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

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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.

_____

_____

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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

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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.

_____

_____

_____

_____

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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

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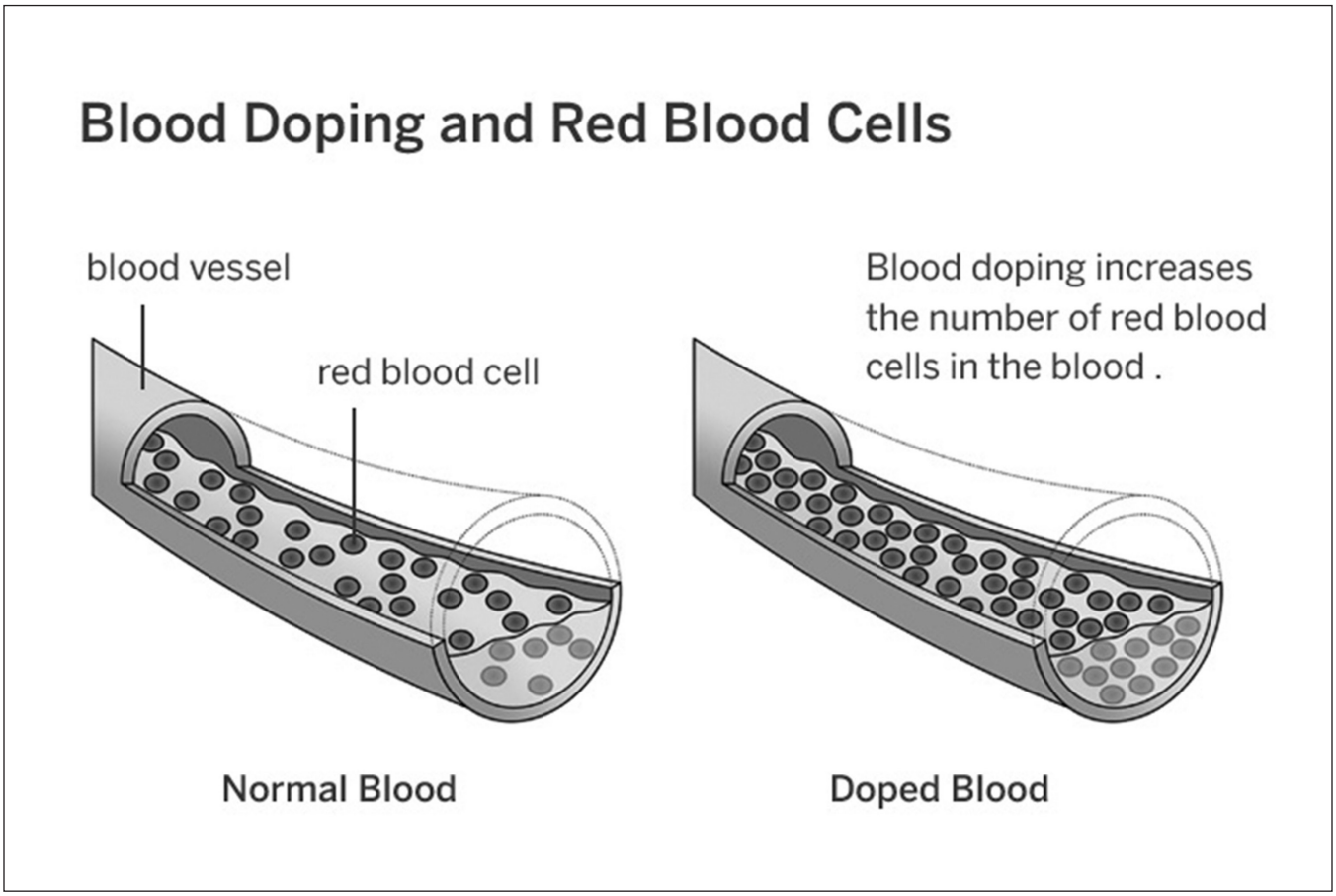
Second Read of "Blood Doping" (continued)

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.

_____

_____

_____

_____

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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?

_____

_____

_____

_____

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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.

_____

_____

_____

_____

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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.

_____

_____

_____

_____

_____

_____

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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.

_____

_____

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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?

_____

_____

_____

_____

_____

_____

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