AmplifyScience

Metabolism:

Making the Diagnosis

Investigation Notebook

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Developed by the Learning Design Group at the University of California, Berkeley's Lawrence Hall of Science.

THE LAWRENCE HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

Amplify.

Amplify.
55 Washington Street, Suite 800
Brooklyn, NY 11201
1-800-823-1969
www.amplify.com

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Table of Contents

Table of Contents (continued)

Chapter 3: Cellular Respiration

Table of Contents (continued)

Chapter 4: Metabolism and Athletic Performance

Safety Guidelines for Science Investigations

1. **Follow instructions.** Listen carefully to your teacher's instructions. Ask questions if you don't know what to do.
2. **Don't taste things.** No tasting anything or putting it near your mouth unless your teacher says it is safe to do so.
3. **Smell substances like a chemist.** When you smell a substance, don't put your nose near it. Instead, gently move the air from above the substance to your nose. This is how chemists smell substances.
4. **Protect your eyes.** Wear safety goggles if something wet could splash into your eyes, if powder or dust might get in your eyes, or if something sharp could fly into your eyes.
5. **Protect your hands.** Wear gloves if you are working with materials or chemicals that could irritate your skin.
6. **Keep your hands away from your face.** Do not touch your face, mouth, ears, eyes, or nose while working with chemicals, plants, or animals.
7. **Tell your teacher if you have allergies.** This will keep you safe and comfortable during science class.
8. **Be calm and careful.** Move carefully and slowly around the classroom. Save your outdoor behavior for recess.
9. **Report all spills, accidents, and injuries to your teacher.** Tell your teacher if something spills, if there is an accident, or if someone gets injured.
10. **Avoid anything that could cause a burn.** Allow your teacher to work with hot water or hot equipment.
11. **Wash your hands after class.** Make sure to wash your hands thoroughly with soap and water after handling plants, animals, or science materials.

Name: _____ Date: _____

Metabolism: Making the Diagnosis
Unit Overview

Welcome, medical students! You will be put to work right away to figure out what the trillions of cells in the body need in order to keep a human body healthy and able to function. Right from the start, you will be assigned a patient, Elisa, who is not feeling well; it will be your job, after you learn more about how the body works, to diagnose what is wrong with your patient. Along the way, we will use the *Metabolism* Simulation to help you get to know what all the cells and systems of your body need to function and how the body works. Finally, we will also ask you to understand how a professional athlete's body works so well that he or she can do things that most people cannot do.

Name: _____ Date: _____

Chapter 1: Molecules Needed by the Cells
Chapter Overview

Welcome to medical school! Soon you'll meet your first patient, Elisa. In order to help diagnose her condition, you are going to become an expert on metabolism—all the things that occur inside our bodies to keep them functioning. Along with your fellow medical students, you will be learning about the human body just as medical professionals do: through investigating, reading, writing, and discussing. With your new knowledge, you will be ready to explain what is going wrong inside Elisa's body that is causing her to feel tired all the time.

Name: _____ Date: _____

Lesson 1.2: Welcome to Medical School

Welcome to your first day of medical training! Today, you'll meet a patient, Elisa, and discuss what might be causing her symptoms. To get started working toward a diagnosis, you'll use the *Metabolism* Simulation to explore what happens inside a human body.

Unit Question

- How do the trillions of cells in the human body get what they need to function, and what do the cells do with the things they absorb?

Chapter 1 Question

- Why does Elisa feel tired all the time?

Vocabulary

- cells
- claim
- metabolism

Digital Tools

- *Metabolism* Simulation (Healthy Body)

Name: _____ Date: _____

Warm-Up

Why do you think your new patient, Elisa, is feeling tired all the time? Explain your ideas.

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Introducing the *Metabolism* Simulation

Part 1

1. Launch the *Metabolism* Simulation.
2. Select HEALTHY BODY from the menu.
3. Select OBSERVE.
4. Explore with your partner.
5. Think about these questions:
    - How does the Simulation work?
    - What do you notice?

Part 2

Keep observing the *Metabolism* Simulation, but now focus on this question:

- What happens to the food and air that enter this healthy Simulation body?

Part 3

Consider the following question as you observe:

- Which molecules are entering the cell?

Name: _____ Date: _____

Homework: Testing Diets in the Sim

In this homework, you will experiment with different diets in the Simulation to see how the diet affects the number of molecules getting to the cells.

1. Launch the *Metabolism* Simulation.
2. Select HEALTHY BODY and then select TEST.
3. Plan at least three different tests of the diet for the healthy body. Record your plans in the Diet Plan tables below.
4. Run your tests and record your results: the number of molecules absorbed by the cells.

How to Use Test Mode:

- Set up a pre-planned diet by pressing on items under Add Food Source. Then, press play and observe the Simulation. The diet you selected is fed to the body automatically, and the test runs until the timer reaches 200. During the test, you can observe the Sim in the Live View or switch to the Graph View. In the Graph View, you can see the final results for Total Molecules Absorbed by Cells, which is the data you will record below.
- **Note:** With some diets, your Simulation body will run out of energy before you reach 200 seconds. You'll need to reset and try a new diet.

Healthy Body Diet Tests

Diet Plan #1

Food	Number of servings
corn	
fish	
sandwich	

Results of Diet Plan #1

Molecule	Number of molecules absorbed by cells
glucose	
amino acids	
oxygen	

Diet Plan #2

Food	Number of servings
corn	
fish	
sandwich	

Results of Diet Plan #2

Molecule	Number of molecules absorbed by cells
glucose	
amino acids	
oxygen	

Diet Plan #3

Food	Number of servings
corn	
fish	
sandwich	

Results of Diet Plan #3

Molecule	Number of molecules absorbed by cells
glucose	
amino acids	
oxygen	

Name: _____ Date: _____

Lesson 1.3: Evaluating Initial Claims About Elisa

What's going on with Elisa? Could it be something happening in her cells? Today, you will learn more about the molecules that cells need to function in a healthy body. Cells are everywhere in your body and make up most of your living tissue—for example, your heart, lungs, skin, and muscles are all made of different types of cells. When your cells don't get the molecules they need, you can feel sick and tired, as Elisa does. Today, you will also get new evidence about Elisa—the results from food and sleep journals she kept. You'll evaluate this evidence and decide whether it supports any of our possible claims.

Unit Question

- How do the trillions of cells in the human body get what they need to function, and what do the cells do with the things they absorb?

Chapter 1 Question

- Why does Elisa feel tired all the time?

Key Concept

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

Vocabulary

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

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
- Scale Tool

Name: _____ Date: _____

Warm-Up

Launch the *Metabolism* Modeling Tool activity: 1.3 Warm-Up.

- The *Metabolism* Modeling Tool is a tool you will use often to show your thinking about how the human body works.
- Spend the next few minutes trying out different things in the Modeling Tool to get familiar with how it works.
- Try moving the molecules around the body to show your ideas about what happens inside a human body.
- When your model is complete, press HAND IN. If you worked with a partner, write his or her name here: _____

Goal: Explore the Modeling Tool.

Do:

- Try moving the molecules around the body to show your ideas about what happens inside a human body.

Name: _____ Date: _____

Reading "Molecules Cells Need"

1. Read the article "Molecules Cells Need." Add annotations as you read.
2. Choose and mark annotations to discuss with your partner. Once you have discussed these annotations, mark them as discussed.
3. Read the article a second time, focusing on the questions your teacher wrote on the board.
4. Answer the reflection question below.

Rate how successful you were at using Active Reading skills by responding to the following statement:

As I read, I paid attention to my own understanding and recorded my thoughts and questions.

- ☐ Never
- ☐ Almost never
- ☐ Sometimes
- ☐ Frequently/often
- ☐ All the time

Active Reading Guidelines

1. Think carefully about what you read. Pay attention to your own understanding.
2. As you read, annotate the text to make a record of your thinking. Highlight challenging words and add notes to record questions and make connections to your own experience.
3. Examine all visual representations carefully. Consider how they go together with the text.
4. After you read, discuss what you have read with others to help you better understand the text.

Name: _____ Date: _____

Modeling Molecules in a Healthy Cell

1. Launch the *Metabolism* Modeling Tool activity: 1.3 Molecules in a Cell.
2. Use the information from the article you have just read to model the molecules you think should be in the functioning cells of a healthy body.
3. When your model is complete, press HAND IN. If you worked with a partner, write his or her name here: _____

Goal: Show which molecules should be in the functioning cells of a healthy body.

Do:

- Add molecules to the cell.

Name: _____ Date: _____

Evaluating New Evidence About Elisa

Part 1

Work with your partner to decide which card offers higher quality evidence, based on how much evidence was collected.

- Be prepared to explain your evaluation.

Evidence Card A

John observed his 14-year-old brother's sleep for one night. His brother slept for 10 hours. Based on this, John concluded that all 14-year-olds need 10 hours of sleep a night.

Evidence Card B

Scientists observed the sleep of 2,000 healthy 14-year-olds every night for a month. The average number of hours the 14-year-olds slept was 9.4 hours. Based on this, the scientists concluded that 14-year-olds need about 9 hours of sleep a night.

Name: _____ Date: _____

Evaluating New Evidence About Elisa (continued)

Part 2

Launch the *Metabolism* Sorting Tool activity: 1.3 Evaluating Evidence.

1. With your partner, examine the evidence cards and consider where these cards would be placed on the Evidence Gradient.
2. Discuss if there are any low-quality pieces of evidence that should be eliminated.
3. Decide whether this evidence supports or contradicts any of the possible claims about Elisa.
4. When you have finished sorting the evidence, press HAND IN. If you worked with a partner, write his or her name here: _____

Claims

Elisa is feeling tired:

- because she isn't getting enough sleep.
- because she is not eating enough food or not eating the right foods.
- because she has a medical condition.

Name: _____ Date: _____

Evaluating Claims About Elisa

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.

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.

Name: _____ Date: _____

Homework: Exploring the Relative Scale of Molecules

Molecules, even though they are very tiny, can be different sizes. Below is a list of some of the molecules that are in the *Metabolism* Simulation.

glucose molecule

starch molecule

protein molecule

carbon dioxide molecule

water molecule

amino acid molecule

oxygen molecule

1. In the space below, list the molecules in order from smallest to largest. It is okay if you aren't sure.

Smallest

_____

_____

_____

_____

_____

_____

_____

Largest

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

_____

_____

_____

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

Name: _____ Date: _____

Homework: Check Your Understanding

This is a chance for you to reflect on your learning so far. This is not a test. Be open and truthful when you respond to the questions below.

Scientists investigate in order to figure things out. Are you getting closer to figuring out why your patient, Elisa, could be feeling so tired?

1. I understand what molecules Elisa's cells need and where they come from.

   ☐ yes
   ☐ not yet

Explain your answer choice above.

_____

_____

2. I understand how those molecules get to the cells in Elisa's body.

   ☐ yes
   ☐ not yet

Explain your answer choice above.

_____

_____

3. I understand how the cells use those molecules to release energy for Elisa's body to function.

   ☐ yes
   ☐ not yet

Explain your answer choice above.

_____

_____

Name: _____ Date: _____

Homework: Check Your Understanding (continued)

4. What do you still wonder about Elisa's condition or how her body gets what it needs to function?

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Chapter 2: Body Systems
Chapter Overview

In Chapter 1, you learned about the molecules that need to get to Elisa's cells. But how do the molecules get to the cells? In Chapter 2 you'll investigate how different systems of the body work together to get the cells what they need. You will also investigate what happens when body systems fail.

Name: _____ Date: _____

Lesson 2.1: Exploring the Classroom Body Systems Model

Today, you'll be playing a role in a classroom-sized model of the human body. You'll get to be one of the body systems that takes in molecules from food and air and delivers them to cells, or you might get to be a cell that needs molecules. Either way, this experience will help you learn more about how a healthy body works so that you can figure out what might be going wrong with the systems in Elisa's body.

Unit Question

- How do the trillions of cells in the human body get what they need to function, and what do the cells do with the things they absorb?

Chapter 2 Question

- What is happening in Elisa's body that could be preventing molecules from getting to her cells?

Vocabulary

- amino acids
- circulatory system
- digestive system
- glucose
- oxygen
- respiratory system

Digital Tools

- *Metabolism* Simulation (Healthy Body)

Name: _____ Date: _____

Warm-Up

1. Launch the *Metabolism* Simulation.
2. Select HEALTHY BODY.
3. Select OBSERVE.
4. Focus on *just* oxygen by selecting the other molecules at the bottom of the screen to hide them.
5. Observe how oxygen moves through different parts of the body. Then, answer the question below.

What do you notice about the path oxygen molecules take inside the *Metabolism* Simulation of a healthy body? Describe in detail.

_____

_____

_____

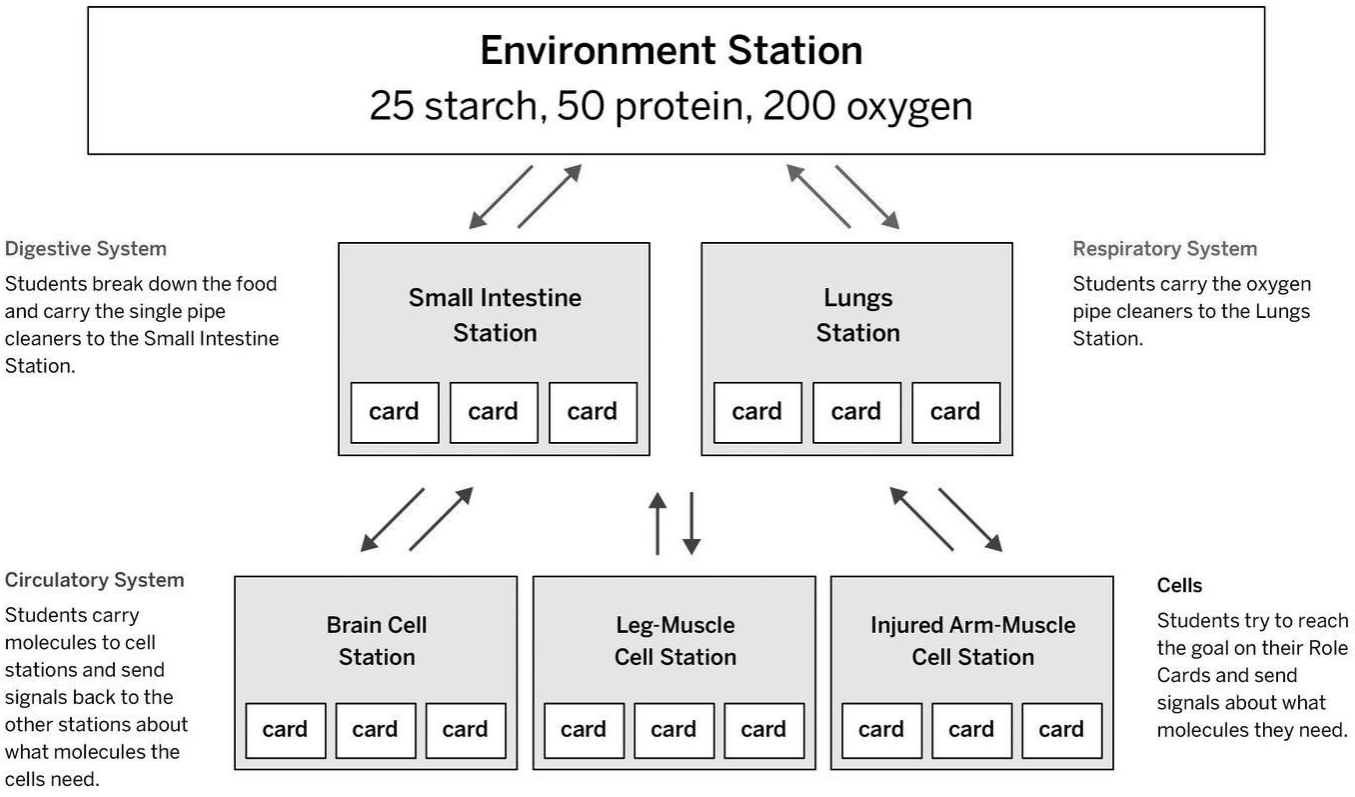
_____

Name: _____ Date: _____

Classroom Body Systems Model

Part 1: Running the Model

Classroom Map for Model Setup



Part 2: Discussing the Model

Discuss your answers to the questions below with your group. Make sure each person in your group has a turn to share.

- What did you do in your role in the Classroom Body Systems Model?
- What did you learn about this body system or the cells in the body from participating in this model?

Name: _____ Date: _____

Homework: Making Observations in the Sim

Make observations about how the different body systems work in the *Metabolism* Sim. Record your observations and answer the questions below.

1. Launch the *Metabolism* Simulation, select HEALTHY BODY, and select OBSERVE.
2. Feed the body sandwiches (which provide a mix of molecule types).
3. Focus on what happens to starch in the digestive system. Turn off all the molecules except for starch and glucose. What do you observe?

_____

_____

4. Now repeat your observation, but this time turn off all the molecules except for protein and amino acids. What do you observe?

_____

_____

5. Finally, turn off all the molecules except for oxygen. What do you observe?

_____

_____

6. Which molecules from food and air end up in the cells in the body? (circle all that apply)

starch amino acids oxygen glucose fiber protein

7. Match each body system to what it does by drawing a line between the system (in the left column) and what it does (in the right column).

circulatory system	breaks down large molecules into smaller molecules
digestive system	takes in oxygen molecules from the environment
respiratory system	delivers molecules to cells in the body

Name: _____ Date: _____

Homework: Making Observations in the Sim (continued)

8. What questions do you still have about how molecules from food and air get to the cells in the body?

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Lesson 2.2: Patient Stories: Problems with Body Systems

Elisa's medical team thinks there are a few different medical conditions that might explain her symptoms. You will be working in a four-person group to learn as much as you can about each condition so that in a few days you can help make a diagnosis. Today, you'll begin to become an expert on one of four conditions—either anemia, asthma, diabetes, or pancreas injury—by reading an article. Each of these conditions can make it difficult for the body's systems to provide molecules the cells need.

Unit Question

- How do the trillions of cells in the human body get what they need to function, and what do the cells do with the things they absorb?

Chapter 2 Question

- What is happening in Elisa's body that could be preventing molecules from getting to her cells?

Key Concepts

- Cells can only use molecules that are small enough to enter a cell.
- The respiratory system brings in oxygen molecules from the air. These oxygen molecules are already small enough to fit into cells.
- The digestive system brings in food and breaks it down into smaller molecules, such as glucose and amino acids, that can fit into cells.
- The circulatory system transports glucose, oxygen, and amino acid molecules to every cell in the body.

Vocabulary

- glucose
- metabolism
- oxygen
- system

Digital Tools

- *Metabolism* Modeling Tool activity: 2.2 Warm-Up
- *Metabolism* Simulation (Anemia, Asthma, Diabetes, and Pancreas Injury)

Name: _____ Date: _____

Warm-Up

1. Launch the *Metabolism* Modeling Tool activity: 2.2 Warm-Up.
2. When your model is complete, press HAND IN. If you worked with a partner, write his or her name here: _____

Goal: Model your ideas about how molecules from food and air get to the cells in the body.

Do:

- Add molecules along the path they take in the body until they reach the cell. Use only as many molecules as you need to show the path.
- A number 1 has been added to the starch molecule to show where this molecule starts its path through the body. Add a number 2 where you think the molecule goes next. Continue to add numbers until the molecules reach the cell.
- If a molecule breaks down into smaller molecules, use an arrow to represent this process.
- If you have time, show the path molecules from air take through the body to reach the cell.

Tips:

- A starch molecule has been placed in the mouth because starch is in food.

Name: _____ Date: _____

Reading *Patient Stories*

1. Choose an article from the article set *Patient Stories: Problems with Body Systems*. Read and annotate the article.
2. Choose and mark annotations to discuss with your partner. Once you have discussed these annotations, mark them as discussed.
3. Now, choose and mark a question or connection, either one you already discussed or a different one you still want to discuss with the class.
4. Answer the reflection question below.

Rate how successful you were at using Active Reading skills by responding to the following statement:

As I read, I paid attention to my own understanding and recorded my thoughts and questions.

- ☐ Never
- ☐ Almost never
- ☐ Sometimes
- ☐ Frequently/often
- ☐ All the time

Active Reading Guidelines

1. Think carefully about what you read. Pay attention to your own understanding.
2. As you read, annotate the text to make a record of your thinking. Highlight challenging words and add notes to record questions and make connections to your own experience.
3. Examine all visual representations carefully. Consider how they go together with the text.
4. After you read, discuss what you have read with others to help you better understand the text.

Name: _____ Date: _____

Homework: Using the Sim to Observe a Condition

1. Launch the *Metabolism* Sim.
2. Choose the condition you read about below, and then select OBSERVE.
3. Feed and observe the body.
4. Record your observations and questions.

Condition: (circle one)

anemia asthma diabetes pancreas injury

Observations in the Simulation of this condition:

_____

_____

_____

_____

Questions I have about this condition:

_____

_____

_____

_____

Name: _____ Date: _____

Lesson 2.3: Learning More About a Condition

What exactly happens in the body of a person with asthma, anemia, diabetes, or a pancreas injury? Today, you'll show your ideas about this by creating a model of the condition you read about, using the *Metabolism* Modeling Tool. You'll get the information you need to make your model by rereading the *Patient Stories* article you read in the previous lesson. Your model will help your group make a diagnosis.

Unit Question

- How do the trillions of cells in the human body get what they need to function, and what do the cells do with the things they absorb?

Chapter 2 Question

- What is happening in Elisa's body that could be preventing molecules from getting to her cells?

Key Concepts

- Cells can only use molecules that are small enough to enter a cell.
- The respiratory system brings in oxygen molecules from the air. These oxygen molecules are already small enough to fit into cells.
- The digestive system brings in food and breaks it down into smaller molecules, such as glucose and amino acids, that can fit into cells.
- The circulatory system transports glucose, oxygen, and amino acid molecules to every cell in the body.
- In a functioning human body, body systems work together to deliver glucose, oxygen, and amino acid molecules to the cells in the body.
- Systems can work together to form a larger more complex system.

Vocabulary

- circulatory system
- digestive system
- glucose
- metabolism
- molecules
- oxygen
- respiratory system
- system

Digital Tools

- *Metabolism* Modeling Tool activity: 2.3 Model a Condition
- *Metabolism* Simulation (Anemia, Asthma, Diabetes, and Pancreas Injury)

Name: _____ Date: _____

Warm-Up

Answer the question below. Then, explain why your answer is the best one.

Why can't a starch molecule enter a cell right after a person eats a meal with starchy foods in it? (check one)

- ☐ Because a starch molecule only stays in the digestive system and never leaves it to go into other systems.
- ☐ Because a starch molecule is too large to fit into a cell and needs to first be broken down into smaller glucose molecules in the digestive system.
- ☐ Because starch molecules first need to enter the respiratory system before they can get into cells.

Why is your answer the best one?

_____

_____

_____

_____

Name: _____ Date: _____

Second Read of *Patient Stories* Articles

Reread the article from the *Patient Stories* article set about the condition you read about in the last lesson. Answer the following questions about this condition.

1. Which condition did you read about? (circle one)

   anemia asthma diabetes injury to the pancreas

2. Which body system or systems are affected by this condition? (circle all that apply)

   digestive respiratory circulatory

3. Which molecules are affected by this condition? (circle all that apply)

   oxygen glucose amino acids

4. Describe what is going wrong in the body of a person with this condition that is preventing the right molecules from getting to the body's cells.

Name: _____ Date: _____

Modeling a Condition

1. Launch the *Metabolism* Modeling Tool activity: 2.3 Model a Condition.
2. When your model is complete, press HAND IN. If you worked with a partner, write his or her name here: _____

Goal: Change this model of a healthy body to show what happens in a body with a medical condition.

Do:

- Add molecules to or remove molecules from her healthy body to show how her body would change if she had the condition you read about (asthma, anemia, pancreas injury, or diabetes).

Tips:

- This model is of a healthy person's body.
- Her body is taking in the molecules she needs and delivering them to her cells.
- Remember to look back at the article to check if your model fits with what you read about the condition.

Name: _____ Date: _____

Comparing Models to the Sim

1. Launch the *Metabolism* Sim.
2. Select the condition you read about (asthma, anemia, diabetes, or pancreas injury), and then select OBSERVE.
3. Feed and observe the body.
4. Explain what you observed in the Sim and how it fits with your model or doesn't fit with your model.

_____

_____

_____

_____

Name: _____ Date: _____

Homework: Ideas About Elisa's Condition

1. Do you think Elisa might have the condition you read about? Why or why not? (Make sure to identify the condition in your response.)

_____

_____

_____

_____

2. What further evidence do we need to diagnose Elisa?

_____

_____

_____

_____

Name: _____ Date: _____

Homework: Reading "Meet a Scientist Who Grows New Cells"

Did you know scientists can grow new cells? To learn more about a scientist who is studying how to solve medical problems by growing new cells, read and annotate the "Meet a Scientist Who Grows New Cells" article. Then, answer the question below.

What is one interesting thing you learned from this article?

_____

_____

_____

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Lesson 2.4: Conducting Sim Tests

In this lesson, you will deepen your understanding of how medical conditions affect the human body. To do this, you will use the *Metabolism* Sim to conduct tests that will reveal how healthy bodies are different from bodies with medical conditions. You will work with a partner to discuss the data you collect from the Sim.

Unit Question

- How do the trillions of cells in the human body get what they need to function, and what do the cells do with the things they absorb?

Chapter 2 Question

- What is happening in Elisa's body that could be preventing molecules from getting to her cells?

Key Concepts

- Cells can only use molecules that are small enough to enter a cell.
- The respiratory system brings in oxygen molecules from the air. These oxygen molecules are already small enough to fit into cells.
- The digestive system brings in food and breaks it down into smaller molecules, such as glucose and amino acids, that can fit into cells.
- The circulatory system transports glucose, oxygen, and amino acid molecules to every cell in the body.
- In a functioning human body, body systems work together to deliver glucose, oxygen, and amino acid molecules to the cells in the body.
- Systems can work together to form a larger more complex system.

Vocabulary

- circulatory system
- digestive system
- glucose
- metabolism
- molecules
- oxygen
- respiratory system
- system

Digital Tools

- *Metabolism* Simulation (Healthy Body, Anemia, Asthma, Diabetes, and Pancreas Injury)
- *Metabolism* Modeling Tool activity: 2.4 Homework

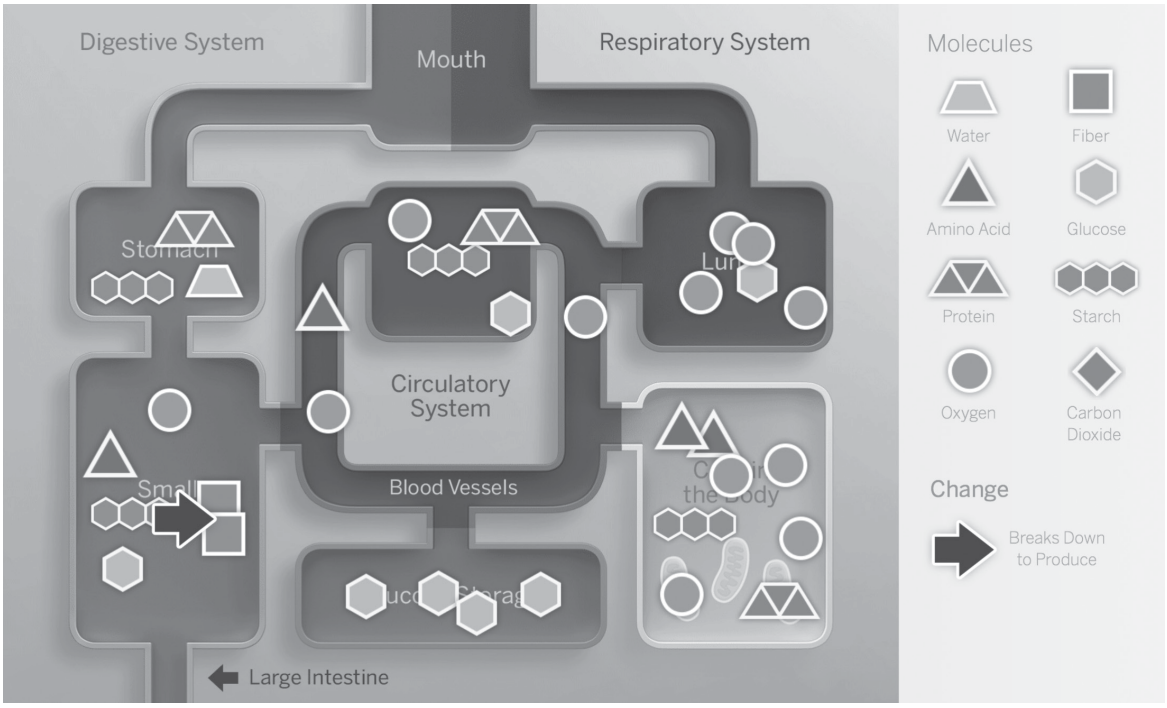
Name: _____ Date: _____

Warm-Up

An intern at the hospital created this model to show what happens to the molecules in a healthy person's body after they eat and breathe. The model has some very big mistakes. Add annotations to the image to explain to the intern what is inaccurate about the model.

These sentence starters can help you:

- This molecule would not be found in this body system because . . .
- This molecule would not be found in the cells in the body because . . .



Name: _____ Date: _____

Making Comparisons with the Sim

Part 1: Making Predictions

Predict what you will see in the Simulation of the body with the condition you studied. Circle your answers below.

The medical condition that I am learning about is (**anemia** / **asthma** / **diabetes** / **pancreas injury**).

It affects this/these molecule(s) that the human body needs to function: (**oxygen** / **glucose** / **glucose and amino acids**).

In the cells of a body with this condition, I would expect to see (**fewer** / **more**)
(**oxygen** / **glucose** / **glucose and amino acids**) molecules than in a healthy body.

Why do you expect to see this in the Simulation? Explain your ideas.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Making Comparisons with the Sim (continued)

Part 2: Testing a Healthy Body

Launch the *Metabolism* Simulation.

1. Select HEALTHY BODY, select TEST, and then feed the Healthy Body: two corn, two fish, and two sandwiches.
2. Set the activity level to Walk.
3. Press play to begin the test and switch to Graph View to see the results. (Hint: You can make the tests faster by changing the speed of the Simulation.)
4. Record the results in the data table.
5. Repeat the test and record the results in the Trial 2 column of the table. Record any additional observations in the space below the table.

Data for Healthy Body

	Trial 1	Trial 2
Total glucose molecules absorbed by cells		
Total amino acid molecules absorbed by cells		
Total oxygen molecules absorbed by cells		
Oxygen molecules taken in per breath		

Observations

_____

_____

_____

_____

Name: _____ Date: _____

Making Comparisons with the Sim (continued)

Part 3: Testing a Body with a Condition

Launch the *Metabolism* Simulation.

1. Select the body with the condition you read about, select TEST, and then feed the body with a condition: two corn, two fish, and two sandwiches.
2. Set the activity level to Walk.
3. Press play to begin the test and switch to Graph View to see the results. (Hint: You can make the tests faster by changing the speed of the Simulation.)
4. Record the results in the data table.
5. Repeat the test and record the results in the Trial 2 column of the table. Record any additional observations in the space below the table.

The medical condition I tested was: _____

Data for Body with a Medical Condition

	Trial 1	Trial 2
Total glucose molecules absorbed by cells		
Total amino acid molecules absorbed by cells		
Total oxygen molecules absorbed by cells		
Oxygen molecules taken in per breath		

Observations

_____

_____

_____

_____

Name: _____ Date: _____

Making Comparisons with the Sim (continued)

Part 4: Comparing Your Results

1. Review your data and observations for the healthy body and the body with a condition. How are these two bodies different? Record your ideas below.

_____

_____

_____

_____

_____

_____

_____

_____

2. Use your data tables and your recorded observations to discuss these questions with your partner:
   - How were the healthy body results different from the results for the body with a condition? Was this what you predicted?
   - Why do you think the body with a condition was different from the healthy body? Explain your understanding of this medical condition to your partner.

Name: _____ Date: _____

Word Relationships: Discussing Conditions

1. Work with your partner to create a sentence that answers each question, using one or more of the vocabulary words. Every word must be used at least once.
2. After you have discussed, record your sentences below.

Note: Work on either the asthma and anemia questions OR the diabetes and pancreas injury questions, not both.

Word Bank

oxygen	circulatory system	starch
respiratory system	cells	digestive system

Asthma and anemia questions	Diabetes and pancreas injury questions
1. What happens to oxygen in the body of a healthy person?	1. What happens to glucose in the body of a healthy person?
2. What happens to oxygen in the body of a person with anemia?	2. What happens to glucose in the body of a person with diabetes?
3. What happens to oxygen in the body of a person with asthma?	3. What happens to glucose in the body of a person with a pancreas injury?
4. What happens to glucose in the body of a healthy person?	4. What happens to oxygen in the body of a healthy person?

Name: _____ Date: _____

Homework: Revising Inaccurate Models in the Modeling Tool

1. Launch the *Metabolism* Modeling Tool activity: 2.4 Homework.
2. When your model is complete, press HAND IN. If you worked with a partner, write his or her name here: _____
3. Then, answer the question below.

Goal: Change this incorrect model so that it correctly shows what happens after a healthy person eats and breathes.

Do:

- Add and remove molecules from the different body systems so that the model accurately represents a healthy body.

Tips:

- Remember this model has some very big mistakes.

Which molecules do cells need to get from outside the body in order to function properly? (check one)

- ☐ water, oxygen, and carbon dioxide
- ☐ glucose, amino acids, and oxygen
- ☐ starch, protein, and fiber
- ☐ glucose, water, and protein

Explain what you changed about the model and why.

_____

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Lesson 2.6: Playing Guess My Model

Even medical students have fun sometimes, right? Today, you will play a game using the *Metabolism* Modeling Tool. You will work with a partner, and each of you will make a model of something that can happen inside the human body. You won't know what your partner is modeling. Then, you will try to figure out what your partner modeled. This game will help you review important ideas and apply everything you've learned so far about how the human body gets molecules to its cells.

Unit Question

- How do the trillions of cells in the human body get what they need to function, and what do the cells do with the things they absorb?

Chapter 2 Question

- What is happening in Elisa's body that could be preventing molecules from getting to her cells?

Key Concepts

- A functioning human body has molecules from food (glucose and amino acids) and molecules from air (oxygen) in its cells.
- Cells can only use molecules that are small enough to enter a cell.
- The respiratory system brings in oxygen molecules from the air. These oxygen molecules are already small enough to fit into cells.
- The digestive system brings in food and breaks it down into smaller molecules, such as glucose and amino acids, that can fit into cells.
- The circulatory system transports glucose, oxygen, and amino acid molecules to every cell in the body.
- In a functioning human body, body systems work together to deliver glucose, oxygen, and amino acid molecules to the cells in the body.
- A problem with a body system can result in fewer oxygen, glucose, and/or amino acid molecules getting to the body's cells.
- Systems can work together to form a larger more complex system.

Vocabulary

- amino acids
- circulatory system
- digestive system
- glucose
- metabolism
- molecules
- oxygen
- protein
- respiratory system
- starch
- system

Digital Tools

- *Metabolism* Modeling Tool activities: 2.6 Green Group, 2.6 Blue Group, 2.6 Purple Group

Name: _____ Date: _____

Warm-Up

In your Digital Resources, find and read the background information for your group.

- For example, if you are in the Purple Group, you will read the background information labeled "Purple Group." This will help prepare you for the game we are going to play today.

Name: _____ Date: _____

Playing the Guess My Model Game

Launch the *Metabolism* Modeling Tool activity for your group, and then follow the instructions below to play the Guess My Model Game.

Guess My Model Game Instructions

1. Each partner gets an envelope with a set of cards.
2. Each partner shuffles their set of cards and turns them face down.
3. Each partner chooses a card from their pile. (Do not let your partner see your card.)
4. Reread the Background Information for the scenario on the card you chose.
5. Using the Modeling Tool, make a model of the scenario.
6. The first partner guesses first: use the Key and Background Information to decide which scenario you think your partner modeled.
7. Give feedback and revise the model with your partner, if needed.
8. Switch roles: the second partner guesses the first partner's model.
9. Play another round: each partner draws a new card.

Which group are you in (circle one)?

Green Group Blue Group Purple Group

What is one scenario that you modeled? _____

Describe what you showed in your model.

_____

_____

_____

_____

Name: _____ Date: _____

Reflecting on the Guess My Model Game

- Were there any scenarios that you had a hard time modeling?
- What did you learn from the game?
- Do you have any more questions about body systems?

Name: _____ Date: _____

Homework: Reading *Systems of the Human Body*

You have learned a lot about the circulatory, digestive, and respiratory systems. From the *Systems of the Human Body* article set, choose one of the other systems to read about and answer the questions below.

I read the article: (check one)

- ☐ "The Nervous System"
- ☐ "The Excretory System"
- ☐ "The Musculoskeletal System"
- ☐ "The Reproductive System"

1. What does this system do?

_____

_____

_____

_____

2. What are the important parts of this system?

_____

_____

_____

_____

Name: _____ Date: _____

Lesson 2.7: Diagnosing Elisa

Today, you will finally diagnose Elisa! You'll share your expertise with your group, explaining the condition you investigated and how it could affect Elisa's body systems. Then, you'll receive Elisa's test results and compare them to the Sim tests you did earlier. Together, your group will consider the possible claims about why Elisa is tired and decide on a diagnosis that is supported by all the available evidence. You'll craft a written argument supporting this diagnosis. This will help Elisa get the treatment she needs.

Unit Question

- How do the trillions of cells in the human body get what they need to function, and what do the cells do with the things they absorb?

Chapter 2 Question

- What is happening in Elisa's body that could be preventing molecules from getting to her cells?

Key Concepts

- Cells can only use molecules that are small enough to enter a cell.
- The respiratory system brings in oxygen molecules from the air. These oxygen molecules are already small enough to fit into cells.
- The digestive system brings in food and breaks it down into smaller molecules, such as glucose and amino acids, that can fit into cells.
- The circulatory system transports glucose, oxygen, and amino acid molecules to every cell in the body.
- In a functioning human body, body systems work together to deliver glucose, oxygen, and amino acid molecules to the cells in the body.
- A problem with a body system can result in fewer oxygen, glucose, and/or amino acid molecules getting to the body's cells.
- Systems can work together to form a larger more complex system.

Vocabulary

- circulatory system
- diagnosis
- digestive system
- evidence
- glucose
- molecules
- oxygen
- respiratory system
- system

Name: _____ Date: _____

Warm-Up

Read the message below. Then, answer the questions below the message.

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

Today is an exciting day; you will get Elisa's test results and work together to use all the available evidence to make a diagnosis.

Remember, our hospital medical team started you out with four possible claims about Elisa's condition:

- Elisa is feeling tired because she has diabetes.
- Elisa is feeling tired because she has anemia.
- Elisa is feeling tired because she has an injury to her pancreas.
- Elisa is feeling tired because she has asthma.

1. Which condition are you investigating? (circle one)

anemia asthma diabetes injury to the pancreas

2. Which body system would have a problem if Elisa has the medical condition you've been investigating? (circle all that apply)

respiratory system circulatory system digestive system

3. Which molecule that cells need is affected by the medical condition you've been investigating? (circle all that apply)

amino acids glucose oxygen water

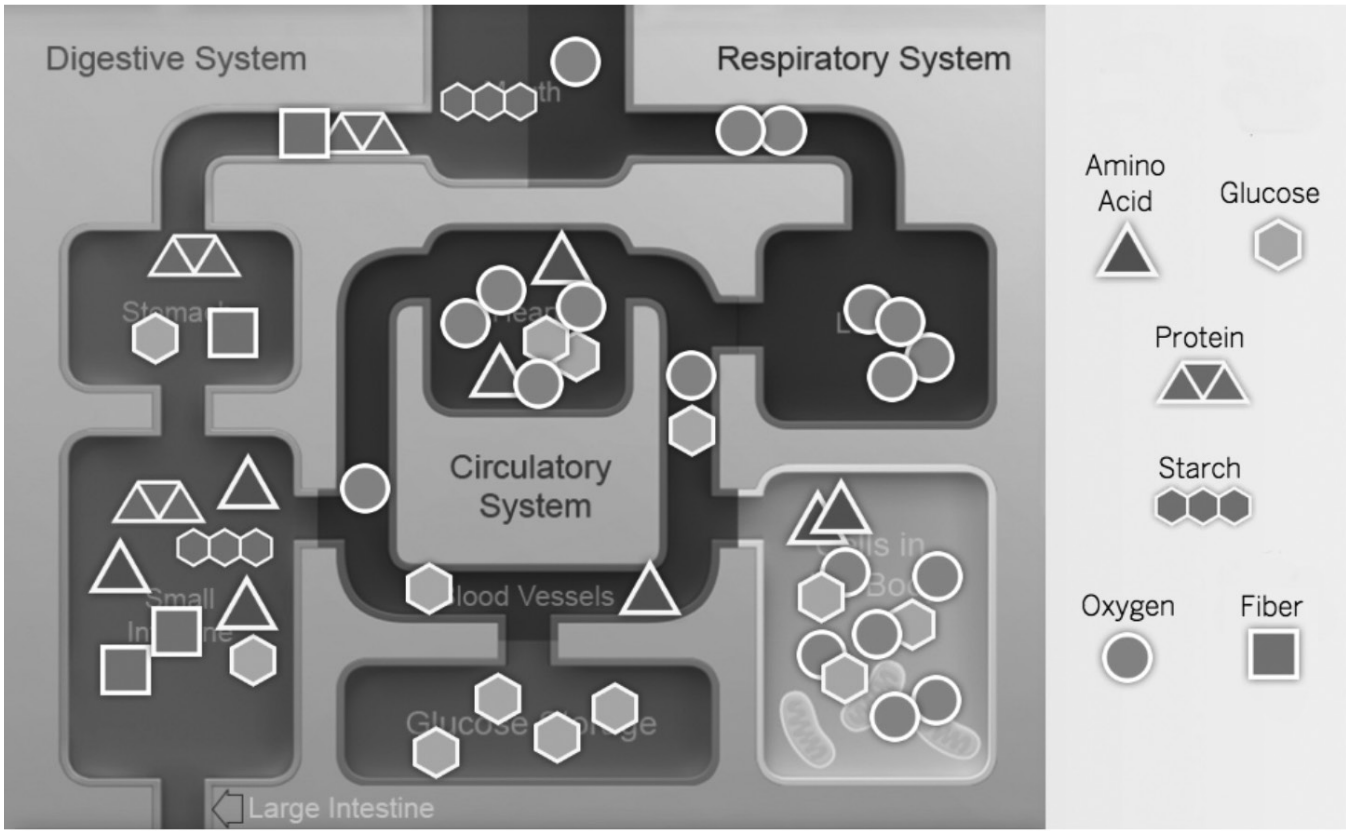
Name: _____ Date: _____

Analyzing Elisa's Test Results

Part 1: Using the Diagram to Explain Medical Conditions

Take turns explaining your medical conditions, using the diagram and these sentence starters:

- The medical condition I investigated was . . .
- This medical condition affects the body's ability to get the molecules . . .
- This medical condition works like this . . .
    - (Explain how the molecules move through the body system(s) when someone has this condition, and how or why the number of molecules that get to the cells changes because of the condition.)
- If Elisa has this condition, I would expect to see in her test results . . .



Name: _____ Date: _____

Analyzing Elisa's Test Results (continued)

Part 2: Comparing Test Results to Data from the Sim

1. Work with your partner to compare Elisa's test results (in the table below) to your experiments with the Sim:
   - One partner stays on this notebook page, and the other partner turns back to the Data for Healthy Body and the Data for Body with the Medical Condition from Lesson 2.4 (on pages 39–40).
   - Compare Elisa's test results below to the Healthy Body and the Body with a Condition results. Does the evidence support the claim that Elisa has this condition?
2. Switch and compare to the other condition.
3. Discuss your evidence with your group and agree on a diagnosis.

Elisa's Test Results

	Test result
Total glucose molecules absorbed by cells	19
Total amino acid molecules absorbed by cells	54
Total oxygen molecules absorbed by cells	273
Oxygen molecules taken in per breath	25

Name: _____ Date: _____

Writing an Argument to Support a Diagnosis

You and your group are presenting a diagnosis for Elisa. Each of you will be responsible for explaining why Elisa does or does not have one of the four conditions.

1. First, you will explain how a healthy body functions.
2. Then, you will write an argument in which you explain what happens in the body of someone who has the condition you investigated and support your claim that Elisa does or does not have that condition.

Part 1: Explaining a Healthy Body

Elisa feels tired because she has a condition that affects whether the right molecules are getting to her cells. If her body were functioning correctly, this is what would happen with oxygen:

_____

_____

_____

_____

_____

_____

_____

If her body were functioning correctly, this is what would happen with starch/glucose:

_____

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Writing an Argument to Support a Diagnosis (continued)

Part 2: Diagnosis

For each claim below, circle **supported** or **not supported**.

Elisa is feeling tired because she has diabetes.	**supported** / **not supported** by the evidence
Elisa is feeling tired because she has anemia.	**supported** / **not supported** by the evidence
Elisa is feeling tired because she has an injury to her pancreas.	**supported** / **not supported** by the evidence
Elisa is feeling tired because she has asthma.	**supported** / **not supported** by the evidence

Now explain your diagnosis.

- Start your argument by writing something like this:

"My group believes that Elisa has/does not have _____. I think that she does/does not have the _____ condition because . . ."

- Then, explain how molecules move through the body when someone has the condition you investigated, and compare that to Elisa's test results.

_____

_____

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Homework: Revising Your Argument

1. Read your argument on page 54 and evaluate how well you did each of the following items listed below.
2. Then, revise your argument to make it more convincing. Use the space below if needed.

I stated my claim clearly. (circle one)

Definitely! Sort of Not really Not at all

I included evidence to support the claim. (circle one)

Definitely! Sort of Not really Not at all

I made my reasoning clear by explaining how the evidence supports the claim. (circle one)

Definitely! Sort of Not really Not at all

(If you need more space to revise your argument, use the lines below.)

Name: _____ Date: _____

Homework: Check Your Understanding

This is a chance for you to reflect on your learning so far. This is not a test. Be open and truthful when you respond to the question below.

Scientists investigate in order to figure things out. Are you getting closer to figuring out why your patient, Elisa, could be feeling so tired?

1. I understand what molecules Elisa's cells need and where they come from.

   ☐ yes

   ☐ not yet

Explain your answer choice above.

_____

_____

2. I understand how those molecules get to the cells in Elisa's body.

   ☐ yes

   ☐ not yet

Explain your answer choice above.

_____

_____

3. I understand how the cells use those molecules to release energy for Elisa's body to function.

   ☐ yes

   ☐ not yet

Explain your answer choice above.

_____

_____

Name: _____ Date: _____

Homework: Check Your Understanding (continued)

4. What do you still wonder about Elisa's condition or how her body gets what it needs to function?

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Chapter 3: Cellular Respiration
Chapter Overview

Congratulations on your successful diagnosis! However, your work isn't done yet: You still need to be able to explain *why* Elisa's condition had such an effect on her energy levels. And once you can explain that, you can use what you've learned about metabolism to help explain how elite athletes are able to perform so much better than average people.

Name: _____ Date: _____

Lesson 3.1: Learning About Energy Release in the Body

You already know that the cells in your body need three molecules that come from food and air: glucose, amino acids, and oxygen. But what exactly happens with these molecules once they are in the cells in the body? In this lesson, you will begin to investigate which molecules cells need to release the energy the body needs to function. Determining which molecules release energy for the body will enable you to explain why your patient with a medical condition, Elisa, felt so tired.

Unit Question

- How do the trillions of cells in the human body get what they need to function, and what do the cells do with the things they absorb?

Chapter 3 Question

- How do molecules in the cells of the body release energy?

Vocabulary

- amino acid
- circulatory system
- digestive system
- energy
- glucose
- metabolism
- molecules
- oxygen
- respiratory system

Digital Tools

- *Metabolism* Simulation (Healthy Body)

Name: _____ Date: _____

Warm-Up

In Chapter 2, you received Elisa's test results, and you compared those results to your Sim test results for a healthy body.

The data table below shows Elisa's test results and test results from a healthy body. Use the data to answer the questions below the table.

Molecules absorbed by the cells in the body	Healthy body	Elisa's body
Glucose	44	18
Amino acids	37	52
Oxygen	300	270

1. Compared to the cells in a healthy body, Elisa's cells are getting far fewer _____ molecules.

   a. amino acid

   b. oxygen

   c. glucose

2. How do you think getting fewer of these molecules to her cells contributed to Elisa's tiredness? Explain your ideas.

_____

_____

_____

Name: _____ Date: _____

Considering Claims About Energy Release

Which molecules do cells need to release energy? Select the claim you think is most accurate.

- ☐ **Claim 1:** Cells need glucose to release energy.
- ☐ **Claim 2:** Cells need amino acids to release energy.
- ☐ **Claim 3:** Cells need oxygen to release energy
- ☐ **Claim 4:** Cells need glucose AND amino acids to release energy.
- ☐ **Claim 5:** Cells need glucose AND oxygen to release energy.
- ☐ **Claim 6:** Cells need ALL THREE types of molecules to release energy.

Name: _____ Date: _____

Gathering Evidence from Heart and Breath Rates

Heart and Breath Rate Activity

1. **Observe breath rate.** Put a finger just under your nose to feel the gas leaving the body when breathed out.
2. **Observe heart rate.** Place two fingers gently on your neck just under your jaw (or on your wrist). Move your fingers around until you can feel a steady beat. Each beat you feel is a pulse of blood from one pump of the heart.
3. **Exercise for one minute.** Wait for the teacher's signal to begin. Run in place, lifting your knees as high as you can and stepping as fast as you can. Be careful not to bump into anyone or anything. Stop at the teacher's signal.
4. **Observe breath rate and heart rate again.** As soon as you stop exercising, observe your breath rate and heart rate as you did before.
5. **Discuss your observations with your partner.** How did your breath change after one minute of exercise? How did your heart rate change after one minute of exercise?

Name: _____ Date: _____

Gathering Evidence from the Sim

Which molecules do cells need to release energy?

1. Gather evidence to answer this question by running three tests in the Sim. You will be measuring **the length of time a healthy body can jog** under three conditions: without glucose, without amino acids, and without oxygen.

2. For each test:
   - Launch the *Metabolism* Simulation, select HEALTHY BODY, and then select OBSERVE.
   - Pause the Sim and set the activity level to Jog.
   - For the "without oxygen" test, also press STOP for the breath.
   - Press Play and then feed the body as directed in the data table for that condition.
   - Immediately switch to Graph View and wait for the activity level to drop from Jog to Walk.
   - Pause the Sim and record the length of time the body stayed at Jog.

3. For each test, do two trials. Compare the results of your tests to the control test in the first row of the table to decide if removing that molecule affects energy release. Discuss your ideas with your partner.

Molecule observation test	Trial 1: length of time jogging	Trial 2: length of time jogging
Control test: with glucose, amino acids, and oxygen (breath on, feed 1 fish and 1 corn)	100–132 time units	100–132 time units
Test A: without glucose (breath on, feed 1 fish)		
Test B: without amino acids (breath on, feed 1 corn)		
Test C: without oxygen (STOP breath, feed 1 fish and 1 corn)		

Name: _____ Date: _____

Revising Claims

Which molecules do cells need to release energy?

1. Discuss with your partner the evidence you collected today, and then select the claim you now think is most accurate.

   ☐ **Claim 1:** Cells need glucose to release energy.

   ☐ **Claim 2:** Cells need amino acids to release energy.

   ☐ **Claim 3:** Cells need oxygen to release energy

   ☐ **Claim 4:** Cells need glucose AND amino acids to release energy.

   ☐ **Claim 5:** Cells need glucose AND oxygen to release energy.

   ☐ **Claim 6:** Cells need ALL THREE types of molecules to release energy.

2. Explain how the evidence supports this claim.

_____

_____

_____

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Homework: Running Tests, Using the Sim

Run tests to compare two different activity levels in the Healthy Body of the *Metabolism* Simulation.

1. Select HEALTHY BODY and select TEST.
2. Food Queue: 6 corn.
3. Do two trials for each activity level (Rest and Jog).
4. Record your results in the data table, and then answer the questions on the next page.

Activity level	Glucose molecules absorbed by the cells	Oxygen molecules absorbed by the cells	Observations
Rest, Trial 1			
Rest, Trial 2			
Jog, Trial 1			
Jog, Trial 2			

Name: _____ Date: _____

Homework: Running Tests, Using the Sim (continued)

What differences do you notice between what happens in the Rest activity level and what happens in the Jog activity level?

_____

_____

_____

_____

Why do you think these different activity levels produced different results?

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Lesson 3.2: Exploring Chemical Reactions

What exactly happens with glucose and oxygen in your cells, and what does it have to do with energy? Today, you'll be doing a hands-on activity that is an example of molecules releasing energy in a process called a chemical reaction. Then, through reading an article and exploring the Sim, you will compare that process to what happens in the cells of the body.

Unit Question

- How do the trillions of cells in the human body get what they need to function, and what do the cells do with the things they absorb?

Chapter 3 Question

- How do molecules in the cells of the body release energy?

Key Concepts

- In order to release energy, cells need both glucose and oxygen molecules.

Vocabulary

- cells
- cellular respiration
- energy
- glucose
- metabolism
- molecules
- oxygen
- respiratory system

Digital Tools

- *Metabolism* Simulation (Healthy Body)

Name: _____ Date: _____

Warm-Up

1. If a patient has a medical condition that causes his cells to absorb fewer than normal _____ molecules, this patient would likely feel very tired. (check one)

   ☐ oxygen

   ☐ fiber

   ☐ starch

   ☐ protein

2. Explain your reasoning.

_____

_____

_____

_____

Name: _____ Date: _____

Observing a Chemical Reaction

CHEMICAL WARNING

The *Metabolism* kit contains chemicals that may be harmful if misused. Read cautions on individual containers carefully. Not to be used by children except under adult supervision.

Chemicals used in this activity are:

- phenol red
- calcium chloride
- baking soda

Safety Note: Using Chemicals

Do not taste or touch the substances in the investigation, do smell substances as a chemist does, and do mix substances only when you are told to do so. Use safety goggles and gloves as necessary. Calcium chloride and phenol red present irritation risks. Wash exposed areas when finished. If calcium chloride, phenol red, or a mixture of substances gets on skin or clothes, rinse the substance off with water. If a substance gets in eyes, rinse the affected eye(s) with water for 15 minutes.

What Happens When These Substances Combine?

Instructions: Each group member should perform one of the first four steps below. Decide among your group members who will perform each step.

1. Measure 10 mL of phenol red solution from the squeeze bottle into the graduated cylinder.
2. Carefully open the bag with the powders.
3. Pour the phenol red solution from the graduated cylinder into the bag.
4. Get as much air as possible out of the bag before sealing it. With your hands on the outside of the bag, gently mix the substances together.
5. Each group member should touch the bag.
6. What do you notice? Make sure each group member shares their observations.

Name: _____ Date: _____

Observing Cellular Respiration in the Sim

1. Launch the *Metabolism* Sim. Select HEALTHY BODY, and then select OBSERVE. Feed the body as needed.
2. Slow down the Sim to x0.5 speed and observe closely what happens in the cell by pressing the yellow box (Cells in the Body) and then pressing the magnifying glass.
3. Observe what happens BEFORE and AFTER the chemical reaction, then answer the questions below.

Describe what happens in the cell before the chemical reaction.

_____

_____

_____

_____

_____

_____

Describe what happens after the chemical reaction. What evidence did you see of energy release?

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Reflecting on Cellular Respiration

Discuss the following reflection questions with your partner. Take turns reading and answering the questions.

- Partner A: What molecules are needed for cellular respiration to happen?
- Partner B: What are the outputs of cellular respiration?
- Partner A: How was the chemical reaction we observed similar to what happens in the mitochondria in your cells?
- Partner B: How does what you learned today help explain why Elisa felt tired?

Name: _____ Date: _____

Homework: Exploring Cellular Respiration

1. Watch the video called *The Story of Sanctorius*, which is in your Digital Resources for Lesson 3.2. This video tells the story of one of the first scientists to study cellular respiration.
2. Use what you've learned today about cellular respiration to answer the question below. Use these words in your response:
    - oxygen
    - glucose
    - cellular respiration
    - energy
    - cells

Because of her diabetes, Elisa had lower numbers of glucose molecules getting to her cells. Why did this cause her to feel so tired?

_____

_____

_____

_____

Name: _____ Date: _____

Lesson 3.3: Cellular Respiration, Growth, and Repair

You know that glucose and oxygen are needed for cellular respiration, which releases energy—but what exactly does the body do with that energy? And, what about those amino acids, anyway? To investigate these questions, you will observe the *Metabolism* Simulation, complete a short reading, and model your ideas about how healthy cells in the body function. This will help you understand more about how Elisa's body could be affected by her medical condition.

Unit Question

- How do the trillions of cells in the human body get what they need to function, and what do the cells do with the things they absorb?

Chapter 3 Question

- How do molecules in the cells of the body release energy?

Key Concepts

- In order to release energy, cells need both glucose and oxygen molecules.
- Inside the cell, the atoms that make up glucose and oxygen can be rearranged to make different molecules. This chemical reaction is called cellular respiration and releases energy.

Vocabulary

- amino acid
- cell
- cellular respiration
- energy
- glucose
- metabolism
- molecules
- oxygen
- protein

Digital Tools

- *Metabolism* Simulation (Healthy Body)
- *Metabolism* Modeling Tool activity: 3.3 Model a Cell

Name: _____ Date: _____

Warm-Up

Use the *Metabolism* Simulation to observe what happens with amino acid molecules inside a cell of a healthy body.

1. Select HEALTHY BODY and then select OBSERVE.
2. Feed the body three sandwiches.
3. Zoom in to see what is happening inside the cell by pressing the yellow box (Cells in the Body) and then pressing the magnifying glass.
4. Observe closely and then answer the questions.

What did you notice happening with the amino acid molecules in the cell?

_____

_____

In the cell, amino acid molecules combine to form _____. (check one)

- ☐ fiber molecules
- ☐ protein molecules
- ☐ water molecules
- ☐ starch molecules

Name: _____ Date: _____

Reading "Growth and Repair”

Read and annotate the “Growth and Repair" article. After you read, discuss the following questions with your partner.

- What surprised you about this article?
- How are amino acid molecules used in cellular growth and repair?
- How are glucose and oxygen molecules used in cellular growth and repair?

Active Reading Guidelines

1. Think carefully about what you read. Pay attention to your own understanding.
2. As you read, annotate the text to make a record of your thinking. Highlight challenging words and add notes to record questions and make connections to your own experience.
3. Examine all visual representations carefully. Consider how they go together with the text.
4. After you read, discuss what you have read with others to help you better understand the text.

Name: _____ Date: _____

Modeling Cellular Growth and Repair

1. Launch the *Metabolism* Modeling Tool activity: 3.3 Model a Cell.

2. When your model is complete, press HAND IN. If you worked with a partner, write his or her name here: _____

Goal: Show how energy is released to make growth and repair occur in a healthy, functioning cell.

Do:

- Add molecules and use the arrow and energy symbol to represent changes that result in energy release.

What does your model show about how energy is released to make growth and repair occur in a healthy, functioning cell?

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Writing About Elisa

1. Elisa's diabetes causes her to have lower than normal numbers of glucose molecules in her cells. You already wrote about how this makes her tired.
2. Now, write an explanation that answers the question, *How could Elisa's diabetes also affect her body's ability to grow and repair cells?*
3. Use the following sentence to start your explanation, or use a sentence of your own.
   - *Diabetes could affect how well Elisa's cells can grow and repair themselves.*

Word Bank

glucose	amino acid
oxygen	protein
cellular respiration	energy

Name: _____ Date: _____

Homework: Reading "The Big Climb"

Read and annotate the "The Big Climb: A Story in Large and Small Scale" article. Then, choose an example from the article that shows what is happening to the rock climbers' bodies at the large scale. Describe what is happening to rock climbers' body systems and cells at the small scale.

_____

_____

_____

_____

_____

_____

_____

_____

Find a part of the article that describes signals that are sent within Diego's body. Where does the signal come from, and how does it cause Diego to feel or react?

_____

_____

_____

Active Reading Guidelines

1. Think carefully about what you read. Pay attention to your own understanding.
2. As you read, annotate the text to make a record of your thinking. Highlight challenging words and add notes to record questions and make connections to your own experience.
3. Examine all visual representations carefully. Consider how they go together with the text.
4. After you read, discuss what you have read with others to help you better understand the text.

Name: _____ Date: _____

Lesson 3.4: "Blood Doping: Messing with Metabolism to Win Races"

Energy is constantly being released in your cells, even when you're just sitting around and thinking—so imagine what must be happening in the cells of an elite athlete during a competition! Today, you will read about a controversial and illegal procedure called blood doping, which some athletes have used to increase their cellular respiration and enhance their athletic performance. Understanding how this process works will help you deepen your understanding of metabolism.

Unit Question

- How do the trillions of cells in the human body get what they need to function, and what do the cells do with the things they absorb?

Chapter 3 Question

- How do molecules in the cells of the body release energy?

Key Concepts

- In order to release energy, cells need both glucose and oxygen molecules.
- Inside the cell, the atoms that make up glucose and oxygen can be rearranged to make different molecules. This chemical reaction is called cellular respiration and releases energy.
- Cells can grow and repair themselves by combining amino acid molecules to form larger protein molecules. This growth and repair requires energy release from cellular respiration.

Vocabulary

- blood doping
- cellular respiration
- circulatory system
- energy
- glucose
- metabolism
- oxygen

Name: _____ Date: _____

Warm-Up

Read the message from Dr. Walker. Then, answer the questions below the message.

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

Thank you for wrapping up the diagnosis of Elisa. Thanks to your careful investigation, we've been able to get started with a course of treatment that should have Elisa feeling more energetic soon.

We have a new assignment for you now. We want you to learn about the metabolism of athletes—not just any athletes, but world-class athletes that train for many hours every day. Energy release in the cells is very important to these athletes. To start your thinking about the energy needs of these athletes, please answer the following questions with your best ideas.

1. In order to maintain a high level of performance, what types of foods do you think an athlete should eat right before a race? (check one)

   ☐ foods high in fiber

   ☐ foods high in protein

   ☐ foods high in starch

2. Explain your reasoning.

_____

_____

_____

3. The energy released in cellular respiration helps an athlete perform. How do you think an athlete might be able to increase cellular respiration?

_____

_____

_____

Name: _____ Date: _____

Reading "Blood Doping"

1. Read and annotate the article "Blood Doping: Messing with Metabolism to Win Races."
2. Choose and mark annotations to discuss with your partner. Once you have discussed these annotations, mark them as discussed.
3. Now, choose and mark a question or connection, either one you already discussed or a different one you still want to discuss with the class.
4. Answer the reflection question below.

Rate how successful you were at using Active Reading skills by responding to the following statement:

As I read, I paid attention to my own understanding and recorded my thoughts and questions.

- ☐ Never
- ☐ Almost never
- ☐ Sometimes
- ☐ Frequently/often
- ☐ All the time

Active Reading Guidelines

1. Think carefully about what you read. Pay attention to your own understanding.
2. As you read, annotate the text to make a record of your thinking. Highlight challenging words and add notes to record questions and make connections to your own experience.
3. Examine all visual representations carefully. Consider how they go together with the text.
4. After you read, discuss what you have read with others to help you better understand the text.

Name: _____ Date: _____

Homework: Reading *Odd Organisms and How They Get the Molecules They Need*

You have learned a lot about body systems in humans, but how are other organisms similar and different? From the *Odd Organisms and How They Get the Molecules They Need* article set, choose one organism to read about and answer the questions below.

I read about the (check one)

- ☐ blue whale
- ☐ grasshopper
- ☐ sea sponge
- ☐ trout
- ☐ water bear

1. Compared to a human, what is **different** about how this organism gets molecules from food and air?

_____

_____

_____

_____

_____

_____

2. Compared to a human, what is **similar** about how this organism gets molecules from food and air?

_____

_____

_____

_____

Name: _____ Date: _____

Lesson 3.5: Modeling Cellular Respiration in an Athlete's Body

Highly-trained athletes' bodies perform differently than non-athletes' bodies. For example, an athlete will most likely be able to run faster and farther than a normal healthy person. Is there something different about the ways athletes take in oxygen or how cellular respiration happens in their cells? And what about blood doping—how does it give athletes an edge when they are already some of the most physically fit people in the world? Today, you will compare the bodies of normal healthy people, athletes, and athletes who are blood doping to see how and why their cellular respiration rates and oxygen levels differ. You will run Sim tests, create models in the Modeling Tool, and read, in order to analyze these different bodies.

Unit Question

- How do the trillions of cells in the human body get what they need to function, and what do the cells do with the things they absorb?

Chapter 3 Question

- How do molecules in the cells of the body release energy?

Key Concepts

- In order to release energy, cells need both glucose and oxygen molecules.
- Inside the cell, the atoms that make up glucose and oxygen can be rearranged to make different molecules. This chemical reaction is called cellular respiration and releases energy.
- Cells can grow and repair themselves by combining amino acid molecules to form larger protein molecules. This growth and repair requires energy release from cellular respiration.

Vocabulary

- blood doping
- cellular respiration
- circulatory system
- energy
- glucose
- metabolism
- oxygen

Digital Tools

- *Metabolism* Simulation (Healthy Body)
- *Metabolism* Modeling Tool activity: 3.5 Model an Athlete

Name: _____ Date: _____

Warm-Up

In the next activity, you will consider how a normal healthy body is different from an athlete's body. Make a prediction of how you think they are different and explain your reasoning.

1. Oxygen molecules taken in per breath: The athlete's result will be _____ the normal healthy body's result.

   ☐ higher than

   ☐ lower than

   ☐ the same as

Explain your reasoning.

_____

_____

2. Oxygen molecules absorbed by cells: The athlete's result will be _____ the normal healthy body's result.

   ☐ higher than

   ☐ lower than

   ☐ the same as

Explain your reasoning.

_____

_____

3. Highest cellular respiration level: The athlete's result will be _____ the normal healthy body's result.

   ☐ higher than

   ☐ lower than

   ☐ the same as

Explain your reasoning.

_____

_____

Name: _____ Date: _____

Comparing a Healthy Body to an Athlete's Body

This data represents tests from a simulation similar to the one we've been using. This simulation represents the body of an athlete.

Talk to your partner and discuss how metabolism in an athlete's body is different from that in a normal healthy body.

	Healthy body	**Athlete**
Oxygen molecules taken in per breath	25 molecules	45 molecules
Oxygen molecules absorbed by cells	270 molecules	350 molecules
Maximum cellular respiration level during test	8	12

Name: _____ Date: _____

Modeling an Athlete's Body

1. Launch the *Metabolism* Modeling Tool activity: 3.5 Model an Athlete. The starting model represents the molecules in a healthy body, when exercising.
2. When your model is complete, press HAND IN. If you worked with a partner, write his or her name here: _____

Goal: Show what is happening in an athlete's body during exercise.

Do:

- Change this model of the starch, glucose, and oxygen molecules in a healthy body during exercise to model what happens in an athlete's body during exercise.

Tips:

- Refer to your data table to identify the differences between the healthy body and the athlete's body.
- Note: You'll be revising and handing in this model later in this lesson.

In the space below, describe how your model is different from the Healthy Body Model.

_____

_____

_____

_____

Name: _____ Date: _____

Second Read of "Blood Doping"

Part 1

1. Reread the sections called "What Is Blood Doping?" and "How Blood Doping Works in the Body" to better understand what happens to the molecules, especially oxygen, in an athlete's body and in a blood-doping athlete's body.
2. Number the steps below from 1–3 to indicate what an athlete does when she blood dopes.

   _____ She chills the blood and stores it.

   _____ She puts the blood back into her body just before a competition.

   _____ She removes the blood from her body.

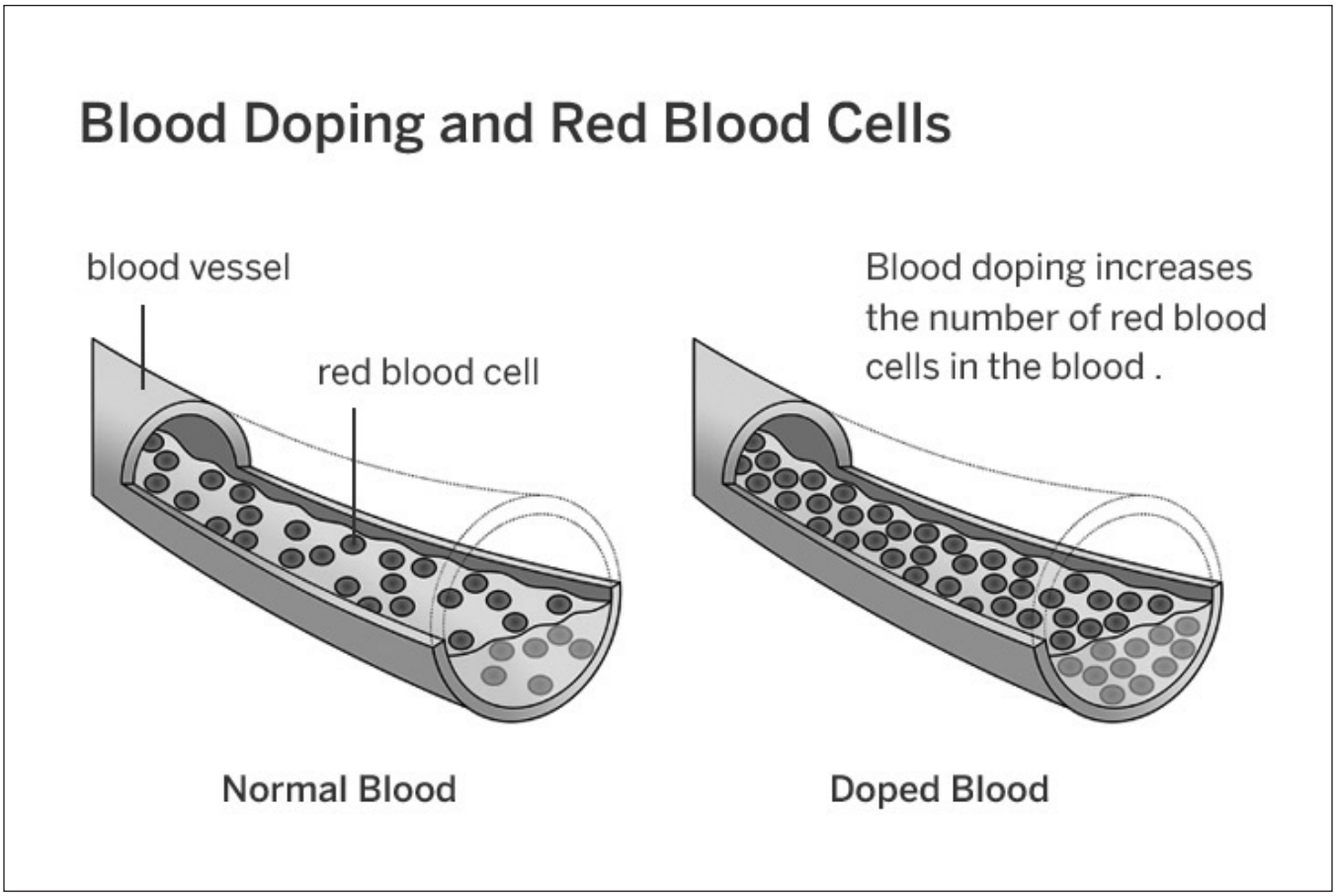
3. Reread the first paragraph in the section "How Blood Doping Works in the Body" and highlight the following:
   - the sentences that describe how oxygen gets into the blood and then to the cells in a normal healthy body
   - in a different color, the sentences that describe how blood doping affects the circulatory system's ability to carry oxygen

Name: _____ Date: _____

Second Read of "Blood Doping" (continued)

Part 2

Look at the diagram "Blood Doping and Red Blood Cells" from the article and answer the question.



Explain what the diagram shows about how doped blood is different from normal blood.

_____

_____

_____

_____

Name: _____ Date: _____

Second Read of "Blood Doping" (continued)

Part 3

Use what you read to make predictions about an athlete who is blood doping. If needed, look at the "Blood Doping" article for evidence to support your predictions.

1. How would the amount of oxygen in the circulatory system be different in an athlete who is blood doping, compared to a normal athlete?

_____

_____

_____

_____

2. How would the amount of oxygen absorbed by the cells be different in an athlete who is blood doping, compared to a normal athlete?

_____

_____

_____

_____

Name: _____ Date: _____

Modeling an Athlete Who Is Blood Doping

1. Go back to the *Metabolism* Modeling Tool activity: 3.5 Model an Athlete, where you made a model of an athlete's body during exercise.
2. Based on your predictions (on page 89) about the athlete who is blood doping, change your model in order to represent what a blood-doping athlete's body would look like during the same activity.
3. When your model is complete, press HAND IN. If you worked with a partner, write his or her name here: _____

Explain how your model of a blood-doping athlete's body is different from your model of an athlete's body.

_____

_____

_____

_____

Name: _____ Date: _____

Homework: Getting a High Cellular Respiration Rate in the Sim

Try to get the highest cellular respiration rate possible in the Sim. Note: You can see the cellular respiration level in the yellow meter in Live View, and as the yellow line and yellow number in Graph View.

1. Plan your strategy! Record your ideas about how to achieve the maximum level of cellular respiration.

_____

_____

_____

_____

2. Launch the *Metabolism* Simulation and complete your mission.
3. Record your observations below. Be sure to describe the highest cellular respiration level reached and how you achieved this level.

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Homework: Check Your Understanding

This is a chance for you to reflect on your learning so far. This is not a test. Be open and truthful when you respond to the question below.

Scientists investigate in order to figure things out. Are you getting closer to figuring out why your patient, Elisa, could be feeling so tired?

1. I understand what molecules Elisa's cells need and where they come from.

   ☐ yes

   ☐ not yet

Explain your answer choice above.

_____

_____

2. I understand how those molecules get to the cells in Elisa's body.

   ☐ yes

   ☐ not yet

Explain your answer choice above.

_____

_____

3. I understand how the cells use those molecules to release energy for Elisa's body to function.

   ☐ yes

   ☐ not yet

Explain your answer choice above.

_____

_____

Name: _____ Date: _____

Homework: Check Your Understanding (continued)

4. What do you still wonder about Elisa's condition or how her body gets what it needs to function?

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Chapter 4: Metabolism and Athletic Performance
Chapter Overview

In this final chapter, you'll use what you've learned about metabolism to solve a new problem. A champion athlete is suspected of increasing his cellular respiration through illegal methods. Analyze the evidence to decide for yourself what the best explanation is for his improved performance.

Name: _____ Date: _____

Lesson 4.1: Going for Gold: A Cycling Champion's Story

Today, you will learn about a professional racing cyclist who placed 35th in a competitive race and then won a similar race the following year. Some officials think that this athlete's dramatic improvement might have been due to illegal blood doping. Others believe that his improvement could have been caused by changes he made to his diet or the way he trained. In the next two lessons, you will examine evidence and decide for yourself what you think he did to improve his performance so drastically in one year.

Unit Question

- How do the trillions of cells in the human body get what they need to function, and what do the cells do with the things they absorb?

Chapter 4 Question

- How did the athlete increase his cellular respiration and improve his performance?

Key Concepts

- The respiratory system brings in oxygen molecules from the air. These oxygen molecules are already small enough to fit into cells.
- The digestive system brings in food and breaks it down into smaller molecules, such as glucose and amino acids, that can fit into cells.
- The circulatory system transports glucose, oxygen, and amino acid molecules to every cell in the body.
- In a functioning human body, body systems work together to deliver glucose, oxygen, and amino acid molecules to the cells in the body.
- In order to release energy, cells need both glucose and oxygen molecules.
- Inside the cell, the atoms that make up glucose and oxygen can be rearranged to make different molecules. This chemical reaction is called cellular respiration and releases energy.
- Systems can work together to form a larger more complex system.

Vocabulary

- cellular respiration
- energy
- glucose
- metabolism
- molecules
- oxygen

Name: _____ Date: _____

Warm-Up

Soon you will watch a video about an athlete whose improved performance has led some to suspect him of blood doping. Think back to what you learned about the blood doping process. What do you remember about how blood doping works and how it could affect cellular respiration?

_____

_____

_____

_____

Name: _____ Date: _____

Introducing the Science Seminar Sequence

Elite athlete Jordan Jones finished 35th in a competitive bike race last year and finished first in a similar race this year.

How did he increase his cellular respiration and improve his performance?

- **Claim 1:** Jordan Jones increased his cellular respiration and improved his performance by blood doping.
- **Claim 2:** Jordan Jones increased his cellular respiration and improved his performance by changing his pre-race meal.
- **Claim 3:** Jordan Jones increased his cellular respiration and improved his performance by training at a higher altitude.

Name: _____ Date: _____

Blood Doping and High-Altitude Training

1. Focus on the sections "Catching Blood Dopers" and "An Alternative to Blood Doping" in the "Blood Doping: Messing with Metabolism to Win Races" article.
2. Then, answer the questions below.

How do doctors use the age of red blood cells to decide whether or not someone was blood doping?

_____

_____

How do doctors use hemoglobin levels to decide whether or not someone was blood doping?

_____

_____

At high altitude there is _____ oxygen in the air than at lower altitudes, such as sea level.

- ☐ more
- ☐ less
- ☐ the same amount of

How can high-altitude training help athletes get more oxygen to their cells?

_____

_____

Name: _____ Date: _____

Evaluating Example Evidence

Review the following two examples of evidence and claims, and then answer the question below.

Example A: A person ate a ham sandwich and ran a race. She finished in first place.

Claim: The ham sandwich was the reason she won, and she should eat ham sandwiches before all her races.

Example B: A person ate different meals before 20 races that he ran. For ten races, he ate spaghetti before the race and finished in either first, second, or third place. For the other ten races, he ate fried chicken and finished in second place once, but finished in sixth or seventh place in the rest of the races.

Claim: Spaghetti helped his performance, and he should eat spaghetti before all his races.

Which claim is based on higher-quality evidence?

- ☐ example A
- ☐ example B

Name: _____ Date: _____

Evaluating Evidence Cards

Scientists evaluate the quality of evidence when they are building a scientific argument. Evidence is higher quality when it is based on more data because there can be more confidence in the patterns seen in the data.

1. With your partner, discuss each evidence card and use the Evidence Gradient to rate whether the evidence is high quality, medium quality, or low quality. For each piece of evidence, ask yourself the following question: *Does this provide enough data to establish a pattern?*
2. Review the evidence cards you rated as low quality. If you feel they are not of high enough quality to include in your argument, put them in a discard pile.
3. Once you have decided which evidence cards to keep, place your cards in your own envelope and write your name on the envelope. Your partner should do the same.

Name: _____ Date: _____

Lesson 4.2: Analyzing Evidence

Today you will get more evidence about Jordan Jones. You will use this evidence to think about the claims that were made about his improved performance. Did Jordan really use blood doping to improve his performance so greatly? Or, did high-altitude training help his performance? Maybe it was the pre-race meal that he had? It will be up to you to consider the evidence and decide what Jordan Jones did to make such an amazing leap from 35th to 1st place in just one year!

Unit Question

- How do the trillions of cells in the human body get what they need to function, and what do the cells do with the things they absorb?

Chapter 4 Question

- How did the athlete increase his cellular respiration and improve his performance?

Key Concepts

- The respiratory system brings in oxygen molecules from the air. These oxygen molecules are already small enough to fit into cells.
- The digestive system brings in food and breaks it down into smaller molecules, such as glucose and amino acids, that can fit into cells.
- The circulatory system transports glucose, oxygen, and amino acid molecules to every cell in the body.
- In a functioning human body, body systems work together to deliver glucose, oxygen, and amino acid molecules to the cells in the body.
- In order to release energy, cells need both glucose and oxygen molecules.
- Inside the cell, the atoms that make up glucose and oxygen can be rearranged to make different molecules. This chemical reaction is called cellular respiration and releases energy.
- Systems can work together to form a larger more complex system.

Vocabulary

- cellular respiration
- claim
- energy
- evidence
- glucose
- metabolism
- molecules
- oxygen

Name: _____ Date: _____

Warm-Up

Officials working for the National Biking Association have made different claims about how Jordan Jones won the American Cycling Classic this year. Right now, which claim do you think is the strongest?

- ☐ **Claim 1:** Jordan Jones increased his cellular respiration and improved his performance by blood doping.
- ☐ **Claim 2:** Jordan Jones increased his cellular respiration and improved his performance by changing his pre-race meal.
- ☐ **Claim 3**: Jordan Jones increased his cellular respiration and improved his performance by training at a higher altitude.

Why do you think that claim is the strongest?

_____

_____

_____

_____

Name: _____ Date: _____

Examining and Discussing Evidence About Jordan Jones's Race

Part 1: Reading and Annotating Evidence Cards

1. Set the three claim cards aside for now.
2. Read each evidence card carefully and annotate as needed.
3. At the bottom of each card, write one sentence to explain how this evidence connects to one or more of the claims about how Jordan Jones improved his performance.
4. Combine these cards with the evidence cards you evaluated in the last lesson.

Part 2: Discussing and Sorting Evidence

1. Place the three claim cards in a row on your desk.
2. With your partner, choose one evidence card at a time to focus on. Before you place each card under a claim, discuss your thinking with your partner.
3. Place each evidence card under the claim you think it best supports. Repeat this process until you've sorted all your cards. (Note: Do not sort Card O yet; set that card aside for now.)

Name: _____ Date: _____

Compare Jordan Jones' Pre-race Meals

1. Re-read Card N.
2. Read and annotate Card O
3. Discuss what Card O tells you about Card N with a partner.

Name: _____ Date: _____

Lesson 4.3: The Science Seminar

Did Jordan Jones engage in blood doping? In the Science Seminar today, you and your classmates will be doing most of the talking as you discuss the evidence and try to arrive at the best explanation for Jordan Jones's improved performance. By the end of the lesson, you'll be ready to write a convincing scientific argument.

Unit Question

- How do the trillions of cells in the human body get what they need to function, and what do the cells do with the things they absorb?

Chapter 4 Question

- How did the athlete increase his cellular respiration and improve his performance?

Key Concepts

- The respiratory system brings in oxygen molecules from the air. These oxygen molecules are already small enough to fit into cells.
- The digestive system brings in food and breaks it down into smaller molecules, such as glucose and amino acids, that can fit into cells.
- The circulatory system transports glucose, oxygen, and amino acid molecules to every cell in the body.
- In a functioning human body, body systems work together to deliver glucose, oxygen, and amino acid molecules to the cells in the body.
- In order to release energy, cells need both glucose and oxygen molecules.
- Inside the cell, the atoms that make up glucose and oxygen can be rearranged to make different molecules. This chemical reaction is called cellular respiration and releases energy.
- Systems can work together to form a larger more complex system.

Vocabulary

- cellular respiration
- claim
- energy
- evidence
- glucose
- metabolism
- molecules
- oxygen

Name: _____ Date: _____

Warm-Up

Read the message from Dr. Walker and answer the question below.

To: Medical Students
From: Dr. Walker
Subject: Jordan Jones

After reviewing Jordan Jones's pre-race meals, along with the evidence from Card N, we don't believe the changes in his meals could explain his improved performance. The difference in the amount of starch between the two meals wasn't enough to have a dramatic effect on his body's ability to release energy through cellular respiration.

Therefore, we want you to focus on the two other claims the National Biking Association asked us to investigate:

Claim 1: Jordan Jones increased his cellular respiration and improved his performance by blood doping.

Claim 3: Jordan Jones increased his cellular respiration and improved his performance by training at a higher altitude.

Do you agree with Dr. Walker and his colleagues that the changes to Jordan Jones's meal could not explain his improved performance? Why or why not?

_____

_____

_____

_____

Name: _____ Date: _____

Preparing for the Science Seminar

Instructions for Preparing Argument Organizers for Claims 1 and 3

1. Review the evidence that you already connected to Claim 1. Choose the most important evidence cards to support this claim.
2. Glue these evidence cards onto the Argument Organizer under the claim.
3. Clip any other evidence cards that support the claim to the back of the Argument Organizer.
4. Repeat steps 1–3 for Claim 3 to make your second Argument Organizer.
5. If time allows, write notes about the evidence cards in the extra space on each Argument Organizer.

Name: _____ Date: _____

Participating in the Science Seminar

Science Seminar Expectations

Students are expected to:

- run the conversation.
- use evidence to support ideas.
- explain their thinking.
- listen to one another.
- respond to one another.
- be open to changing their minds.

Name: _____ Date: _____

Science Seminar Observations

Write a check mark in the right-hand column every time you hear one of your peers say or do something listed in the left-hand column. If you hear an interesting idea, write it in the last row of the table.

Observations during the Seminar	Check marks
I heard a student use evidence to support a claim.	
I heard a student respectfully disagree with someone else's thinking.	
I heard a student explain how her evidence is connected to her claim.	
I heard a student evaluate the quality of the evidence.	
I heard an idea that makes me better understand one of the claims. That idea is:	

Name: _____ Date: _____

Homework: Writing a Final Argument

Over the last few days, you and your classmates thought about arguments that could be made to answer this question:

How did the athlete increase his cellular respiration and improve his performance?

You have considered three claims.

- **Claim 1:** Jordan Jones increased his cellular respiration and improved his performance by blood doping.
- **Claim 2:** Jordan Jones increased his cellular respiration and improved his performance by changing his pre-race meal.
- **Claim 3:** Jordan Jones increased his cellular respiration and improved his performance by training at a higher altitude.

Your final written argument about Jordan Jones has three parts:

- **Part 1:** Writing an argument to support Claim 1 or Claim 3.
- **Part 2:** Explaining why the other claim is not as strong.
- **Part 3:** Explaining why Claim 2 is not supported.

Scientific Argument Sentence Starters

Describing evidence:	**Describing how evidence supports a claim:**
The evidence that supports my claim is . . .	If _____, then . . .
My first piece of evidence is . . .	This is important because . . .
Another piece of evidence is . . .	Since . . .
This evidence shows . . .	Based on the evidence, I conclude that . . .

Name: _____ Date: _____

Homework: Writing a Final Argument (continued)

Part 1: Use the Science Seminar Evidence Cards, along with any other evidence from the unit you think is important, to support the claim that you think is strongest based on all the evidence that was available to you.

Write the claim you chose first, then complete the argument. In order to be convincing to someone who reads it, your argument should explain:

- what cellular respiration is;
- what blood doping or training at a higher altitude does to increase cellular respiration; and
- why you think your claim is the best explanation for Jordan Jones's improved performance.

_____

_____

_____

_____

_____

_____

Part 2: Use the Science Seminar Evidence Cards to explain why you think the other claim (Claim 1 or Claim 3) is not as strong.

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____

Homework: Writing a Final Argument (continued)

Part 3: Write an argument against Claim 2.

We do know that diet can affect cellular respiration and performance, even if it doesn't explain why Jordan Jones performed better in his race. In order to explain why Claim 2 is not supported, write an argument that includes:

- how starch/glucose are involved in cellular respiration;
- how a diet high in starch could help an athlete perform well; and
- why the evidence does not support the claim that Jordan Jones's change in diet resulted in his improved performance.

Name: _____ Date: _____

Homework: Check Your Understanding

This is a chance for you to reflect on your learning so far. This is not a test. Be open and truthful when you respond to the questions below.

1. I understand that scientists can be more or less certain of their claims depending on the evidence they have. ☐ yes ☐ not yet (check one and explain your answer choice)

_____

_____

_____

_____

_____

2. What are the most important things you have learned in this unit?

_____

_____

_____

_____

_____

3. What questions do you still have?

_____

_____

_____

_____

_____

Metabolism Glossary

amino acids: molecules that are the building blocks of proteins
aminoácidos: moléculas que son los componentes fundamentales de las proteínas

carbon dioxide: a molecule made of carbon and oxygen atoms
dióxido de carbono: una molécula hecha de átomos de carbono y oxígeno

cellular respiration: the chemical reaction between oxygen and glucose that releases energy into cells
respiración celular: la reacción química entre oxígeno y glucosa que libera energía en las células

chemical reaction: a process in which atoms rearrange to form new substances
reacción química: un proceso en el que los átomos se reorganizan para formar nuevas sustancias

circulatory system: the body system that transports molecules to and from all cells of the body
sistema circulatorio: el sistema que transporta moléculas desde y hacia todas las células del cuerpo

claim: a proposed answer to a question about the natural world
afirmación: una respuesta propuesta a una pregunta sobre el mundo natural

digestive system: the body system that takes in food and breaks it down
sistema digestivo: el sistema del cuerpo que toma alimento por dentro y lo desintegra

energy: the ability to make things move or change
energía: la capacidad de hacer que las cosas se muevan o cambien

evidence: information about the natural world that is used to support or go against (refute) a claim
evidencia: información sobre el mundo natural que se utiliza para respaldar o rechazar (refutar) una afirmación

glucose: a molecule that organisms can use to release energy, and that is made of carbon, hydrogen, and oxygen atoms
glucosa: una molécula que los organismos pueden usar para liberar energía y que está hecha de átomos de carbono, hidrógeno y oxígeno

metabolism: the body's use of molecules for energy and growth
metabolismo: el uso de moléculas por el cuerpo para obtener energía y crecer

molecule: a group of atoms joined together in a particular way

molécula: un grupo de átomos unidos de una manera particular

oxygen: a molecule that organisms get from the air or water around them and use to release energy

oxígeno: una molécula que los organismos obtienen del aire o del agua a su alrededor y que se utiliza para liberar energía

proteins: a category of large molecules that perform important functions inside living things

proteínas: una categoría de moléculas grandes que desempeñan funciones importantes dentro de los seres vivientes

reasoning: the process of making clear how your evidence supports your claim

razonamiento: el proceso de aclarar cómo tu evidencia respalda tu afirmación

respiratory system: the body system that takes in oxygen and releases carbon dioxide

sistema respiratorio: el sistema del cuerpo que toma dentro oxígeno y libera dióxido de carbono

scientific argument: a claim supported by evidence

argumento científico: una afirmación respaldada por evidencia

starch: a type of energy storage molecule made of many glucose molecules connected together

almidón: un tipo de molécula de almacenamiento de energía hecha de muchas moléculas de glucosa unidas

system: a set of interacting parts forming a complex whole

sistema: un conjunto de partes que interactúan formando un todo complejo

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