AmplifyScience

Unit Overview:
Metabolism: Making the Diagnosis

Grade 6

AmplifyCurriculum

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Grade 6: *Metabolism: Making the Diagnosis*

Unit Summary

What's in this Unit?

Through inhabiting the role of medical students in a hospital, students—as they first diagnose a patient and then analyze the metabolism of world-class athletes—are able to draw the connections between the large-scale, macro-level experiences of the body and the micro-level processes that make the body function. By investigating a patient whose body systems are not working properly, students learn how body systems work together to provide the trillions of cells in the human body with the molecules they need. By exploring how athletic training improves the body's function, students learn how energy is released in the cells through cellular respiration and how that energy supports movement and cellular growth and repair. In the final chapter of the unit, students apply what they have learned to determine whether an athlete's improved performance could have been the result of blood doping.

Why?

This unit has been designed to connect ideas about the human body that have often been taught in isolation from one another. In a typical middle school life science curriculum, students may learn about the parts of the cell in one unit, cellular respiration in another, and body systems many months later. As a result, students are not guided to draw connections between these concepts, or to connect the abstract concepts to their actual experiences with their own bodies. They are also never provided the experience of connecting microscopic processes (how molecules from the environment are broken down and enter the cells to produce energy and to aid in cellular growth and repair) to the macro-level functions of the body systems and our overall health. We chose the medical student role because it provides a compelling and accessible context for connecting ideas about cells, body systems, molecules, and energy with phenomena that students are likely to be familiar with in their own bodies. This unit builds on students' interest in and awareness of problems like asthma and diabetes, as well as an interest in how the bodies of athletes who are competing at their peak of performance can function so well.

How?

Chapters 1 and 2 focus on how body systems work together to take molecules from the environment and get them, in usable form, to the cells. Students are presented with the challenge of helping diagnose a teenage patient, Elisa, who feels tired all the time. Through exploring the Metabolism Simulation, reading about different medical conditions, and

participating in a classroom-sized model of the body, students learn that in a functioning body the digestive, respiratory, and circulatory systems work together to get glucose, oxygen, and amino acids to the cells. By the end of Chapter 2, students diagnose Elisa with diabetes and are able to explain how this condition affects her body systems and the molecules that get to her cells.

In Chapter 3, students learn more about what the cells do with these molecules. They explore the effects of activity on their own bodies and in the Simulation, and are then introduced to cellular respiration, the chemical reaction that releases energy in the cells. Students learn that the energy released in cellular respiration also supports growth and repair at the cellular level. Students then shift their focus to considering cellular respiration in the context of high-performance athletes and read an article about a controversial practice called blood doping, which is used to enhance athletic performance. They apply what they have learned as they prepare to participate in a whole-class discussion and debate routine called a Science Seminar. In preparation for the Science Seminar, students analyze evidence to determine if an athlete increased his cellular respiration and improved his athletic performance through permitted methods.

Unit Progress Build Overview

Unit Progress Build Summary

The Unit Progress Build (PB) describes the way that students' explanations of the focal phenomenon should develop and deepen over the course of the unit. It is an important tool in understanding the design of the unit and in supporting students' learning. It organizes the sequence of instruction, defines the focus of the assessments, and informs the way that students' understanding of the content is diagnosed, specifically mid-unit to inform differentiation at the unit's Critical Juncture. The Critical Juncture is the differentiated instruction designed to address specific gaps in student understanding. This overview describes the *Metabolism* PB and the Critical Juncture for this unit.

Expected Student Background Knowledge

Educational research and our own studies have shown that at the start of the *Metabolism* unit, middle school students will likely know that eating and breathing are necessary for life, but will know little about the specifics of why these activities allow our bodies to function. Students may associate eating with gaining energy, but will not know that oxygen is also required for energy release. Students may know about the process of digestion, but are unlikely to know what happens to food after it is digested. Depending on previous instruction, some students may know about cells. Additionally, students will know that we have blood and a heart but will not generally know how these contribute to our bodies' ability to function. This experience and prior knowledge can be built on and refined, which the *Metabolism* Progress Build and unit structure are designed to do.

Metabolism Progress Levels

The *Metabolism* Progress Build consists of three levels of science understanding. At each level, students add and integrate new ideas to deepen their understanding about how human bodies use molecules from outside the body to function. Since the PB is an increasingly complex but integrated explanation, we represent it below by underlining new ideas in each level. The bolded level descriptions are intended to briefly capture the essence of the new ideas.

Prior Knowledge
The body can function when we eat food and breathe air.

Level 1: Cells in the body need molecules from outside to function
The body can function when the cells of the body are getting and using molecules that come from outside the body, from the food we eat and the air we breathe. Oxygen, glucose and amino acids are molecules the cells need that come from outside the body.

Level 2: Body systems work together to take in, break down, and deliver needed molecules to the cells
The body can function when the cells of the body are getting and using molecules that come from outside the body, from the food we eat and the air we breathe. Oxygen, glucose and amino acids are molecules the cells need that come from outside the body. The digestive system breaks down starch and protein molecules from food into glucose and amino acids, and then the circulatory system transports these molecules to the cells. Also, the respiratory system takes in oxygen molecules from the air, and the circulatory system transports those molecules unchanged to the cells because oxygen molecules are already small enough to fit into cells.

Level 3: Cells can use these molecules to release energy for the body
The body can function when the cells of the body are getting and using molecules that come from outside the body, from the food we eat and the air we breathe. Oxygen, glucose and amino acids are molecules the cells need that come from outside the body. The digestive system breaks down starch and protein molecules from food into glucose and amino acids, and then the circulatory system transports these molecules to the cells. Also, the respiratory system takes in oxygen molecules from the air, and the circulatory system transports those molecules unchanged to the cells because oxygen molecules are already small enough to fit into cells. When glucose and oxygen molecules are both in a cell, they undergo a chemical reaction, called cellular respiration, that releases energy. Cells use the energy released in cellular respiration to function, which allows the whole body to function.

NGSS Standards Addressed in the *Metabolism* Unit

Central Performance Expectations

MS-LS1-3. Use argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.]

MS-LS1-7. Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.] [Assessment Boundary: Assessment does not include details of the chemical reactions for photosynthesis or respiration.]

Secondary Performance Expectations

MS-LS1-1. Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells. [Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.]

MS-LS1-2. Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.] [Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.]

MS-LS1-5. Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms. [Clarification Statement: Examples of local environmental conditions could include availability of food, light, space, and water. Examples of genetic factors could include large breed cattle and species of

grass affecting growth of organisms. Examples of evidence could include drought decreasing plant growth, fertilizer increasing plant growth, different varieties of plant seeds growing at different rates in different conditions, and fish growing larger in large ponds than they do in small ponds.] [Assessment Boundary: Assessment does not include genetic mechanisms, gene regulation, or biochemical processes.]

MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories. [Assessment Boundary: Assessment does not include mechanisms for the transmission of this information.]

Central Disciplinary Core Ideas

LS1.A: Structure and Function: In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (MS-LS1-3)

LS1.C: Organization for Matter and Energy Flow in Organisms: Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (MS-LS1-7)

PS3.D: Energy in Chemical Processes and Everyday Life Cellular respiration in plants and animals involves chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (MS-LS-1-7)

Other NGSS Disciplinary Core Ideas

LS1.A: Structure and Function: All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (MS-LS1-1) Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2)

LS1.D: Information Processing: Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. (MS-LS1-8)

Primary Cross-Cutting Concept

Systems and System Models

Secondary Cross-Cutting Concept

Scale, Proportion, and Quantity

Primary Science and Engineering Practices

Developing and Using Models
Engaging in Argument from Evidence
Constructing Explanations and Designing Solutions
Obtaining, Evaluating and Communicating Information
Planning and Carrying Out Investigations

Organization of the Metabolism Unit

Unit Length: approximately 20 lessons (includes time for pre-, post-, and interim assessment)

Pre-Unit Assessment

Students take an online Pre-Unit Assessment that includes multiple-choice and written-response questions.

Chapter 1: Molecules Needed by the Cells

1.1 Welcome to Medical School
1.2 Evaluating Initial Claims About Elisa

Chapter 2: Body Systems

2.1 Exploring the Classroom Body Systems Model
2.2 Patient
2.2 Patient Stories: Problems with Body Systems
2.3 Learning More About a Condition
2.4 Conducting Sim Tests
2.5 Critical Juncture Assessment
2.6 Playing Guess My Model
2.7 Diagnosing Elisa

Chapter 3: Cellular Respiration

3.1 Learning About Energy Release in the Body
3.2 Exploring Chemical Reactions
3.3 Cellular Respiration, Growth and Repair
3.4 Blood Doping: Messing with Metabolism to Win Races
3.5 Modeling Cellular Respiration in an Athlete's Body

Chapter 4: Metabolism and Athletic Performance

4.1 Going for Gold: A Cycling Champion's Story
4.2 Analyzing Evidence
4.3 Science Seminar

Post-Unit Assessment

Students take an online Post-Unit Assessment that includes multiple-choice and written-response questions. Results of this assessment will indicate each student's level of understanding of core concepts from the unit, as specified in the Progress Build, showing growth over time when compared with the Pre-Unit Assessment.

Pre-Unit Assessment

Lesson Summary

Students complete a Pre-Unit Assessment consisting of twelve multiple-choice questions and two written-response questions. The Pre-Unit Assessment is diagnostic and designed to reveal students' understanding of the unit's core content prior to instruction by indicating, for formative purposes, where students initially fall along the levels of the Progress Build (PB). The Pre-Unit Assessment also measures students' understanding of important supporting content not explicitly included in the PB. As such, it offers a baseline from which to measure growth of understanding over the course of the unit.

Lesson at a Glance

Section 1: Multiple-Choice Questions (20 min)
These multiple-choice questions provide information about students' placements on the Progress Build. This item can be scored by referencing the provided rubric.

Section 2: Written-Response Question #1 (10 min)
This written-response question provides additional information about students' placements on the Progress Build. This item can be scored by referencing the provided rubric.

Section 3: Written-Response Question #2 (10 min)
This written-response question provides additional information about students' placements on the Progress Build. This item can be scored by referencing the provided rubric.

CHAPTER 1: Molecules Needed by the Cells

Students build an understanding that cells in the body need molecules from the external environment to function. Students are given the challenge of helping to diagnose a teenage patient, Elisa, who feels tired all the time, and they learn that the first thing they must understand is which molecules the body's cells need in order to function. Through a short reading and use of the Metabolism Simulation, students identify glucose, oxygen, and amino acids as molecules necessary for cellular function. By the end of the chapter, students will be able to explain that the body functions when its cells are getting and using molecules that come from outside the body—from the food we eat and the air we breathe.

Lesson 1.1: Welcome to Medical School

Lesson Summary

Students begin the unit by viewing a dramatic video that immerses them in their new role as medical students. They build on the video by brainstorming initial thoughts about why their patient, Elisa, could be feeling so tired. The teacher helps the class to create plausible alternative claims from these initial ideas. Students are then introduced to the Metabolism Simulation and they begin to observe how molecules travel through systems in a healthy body. The purpose of this lesson is to help students begin to make connections between macro-effects, such as how tired someone feels, and the microscopic world of metabolism—the body's use of molecules for energy and growth.

Students learn:

- The body takes in molecules by eating and breathing.
- Some of these molecules travel to the cells of the body.

Lesson at a Glance

Introducing Medical Student Role (5 min) [*Video*]
An introductory video plunges students into their new role as medical students and introduces them to their patient, a teenager who feels tired all the time.

Warm-Up (5 min)
Writing and discussing ideas about their new role provides students a chance to access and share background knowledge about how bodies function.

Section 1: Generating Claims About Elisa (5 min) [*Teacher-Led Discussion*]
The teacher helps students frame their initial ideas as possible claims to investigate. This whole-class share provides a sense of the ideas that students bring to this topic.

Section 2: Introducing the Metabolism Simulation (20 min) [*Sim]*
Students familiarize themselves with the Sim, and focus on thinking about and observing how a healthy body functions. This prepares them for later investigations into what happens when body systems fail.

Section 3: Returning to the Patient (5 min) [*Teacher-Led Discussion*]
Students connect their observations of the Sim to the term metabolism, and relate this to their ideas about their patient's problems.

Homework: Testing Different Diets in the Sim [*Sim*]
By experimenting with different diets in the Sim, students observe the relationship between food intake and molecules getting to the cells.

Lesson 1.2: Evaluating Initial Claims About Elisa

Lesson Summary

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

Students learn:

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

Lesson at a Glance

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

Section 1: Reading "Molecules Cells Need" (15 min) [*Reading*]
Students practice Active Reading with a brief article that reinforces the idea that cells need glucose, oxygen, and amino acids.

Section 2: Modeling Molecules in a Healthy Cell (5 min) [*Modeling Tool*]
Students draw on what they learned from the Sim and the article in order to represent their ideas about which molecules are found in a healthy cell.

Section 3: Evaluating New Evidence About Elisa (10 min) [*Sorting Tool*]
Students critique and evaluate evidence about Elisa's diet and sleep patterns, applying the criterion that evidence is higher quality when it consists of a larger set of data.

Section 4: Evaluating Claims About Elisa (10 min) [*Teacher-Led discussion*]
Students use the evidence they've received about Elisa to rule out the claims that diet or sleep may be the cause of her problems.

Homework: Relative Scale of Molecules [*Writing*]
Students have an opportunity to think about the relative sizes of the molecules that the body takes in from the environment. This will be important for when students learn about the role of the digestive system in breaking down large molecules.

CHAPTER 2: Body Systems

Students learn that the body's systems take in, break down, and deliver molecules to the cells, adding to their understanding of metabolism from Chapter 1. A classroom-sized model of the body helps students develop an understanding of how body systems work together to get the necessary molecules to the cells. Students are introduced to the three main body systems involved in metabolism: the digestive, respiratory, and circulatory systems. Through working with the Simulation, a hands-on model, and reading, students learn that starches and proteins are broken down into glucose and amino acids in the digestive system, while oxygen comes in through the respiratory system. They will also come to understand that the circulatory system transports these molecules to the cells. Students read one of four articles describing possible conditions their patient might have, all of which affect how either glucose or oxygen get into the cells and therefore, could account for their patient's tiredness. By the end of the chapter, with a focus on supporting claims about their patient's condition, students diagnose Elisa as having diabetes, but are still left considering exactly how a low level of glucose in cells results in feeling tired.

Lesson 2.1: Exploring the Classroom Body Systems Model

Lesson Summary

Students participate in a classroom-sized model of the human body in which students play the roles of body systems delivering molecules (represented by pipe cleaners) to cells. This kinesthetic experience demonstrates the important role that each body system plays in bringing necessary molecules to the body's cells. The digestive system breaks down starches and proteins into glucose and amino acid molecules. The respiratory system brings in oxygen molecules from air. The circulatory system connects the digestive and respiratory systems to the cells, transporting these molecules to all the cells in the body. This memorable classroom body systems model helps students understand the body as a system made of subsystems, which ultimately transports the necessary molecules to all the cells in the body.

Students learn:

- 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.
- Scientists use models to understand the processes that happen inside the human body because they are difficult to observe directly due to being too small or hidden from view.

Lesson at a Glance

Warm-Up (5 min)
By observing the path that oxygen takes through the body, students focus on the systems involved in this transport, which prepares them for the model used in this lesson.

Section 1: Introducing the Classroom Body Systems Model (5 min) [*Teacher-Led Discussion*]
Students are introduced to the components and purpose of the physical model in order to ensure that it runs smoothly.

Section 2: Playing Body Systems Model Video (5 min) [*Video*]
A realistic animation helps students visualize some of the processes and structures represented in their model.

Section 3: Running the Model (20 min) [*Hands-On Activity*]
As students assume the roles of human body systems and cells, they experience kinesthetically how the digestive, respiratory, and circulatory systems work together to transport molecules to the body's cells.

Section 4: Debriefing the Model (10 min) [*Teacher-Led Discussion*]
Small-group and whole-class discussions allow students to reflect on the model and what they learned from the experience. The teacher uses this opportunity as an On-the-Fly Assessment of students' engagement with the crosscutting concept of systems and system models.

Homework
Students revisit the healthy body in the Metabolism Simulation to observe the roles of the different body systems.

Lesson 2.2: Patient Stories: Problems with Body Systems

Lesson Summary

Students prepare to diagnose Elisa by engaging in a jigsaw reading experience. Each student becomes an expert on one of four medical conditions—anemia, asthma, diabetes, or pancreas injury—that might explain Elisa's symptoms. Each condition involves a failure in one of the body systems students have been learning about. In this lesson, students also continue to practice their Active Reading skills, focusing on deepening their questioning. For homework, students use the Sim to observe the condition they read about earlier in the lesson.

Students learn:

- In a functioning human body, body systems work together to deliver glucose, oxygen, and amino acid molecules to the cells in the body.
- Medical conditions can affect the functioning of body systems, resulting in the cells of the body not getting enough of the important molecules they need to function.
- Understanding of difficult texts, such as science texts, can be enhanced when you pay attention and ask meaningful questions while reading.

Lesson at a Glance

Warm-Up (10 min)
This Modeling Tool use serves as both a review of ideas from the previous lesson and a preview to support today's lesson.

Section 1: Active Reading: Patient Stories Article Set (20 min) [*Reading*]
Students continue to develop their Active Reading skills, focusing on deeper questioning. This article set serves as a jigsaw, with one student in each group becoming an expert on one of the conditions that Elisa might have.

Section 2: Discussing Annotations (15 min) [*Student-to-Student Talk*]
The after-reading discussion allows students to explain the condition they read about to a partner and provides time for students to share their thinking and clear up any confusion.

Homework: Observing a Condition in the Sim [*Sim*]
An initial observation of their condition in the Sim prepares students for more systematic comparisons between their condition and a healthy body in later lessons.

Lesson 2.3: Learning More About a Condition

Lesson Summary

Students revisit the Patient Stories: Problems with Body Systems article they read in the previous lesson. Using what they learn from the article, students create models to represent what happens in a body that has the condition they read about. These models will be a tool in the process of diagnosing Elisa. Students then compare their models to the simulation of their condition in the Sim. Finally, students are introduced to the Discussion Forum, a place where they will have a chance to interact with one another as a community of science researchers. For homework, students make their first posts to the Forum, expressing their ideas about Elisa's condition and about the evidence they need.

Students learn:

- With anemia, less oxygen gets into the circulatory system and the cells.
- With diabetes, less glucose gets into the cells.
- With asthma, less oxygen gets into the respiratory system, the circulatory system, and the cells.
- With a pancreas injury, less glucose gets into the circulatory system and the cells.
- Scientists create models to express their ideas about how something works.

Lesson at a Glance

Warm-Up (5 min)
This Warm-Up provides a quick review of, and a chance for you to assess students' understanding of, how body systems work together to break down larger molecules into smaller molecules and transport them to cells.

Section 1: Second Read of Patient Stories Articles (15 min) [*Reading*]
Students reread with a new purpose: to find the information they need to create a model of how the transport of molecules through body systems is affected by the condition they read about.

Section 2: Modeling a Condition (15 min) [*Modeling Tool*]
Creating a visual representation of the changes to a body's systems helps students to connect their reading to what they have learned about how body systems work.

Section 3: Comparing Models to the Sim (5 min) [*Sim*]
Students annotate a screenshot of the Sim in order to connect their own models to what they observe in the Simulation.

Section 4: Introducing the Forum (5 min) [*Teacher-Led Discussion*]
Prior to students' first encounter with the Discussion Forum, the teacher sets expectations to ensure that students know how to participate constructively.

Homework: Posting Ideas to the Forum [*Online Forum*]
Sharing ideas about Elisa's condition in an online forum will create a buzz as students begin to debate and consider the evidence they need to gather to make a diagnosis.

Lesson 2.4: Conducting Sim Tests

Lesson Summary

Students use the Metabolism Sim to run tests on a healthy body and on a body with one of the conditions they are investigating (asthma, anemia, diabetes, or pancreas injury). The quantitative data students collect will be compared to Elisa's test results in Lesson 2.7, allowing them to make a diagnosis. Students wrap up the lesson by reflecting on their understanding of body systems using the Word Relationships routine, and posting their ideas to the Forum. For homework, students use the Metabolism Modeling Tool to revise an inaccurate model of a body. In this lesson, students deepen their understanding of how a medical condition can affect the overall functioning of the human body, and they get practice making controlled comparisons and careful observations.

Students learn:

- A problem with a body system can result in fewer oxygen, glucose, and/or amino acid molecules getting to the body's cells.

Lesson at a Glance

Warm-Up (10 min)
Students reflect on their understanding of body systems by critiquing and discussing a flawed model of a healthy human body.

Section 1: Making Comparisons with the Sim (20 min) [*Sim*]
Students gather evidence that will help them diagnose Elisa in Lesson 2.7. They also get experience making controlled comparisons, making careful observations, and collecting quantitative data.

Section 2: Discussing Conditions (10 min) [*Student-to-Student Talk*]
Using the Word Relationships routine, students have an opportunity to reflect on the body systems and molecules they have been learning about.

Section 3: Posting to the Forum (5 min) [*Online Forum*]
By posting to the Forum and responding to others' posts, students get a chance to share and reflect on their knowledge.

Homework: Revising an Inaccurate Model [*Writing*]
Students display their understanding of body systems by correcting the flawed model of the healthy human body that was the subject of their Warm-Up critique.

Lesson 2.5: Critical Juncture Assessment

Lesson Summary

Students complete a Critical Juncture Assessment (CJ) consisting of twelve multiple-choice questions. The CJ is designed to reveal students' current levels of understanding about the core content from the unit, and the results are used to place each student at a particular level of the Progress Build (PB). The assessment results indicate students' progress from the beginning of the unit and are used to group students for differentiated instruction in the next lesson. As with the Pre-Unit Assessment, the CJ includes content beyond what a student is expected to have mastered. Therefore, the CJ is not intended to be used for summative purposes.

Lesson at a Glance

Section 1: Multiple-Choice Questions (25 min)
These multiple-choice questions provide an auto-scorable measure of students' placements on the Progress Build.

Lesson 2.6: Playing Guess My Model

Lesson Summary

This differentiated lesson uses the results of the Critical Juncture Assessment to provide students with experiences tailored to their particular content-learning needs. Students work in pairs to play a game that involves creating models of different scenarios in the body and guessing the model created by their partners. Although all students play the same game, the materials are differentiated to help students focus on the concepts with which they need more experience. This lesson is designed to help bring all students closer to mastery of important concepts before they move on in the unit, while also providing an appropriate challenge for advanced learners.

Students review and reinforce these 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.

Lesson at a Glance

Warm-Up (5 min)
After being assigned to a group (Blue, Green, or Purple), students read differentiated background information that supports their ability to participate in the Guess My Model Game.

Section 1: Introducing the Guess My Model Game (10 min) [*Teacher-Led Discussion*]
The teacher ensures that students understand how to play the Guess My Model Game so that students will be able to participate independently.

Section 2: Playing the Guess My Model Game (25 min) [*Student-to-Student Talk*]
Students create models representing their understanding of how body systems work; this activity is crafted as a game to increase motivation and is differentiated to support students at different levels of the Progress Build.

Section 3: Reflecting on the Guess My Model Game (5 min) [*Teacher-Led Discussion*]
A short reflection activity offers students a chance to share confusion or successes related to playing the Guess My Model Game.

2.7: Diagnosing Elisa

Lesson Summary

Students analyze new data in order to diagnose Elisa's condition. They begin by participating in a jigsaw discussion in which each student explains the condition they have been investigating and how that condition would affect Elisa's body systems. Students are then given Elisa's test results, and they compare these data to the evidence they gathered using the Sim in Lesson 2.4. They share their analysis with their group in order to make a diagnosis, and finally, each student produces a written argument about the diagnosis. This lesson provides students with an authentic context in which to practice their argumentation skills, as well as to apply their understanding of how body systems work to get needed molecules to the cells in the body.

Students learn:

- A diagnosis in medicine is a form of scientific argumentation in which evidence is used to rule out claims and support the best conclusion.

Lesson at a Glance

Warm-Up (5 min)
A message from Dr. Walker presents the possible claims about Elisa's condition and motivates students to begin thinking about diagnosing Elisa.

Analyzing Elisa's Test Results (25 min) [*Student-to-Student Talk*]
A jigsaw discussion allows students to articulate and share what they each know about their condition prior to analyzing Elisa's data and diagnosing her condition.

Writing an Argument to Support a Diagnosis (15 min) [*Writing*]
Students apply their argumentation skills and knowledge about metabolism to produce a written argument supporting their diagnosis of Elisa's condition.

Homework: Evaluating and Revising the Argument [*Writing*]
Students reflect on what makes a strong argument as they evaluate and revise their own writing.

CHAPTER 3: Cellular Respiration

Students learn that cells use the molecules delivered from the body's systems to release the energy needed for the body to function, integrating this idea into their understanding of metabolism from Chapters 1 and 2. Students begin by exploring the effects of activity on their own bodies and in the Simulation. They are then introduced to cellular respiration, the chemical reaction that releases energy in the cells, via further Sim use and a hands-on observation of another chemical reaction that releases energy. They consider how the energy released in cellular respiration allows the whole body to function, both when it's at rest and during activity. Students learn that the energy released in cellular respiration also supports growth and repair at the cellular level, which keeps the whole body functioning. They read an article about the controversial practice called blood doping, which some athletes use to enhance their athletic performance. The topic of blood doping helps students make connections between the energy released in cellular respiration, which happens in the cells, and the macro effects on the body. This article also emphasizes the role of oxygen and glucose in cellular respiration. By the end of the chapter, students will integrate the mechanism of cellular respiration into their explanation of metabolism: when glucose and oxygen molecules are both in a cell, they undergo a chemical reaction that releases energy. Cells use this energy to function, grow, and repair, which allows the whole body to function.

Lesson 3.1: Learning About Energy Release in the Body

Lesson Summary

Students dive deeper into metabolism, focusing on how molecules from food and air are involved in releasing the energy that the cells and body need to function. Students collect evidence from two sources; first they examine what happens to their own heart and breath rates when they exercise, and then they observe what is happening inside the body at the molecular level, using the Simulation. These activities allow students to discover that glucose molecules and oxygen molecules are needed in cells for energy release, which is preparation for learning about the process of cellular respiration in the next lesson.

Students learn:

- The body requires energy to function.
- In order to release energy, cells in the body need both glucose and oxygen molecules.

Lesson at a Glance

Warm-Up (5 min)
Students express initial ideas about the connection between Elisa's diabetes and her tiredness, preparing them for this chapter's focus on energy release in the body.

Section 1: Considering Claims About Energy Release (5 min) [*Teacher-Led Discussion*]
A poll, which students will revisit at the end of the lesson, targets common misconceptions about how the body releases energy.

Section 2: Gathering Evidence from Heart and Breath Rates (10 min)
[*Hands-On Activity*]
An engaging physical activity helps students observe directly how body systems (circulatory and respiratory) respond to increased energy demands.

Section 3: Gathering Evidence from the Sim (20 min) [*Sim*]
Through a series of controlled tests, students discover that glucose and oxygen molecules are needed in the cells for energy release.

Section 4: Revising Claims (5 min) [*Student-to-Student Talk*]
Students discuss how the evidence they've collected in the lesson supports the claim that glucose and oxygen are needed for energy release in the body.

Homework: Investigating Activity Level in the Sim [*Sim*]
Students use the Sim to gather more evidence supporting the idea that glucose and oxygen are needed for energy release.

Lesson 3.2: Exploring Chemical Reactions

Lesson Summary

Students investigate chemical reactions—in particular, reactions that release energy. They witness dramatic evidence of energy being released in a chemical reaction when several substances (baking soda, phenol red solution, and calcium chloride) are combined. This reaction serves as an analogy to the chemical reaction between glucose and oxygen, which releases energy in the cells of the body. Students further explore cellular respiration by reading about it in a short article and observing it in the Sim. This lesson provides students with multiple exposures, in different modalities, to the role that cellular respiration plays in human metabolism.

Students learn:

- 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.

Lesson at a Glance

Warm-Up (5 min)
The Warm-Up reinforces the idea that oxygen molecules, as well as glucose molecules, are needed to release energy in cells.

Section 1: Observing a Chemical Reaction (10 min) [*Hands-On*]
Students have a tactile experience with substances that combine to release energy. This reaction provides an analogy for how cellular respiration releases energy in the cells.

Section 2: Reading About Cellular Respiration (10 min) [*Reading]*
Students learn more about the chemical reaction that releases energy in the cells of the body by reading an article.

Section 3: Observing Cellular Respiration in the Sim (15 min) [*Sim*]
Students learn about cellular respiration in another modality; they observe the conversion of glucose and oxygen into water and carbon dioxide in the Sim.

Section 4: Reflecting on Cellular Respiration (5 min) [*Student-to-Student Talk*]
Through discussion with partners, students reflect on their new understanding of cellular respiration and connect these concepts to their patient, Elisa.

Homework: The Story of Sanctorius Video [*Video*]
A video about the seventeenth-century scientist Sanctorius provides an engaging perspective on cellular respiration. Students also apply ideas about cellular respiration to explain Elisa's condition.

Lesson 3.3: Cellular Respiration, Growth, and Repair

Lesson Summary

Students use the Sim to investigate amino acid molecules, observing that they combine in the cells to form protein molecules. To better understand this phenomenon, students read a short article about how cells form proteins, which the cells use for growth and repair. Next, students use the Modeling Tool to represent their understanding of how energy released in cellular respiration makes cellular growth and repair happen. Students then apply their new understanding of cellular growth and repair to their patient, Elisa. This lesson expands students' understanding of what happens in the cell to include the idea that energy from cellular respiration allows the cell to build proteins from amino acids.

Students learn:

- 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.
- Conditions that affect energy release in the cells, like diabetes, can also affect the body's ability to grow and repair cells.

Lesson at a Glance

Warm-Up (7 min)
To set the stage for today's focus on cellular growth and repair, students use the Metabolism Simulation to observe what happens with amino acid molecules in the cells of the body.

Section 1: Reading About Cellular Growth and Repair (15 min) [*Reading*]
Students read about the processes related to cellular growth and repair in the cells, deepening their understanding of the role of protein and amino acid molecules in the human body.

Section 2: Modeling Cellular Growth and Repair (15 min) [*Modeling Tool*]
Students create a new model of what is happening in a healthy cell, which incorporates their understanding of cellular respiration, growth, and repair.

Section 3: Writing About Elisa (8 min) [*Writing*]
Students apply their understanding of cellular growth and repair to their patient, Elisa, by responding to a writing prompt.

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

Lesson Summary

Students apply their Active Reading skills to an article about blood doping. Blood doping is an illegal process in which athletes increase their bodies' ability to carry out cellular respiration by storing their own blood and then injecting the stored blood back into their bodies before competitions. Students annotate the article about blood doping, continuing to focus on the strategy of asking meaningful questions, and then they post their questions to the Forum. This lesson provides students with an intriguing new context in which to apply their understanding of cellular respiration and also provides background for students' discussions in the Science Seminar in Chapter 4.

Students learn:

- Increased cellular respiration can occur when more oxygen is available to the cells of the body.
- Some athletes increase the amount of oxygen that can be carried by their circulatory systems through a process called blood doping.
- Training at high altitude can also increase the amount of oxygen that can be carried by the circulatory system.

Lesson at a Glance

Warm-Up (10 min)
In order to prepare for today's reading, students activate prior knowledge, considering their initial ideas about how cellular respiration might be different for elite athletes.

Section 1: Active Reading: "Blood Doping: Messing with Metabolism to Win Races" (23 min) [*Reading*]
By reading about how metabolism is altered in the illegal process of blood doping, students practice their Active Reading skills and deepen their understanding of metabolism.

Section 2: Posting Questions to the Forum (12 min) [*Online Forum*]
Posting questions to the Forum provides students with motivation to ask deeper questions and allows them to build shared knowledge through interaction with other students.

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

Lesson Summary

Students use the Metabolism Simulation to investigate how metabolism differs in a normal healthy body and a highly-trained athlete's body. Students use these Sim results to help them make a model of an athlete during exercise with the Metabolism Modeling Tool. Students then reread a section of the "Blood Doping: Messing with Metabolism to Win Races" article in order to better understand how blood doping affects cellular respiration. Finally, students make predictions about what the oxygen levels and rate of cellular respiration in a blood-doping athlete's body would be, and then they model these predictions with the Modeling Tool. This lesson deepens students' understanding of cellular respiration as they investigate it in the context of the special case of blood doping.

Students learn:

- Increased cellular respiration can occur when more oxygen is available to the cells of the body, especially during exercise.

Lesson at a Glance

Warm-Up (5 min)
By making predictions, students prepare for comparing a normal healthy body and an athlete's body in the Sim.

Section 1: Comparing a Normal Healthy Body to an Athlete's Body (15 min) [*Sim*]
This Simulation activity reinforces ideas about cellular respiration and the role of oxygen in this process, and helps to frame the second read of the blood doping article.

Section 2: Modeling an Athlete's Body (5 min) [*Modeling Tool]*
Students revise a model of a healthy body to show that athletes take in more oxygen and have a higher rate of cellular respiration in their cells.

Section 3: Second Read: "Blood Doping: Messing with Metabolism to Win Races" (15 min) [*Reading*]
Students reread sections of the article in order to better understand how cellular respiration and blood doping work.

Section 4: Modeling an Athlete Who Is Blood Doping (5 min) [*Modeling Tool*]
Students model their understanding of how the body of an athlete who is blood doping would be different from the body of an athlete who is not blood doping, in order to show how blood doping affects cellular respiration.

Homework: Cellular Respiration Sim Mission [*Sim*]
Students apply their understanding of cellular respiration by completing an engaging mission with the Sim.

CHAPTER 4: Metabolism and Athletic Performance

To conclude the unit, students consider different sources of evidence and participate in a whole-class discussion and debate routine called a Science Seminar. Through this experience, students apply and consolidate their understanding from Chapters 1–3. In preparation for the Science Seminar, students learn about a professional cyclist whose performance in races improved drastically from one year to the next. As medical students, they have been called upon to investigate the claim that the athlete increased his cellular respiration, and hence his performance, through the banned practice of blood doping. They will need to determine if the athlete improved his performance through legal training techniques that naturally increased his body's capacity for cellular respiration, or through the illegal practice of blood doping.

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

Lesson Summary

Students are introduced to the story of an elite cyclist who, in the span of just one year, went from placing 35th to placing first in a competitive bike race. Dr. Walker and his medical students have been called upon to investigate a claim that this cyclist increased his cellular respiration, and hence his performance, through the banned practice of blood doping. Students return to a section of "Blood Doping: Messing with Metabolism to Win Races," to get evidence to help them evaluate competing claims about the cyclist. Students are then presented with evidence about the cyclist, and they evaluate the quality of this evidence. This lesson begins students' preparation for participating in a whole-class discussion called a Science Seminar in Lesson 4.3.

Students learn:

- Scientists try to use the highest-quality evidence available when considering and comparing different claims.
- Evidence for blood doping can include age of red blood cells and levels of hemoglobin.
- High-altitude training can have a similar effect as blood doping, by increasing the number of red blood cells in the body.

Lesson at a Glance

Warm-Up (2 min)
Students review what they know about blood doping in preparation for watching The Bike Race video and this lesson's related activities.

Section 1: Playing The Bike Race Video (3 min) [*Video*]
An engaging video introduces the context for the Science Seminar sequence and connects to students' role as medical students.

Section 2: Introducing the Science Seminar Sequence (5 min)
[*Teacher-Led Discussion*]
Students are presented with competing claims, framing the argumentation that will take place in the Science Seminar sequence.

Section 3: Reading About Blood Doping and High-Altitude Training (15 min) [*Reading*]
A third read of the "Blood Doping" article gives students an opportunity to review how blood doping is detected and how high-altitude training affects cellular respiration.

Section 4: Reviewing Criteria for High-Quality Evidence (5 min)
[*Teacher-Led Discussion*]
Students review the idea that the quantity of data can affect the quality of evidence.

Section 5: Evaluating Evidence (15 min) [*Student-to-Student Talk*]
Students practice evaluating the quality of evidence as they begin to consider evidence about Jordan Jones.

Lesson 4.2: Analyzing Evidence

Lesson Summary

Students evaluate more evidence about Jordan Jones as they prepare to participate in the Science Seminar. After receiving a new set of evidence cards, students read and annotate the cards to help make sense of how the evidence relates to the claims. Then, in pairs, students discuss and sort the evidence according to which claim it might support. Finally, students use the Metabolism Sim to analyze Jordan Jones's pre-race meals, collecting more evidence about whether a change in diet might explain his improved performance. This lesson gives students experience with analyzing data and engaging in oral argumentation and prepares them to participate in the large-group discussion in the next lesson.

Students learn:

- Scientists must carefully consider all available evidence before making arguments about a phenomenon.

Lesson at a Glance

Warm-Up (5 min)
Students express their current ideas about the three claims about Jordan Jones, which helps prepare them to consider more evidence in today's lesson.

Section 1: Examining Evidence About Jordan Jones's Race (10 min) [*Reading*]
Students individually read and annotate new evidence about Jordan Jones in preparation for analyzing and discussing how this evidence connects to the claims.

Section 2: Discussing Evidence About Jordan Jones's Race (15 min)
[*Student-to-Student Talk*]
By discussing in pairs as they sort evidence cards, students get a chance to engage in oral argumentation and to articulate their reasoning. The teacher uses this opportunity as an On-the-Fly Assessment of students' engagement in the practice of arguing from evidence.

Section 3: Testing Jordan Jones's Pre-Race Meals with the Sim (15 min) [*Sim*]
Collecting more data from the Sim helps students to eliminate the claim that Jordan Jones's pre-race meals could account for the unusual leap from 35th to first place.

Lesson 4.3: The Science Seminar

Lesson Summary

Students engage in oral argumentation as they grapple with ideas about how energy is released in the body, in the context of a controversial claim that an athlete might be blood doping. Students prepare for their discussion by creating paper organizers with the evidence they are considering. They then participate in the Science Seminar, a group discussion in which students make sense of evidence and debate which claims are best supported. For homework, students craft a final written argument. The Science Seminar gives students an authentic context for applying what they have learned about the mechanisms of energy release in the body. The structure of the Science Seminar provides a unique student-centered argumentation experience.

Students learn:

- Discussing evidence and ideas with others helps build new understanding.
- Scientists can change their minds when presented with convincing evidence.

Lesson at a Glance

Warm-Up (5 min)
Students reflect on the evidence that supports the elimination of Claim 2. This will help narrow students' focus to Claims 1 and 3 for the Seminar.

Section 1: Preparing for the Science Seminar (15 min) [*Writing*]
Students review and reflect on evidence as they prepare paper organizers for ease of reference during the Seminar discussion.

Section 2: Introducing the Science Seminar (5 min) [*Teacher-led Discussion*]
The teacher explains the logistics and goals of the Science Seminar.

Section 3: Participating in the Science Seminar (20 min) [*Student-to-Student Talk]*
Students apply content knowledge and argumentation skills as they engage in a student-led discussion.

Homework: Writing an Argument [*Writing*]
Students build on their oral argumentation experience to produce a written scientific argument.

Metabolism Post-Unit Assessment

Lesson Summary

Students complete a Post-Unit Assessment consisting of twelve multiple-choice and two written-response questions. The Post-Unit Assessment indicates where students fall along the levels of the Progress Build (PB) after instruction by measuring their mastery of the specific ideas that comprise each level of the PB. The Post-Unit Assessment also measures students' understanding of important supporting content not explicitly included in the PB. When analyzed with the Pre-Unit Assessment and Critical Juncture, the Post-Unit Assessment results indicate students' progress over the course of the unit.

Lesson at a Glance

Section 1: Multiple-Choice Questions (25 min)
These multiple-choice questions provide an auto-scorable measure of students' placements on the Progress Build.

Section 2: Written-Response Question #1 (10 min)
This written-response question provides additional information about students' placements on the Progress Build. This item can be scored by referencing the provided rubric.

Section 3: Written-Response Question #2 (10 min)
This written-response question provides additional information about students' placements on the Progress Build. This item can be scored by referencing the provided rubric.

Assessment Overview

Metabolism Critical Juncture

Critical Junctures signify points in the unit at which it is especially important that all students understand the content before continuing. Critical Juncture assessments provide formative information about students' progress in the unit and can be used to group students for the differentiated lesson that follows it. This offers an opportunity to provide targeted experiences to students who have yet to understand the content. An assignment recommendation will be made automatically, based on auto-scoring of the formative assessments completed in the Critical Juncture lesson.

In the *Metabolism* unit, students' understanding should ideally be at Level 2 of the PB after Lesson 2.4. However, there are many reasons that this may not be the case (from differences in background knowledge to missing class), so the Critical Juncture assessment is intended to diagnose the Progress Level at which each student understands the content by Lesson 2.4. In Lesson 2.5, students have the opportunity to receive instruction targeted to their current level of understanding. This lesson provides similar activities for each group, so that particular groups will not feel singled out, but each group's specific activity targets an area of the unit in which these students are struggling. You may use the recommended grouping assignments, and can make adjustments to these recommendations based on your own insights about your students' understandings and needs. The goal of the differentiated lesson is to ensure that all students reach a level on the PB from which they can all continue on together. The table below describes the differentiated groups and offers a brief description of the instruction for this lesson.

Group	Instructional Activity
Green: Students in this group are still not at Level 1 of the PB. They need additional instruction that focuses on what molecules from outside the body are needed by the cells to function.	Students in this group will create models to show what molecules will be present in the cells of individuals under various conditions, and guess what condition is represented in their partner's models.
Blue: Students in this group are at Level 1 of the PB. They need additional instruction that focuses on the process by which the molecules get transported	Students in this group will create models to show where molecules will be present in the body systems of individuals under various conditions, and guess what condition is represented in their

to the cells.	partner's models - focusing on glucose, amino acids and oxygen.
Purple: Students in this group have reached Level 2 of the PB. They receive instruction that allows them to explore a new context, thus providing them with the option to gain breadth of knowledge without necessarily moving them farther along the PB.	Students in this group will create models to show what happens and where molecules will be present in the body systems of in various conditions, and guess what condition is represented in their partner's models - focusing on additional molecules or conditions that bypass certain aspects of a healthy body.

Metabolism On-The-Fly and Embedded Assessments

Lesson 1.2 Section 3	**MOLECULES FROM OUR FOOD TO OUR CELLS** **Embedded Assessment 1: Reviewing Submitted Student Models** The models students submit will help you gauge how well students are building their understanding that our bodies can function when our cells get certain molecules from outside the body—from the food we eat and the air we breathe. When reviewing students' Modeling Tool submissions, check that the models include oxygen, glucose, and amino acids in the cells.
Lesson 2.1 Section 4	**SYSTEMS** **On-the-Fly Assessment 1: Systems and System Models** **Look For:** Listen to students describe how the body systems work. In particular, listen for how their understanding of each body system's role is emerging: are they talking about how the respiratory system takes in oxygen, how larger molecules are broken down into smaller molecules in the digestive system, or how the circulatory system delivers molecules to the cells? Also, listen to how they refer to the interactions between parts of the system (e.g., the role of villi in the intestinal wall), and how systems work together to bring needed molecules to the cells. If you included the Going Further instructional suggestion in your discussion, listen for how students relate the way a system is modeled to the role it performs, and how the system model simplifies the system to make its functions, components, and interactions easier to understand. Now what? If students are describing the role of individual systems without describing how those systems function together, prompt them to focus on the interactions between systems. (For example, ask students how the alveoli involve both the respiratory and circulatory systems.) If you included the Going Further instructional suggestion, ask students what the model makes easier to understand, and how it does so (e.g., by simplifying interactions and highlighting the inputs and outputs of each system so they are easier to understand).
Lesson 2.7 Section 4	**BODY SYSTEMS' ROLES** **Embedded Assessment 2: Reviewing Students' Written Arguments**

	By this point in the unit, students should be integrating into their understanding of metabolism the idea that the body's systems take in, break down, and deliver molecules to the cells. For whichever condition students are writing about, their arguments should indicate the body system(s) that the condition affects and the molecule(s) that system takes in, breaks down (when necessary), or delivers to the cells—that the digestive system breaks down starch and protein molecules from food into glucose and amino acids, and then the circulatory system transports them to the cells. Also, the respiratory system takes in oxygen molecules, and the circulatory system transports them unchanged to the cells (because they are already small enough to fit into cells). Look for how students are developing the practice of argumentation by examining how explicitly their arguments cite data from Elisa's test results, as well as evidence from the Sim in 2.4, and how well they connect that evidence to their claim about Elisa's diagnosis. Students will have additional practice with argumentation in Chapter 4.
Lesson 3.3 Section 3	**CELLULAR RESPIRATION** **Embedded Assessment 3: Reviewing Submitted Student Models** Students should be building their understanding of metabolism to include the idea that cells use the molecules delivered from the body's systems to release energy for the body to function, grow, and repair. When reviewing students' Modeling Tool submissions, be sure that they properly indicate each of the two processes at play: that cellular respiration requires oxygen and glucose to release energy, and that cells grow and repair by using the energy released to combine amino acids into larger protein molecules.
Lesson 4.2 Section 3	**ARGUMENTATION** **On-the-Fly Assessment 2: Engaging in Argument from Evidence** **Look for:** Listen to several pairs of students, and observe as they sort their claim and evidence cards. Students should be applying what they've learned about metabolism by making connections between the evidence and provided claims about Jordan Jones's race. While students may make a variety of connections between the claims and available evidence with their cards, at this point it is important that they are not just randomly placing cards together. Listen to their conversations and listen for

	whether they have a rationale, even if incorrect, for why a particular piece of evidence is connected to a particular claim. Now what? If students are silently placing cards, prompt them to explain why they are making the connections they are making. To further encourage the practice of connecting evidence to claims, remind students to continue to discuss with their partner why a particular piece of evidence is connected to a particular claim about Jordan Jones's improved performance. If students are struggling to make connections between the evidence and claims, ask them which claim they think is right, and then ask them why they think so. If students are struggling to give a reason why, ask them what they would expect to see if the claim were true (for example, "If Jordan improved by changing his pre-race meal, what might we see in his cells?"). If students are having trouble making sense of the evidence cards, ask them what, specifically, the evidence reveals to be different about Jones's body systems or cells. Then, ask students to think about what types of things might lead to this difference.

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