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

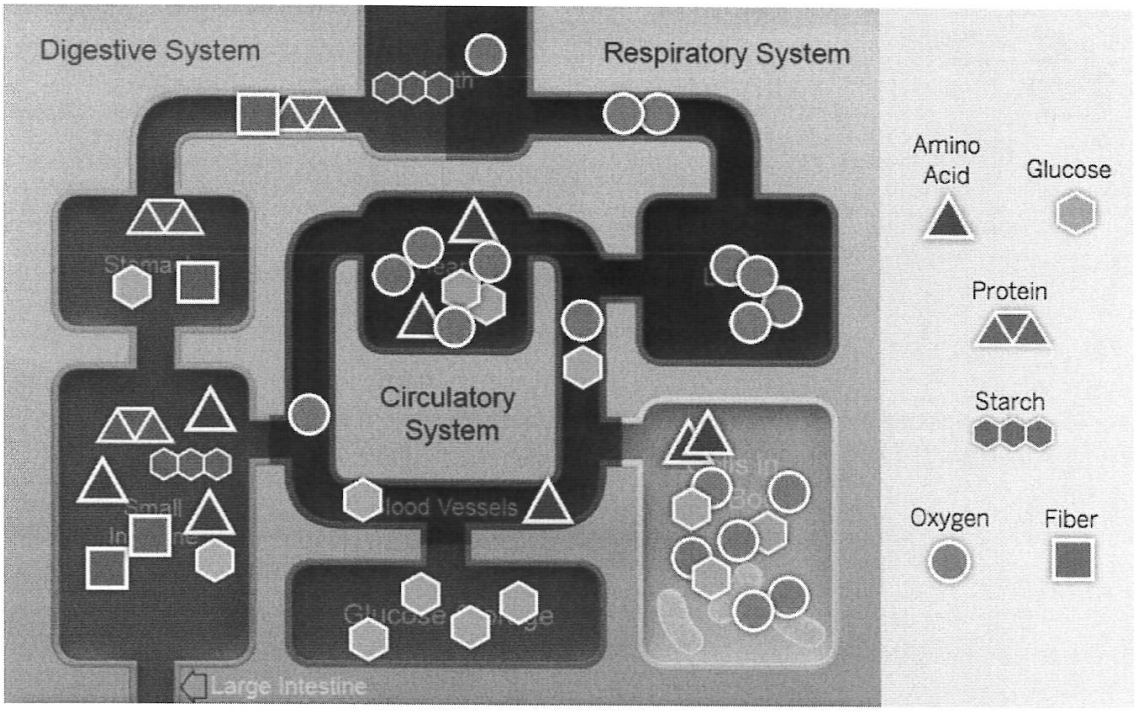
Name: _____ Date: _____

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

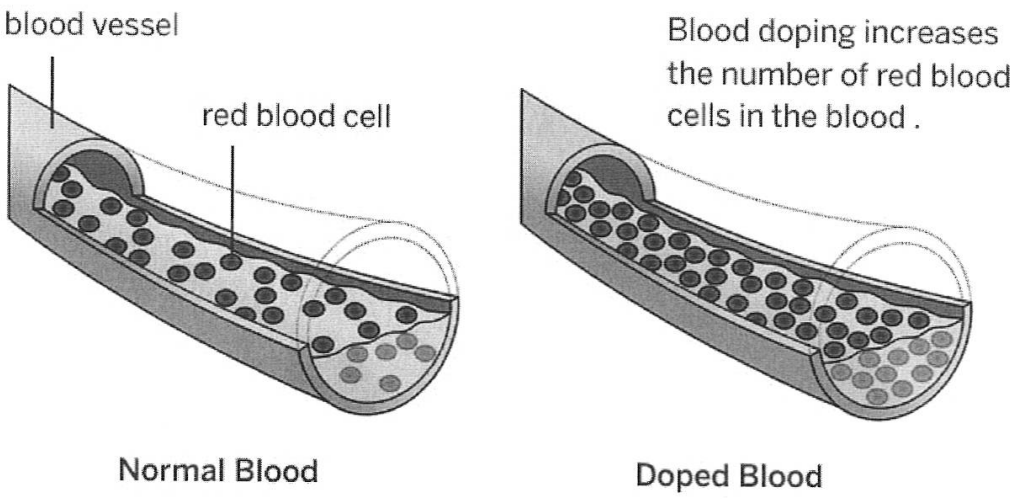
Name: _____ Date: _____

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.

Blood Doping and Red Blood Cells



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.