Lesson 1.3

Evaluating Initial Claims About Elisa

Overview

Students continue their efforts to diagnose Elisa. They first apply their Active Reading skills to a brief article about molecules that cells need to function and then they use the *Metabolism* Modeling Tool to represent their ideas about the molecules found in a healthy cell. Next, students receive a new set of evidence about Elisa's diet and sleep habits. Students critique this evidence, considering whether enough data was collected. Finally, students reconsider the possible claims about why Elisa is so tired. The purpose of this lesson is to give students practice with important aspects of scientific argumentation, such as critiquing evidence, while also helping them rule out several explanations for Elisa's problems. Students will next pursue the possibility that something is affecting the molecules that get to Elisa's cells.

Anchor Phenomenon: Elisa, a young patient, feels tired all the time.
Investigative Phenomenon: The human body needs oxygen and food to function.

Students learn:

- A functioning human body has molecules from food (glucose and amino acids) and molecules from air (oxygen) in its cells.
- Scientists consider how much data was collected in an investigation when they evaluate whether the investigation provides high-quality evidence.

Lesson at a Glance

ACTIVITY

1 **Warm-Up** (5 min)
Students get a chance to become familiar with the *Metabolism* Modeling Tool before using it later in the lesson.

WARM-UP

2 **Reading "Molecules Cells Need"** (15 min)
Students practice Active Reading with a brief article that reinforces the idea that cells need glucose, oxygen, and amino acids.

READING

3 **Modeling Molecules in a Healthy Cell** (5 min)
Students draw on what they learned from the Sim and the article in order to represent their ideas about which molecules are found in a healthy cell. The teacher uses this opportunity as an On-the-Fly Assessment of students' understanding of the molecules that cells need to function.

MODELING TOOL

4 **Evaluating New Evidence About Elisa** (10 min)
Students critique and evaluate evidence about Elisa's diet and sleep patterns, applying the criterion that evidence is higher quality when it consists of a larger set of data.

SORTING TOOL

5 **Evaluating Claims About Elisa** (10 min)
Students use the evidence they've received about Elisa to rule out the claims that diet or sleep may be the cause of her problems.

TEACHER-LED DISCUSSION

6 **Homework**
Students have an opportunity to think about the relative sizes of the molecules that the body takes in from the environment. This will be important when students learn about the role of the digestive system in breaking down large molecules.

HOMEWORK

7

Self-Assessment (Optional)
Students check their understanding of key content in the unit, and are given a chance to reflect on additional questions they have about metabolism.

HOMEWORK

Materials & Preparation

Materials

For the Classroom Wall

- vocabulary cards: *molecule*, *amino acid*, *oxygen*, *glucose*
- key concept: *A functioning human body has molecules from food (glucose and amino acids) and molecules from air (oxygen) in its cells.*

For the Scientific Argumentation Wall

- Evaluating Evidence Criterion

For the Class

- 1 set of Evidence Comparison Cards (2 cards/set)
- 1 set of Elisa's Evidence Cards (5 cards/set)
- masking tape*
- 1 copy of the Annotation Tracker*
- optional: 1 sheet of chart paper*

For Each Student

- optional: printed copy of the "Molecules Cells Need" article*
- optional: *Metabolism* Investigation Notebook, pages 9–18*

Digital Tools

- *Metabolism* Modeling Tool activities: 1.3 Warm-Up and 1.3 Molecules in a Cell
- *Metabolism* Sorting Tool activity: 1.3 Evaluating Evidence
- "Molecules Cells Need" article in Amplify Library
- Scale Tool

*teacher provided

VOCABULARY

- cells
- claim
- evidence
- glucose
- metabolism
- molecules
- oxygen

UNPLUGGED?

Digital Devices Required

It is highly recommended that students have access to digital devices for this lesson. If students do not have individual devices, print copies of the article and Investigation Notebook pages for this lesson and have students complete the Sorting Tool and Modeling Tool activities in pairs. (PDF files of the article and notebook pages are available in the Digital Resources.)

If students do not have access to Amplify Science at home, provide them with copies of pages 16–18 of the Investigation Notebook.

DIGITAL RESOURCES

Preparation

Before the Day of the Lesson

1. Gather the following items for the wall:
    - vocabulary cards: *molecule*, *amino acid*, *oxygen*, *glucose*
    - key concept: *A functioning human body has molecules from food (glucose and amino acids) and molecules from air (oxygen) in its cells.*

    Note: Key concepts are posted at the end of the day.
2. Locate the Evaluating Evidence Criterion Card (in your *Metabolism* Kit) for the scientific argumentation wall.
3. Locate the Evidence Comparison cards and Elisa's Evidence Cards (in your *Metabolism* Kit). You will model how to evaluate this evidence in Activity 4 of this lesson.
4. Watch a video from the Argumentation Toolkit. The Lawrence Hall of Science has developed a collection of short videos for teachers in order to support you in implementing scientific argumentation in your classroom. Watch the video: *Approach: Competing Claims*, located in the Digital Resources, for more information on scientific argumentation. You can find additional resources to support teaching argumentation at www.argumentationtoolkit.org.
5. Familiarize yourself with the *Metabolism* Modeling Tool activities: 1.3 Warm-Up and 1.3 Molecules in a Cell and the *Metabolism* Sorting Tool activity: 1.3 Evaluating Evidence.
6. Read the article called "Molecules Cells Need" in the Amplify Library. This article is also located in Digital Resources. You will briefly remind students how to actively read this article in Activity 2 of this lesson.
7. If this is your first time conducting an Active Reading lesson, prepare for it by doing the following:
    - Practice making annotations in the Amplify Library. Practicing this will prepare you to instruct students on how to navigate in the Amplify Library and how to annotate directly on the article.
    - Preview instructions and rationale for using the Annotation Tracker. You will need one copy of the Annotation Tracker for each class. Preview the instructions for using the tracker to record student annotations during Active Reading. Read the Annotation Tracker Instructions and view the Example Annotation Trackers in the Digital Resources for more information.
    - Print a copy of the Annotation Tracker for each class. A PDF file of the Annotation Tracker can be found in the Digital Resources.

Video: Approach: Competing Claims

Molecules Cells Need

Printable article: "Molecules Cells Need"

Annotation Tracker Instructions

Active Reading Guidelines

Annotation Tracker

Annotation Summary Sheet

Example Annotation Trackers and Summary Sheet

Metabolism Investigation Notebook, pages 9–18

Metabolism Glossary

Metabolism Multi-Language Glossary

- Prepare the Active Reading Guidelines Poster. If you haven't already created it for a previous unit, refer to the Active Reading Guidelines in the Digital Resources to create an Active Reading Guidelines Poster for the class on a sheet of chart paper.

8. Prepare for On-the-Fly Assessment. Included in Activity 3 of this lesson is an On-the-Fly Assessment that provides an opportunity to informally assess students' understanding of the concept that bodies can function when cells get certain molecules from outside the body (e.g., from the food humans eat and the air they breathe). Press the hummingbird icon and then select the ON-THE-FLY ASSESSMENT for details about what to look for and how you can use the information to maximize learning by all students.

Immediately Before the Lesson

1. Post the following items on the wall:
   - vocabulary cards: *molecule*, *amino acid*, *oxygen*, *glucose*

2. Post the Evaluating Evidence Criterion on the scientific argumentation wall. You can keep Evaluating Evidence Criteria from past units on the scientific argumentation wall, as well.
3. Write the Investigation Question on the board: "Which molecules do cells need to function?"
4. Write the following reading questions on the board:
   - "Where does the body get glucose molecules from?"
   - "Where does the body get amino acid molecules from?"
   - "Where does the body get oxygen molecules from?"
   - "What do you think could happen if the human body doesn't take in one or all of these molecules? Why?"

5. Write claims about Elisa on the board. Write the heading "Claims", then "Elisa is feeling tired because she:" followed by the claims you summarized based on student input in the previous lesson. Be sure to include the following claims:
   - isn't getting enough sleep.
   - is not eating enough food or not eating the right foods.
   - has a medical condition.
     You can also include any other claims you wrote in the previous lesson.

6. Have on hand the following materials:
   - digital devices
   - Evidence Comparison Cards

- Elisa's Evidence Cards
- masking tape
- Annotation Trackers
- optional: printed copy of the "Molecules Cells Need" article
- optional: *Metabolism* Investigation Notebook, pages 9–18

Between-Class Prep

1. Locate a new Annotation Tracker for the next class.
2. Erase digital annotations. Erase the digital annotations you made in the article in the Amplify Library before modeling for the next class.
3. Take down Elisa's Evidence Cards from the Evidence Gradient and place them nearby to use with your next class.

At the End of the Day

1. Post the key concept on the wall:
    - *A functioning human body has molecules from food (glucose and amino acids) and molecules from air (oxygen) in its cells.*
2. Review students' models. The models completed in Activity 3 provide an opportunity for you to gauge students' progress at this point in the unit.
3. Print a copy of the Annotation Summary Sheet for each class. A PDF file of the Annotation Summary Sheet is in the Digital Resources.
    - Use the Annotation Trackers to review students' submitted articles. If you have time to review students' submitted articles and annotations, continue to fill out each Annotation Tracker to identify questions, alternate conceptions, and exemplary annotations.
    - Use the Annotation Summary Sheets to analyze students' annotations. The Annotation Summary Sheet is intended to help you identify trends in student thinking, recurring questions students have about the text, and other issues that you might want to address. Use your Annotation Trackers to fill out the Annotation Summary Sheets.
    - Collect exemplary annotations and recurring alternate conceptions to share with the class. Exemplary annotations and recurring alternate conceptions can be shared in the subsequent lesson. Identify examples of student annotations that are thought provoking, exemplify the Active Reading approach, and/or target key science ideas.

Differentiation

Embedded Supports for Diverse Learners

Repeated exposure to content using several different learning modalities. In this lesson, students read a short article that supports their understanding of the molecules needed for cellular functioning. This offers a second chance for sense-making around this concept. In addition, students use the Modeling Tool to both reflect on and make sense of this content as well. These experiences together (Sim from previous lesson, Modeling Tool, discussion, and reading) form a supportive and rich set of experiences for students to make sense of the first important concepts in the unit.

Potential Challenges in This Lesson

Synthesis across several complex activities. Lesson 1.3 is meant to help students come to an understanding that the cells of the human body need to have certain molecules (oxygen, glucose, and amino acids) to function. This understanding will provide a base for the content learning that comes in the rest of the unit. Coming to this initial understanding is best ensured if the Sim experience, the reading experience, and the Modeling Tool experiences are all successful for your students. Different students may have trouble with each activity; students who have difficulty reading may have trouble during the reading part of the lesson, and students who have difficulty with visual representations may have trouble with the Modeling Tool part of the lesson. (For instance, these students may not understand the model as a representation of the human body, they may be unable to decode the colors or icons, or they may find the Modeling Tool overwhelming to work in, etc.) If you think that any one of these activities would be troublesome or difficult for your students, you might want to consider explicitly supporting the activity that seems most difficult for your student(s). For example, if reading is difficult for some of your students, you might ask them to read and use the Modeling Tool simultaneously (with guidance), moving back and forth between the two so that meaning can be drawn from one and applied to the other. Similarly, if the Sim or Modeling Tool is difficult for some students, you can use the reading to support the work they do in one of these tools.

Specific Differentiation Strategies for English Learners

Extended discussion of the central visual representation from the Sim and Modeling Tool. Some English learners could have trouble understanding the Sim and Modeling Tool visual representation since it may not be intuitive for all students. (They may not understand the visual representation as a representation of the human body, given its colorfulness, lack of a body shape, and the fact that it looks like a machine.) If you feel these issues may be interfering with some of your English learner (or other) students' understanding, take a few minutes to discuss the model. In addition, some English learners could benefit from a discussion that includes time to translate important words from the Sim into their primary languages. Explain that although the central visual representation in the Sim and Modeling Tool may not look much like the real insides of the human body, it actually contains the main parts (body systems and organs) in the trunk of the human body. The colorful and boxy look of the visual representation is helpful to this model because it helps the viewer to focus on the distinct parts and on what is happening in the body. Help your students to see where the other body parts would be in relation to the Sim (arms, legs, etc.) so that they can more fully visualize what the Sim represents. If it helps, you can provide students with lifelike illustrations of a human body and/or the inside of a human body and place these alongside the Sim. Help students to map back and forth between the Sim and the illustrations.

Specific Differentiation Strategies for Students Who Need More Support

Extended discussion of the visual representation from the Sim and Modeling Tool. Students may be confused by the central visual representation in the Sim and Modeling Tool, and providing some extra discussion of this visual representation can help students to understand what is being represented, what the icons mean, etc.

Specific Differentiation Strategies for Students Who Need More Challenge

Creating multiple models. Students who need more challenge can create a model of a person with different conditions, such as someone who just ate a lot of glucose or someone who is breathing hard.

Standards

Key
Practices Disciplinary Core Ideas Crosscutting Concepts

3-D Statement

Students obtain information from a digital model and an article in order to determine the molecules that cells need to function in a healthy body (scale, proportion, and quantity).

Next Generation Science Standards (NGSS)

NGSS Practices

- Practice 1: Asking Questions and Defining Problems
- Practice 2: Developing and Using Models
- Practice 7: Engaging in Argument from Evidence
- Practice 8: Obtaining, Evaluating, and Communicating Information

NGSS Disciplinary Core Ideas

- LS1.A: Structure and Function:
  - In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3)
- LS1.A: Structure and Function:
  - Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2)

- LS1.C: Organization for Matter and Energy Flow in Organisms:
  - Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7)
- PS3.D: Energy in Chemical Processes and Everyday Life:
  - Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary to MS-LS1-7)

NGSS Crosscutting Concepts

- Scale, Proportion, and Quantity
- Systems and System Models

Common Core State Standards for English Language Arts (CCSS-ELA)

- CCSS.ELA-LITERACY.RST.6-8.1: Cite specific textual evidence to support analysis of science and technical texts.
- CCSS.ELA-LITERACY.RST.6-8.7: Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
- CCSS.ELA-LITERACY.RST.6-8.9: Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic
- CCSS.ELA-LITERACY.WHST.6-8.9: Draw evidence from informational texts to support analysis, reflection, and research
- CCSS.ELA-LITERACY.CCRA.SL.1: Prepare for and participate effectively in a range of conversations and collaborations with diverse partners, building on others' ideas and expressing their own clearly and persuasively.
- CCSS.ELA-LITERACY.CCRA.SL.2: Integrate and evaluate information presented in diverse media and formats, including visually, quantitatively, and orally

Common Core State Standards for Mathematics (CCSS-Math)

CCSS-Math Practices

- CCSS.MATH.PRACTICE.MP1: Make sense of problems and persevere in solving them.
- CCSS.MATH.PRACTICE.MP2: Reason abstractly and quantitatively.

CCSS-Math Content

- CCSS.MATH.CONTENT.6.SP.5a: Summarize numerical data sets in relation to their context, by reporting the number of observations.
- CCSS.MATH.CONTENT.6.SP.5b: Summarize numerical data sets in relation to their context, by describing the nature of the attribute under investigation, including how it was measured and its units of measurement.
- CCSS.MATH.CONTENT.7.SP.1: Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.
- CCSS.MATH.CONTENT.7.SP.2: Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions.

1 WARM-UP
Warm-Up

Warm-Up

Students explore and get familiar with the *Metabolism* Modeling Tool.

5 MIN

Instructional Guide

1. Project Warm-Up; students work independently. Collapse the instructional guide and project the student screen, or have students turn to page 10 in their Investigation Notebooks. Allow a few minutes for students to individually complete the Warm-Up.

Teacher Support

Rationale

Time Management: Using Warm-Up Time for Exploration
In a later activity of this lesson, students will use the *Metabolism* Modeling Tool to make simple models showing their ideas about which molecules are found in healthy cells. Because this lesson is fairly packed, using the Warm-Up time for an initial exploration of the Modeling Tool should allow students to be more efficient when they get to that activity of the lesson.

Possible Responses

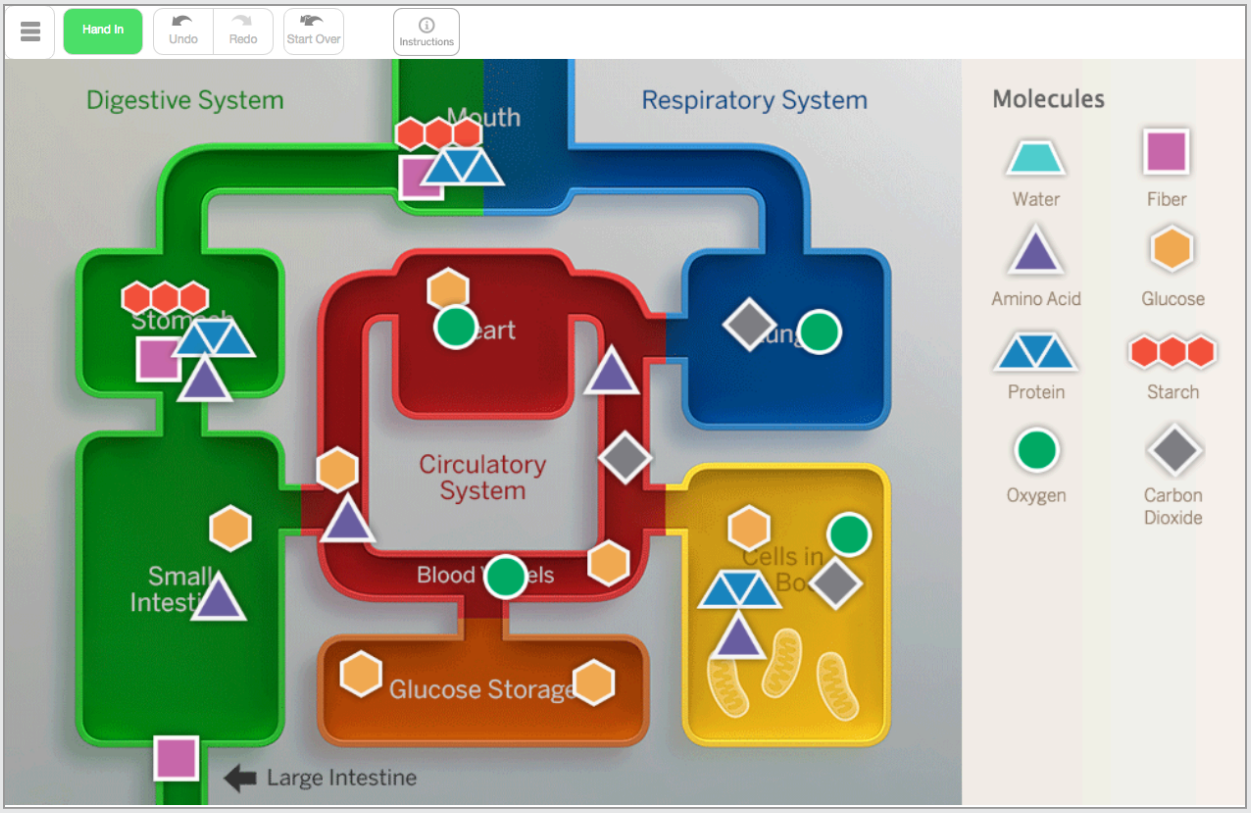
Purpose: In this exploration of the Modeling Tool, students show their ideas about the molecules that can be found in a healthy body.

An ideal response:

- Since this is an early, exploratory activity, student responses can include any configuration of any molecules in the body systems.

A perfect response would include:

- A model that shows glucose in the digestive system, circulatory system, and cells as well as glucose storage.
- A model that shows oxygen/carbon dioxide in the respiratory system, circulatory system, and cells.
- A model that shows amino acids in the digestive system, circulatory system, and cells.
- A model that shows starch/fiber in the digestive system.
- A model that shows protein in the digestive system and cells.
- A model that shows water in cells (water could also be shown in other body systems).



2 READING
Reading "Molecules Cells Need"

Reading "Molecules Cells Need"

15 MIN

Students engage in a quick version of Active Reading, reading a short article about how cells need glucose, oxygen, and amino acid molecules.

Instructional Guide

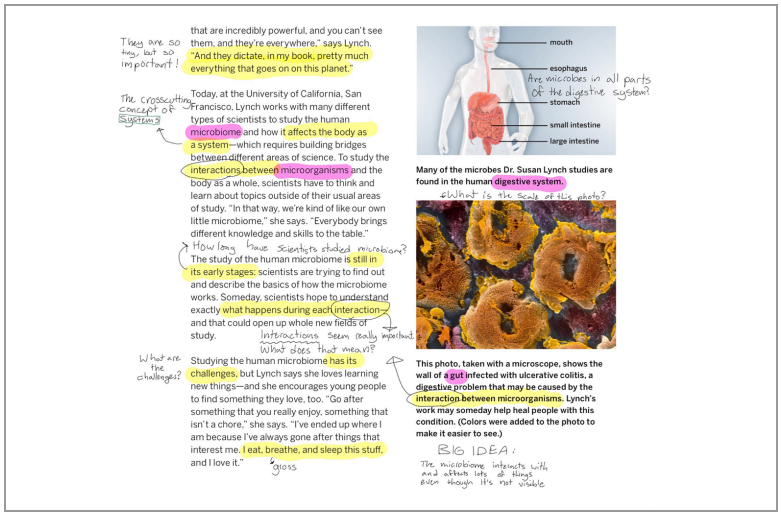
1. Introduce the new vocabulary words on the wall: *molecule, glucose, oxygen,* and *amino acid.* Remind students that they saw these terms in the *Metabolism* Sim.

A molecule is a group of atoms joined together in a particular way. Molecules can be made of two atoms or thousands of atoms. Glucose is an example of a molecule that is made of carbon, hydrogen, and oxygen atoms. Oxygen is a molecule that organisms get from the air or water around them. Amino acids are the molecules that are the building blocks of proteins. These definitions are all in the article and in the glossary.

2. Project the "Molecules Cells Need" article from the Amplify Library. You can also access this article from the Digital Resources. Connect the article to students' investigation of Elisa's problem.

We are investigating why Elisa is feeling so tired all the time. In the last lesson, we explored the *Metabolism* Sim and observed that in a healthy body, cells get certain molecules from food and air. We will learn more about these molecules by actively reading an article called "Molecules Cells Need."

3. Project Example Annotated Article, or project the printed article using a document camera and model writing an annotation. Remind students of the Active Reading process and that reading actively and thoughtfully includes annotating—writing down the questions, comments, and connections you think of as you read. Point out how this example article shows the "conversation" the student was having with the text.



They are so tiny, but so important!

that are incredibly powerful, and you can't see them, and they're everywhere," says Lynch. "And they dictate, in my book, pretty much everything that goes on on this planet."

The crosscutting concept of Systems?

Today, at the University of California, San Francisco, Lynch works with many different types of scientists to study the human microbiome and how it affects the body as a system—which requires building bridges between different areas of science. To study the interactions between microorganisms and the body as a whole, scientists have to think and learn about topics outside of their usual areas of study. "In that way, we're kind of like our own little microbiome," she says. "Everybody brings different knowledge and skills to the table."

How long have scientists studied microbiom?

The study of the human microbiome is still in its early stages: scientists are trying to find out and describe the basics of how the microbiome works. Someday, scientists hope to understand exactly what happens during each interaction and that could open up whole new fields of study.

Interactions seem really important

What does that mean?

What are the challenges?

Studying the human microbiome has its challenges, but Lynch says she loves learning new things—and she encourages young people to find something they love, too. "Go after something that you really enjoy, something that isn't a chore," she says. "I've ended up where I am because I've always gone after things that interest me. I eat, breathe, and sleep this stuff, and I love it."

gross

Are microbes in all parts of the digestive system?

Many of the microbes Dr. Susan Lynch studies are found in the human digestive system.

What is the scale of this photo?

This photo, taken with a microscope, shows the wall of a gut infected with ulcerative colitis, a digestive problem that may be caused by the interaction between microorganisms. Lynch's work may someday help heal people with this condition. (Colors were added to the photo to make it easier to see.)

BIG IDEA:
The microbiome interacts with and affects lots of things even though it's not visible

4. Briefly review the Active Reading Guidelines. Point out that these guidelines are on students' screens, or in their notebooks on page 11.

5. Students read and annotate the article. If necessary, review how to navigate to the Amplify Library and create annotations. Circulate and offer support as needed. Allow about five minutes for reading and annotating.

6. Regain students' attention and project Discussing Annotations. Remind students of the conventions to use for tagging their annotations.

Discussing Annotations

#share	Carefully choose an interesting annotation (comment, question, connection, vocabulary word) you'd like to share with your partner and add #share to this annotation.
#discussed	Add #discussed to your annotation if you feel that you and your partner have resolved a question OR if your discussion gave you a deeper understanding about something in the article.
#present	Add #present to your annotation to mark any unresolved questions or ideas you would like to present to the class.

7. Have partners tag and discuss annotations.

8. Students reread for a specific purpose. Remind students that part of Active Reading is rereading with a specific purpose. Point out the reading questions you wrote on the board before class. Ask students to consider these questions as they reread the article.

- *Where does the body get glucose molecules from?*
- *Where does the body get amino acids molecules from?*
- *Where does the body get oxygen molecules from?*
- *What do you think could happen if the human body doesn't take in one or all of these molecules? Why do you think this?*

Instruct students to reread the article, highlighting parts of the article that relate to the questions, and to be prepared to discuss.

9. Whole-class discussion of questions. Discuss the questions after students reread the article. When discussing the last question, emphasize that some medical conditions can prevent one or all of these molecules from getting to the cells.

If students are using digital devices, ask them to press NEXT to continue this activity.

10. Make sure students press HAND IN to submit their annotated articles.

Teacher Support

Instructional Suggestion

Science Reading: Reviewing Active Reading Processes
In this unit, we assume that your students have already been introduced to the Active Reading approach. If necessary, review the components of Active Reading for your students, reminding them that the goal for reading in your class is to read actively and thoughtfully. Remind students that Active Reading is similar to having a conversation with the text.

Rationale

Science Reading: Abbreviated Version of Active Reading in This Lesson
Typically, the Active Reading process is spread over more than one lesson with students returning to an article in a later lesson for the second read. Since this article is so short and time is limited, students will complete both the first and second reads in one lesson. If necessary, point out this variation from the normal approach.

Rationale

Technology Note: Submitting Annotations
Whenever students read in the Amplify Library, their annotations are saved in their copy of the article. However, students' annotations are not visible to you unless students submit their annotated articles from their student screens in Amplify Science by pressing HAND IN.

3 MODELING TOOL
Modeling Molecules in a Healthy Cell

Modeling Molecules in a Healthy Cell

5 MIN

Students use the *Metabolism* Modeling Tool to show their ideas about the molecules that can be found in a healthy cell.

Instructional Guide

1. Set the purpose for using the Modeling Tool.

Before we can diagnose Elisa, we need to understand more about what's happening in a healthy body. We've learned that for a body to function properly, its cells need certain molecules. You'll use a new tool called the *Metabolism* Modeling Tool to make a model, or diagram, to show your ideas about which molecules are found in a healthy cell.

Scientists often use models to work out their ideas and share them with others. When you use the Modeling Tool you should think carefully and show your best ideas, but you don't have to worry about sharing a wrong idea. Even scientists have ideas that they are not sure about yet. You will become more sure of your ideas throughout the unit, and you will have a chance to make new models to show your new ideas.

2. Launch and project the Modeling Tool activity: 1.3 Molecules in a Cell and demonstrate its features, if needed. Point out that the instructions for the Modeling Tool activity are also on page 12 of the notebook.

3. Students model molecules found in a functioning cell. Circulate and offer support as needed. Emphasize that this is a record of students' thinking at this time and that it doesn't have to be perfect.

4. Have students submit their models. Remind students to press HAND IN in the Modeling Tool so a screenshot of their models will upload to Amplify Science.

5. On-the-Fly Assessment: Reviewing Submitted Student Models. For suggestions on what to look for in students' models, press the hummingbird icon and select ON-THE-FLY ASSESSMENT 1.

6. Project the key concept. Let students know that they just modeled their thinking about a key concept in the *Metabolism* unit. Read the key concept aloud: *A functioning human body has molecules from food (glucose and amino acids) and molecules from air (oxygen) in its cells.*

Key Concept

A functioning human body has molecules from food (glucose and amino acids) and molecules from air (oxygen) in its cells.

Embedded Formative Assessment

On-the-Fly Assessment 1: Reviewing Submitted Student Models

Look for: The models students submit will help you gauge how well students are building their understanding of the concept that bodies can function when cells get certain molecules from outside the body (e.g., from the food humans eat and the air they breathe.) When reviewing students' Modeling Tool submissions, check that models include oxygen, glucose, and amino acids in the cells. (Note: If students also include water, carbon dioxide, and protein molecules, this is not inaccurate; however, these are molecules that form during reactions in the cell.)

Now what? If students' models do not include oxygen, glucose, and amino acids, you may wish to have students engage in a second read of "Molecules Cells Need." Provide students with the guiding question: What molecules do cells need to get from food and air? You might also model highlighting information that helps answer that question. You can have students revisit the Sim, selecting x0.5 speed and observing carefully what happens to the molecules from air and food.

Teacher Support

Instructional Suggestion

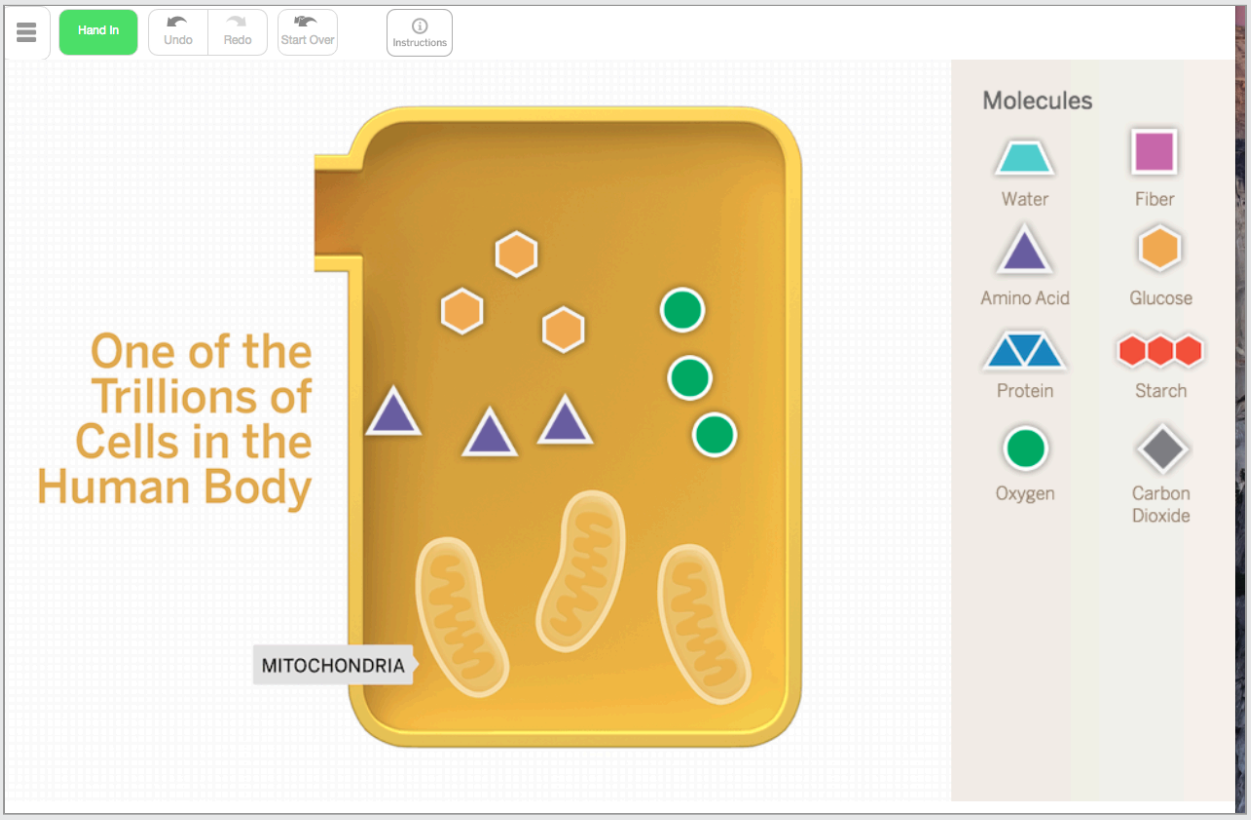
Time Management: Keeping This Activity Brief
Because students had some time during the Warm-Up to become familiar with the Modeling Tool, they should be able to quickly represent their ideas about which molecules can be found in a healthy cell. If you have more time available in your class lesson, you may want to give students a chance to share and discuss their models.

Possible Responses

Purpose: In this activity, students use the *Metabolism* Modeling Tool to show their ideas about the molecules that can be found in a healthy cell. Students' models should be consistent with the key concept introduced at the end of this activity: *A functioning human body has molecules from food (glucose and amino acids) and molecules from air (oxygen) in its cells.*

An ideal response:

- A model that includes 1 glucose, 1 oxygen, and 1 amino acid.
- A model that may include water, carbon dioxide, and protein.
- A model that does not include starch and fiber.



SORTING TOOL 4
Evaluating New Evidence About Elisa

Evaluating New Evidence About Elisa

10 MIN

Students are introduced to a new criterion for evaluating evidence and use the *Metabolism* Sorting Tool to rate pieces of evidence about Elisa's health.

Instructional Guide

1. Project the message from Dr. Walker. Have a student read it aloud to the class.

To: Medical Students
From: Dr. Walker, MD
Subject: Elisa Rodriguez

As you know, we are trying to diagnose why Elisa Rodriguez is so tired. We are running some tests on her, and we also asked her to keep journals to record her eating and sleeping patterns. We want to know if the cause of her problems may be lack of sleep or not eating the right foods.

We've just received the first set of evidence from Elisa's journals. We need you to evaluate the quality of this evidence to see if it can help us understand what is wrong with Elisa. If the evidence is not high enough quality, we may not be able to use it.

Dr. Walker has asked us to look over some evidence that Elisa gave us. He wants us to evaluate this evidence to see if it is high-quality evidence that can help with our diagnosis.

2. Introduce a new criterion for evaluating evidence. Remind students that the scientific argumentation wall features concepts about scientific argumentation that they will practice throughout the rest of this unit. Point out the Evaluating Evidence Criterion Card that you added to the scientific argumentation wall. Explain to students that over the course of the year, they will spend a lot of time considering and evaluating evidence.

Part of what scientists do when they make a scientific argument is to sift through the available evidence and sort out higher-quality evidence from lower-quality evidence. An investigation in which a lot of data has been collected usually provides higher-quality evidence than an investigation in which only a little bit of data has been collected. When you have more data, you can trust the patterns that you see.

3. Remind students about the Evidence Gradient and explain how it will be used in this activity. Refer to the Evidence Gradient on the scientific argumentation wall.

We are going to use the Evidence Gradient. Remember, this gradient helps us visually represent how we are evaluating evidence. Today, we'll use it to evaluate whether enough data has been collected to make a piece of evidence convincing.

If a piece of evidence includes enough data to be strong evidence, place it at the top, the darkest gray section. If there is not enough data to be convincing, place that evidence at the bottom in the lightest gray area.

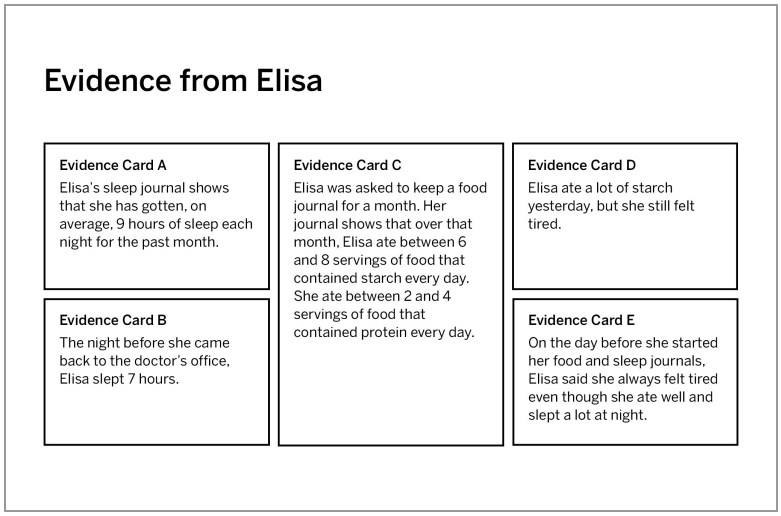
4. Collapse the instructional guide and project the student screen, or have students turn to page 13 in their Investigation Notebooks. Explain that students will first do a practice round by thinking about two pieces of evidence (that don't have to do with Elisa) and deciding which is the higher-quality piece of evidence and which is the lower-quality piece of evidence, based on how much data was collected.

5. Students consider the evidence with their partners. Give students 1–2 minutes to discuss.

6. Whole-class discussion. Using the Evidence Gradient on the scientific argumentation wall and the two Evidence Comparison Cards, hold a brief discussion in which students explain their thinking about which piece of evidence is higher or lower quality. Establish that collecting more data, in this case studying a larger number of people over many nights, provides higher-quality evidence. You can post the cards to the Evidence Gradient in the locations students are discussing.

Ask students to press NEXT (or move on to part 2 on page 14 in their Investigation Notebooks) to continue this activity.

7. Project Evidence from Elisa, and introduce the *Metabolism* Sorting Tool. Explain to students that they will now work with a partner to consider some pieces of evidence from Elisa. Have students read and follow the instructions for the *Metabolism* Sorting Tool activity: 1.3 Evaluating Evidence (on their screens or on page 14 of the notebook). Remind students that they are evaluating the evidence based on the criterion of how much data was collected. Point out that students will need to press HAND IN in the Sorting Tool to see a screenshot of their finished sorts in Amplify Science.



8. Circulate and offer support as needed. If students need support as they discuss, direct their attention to the Argumentation Sentence Starters on the scientific argumentation wall.

9. Discuss evidence as a class. Use the Evidence Gradient to have students help you evaluate and post Elisa's Evidence Cards. Emphasize the criterion that is being focused on in this unit (quality of evidence based on amount of data), but allow other considerations as well, as long as they do not detract from the discussion.

10. Summarize the results.

Elisa's journals were kept daily for a period of a month, so they provide fairly high-quality evidence compared to evidence that is based on just a single data point.

Teacher Support

Instructional Suggestion

Argumentation: Applying Other Criteria for Evaluating Evidence Quality
While students think about how to weigh or think about this evidence, other aspects of the evidence might come up, too. For example, students may point out the fact that one piece of evidence comes from a person named John, and the other comes from scientists. If students note and want to discuss the source of the evidence, allow a bit of time to do this since it is an indication that students are paying close attention and thinking critically. You can encourage students to consider the source in their evaluation of the evidence, but remind them that for this exercise, they are paying particular attention to the amount of data that has been collected.

Instructional Suggestion

Argumentation: Supporting Evidence Gradient Use
This lesson assumes that your students have been introduced to the Evidence Gradient previously. If this is not the case, you will need to offer a brief introduction to what the gradient represents and how students will use it to promote thinking and discussion for this activity. Explain that the Evidence Gradient is a way of visually rating or ranking things. For this class, placing something at the top of the gradient usually means that you think it is better or higher quality compared to something else you are thinking about.

Rationale

Pedagogical Goals: Understanding the Nature of Science
One goal set forth by the Next Generation Science Standards (NGSS) is for students to understand the nature of science as a discipline and how scientific knowledge develops over time. The NGSS calls out eight understandings about the nature of science which are woven throughout the Amplify Science curriculum. This unit gives students an opportunity to experience the understanding that Scientific Knowledge is Based on Empirical Evidence. Specifically, students' evaluation of evidence throughout the unit illustrates the idea that science disciplines share common rules of obtaining and evaluating empirical evidence.

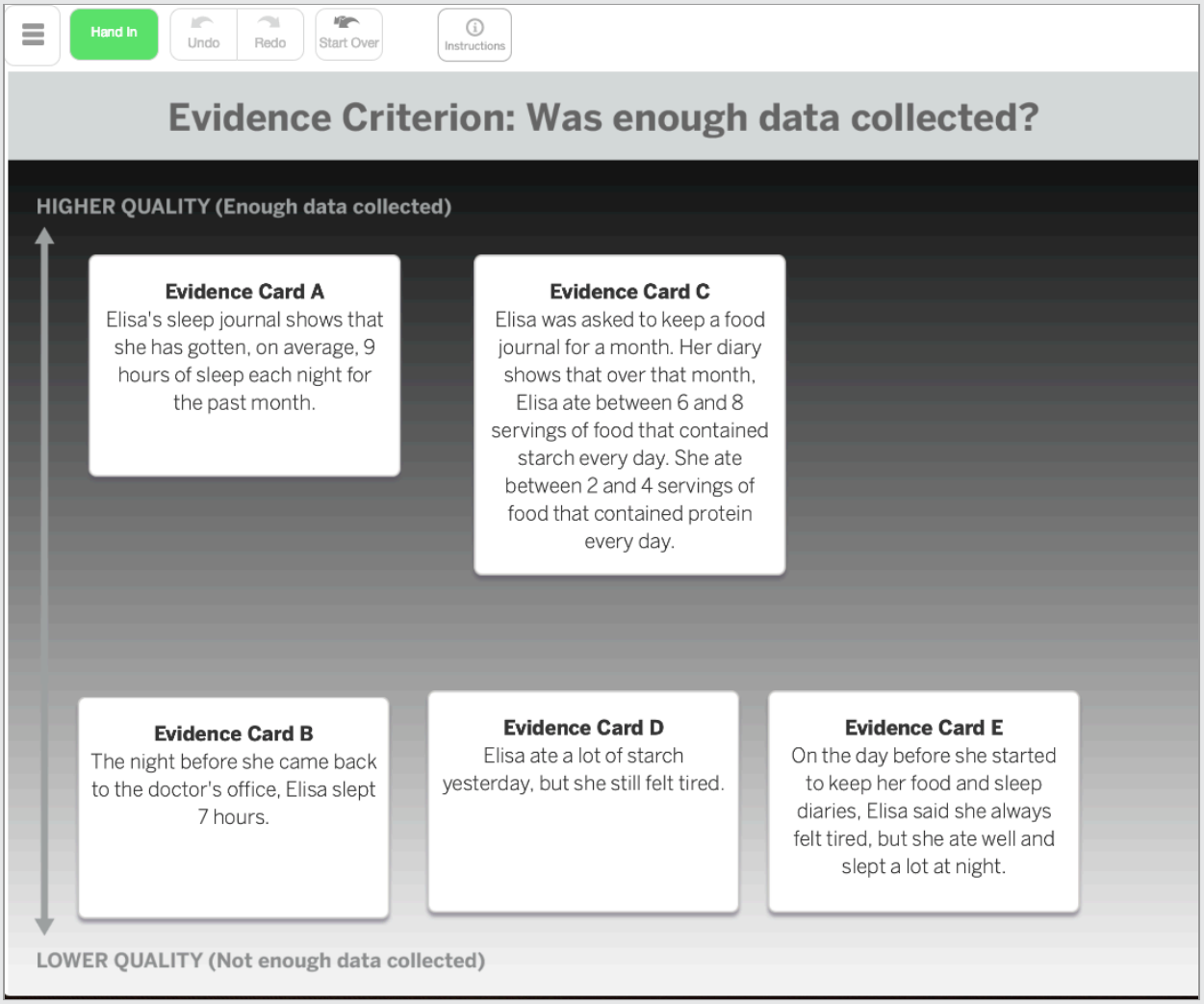
Background

Argumentation: Evaluating the Credibility, Accuracy, and Possible Bias of Evidence Sources
In Amplify Science, students engage with different criteria that help them evaluate the quality of evidence. Some examples of criteria that are specifically emphasized in different units include more careful and precise observations provide stronger evidence, and evidence is higher quality if it comes from a reliable source. Evaluating evidence provides students with the opportunity to assess the credibility, accuracy, and possible bias of evidence that may arise from a variety of factors, such as the source of the evidence and methods used to acquire evidence. In the *Metabolism* unit, students use the following criterion to evaluate evidence: Evidence is higher quality when it is based on more data because there can be more confidence in the patterns seen in the data.

Instructional Suggestion

Going Further: Discussing What Would Make This Evidence Stronger
Students may have ideas about what could make this evidence even stronger—for example, if Elisa had kept a journal for longer than a month, or if an outside observer had recorded the data instead of having Elisa self-report. If you have time, encourage students to bring up other critiques of this evidence.

Possible Responses



1 2 3 4 **5** TEACHER-LED DISCUSSION **Evaluating Claims About Elisa** 6 7

Evaluating Claims About Elisa

10 MIN

Students compare Elisa's data to results from healthy teenagers and conclude that Elisa's diet and sleep patterns are normal.

Instructional Guide

1. Connect the evidence students examined to the claims about Elisa's problems. Explain to students that they will now be using what they have learned about healthy bodies and the evidence they just examined related to Elisa's food and sleep journals to reconsider the claims about why Elisa always feels tired.

2. Explain that doctors often "compare to normal" when they make diagnoses.

Doctors often can't tell if something is wrong with someone unless they know what is normal or average for the human body. To do this, doctors compare the patient to a population or group of people similar to the patient.

3. Review claims. Read aloud the claims on the board. Remind students that these are the claims they are working with to decide what could be wrong with Elisa.

4. Project Healthy Sleep Comparison. Read aloud the information in the table and discuss with students how this can help to eliminate the sleep claim. [If Elisa is getting the same amount of sleep as many other people her age, then lack of sleep probably does not explain her tiredness.]

Healthy Sleep Comparison

Average Teenage Sleep Patterns	Elisa's Sleep Pattern
Many scientific studies of teenagers show that most healthy teenagers get between 8 and 10 hours of sleep each night.	Elisa's sleep journal shows that she is getting about 9 hours of sleep every night.

If students are using digital devices, ask them to press NEXT to continue this activity.

5. Project Healthy Eating Comparison. Read aloud the information in the table and discuss with students whether or not this information can help to eliminate the food claim. [Yes it can. If Elisa is eating the same amounts of food and is eating both starches and proteins like many other people her age, then her eating habits probably do not explain her tiredness.]

Healthy Eating Comparison

Average Teenage Eating Habits	Elisa's Eating Habits
A scientific study done on 1,000 healthy 14-year-olds found that they ate between 5 and 8 servings of starch per day and between 1 and 4 servings of protein per day.	Elisa's food journal shows that she ate between 6 and 8 servings of food that contained starch every day. She ate between 2 and 4 servings of food that contained protein every day.

6. Wrap up the activity.

Since it looks like lack of sleep and poor eating habits do not explain Elisa's tiredness, it seems that we will need to focus more on this third claim moving forward. We need to consider whether or not Elisa has a medical condition that could be preventing one or all of the necessary molecules from getting to her cells. This might explain why she feels so tired. We will continue to investigate this claim in the next few lessons.

7. Point out the homework assignment to students (Activity 6 or page 16 in the Investigation Notebook). If students do not have access to Amplify Science at home, provide them with copies of page 16 of the Investigation Notebook. Remind students that they can press on the items in the Scale Tool for more information.

8. Optional: Point out the Self-Assessment (Activity 7 or pages 17–18 in the Investigation Notebook). If students do not have access to Amplify Science at home, provide them with copies of pages 17–18 of the Investigation Notebook. Explain to students that in order to reflect on their own learning, they will revisit these questions at the end of every chapter. Some of the questions are based on learning that will come later in the unit, so it's fine if students select NOT YET for some of their responses.

Teacher Support

Rationale

Pedagogical Goals: Allowing Students to Eliminate Claims
This activity provides students with evidence that allows them to rule out the claims that Elisa's problems are caused by lack of sleep or poor diet. Students will then focus on the remaining claim—that Elisa has some type of medical condition—and further explore that claim.

Instructional Suggestion

Argumentation: What to Do If Students Aren't Convinced
It is possible that some students may still believe that poor diet or lack of sleep are plausible claims. However, students will receive a note in a following lesson that will provide further evidence that Elisa's problems are not due to either of those causes.

6 HOMEWORK
Homework

Homework

Students sort a list of molecules found in the body into size order. Students get more evidence by exploring the Scale Tool.

Instructional Guide

1. If needed, make additional time to explain homework. If students do not have access to Amplify Science at home, provide them with copies of page 16 of the Investigation Notebook.

Teacher Support

Background

Science Note: Relative Size of Molecules and Cells
For your own information, the molecules listed in correct size order from smallest to largest are: water, oxygen, carbon dioxide, glucose, amino acid, protein, and starch. (Note that oxygen molecules are only slightly larger than water molecules.) It is not important for students to know the exact size of these molecules. The important distinction, which students will learn more about in coming lessons, is the distinction between very large molecules (starch and protein) and smaller molecules (water, oxygen, glucose, and amino acid). The digestive system breaks down large molecules into smaller molecules that are then able to travel through the bloodstream and enter the cells. If your students experienced the *Microbiome* unit, they should remember that cells, though tiny, are much, much larger than molecules.

Possible Responses

1. Place the molecules in the list in order with smallest molecules at the top and largest molecules at the bottom. It is okay if you aren't sure.

- water molecule

- oxygen molecule
- carbon dioxide molecule
- glucose molecule
- amino acid moelcule
- protein molecule
- starch molecule

Students are not expected to know the right answer. (Note that oxygen molecules are only slightly larger than water molecules.)

Do you think these molecules are larger or smaller than a cell in the human body? Explain your answer.

I think some of the molecules (oxygen, amino acids, and glucose) must be smaller than the cell because they go inside the cell. The other molecules might not enter the cell because they are bigger than the cell.

Explore the Scale Tool if you want to learn more about these different-sized molecules that can be found in the human body.

7 HOMEWORK
Self-Assessment (Optional)

Self-Assessment (Optional)

This optional homework provides a chance for students to reflect on their learning so far.

Instructional Guide

1. If needed, make additional time to explain this optional homework assignment. If students do not have access to Amplify Science at home, provide them with copies of pages 17–18 of the Investigation Notebook.

Teacher Support

Assessment

Student Self-Assessment: Reflecting on the Unit's Central Problem
Scientists investigate in order to figure things out. Am I getting closer to figuring out why my patient, Elisa, could be feeling so tired? This is the first of four student self-assessments that invite students to reflect on their progress in solving the overall problem of the unit—diagnosing Elisa's metabolic condition. This quick yet important activity appears at the end of each of the four chapters of this unit and asks students to reflect on what they understand or don't yet understand about the core concepts from the unit. Looking at students' responses can give you a sense of what students believe about what they know. Looking at students' questions about what they are still wondering can also provide insight into their thinking and help you provide motivation for the investigations that follow.

Rationale

Pedagogical Goals: Student Self-Assessment
Having students assess their own learning progress can help them develop habits of self-reflection as well as remind them of the purpose of learning about metabolism. Assign the self-assessment as homework or provide time for students to complete it during class. Encourage students to be open and honest when they respond. Emphasize that the goal of this type of reflection is for students to gauge their own learning in order to better understand what they need to focus on in the remainder of the unit. Also, let them know that they aren't expected to understand everything at the beginning of the unit—each chapter will help them understand a little more about the scientific concepts. Engaging in self-assessment may increase students' motivation and focus throughout the unit.

Possible Responses

Answers will vary. This is a self-reflection.