we can use them to observe what the blood looks like very close up to see if we can answer our question about what's in blood.*

Skip the microscope orientation activities in steps 2, 3, and 4 and proceed to step 5. You may want to make a copy of the "What we can see at microscopic scale" chart in **step 4** for reference of the various magnification powers of the microscope.

Students can use *Microscopic Images of Blood* to make their observations. You might point out to students that the images taken with the microscope camera are rectangular, rather than the round field of view they would see through the eyepiece. If you worry that your students will be overwhelmed with the task of drawing everything they see in these rectangular images, you may choose to have them draw circles of the same size (tracing a cup or lid would work well) on each image to help them concentrate on just a subset of the data to record in their drawing.

Alternately, you can access the Virtual Microscope interactive at https://www.teachersopensciedfieldtest.org/healing . From there, copy the link for viewing **blood** and share it with your students so they can access it on their own devices. By sharing this direct link, your students will only have access to the images needed for this lesson.

ALTERNATE ACTIVITY

If your students are already familiar with microscopes, skip steps 2-4. Be sure to have an explicit discussion of scale when you consider how microscopes could help investigate blood at the beginning of step 5.

2 · PREPARE TO PRACTICE USING MICROSCOPES

10 min

MATERIALS: science notebook

Establish investigation questions for exploring microscopes. Display **slide F.** Say, *We haven't used microscopes yet this year, and when you have a new tool, it's a good idea to practice with it and get familiar with it. What do we need to figure out about microscopes so we can use them to understand what's in blood? Turn and talk with a neighbor and then we'll share ideas with the whole class.*

Sample student responses include:

- *There are lots of dials and things on a microscope--what do they do and how do we use them?*
- *How does the microscope work to help us see objects close-up?*
- *How close-up will we be able to see things with the microscope? How "zoomed-in" can it get?*

Say, *Okay. We will work today to figure out the answers to our questions about microscopes. We want to find out:*

1. *How do you use the different parts of the microscope?*
2. *How does the microscope work to help us see so closely?*
3. *How close-up can we see things with the microscope?*

Consider how the microscope's lenses help us see objects close-up. Display **slide G**. Say, *Raise your hand to show us: How many of you remember using magnifying glasses (hand lenses) in earlier units? How many of you wear glasses, or know someone who does? ✱ Those tools use lenses. We learned in the One-way Mirror Unit that lenses refract or change the direction of light, which changes how we see things. When you use a*

✱ ATTENDING TO EQUITY

Take this opportunity to remind students that we all perceive things in our environment. Some of us do it with our eyes, others with a combination of other senses, and many of our eyes are aided by corrective lenses to see clearly. If your students did not already read *How do eyeglasses help people see better?* during Lesson 6 of the *One-way Mirror Unit*, it is suggested as home learning between days 1 and 2 of this lesson.

As with all things pertaining to ability, it's important to remember to be sensitive with your language. When speaking about a visual

microscope, you're not just looking through a single lens. Microscopes have two lenses that each refract light to help us see many times closer than a hand lens or glasses. While you're working with the microscopes today, be sure to turn or adjust the lenses using the metal edges so you don't get fingerprints on the lenses themselves. Why might it be helpful to keep fingerprints off the lenses?

Sample student responses include:

- *When my glasses get dirty, I can't see as clearly through them--we don't want the microscope lenses to be dirty either or they'll be harder to see through.*
- *If we get fingerprints on the lenses, we'll be looking at fingerprints with the microscope instead of the blood (or anything else)!*

ADDITIONAL GUIDANCE	You may wish to point out to students that not all microscopes look exactly like the image used on these slides. For instance, sometimes the eyepiece is rotated in the other direction away from the arm.

Calculate the total magnification for each objective. Display **slide H.** Note: If your class microscopes' objectives and/or eyepiece lenses are different than those mentioned here, be sure to modify this wording and the slide accordingly. Say, *When you get to work with your microscopes, you'll notice that you can rotate through to use each objective lens. The objective lenses are labeled with their magnification and a color. In addition, they're different sizes. The shortest one is labeled 4x (with a red ring around it), the medium one is 10x (with a yellow ring), and the longest objective is 40x (with a blue ring). Since you're also looking through the eyepiece lens, the magnification you're seeing is 10 times more than the objective's magnification alone. To find the total magnification, multiply the eyepiece magnification times the magnification of the objective you're using. For example, when using the 4x objective, you're also looking through the 10x eyepiece, so the total magnification is 4 x 10 = 40x, meaning you can see objects 40 times closer than you could with your eyes alone.*

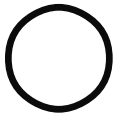
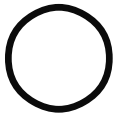
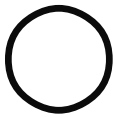
Ask, *What is the total magnification with the 10x objective lens?* (10 x 10 = 100x). *With the 40x objective?* (10 x 40 = 400x).

Prepare a data table in science notebooks. Display **slide I.** Say, *Let's record what you can see with each of those different objectives. I have millimeter graph paper for you to explore with today. Make a table like this in your science notebook to record how much of the graph paper you can see at each magnification. When looking through the microscope, your view will be a circle, so drawing circles for each row in your table can help you more accurately draw what you observe. In the "measurement" column, tell how many millimeters, or squares, you are able to see when you look through the lens at that magnification.*

ADDITIONAL GUIDANCE	If in this digital age your students haven't had much experience with graph paper, you might choose to show them a whole sheet and discuss how it would be used for drawing or graphing before handing out the smaller pieces to look at under the microscope.

impairment, keep your language neutral. Disability isn't good or bad.

As students fill in the total magnification column, remind them of the calculations they just did to arrive at those totals.

Observations of mm graph paper with a microscope		
Total Magnification	**Drawing**	**Measurement in mm**
40x (red)		
100x (yellow)		
400x (blue)		

Say, *You may choose to write notes or draw in your notebook outside this table about other things you figure out about the microscope, especially if you think those ideas will be helpful in our discussion later or when we're using the microscopes to look at blood.*

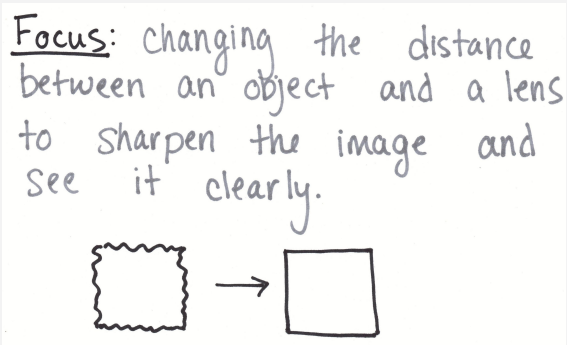
Use prompts, such as those that follow, to review the idea that we are collecting scientific data when we record observations as drawings.

Suggested prompt	Sample student response
How will the scientific drawings you make in your data table differ from drawings you might create as an artist?	*We'll draw what we see and the way we see it - an artist might use their imagination to add things, or change sizes or change how things are arranged.* *We won't worry too much about colors or shading or things like that - we're not trying to have pretty drawings, we just need them to show what we observed.* *Artists might not use words on their drawings, but if it's helpful to us to label parts of our drawings, we could.*

Suggested prompt	Sample student response
Why would we call this a data table when it has drawings and not just numbers or words?	*We're trying to figure out how a microscope helps us see close-up, and what looks different when we change the magnification. We need data to use as evidence to answer those questions.* *Drawing is how we'll record what we observe. Then we'll be able to compare our drawings and use those data to help us understand how a microscope works.* *Data is the information we collect when we're doing an investigation. The information we collect from the microscope might be difficult to describe with just words and numbers, so drawings will help.* *When we record data using a tool like a microscope, the drawings are records of the images that we can use to figure out what things look like up close.*

Introduce the idea of focus. Display **slide J.** Say, *When you are looking through lenses, like the ones in a microscope, what you see might appear blurry or clear. Sometimes it might be so blurry you can't even tell that there's anything there to see! Obviously, we want to be able to see clearly. We use the word "focus" to describe how clear an object appears, or as a verb to describe steps you can take to make an image clearer. When an image is "in focus," you can see it clearly. If it's blurry, you can focus the microscope to make it more clear. Bringing an image into focus is often the trickiest part of using a microscope. Take time to figure out and practice how to use the knobs to adjust the focus of your microscope so you can see clearly, in the sharpest detail. Then share what you learn about focusing with your partner(s).*

Add "focus" to the Word Wall. You might write something like "changing the distance between an object and a lens to sharpen the image and see it clearly."



3 · PRACTICE USING MICROSCOPES

12 min

MATERIALS: Investigating Microscopes, science notebook

Give final directions before beginning the investigation. Display **slide K**. Say, *Use the questions on the slide to help you investigate how microscopes work. I want to remind you to use this tool carefully--move it and its parts slowly and gently. If you try to focus too quickly, everything will keep looking blurry. You will need to be slow and intentional about finding a point when the graph paper is in focus--nice and clear.*

Distribute small pieces of millimeter graph paper. Direct students to work with their groups or partners to find the answers to the questions they raised earlier (posted on **slide K**).

1. How do you use the different parts of the microscope?
    a. Where do you put the graph paper to be able to see it with the microscope?
    b. Where and how do you look through the microscope?
    c. How do you focus the microscope to see clearly?
    d. Does the light help you see the paper differently?
2. How does the microscope work to help us see so closely?
    a. Where are the lenses?
    b. How do the lenses change what you can see?
3. How close-up can we see things with the microscope?
    a. How much of the graph paper can you see with each objective? Record your observations in your notebook.

Give students about 10 minutes to explore the microscope. Circulate and assist as needed, supporting students in their own figuring out rather than telling them what to do. Asking the following questions might be helpful:

- *Where can light come in and out of the microscope?*
- *Which parts of the microscope can you move or adjust (slowly and gently)? How does that change what you can see?*
- *If you can't see anything in your eyepiece, how could you move around your mm graph paper so you could find part of it under the lens?*
- *What part of the microscope could help you hold the paper in place while you look at it?*

4 · BUILDING UNDERSTANDINGS DISCUSSION ABOUT SCALE

15 min

MATERIALS: science notebook, chart paper, markers

Gather the class in a Scientists Circle with their science notebooks to discuss what they figured out. Display **slide L**. Lead a Building Understandings Discussion about the scale at which we can see with the microscope. Record these ideas on chart paper for future reference (see the sample poster below the discussion prompts).

KEY IDEAS

Purpose of this discussion: Students share what they figured out about using microscopes to help them see very close-up, at a microscopic scale.

Listen for these ideas:

- We can use the microscope to see things that we could not see with just our eyes alone (microscopic scale).
- We could see the graph paper closer at higher objectives (we could see more detail).
- There was a smaller field of view of higher objectives (we could see less space).
- We can use the knob(s) on the side(s) of the microscope to adjust the focus.
- We can adjust the light on the microscope to help see better.

ASSESSMENT OPPORTUNITY

Building towards: 4.A Collect data at different scales to answer scientific questions about the structures and function of blood.

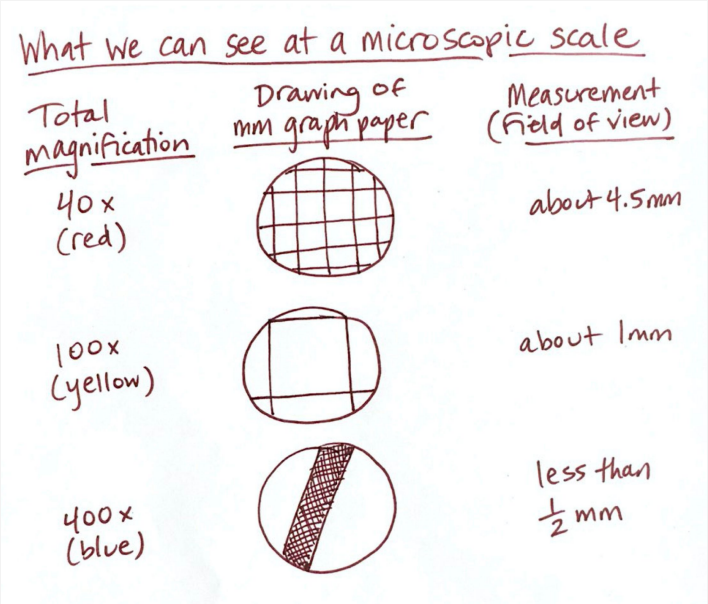
What to look for/listen for: See the key ideas listed above.

What to do: Take note of any students who seem confused or unsure about how to use the microscope, and be sure to check in with them first during the Investigate Blood with a Microscope lab on day 2. Also take note of any students who struggled to draw or describe specific differences they could see with the microscope versus without it or using different objectives. These students may need more practice and support with focusing the microscope before or during the lab on day 2. Consider rearranging groups who share microscopes for the lab on day 2 if you can pair more confident microscope users with those who are less confident.

Suggested prompt	Sample student response
What did you notice about what you could (or couldn't) see with and without the microscope?	*(Accept all responses.)*
We can use a microscope to see things at a microscopic scale (that are too small to see with our eyes alone). In fact, the name of this tool comes from Greek: "micro" for "small" and "scope" for "see." When have you used this idea of seeing (or not seeing) things at different scales before?	*In the Everest Unit unit we used different scales to figure out patterns in where earthquakes and volcanoes occur.* *We also thought about particles within cups in the Cup Design Unit unit when we were trying to figure out the differences in hot and cold substances.*
How did changing the objectives change what you could see? Why?	*The higher the objective's number, the closer we were zoomed in.* *We know the total magnification changes with the different objective lenses. We could see much more detail at the higher numbers.*
When you were looking at that millimeter graph paper at each of those magnifications, how much of it could you see?	*At 40x magnification we could see about 4 or 5 mm.* *At 100x magnification we could see only 1 or 2 mm.* *At 400x magnification we could see less than ½ of a mm.*
The amount of space you can see at one time is called your "field of view." How does the field of view change at different magnifications?	*At higher magnifications, there's a smaller field of view--we can see less space but in more detail.* *At lower magnifications, there's a larger field of view--we can see more space but in less detail.*
What shape is the field of view with a microscope?	*It's a circle.*

Summarize this discussion by saying something like, *We can use this information to help us understand the scale of what we're seeing when we're looking at blood (or anything else) with the microscope*.

See sample poster here.



Ask, *What else did you figure out about using the microscopes that we'll want to keep in mind while we're observing blood (or other things) with them?*

Sample student responses might include:

- *The knob(s) on the side(s) of the microscope adjust the focus--they raise and lower the place you're looking at.* (Teacher may choose to name the stage.)
- *You could see better by adjusting the light on the microscope. There is a dial you can turn to make the light brighter or dimmer.*
- *You really do have to move slowly, or even back and forth a little bit, to find the clearest view.*

SUPPORTING STUDENTS IN MAKING CONNECTIONS IN ELA

Some students might confuse "microscope" with "telescope." If you have a moment, ask students to try to infer what the "tele" in "telescope" means based on what they know about what microscopes and telescopes do (from Greek: "tele" means "far" or "at a distance"). You might also ask students to list other words that use "micro" and consider what part of their meaning is "small."

Conclude today's work. Display **slide M.** Say something like, *Today we explored with the microscope because we were thinking using this tool might help us figure out more about what is in the blood. How could using the microscope help us figure out more about what is in the blood?*

Sample student responses:

- *We can see really close up what is in the blood.*
- *Since the blood is found in all the different parts of the foot that was injured, maybe we can see what is in the blood so we can figure out what it does in each of these parts.*

Say, *Let's plan to use this tool to look close up at some samples of blood next class and see what we can find out.*

HOME LEARNING OPPORTUNITY

If your class did not read *How do eyeglasses help people see better?* from Lesson 6 of the *One-way Mirror Unit*, you might want them to read it as home learning now.

End of day 1

5 · PREPARE TO INVESTIGATE BLOOD WITH A MICROSCOPE

10 min

MATERIALS: science notebook

Navigate into today's work considering the blood samples we'll use. Display **slide N**. Say, *Now that we know how to use microscopes, we're ready to use them to investigate blood samples. I'm sure some of you have had blood taken for tests before, but we can't do that here in our classroom. So we will use samples of human blood that have already been preserved and prepared for us on slides. You'll notice that the slides are made of glass and a very thin smear of blood is on the slide under a clear glass cover slip. The smear of blood is from a freshly-drawn sample.*

ALTERNATE ACTIVITY

If your students will be using the *Microscopic Images of Blood* to gather their data, display **slide N - supplemental** and briefly discuss how the images were taken with a digital camera connected to a microscope and a computer. For the images students are using in this lesson, the camera-plus-computer setup provides about 30x magnification. See the "Materials preparation" section of this lesson for more details.

Use prompts such as the following to navigate into looking at human blood samples and other animal blood samples.

Suggested prompt	Sample student response
Someone remind us: Why do we want to look close up at a sample of blood under the microscope?	*We saw there were blood vessels all over the body so the blood must be important.* *Yeah and we saw the injured foot had dried blood on it, so maybe there is something about the blood that helps the foot heal.* *We wondered why there were blood vessels everywhere in our body and we wanted to see what is in our blood.*

✱ ATTENDING TO EQUITY

Universal Design for Learning: In order to support students who might benefit from other options for *representation*, you may choose to print *Microscopic Images of Blood*, and direct them to annotate those images with ideas about how they compare to what students see in their microscopes and/or ideas about the patterns they notice in the structures they see across the samples.

Suggested prompt	Sample student response
Besides humans do you think any other living things also have blood? What evidence can you share to support your ideas?	*Yes! I think all living animals have blood.* *When my dog got a cut on his paw, it bled.* *I've seen injured animals bleeding in videos.* *When I go fishing with my uncle, we bleed the fish when we're cutting the fillets to cook them.* *I read somewhere that some animals have blood that's not red like ours.*
I have slides that have been prepared with blood from another animal. How could looking at an animal's blood help us?	*We can compare the animal blood to human blood and see if they're the same or different.* *Looking at the chicken wing helped us understand how human body parts work, so looking at animal blood could help us understand what's important in human blood.*

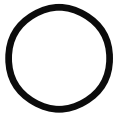
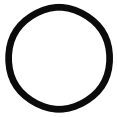
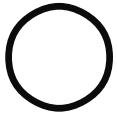
Plan how to record observations.✱ Say, *Okay, so when we are using the microscopes to observe these blood samples, we want to collect this data about what we see. We are trying to answer our question about what is in the blood. What kinds of information should we take note of so we can use this data - our observations - to figure out what's in the blood? How should we record this data?*

Sample student responses include:

- *We'll want to record what we see through the microscope--like everything we can see in the field of view.*
- *We can sketch or draw what we see, but we might need to use some words to explain details or things that are hard to draw.*
- *We'll need to write down what magnification we're using so we know how closely we were zoomed in.*

Summarize by saying something like, *Okay, so we want to draw what we can see because that will help us communicate about the sizes and shapes of what we're seeing. In addition, we may need to use some words and numbers to describe what we are seeing in our sketches.*

Prepare data tables in science notebooks. Display **slide O**. Direct students to create one data table like this on a whole page in their science notebooks (as shown on **slide O**). They should be sure to have enough room in each row to draw a circle for the field of view of what they will see. Then, have them create a second table on the next page because each group will look at a human blood sample and one of the animal samples. If your class microscopes' objectives and/or eyepiece lenses are different magnifications than those listed below, be sure to modify the total magnifications accordingly.

Blood sample from: _____	
Total magnification	**Observations**
None (just looking at the slide with eyes)	
40x (red)	
100x (yellow)	
400x (blue)	

ALTERNATE ACTIVITY

If no microscopes are available, images of human and cat blood at low, medium, and high magnifications are provided in *Microscopic Images of Blood*. Students can observe these images and record their observations in their notebooks (with magnifications noted in their data tables accordingly).

You might point out to students that the images taken with the microscope camera are rectangular, rather than the round field of view they would see through the eyepiece themselves. If you worry that your students will be overwhelmed with the task of drawing everything they see in these rectangular images, you may choose to have them draw circles of the same size (tracing a cup or lid would work well) on each image to help them concentrate on just a subset of the data to record in their drawing.

You can also access the Virtual Microscope interactive at https://www.teachersopensciedfieldtest.org/healing . From there, copy the link for viewing **blood** and share it with your students so they can access it on their own devices. By sharing this direct link, your students will only have access to the images needed for this lesson. Students can observe these images and record their observations in their notebooks (with magnifications noted in their data tables accordingly).

Alternately, you could print consumable copies of the *Microscopic Images of Blood* and direct students to annotate the images with their thoughts about patterns and scales. If you choose to have students annotate images, it will likely take less time than if students are recording observations in their notebooks.

6 · INVESTIGATE BLOOD WITH A MICROSCOPE

15 min

MATERIALS: Investigate Blood with a Microscope, science notebook

Give directions and reminders about using the microscope to view slides. Display **slide P**. Review the following procedures for using the microscope and slides, which are also available in *Procedures for Investigating Blood with a Microscope*.

1. Slides are fragile so handle them gently.
2. Hold slides by the edges.
3. Put the slide under the clips to hold it still.
4. Start at the lowest objective (40x, red).
5. Focus slowly! If you only see a blur of one color across your view, that's not what you're looking for.
6. Adjust the amount of light coming in through the slide to help you see better.
7. Draw what you see in the whole field of view in the corresponding section of your data table.
8. Be sure everyone in your group has a chance to see (and adjust the focus if needed).
9. Switch to the next highest objective and repeat the process at step 5 (and then again for the highest objective).
10. When everyone in your group has seen the human blood sample at each objective, follow your teacher's directions to observe the slide with animal blood.

Say, *Remember we are using the microscope to see if we can find out what is in blood, or what blood is made up of. A good clue that you're seeing something significant is if you're noticing repeats. For example, if you're seeing patterns that occur at different magnifications, that's likely a significant observation. If you and your partner(s) are seeing similar patterns, that's likely something to take note of. It will also be interesting to notice if you see similar patterns (or not) between the human blood and animal blood.*

Direct students to begin their observations. Circulate among groups to support students as they work.

ALTERNATE ACTIVITY

If you have a classroom microscope whose view can be projected (rather than a class set of microscopes for students to use themselves), you may carry out this lab as a whole-class demonstration. You might invite different students to focus the microscope while everyone records what they see in their data tables. It is still important for students to draw their observations so they can compare patterns across magnifications and samples.

ADDITIONAL GUIDANCE

It is possible that students will see bubbles in their slides during this lesson and throughout the unit. So, take a moment to identify bubbles if you notice they are confusing or distracting students' observations. You may also describe how a smear slide is created and Bubbles may be more common in the wet-mount slides of onion skin that students will prepare and observe in Lesson 11.

Individually consider how what we can see changes at different scales. Display **slide Q.** After students have had time to observe and record data about both of their group's blood samples, have them complete this reflection to prepare to make sense of their observations. Direct students to write their response to this question in their notebooks: *What did you notice about the structure of the blood with the microscope compared to what you could (or couldn't) see without it?*

ASSESSMENT OPPORTUNITY

Building towards: 4.A Collect data at different scales to answer scientific questions about the structures and function of blood.

What to look for: When skimming what students have written in their notebooks, look for ideas such as:

- With the microscope, I could see different parts of the blood (circles, dots, blobs, different colors).
- With the microscope, I can tell that blood is a mixture because I can see the different parts that make it up.
- Without the microscope, the slide just looks like pink glass.
- Without the microscope, blood looks like it's all the same throughout.

What to do:

- Take note of any students who are struggling to describe these differences in what they could see with the microscope versus without. Support especially those students in the Building Understandings Discussion in the next step. For instance, you might choose to have students talk with a partner before sharing their ideas, and make intentional decisions about pairing these students with others who have clearer understandings about what they observed. You might also ask these students to help scribe or draw what the class is describing during the discussion that follows. Those students should realize that blood (in humans and other animals) is composed of a mixture of things we cannot see without a microscope.

7 · SHARE OBSERVATIONS OF BLOOD

20 min

MATERIALS: science notebook, 1 sheet of blank 8.5x11 inch paper, markers

Gather the class together to share their data with a partner. Assign each student a partner to talk with who was not in their microscope group. Have students use the data they recorded in their notebooks to discuss each of the following questions with their partner.

ADDITIONAL GUIDANCE

If you have a microscope that can be plugged into a computer, it may be helpful to project that while the class reports out what they found. This way students can come up to the screen and point out what they found or are referring to in their explanations.

Display **slide R** and give student pairs about 2 minutes to compare their observations of human blood. What did they see that was the same and different? What patterns do they notice?

Display **slide S** and give student pairs about 2 minutes to compare their observations of another animal's blood. What is the same between the blood samples they observed? What's different? How does the animal blood compare to the human blood? What patterns do they notice?

Display **slide T** and give student pairs about 2 minutes to compare their observations about what they could see at different scales. How did changing objectives/magnifications change what they could see?

Discuss the colors we observed. Tell students that you're going to record the patterns they noticed in their observations to add to a "zoom in" on our classroom consensus model, and you're considering what colors (marker or digital pen) we should use to draw the structures we observed.

Ask, *What colors did you observe in the blood samples you investigated with the microscope? Accept all responses.*

Ask, *Based on the samples we looked at in the test tubes (image) or your own experiences with blood, what colors did you expect to see?* Sample student responses likely include shades of red and yellow.

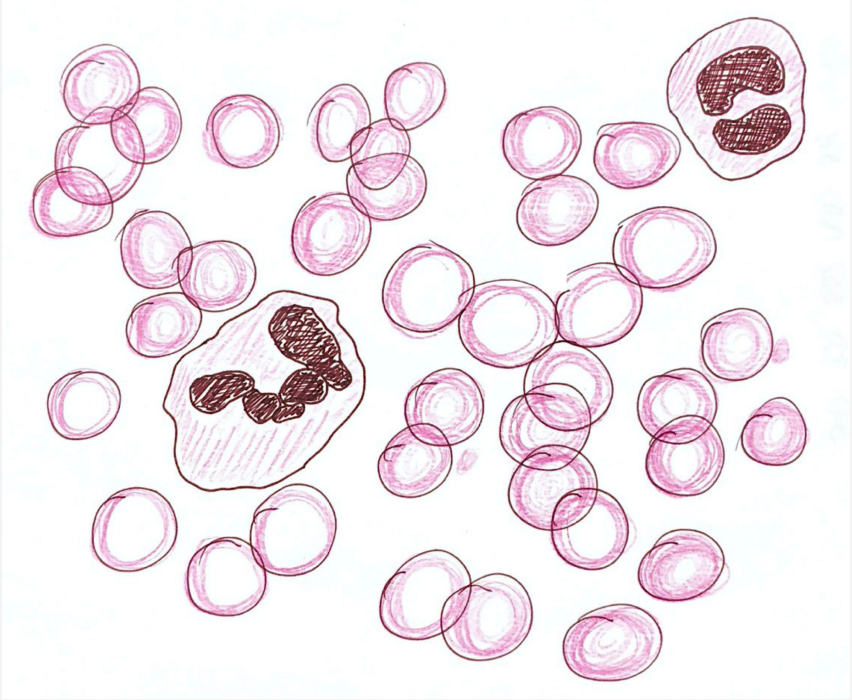
Say, *The colors we see on most slides are different than the original actual colors of those samples because they have been stained. The stain is added when the slide is being prepared so we can see the structures in the sample more clearly. Different stains are used for different types of samples to help different structures stand out. So, we can choose if we'd like to use colors that we think would best represent the actual colors or what we saw on the stained slide samples, or whatever colors we think help us record these structures most clearly.*

Share observation patterns with the whole class. Display **slide U.** Use prompts such as those shown below to invite students to share the patterns they noticed with the whole class. Record these ideas in drawings (possibly with words) on a piece of 8.5x11 inch paper that you will later be able to attach to the classroom consensus model as a "zoom in" on the blood. Note that we are not naming these structures yet; students will read about that on day 2 and you can add labels to these notes after that.

Suggested prompt	Sample student response
What patterns did you and your partner find in your observational data?	*We saw little pink circles--many look paler pink or maybe open in the center.* *We saw some bigger circles with dark purple blotches or spots in them.* *Blood from these animals looked about the same as blood from humans.* *When we zoomed in really close, we could see some solid pinkish-purple dots that were smaller than the other circles.* *We saw some whitish-gray perfectly round circles... maybe those were bubbles?*
What can we conclude about blood based on these patterns in your observations?	*It's a mixture - I saw different things in the same blood sample.* *What's on the slide is all blood, but it's made of different parts or components.*
How similar or different was the blood on the slide just looking at it with your eyes compared to when you saw it at the microscopic scale?	*We could see way more details in the blood with the microscope.* *With eyes alone, the slide just looks like it's pink glass.* *At lower objective(s), we could see that there were mostly tiny pink dots, some purple dots, and some space in between.* *At higher objective(s), we could see that the pink dots looked like rings with a darker pink edge. And the larger circles have a pink edge around them with dark purple blobs inside them.* *We couldn't see the tiny solid purple specs until we were zoomed into a really high magnification.*

Suggested prompt	Sample student response
Let's make some predictions: Why do you think the blood contains structures like this?	*Maybe the circle shape helps them fit in the blood vessel tubes.* *Maybe like all the ingredients in a salad dressing make it taste better than just one by itself, all the different parts of the blood do something for it more than just one by itself could.*

See the sample drawing shown here, based on human blood at high magnification.



Close today's work by looking forward to next time. Say something like, *Your observations at the microscopic scale answered some of our questions about what makes up blood - we saw the smaller structures that make up that mixture. But we didn't yet get to answer our questions about what those parts do for the body or answer our new questions about what these structures are. That will be our focus next time.*

End of day 2

8 · READ ABOUT BLOOD

15 min

MATERIALS: *Guidance for Reading about Blood*, *Reading: What is Blood?* or *What is Blood?* in student editions

Navigate into today's work. Display **slide V**. Ask, *What were some of the patterns we noticed when we looked at blood at a different scale than our eyes can see alone?*

Sample student responses include:

- *Human blood and blood from other animals is about the same.*
- *Blood is a mixture of tiny little circles.*
- *Most of the circles are pink (darker around the edges), but some had pale pink edges and dark purple blobs inside, and some were super tiny and solid purple.*

Say something like, *Thanks for that summary of the data we collected about blood. We saw those structures that the blood is made of, but we are still wondering what blood (and all those separate parts) do for the body...what is its function? Why is it so important that it goes everywhere? So, I have an article for you to read today.*

Plan to read closely. Display **slide W**. Say, *Remember as you read this article to keep our questions in mind: What are all those parts of the mixture doing for the body? Why is blood so important that it goes everywhere? Underline or highlight key ideas in the text that help you answer these questions about the structures of the blood and their functions. Also jot down any questions that come up during your reading. If we don't get them answered today, we can add them to our Driving Question Board.*

Distribute *Guidance for Reading about Blood* for students to complete during and after their reading.

Give students time to read independently. Distribute *Reading: What is Blood?* (printed for students so they can mark up the text), or alternately direct students to *What is Blood?* in their student edition book. Display **slide W** while students read and complete the handout for 10-12 minutes. You may choose to collect *Guidance for Reading about Blood* as an assessment.

ASSESSMENT OPPORTUNITY

Building towards: 4.B Critically read scientific text to make sense of patterns within structures we observed in the blood related to their function in the body.

What to look for: On the last question of *Guidance for Reading about Blood*, look for students to respond with any one of the following examples of how structure and function are related in the blood:

- The blood plasma is a liquid that flows easily through the blood vessels to move blood cells, nutrients, etc. around the whole body (or throughout the circulatory system).
- White blood cells and red blood cells are circular or round in shape so they can move through blood vessels without getting caught or stuck.
- Platelets have arms that help them create plugs to prevent blood from leaking out of damaged blood vessels. They do so by sticking to one another and to the sides of a damaged blood vessel.

What to do: If students struggle to answer this question on the handout, first make sure they know the terms "structure" and "function." You may want to rephrase the question to ask, "What is one way the shape of a blood cell helps it do its job?" You may also want to offer a sentence frame using a specific structure of the blood, such as "The function or job of the platelets is to _____. Their structure or shape helps them do this because _____." Refer students to the images in the reading as well. They may be more comfortable making inferences about the structure/function relationship of the blood parts based on images rather than what they read in the text. Finally, it may help students to consider, "What if the opposite were true?" For example, "What if the blood plasma was really thick and sticky? How would that make it hard to do its job?" or "What if the blood cells were square-shaped? Would they be able to do their job well?"

9 · BUILDING UNDERSTANDINGS DISCUSSION ABOUT BLOOD

15 min

MATERIALS: *Guidance for Reading about Blood*, *Reading: What is Blood?* or *What is Blood?* in student editions, science notebook, Parts of a Body poster, markers

Lead a Building Understandings Discussion about blood. Display **slide X**. Gather the class together in a Scientists Circle with their articles, handouts, and science notebooks. Use prompts such as those that follow to discuss the structures and functions of the blood. Update the Parts of a Body poster during and/or after this discussion to summarize these ideas. (A sample updated poster is shown below the discussion prompts.)

KEY IDEAS

Purpose of this discussion: Students share what they figured out from the reading about the functions of blood and its components and connect these ideas to their observational data from last time. They make sense of the patterns they saw and consider how the structures of the blood and its components support their functions.

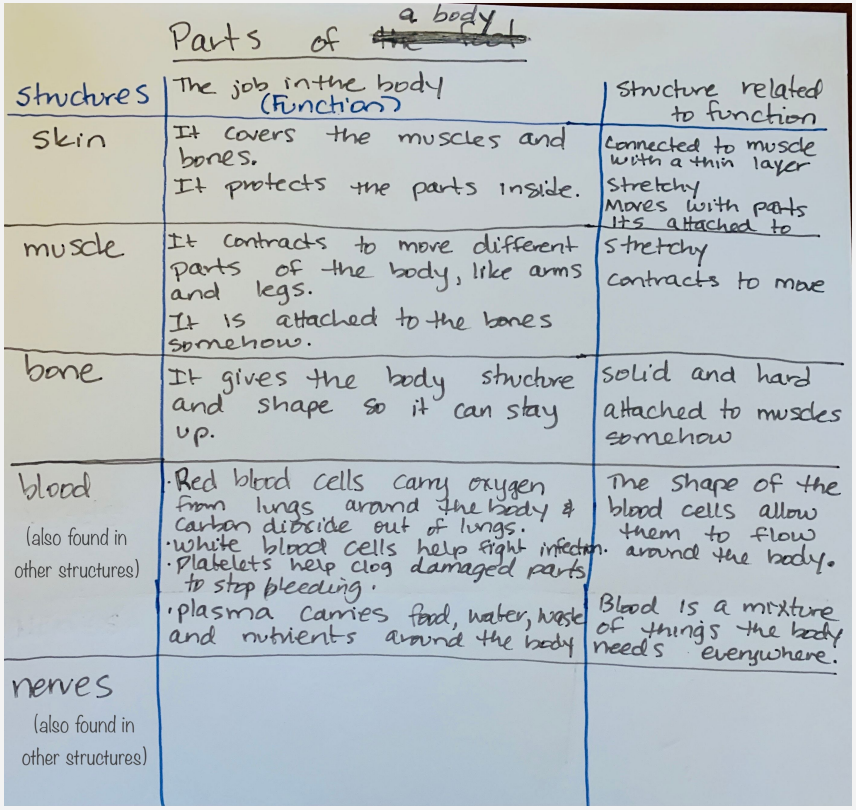
Listen for these ideas:

- Blood (in humans and other animals) is made of
    - Red blood cells - carry oxygen to the body parts
    - White blood cells - aid in responding to disease and infection
    - Platelets - clot blood so it doesn't leak out of injuries
    - Blood plasma - brings water, food particles, vitamins, and electrolytes to the body parts and carries waste away
- Blood cells' structure relates to their function: their round shape helps them travel easily through the tubular blood vessels.
- Platelets' structure relates to their function: their arms help them plug damaged parts of the blood vessels to stop leaks.
- Blood's function as a whole is to travel around carrying many different things the body needs, so its structure (flowy liquid mixture) allows it to do that.

Suggested prompt	Sample student response
When we observed blood at the microscopic scale, we noticed patterns of smaller structures that make up the mixture of the blood. What did you find out in your reading that helped you make sense of that pattern of structures we saw?	*Each of the parts of the blood - each of those structures has a different job.* *All those different circles we saw are blood cells, and there are different kinds that do different things.* *The blood is a mixture of different things because there are so many jobs it does for the body!*

Suggested prompt	Sample student response
What did you find out about the functions of each of those structures?	*The red blood cells carry oxygen from the lungs to all the body parts. They carry carbon dioxide back to the lungs.* *The white blood cells help your body fight infections.* *The platelets help clog any damaged parts so the blood doesn't keep leaking out.* *The blood plasma is the liquid that all those cells move around in--it's mostly water! But the body parts need that water, and the plasma also carries food particles, other nutrients, and waste around the body.*
Hmmmm... did we see blood plasma on our slides?	*Not really, because the particles in the blood plasma (like water and vitamins) are too small to see, even with a microscope.* *But these samples are from fresh blood that hasn't been sitting, so all the parts are still mixed together - the blood plasma is just around all the other parts we did see.*
How do the shapes of the blood cells help them function?	*They're all circular or round (even though they're different sizes). That shape probably helps them flow easily through the blood vessels, which are round tubes.* *Yeah, if they had sharp edges or were bigger, they'd be getting clogged up all the time and wouldn't be able to get everywhere.*
When we're talking about the structures in the blood, now, it seems we mean more than just the parts of the blood. When we're thinking about how the blood or its parts are structured, what else have we been talking about?	*How it's shaped.* *How it's built (in ELA we learned that "struct" means "build").*
So how does the structure of the blood itself relate to its function?	*The blood has to be able to move around the whole body in little tubes, so it makes sense that it's a liquid that can flow around.* *It's a mixture of lots of smaller things because each part does something important but different for the body.*

See example updated “Parts of a Body” poster here.

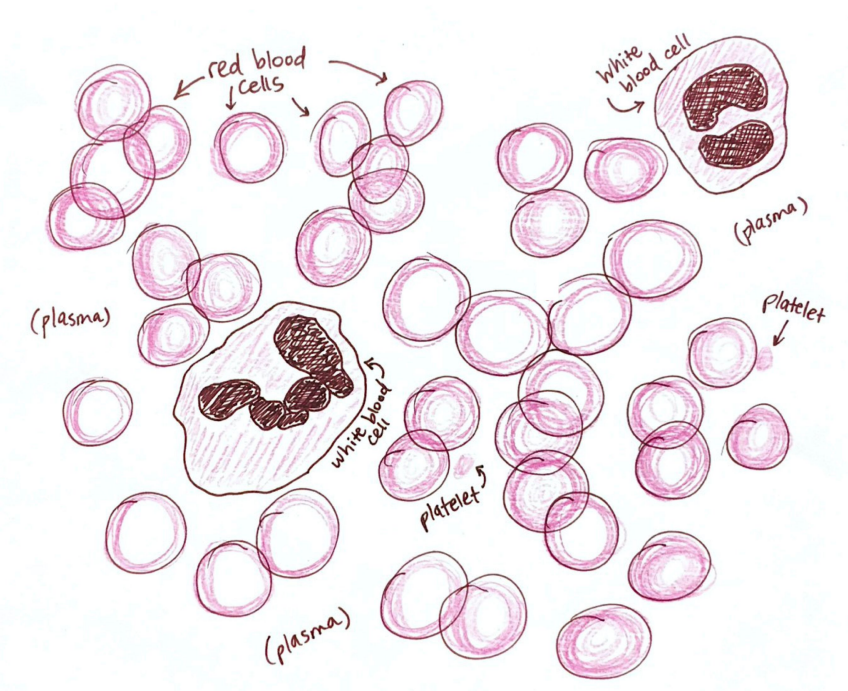


Parts of ~~the robot~~ a body

Structures	The job in the body (Function)	Structure related to function
skin	It covers the muscles and bones. It protects the parts inside.	connected to muscle with a thin layer stretchy Moves with parts it's attached to
muscle	It contracts to move different parts of the body, like arms and legs. It is attached to the bones somehow.	stretchy contracts to move
bone	It gives the body stucture and shape so it can stay up.	solid and hard attached to muscles somehow
blood (also found in other structures)	·Red blood cells carry oxygen from lungs around the body & carbon dioxide out of lungs. ·White blood cells help fight infection. ·Platelets help clog damaged parts to stop bleeding. ·plasma carries food, water, waste and nutrients around the body	The shape of the blood cells allow them to flow around the body. Blood is a mixture of things the body needs everywhere.
nerves (also found in other structures)		

Label the parts of the blood on our drawings. Display **slide Y.** After naming the parts of the blood on the slide image, take a moment to label the red and white blood cells, platelets, and plasma in the drawing you made last time (that is now attached to your classroom consensus model). Direct students to annotate one of the drawings they made of their observations in their science notebooks, as well. Be sure to include the components in the blood plasma (i.e. water, food particles, vitamins, electrolytes) even though they are too small to see.

See the labeled example shown here.



Add circulatory system to the Word Wall. Your definition might be something like, "the blood, blood vessels, and heart which move things your body needs all around it."

Circulatory System: the blood, blood vessels, and heart which move things your body needs all around it.

ADDITIONAL GUIDANCE

If students in your class have raised the idea of cells already in this unit, they may have more questions now about what cells are and where they are found since reading about white blood cells and red blood cells. Take time during this lesson to add those questions to the Driving Question Board.

At the end of Lesson 3, students were interested in investigating both blood and nerves, so if your class has questions about cells, your navigation at the end of this lesson might include asking, *Are there cells in the nerves?*

Students will observe different cells in the next two lessons and the class will have enough evidence to define cells generally at the end of Lesson 6.

SUPPORTING STUDENTS IN MAKING CONNECTIONS IN MATH

You may choose to take time to explore the mathematics of ratios of blood cells given the percentages of each type in the reading. If those percentages are true for the samples we have on our slides, and we can see X white blood cells in the field of view, how many red blood cells might we estimate are in that same field of view? If the total volume of a blood sample is 10 mL, how much of that sample would we expect to be blood plasma?

This math extension would support CCSS.MATH.CONTENT.6.RP.A.1: *Understand the concept of a ratio and use ratio language to describe a ratio relationship between two quantities* and/or CCSS.MATH.CONTENT.6.RP.A.3.C: *Find a percent of a quantity as a rate per 100 (e.g., 30% of a quantity means 30/100 times the quantity); solve problems involving finding the whole, given a part and the percent.*

10 · UPDATE PROGRESS TRACKER AND REVISIT THE DQB

15 min

MATERIALS: science notebook

Update Progress Trackers in science notebooks. Display **slide Z**. Direct students to the Progress Tracker section of their notebooks (landscape orientation) and have them add rows for what we've figured out about blood. 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. Give students 5-8 minutes to add to their Progress Trackers. See the sample student responses shown below.

Question	What we figured out in words/pictures	This makes me think or wonder about healing...

Why is there blood in all these places?	• Blood (in humans and other animals) is made of:
	  • Red blood cells (which carry oxygen to the body parts).
	  • White blood cells (fight disease and infection).
	  • Platelets (which clot blood so it doesn't leak out of injuries).
	  • Blood plasma (which brings water, food particles, vitamins, and electrolytes to the body parts and carries waste away).
	• Blood cells' structure relates to their function: their round shape helps them travel easily through the tubular blood vessels.
	• Blood's function as a whole is to travel around carrying many different things the body needs, so its structure (flowy liquid mixture) allows it to do that.
		The platelets might help make the scab on the skin - they're blocking the blood from leaking out.
		
		When everything's healthy, blood brings the body what it needs. When parts are injured, can the blood still get there?
		
		Does blood have to bring more or different things to help healing happen?

Revisit the Driving Question Board. Display **slide AA**. It's possible that your class had questions on the DQB about blood that you can now celebrate answering. (Lesson 5 includes more specific directions about how the class could document their answers.) However, it is more likely that students have additional questions to add to the DQB from their reading today or considerations about how blood and healing are related. Take time to add these questions now.

Navigate to next time. Say, *Okay, so we know why blood is in all these parts of the foot (and body), and the microscopes helped us see the structures that help blood carry out its functions. But we had also wondered about nerves - they were also in the skin, muscle, and bone. So next time, let's work on figuring out why the nerves are all over!*

Additional Lesson 4 Teacher Guidance

SUPPORTING STUDENTS IN MAKING CONNECTIONS IN ELA	**CCSS.ELA-LITERACY.RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.** The informational text students read about blood in this lesson is the first time they're introduced to cells. Determining the similarities and differences among red blood cells, white blood cells, and platelets will set a foundation for students to continue refining their definition of cells and the variety of structures they can have, all related to specific functions they carry out.