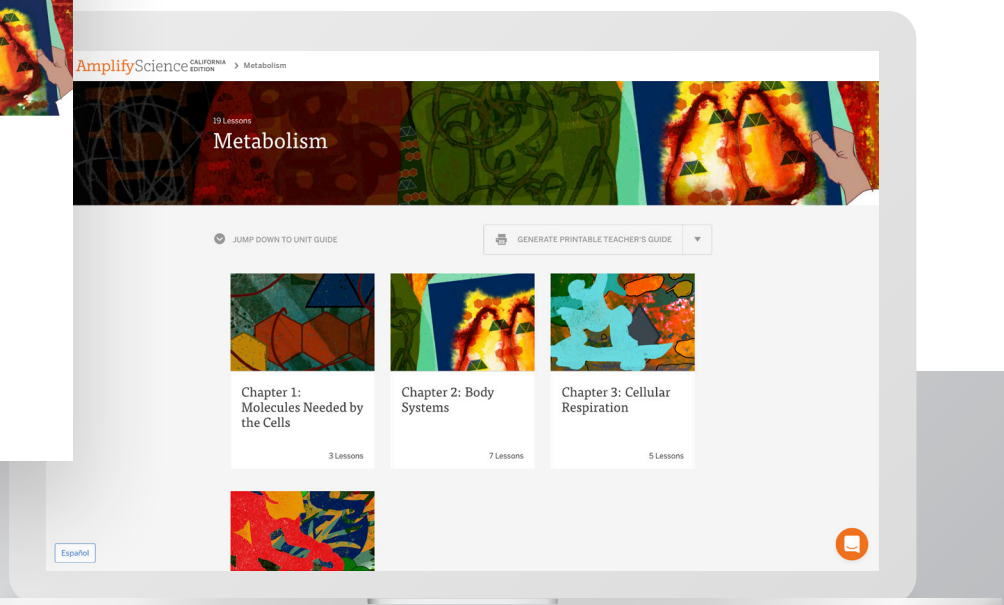
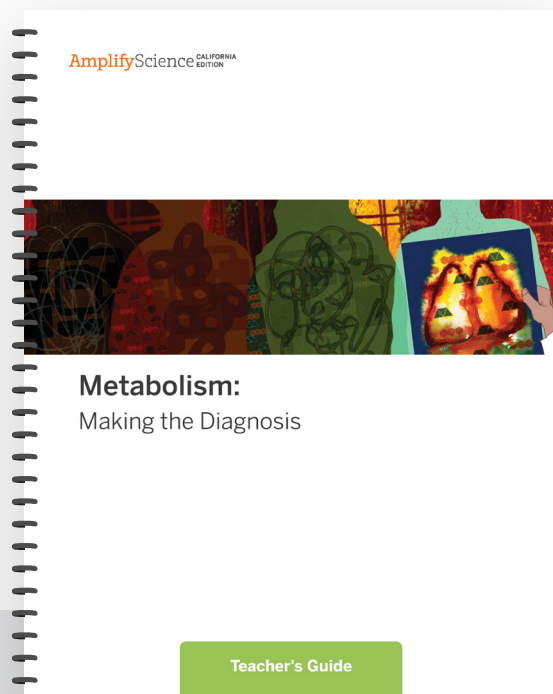


UNIT GUIDE

Metabolism





Amplify.



THE LAWRENCE
HALL OF SCIENCE
UNIVERSITY OF CALIFORNIA, BERKELEY

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Welcome to Metabolism

When it comes to the topic of metabolism, most curricula teach students 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 among 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 to the macro-level functions of the body systems and our overall health. In contrast, Amplify Science California invites students to investigate a compelling and accessible storyline that connects ideas about cells, body systems, molecules, and energy with phenomena that they are likely to be familiar within their own bodies.

Unlike a typical curriculum, Amplify Science California anchors learning by inviting students to take on the role of scientists and engineers.

In this unit, students take on the role of medical students. Their job is to help a team of doctors diagnose a teenage patient, Elisa, who feels tired all the time. Working together, they learn about body systems, cellular respiration, and cellular growth and repair. The unit concludes with a Science Seminar, in which students use what they have learned to analyze evidence and participate in a discussion about whether Jordan Jones, a fictional professional cyclist, improved his performance through legal or illegal practices.

Unit Type: Core

Student Role: Medical Students

Phenomenon: Elisa, a young patient, feels tired all the time.

Core Concept: Understanding how body systems work together to provide cells in the human body with the molecules they need

Target Performance Expectations:

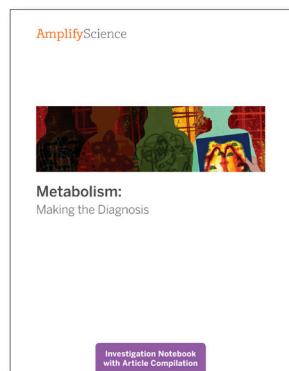
- LS1-1: Living Things Made of Cells
- LS1-2: Cell Parts
- LS1-3: Body Systems
- LS1-8: Sensory Receptors

Related Performance Expectations:

- LS1-7: Cellular Respiration

Students figure out the unit phenomenon through the use of a variety of resources.

Student Investigation Notebook



Hands-On Kit



Videos



Digital Tools



About technology in this unit:

All Amplify Science California lessons were designed with device sharing in mind, and never assume that every student has a separate device.

In this grade, student-facing technology includes Practice Tools and digital Simulations. When the use of a digital tool is called for in a lesson, teachers have several implementation options:

If limited student devices are available—teachers can have students do activities in pairs or small groups.

If no student devices are available—teachers can project the digital tool to the class and either “drive” the digital tool themselves or invite students to “drive” by using their device.

If internet access is unavailable—teachers can “pre-load” the digital tool on their device for use offline.

Chapter 1: The storyline begins

What students investigate:

Why does Elisa feel tired all the time?

What they figure out:

Cells in the body need molecules from the external environment to function, grow, and repair. In particular, our bodies need glucose, oxygen, and amino acids, which come from the food we eat and the air we breathe. Elisa feels tired because her cells aren't getting the molecules they need.

How they figure it out:

- Making observations of various body systems using the Sim
- Reading an article about how cells get glucose, oxygen, and amino acid molecules from the environment

KEY



CLASS



HANDS-ON



HOMEWORK



MODELING



READING



SIM



SORTING



STUDENT-TO-STUDENT
DISCUSSION



TEACHER



TEACHER-LED
DISCUSSION






WARM-UP



WRITING

DAY 1 | LESSON 1.1







Pre-Unit Assessment

-  Multiple-Choice Questions (25 min)
-  Written-Response Question #1 (10 min)
-  Written-Response Question #1 (10 min)

Pre-Unit Assessment








DAY 2 | LESSON 1.2

Welcome to Medical School

-  Introducing the Medical Student Role (5 min)
-  Warm-Up (5 min)
-  Generating Claims About Elisa (5 min)
-  Introducing the Metabolism Simulation (20 min)
-  Returning to the Patient (5 min)
-  Homework

DAY 3 | LESSON 1.3

Evaluating Initial Claims About Elisa

-  Warm-Up (5 min)
-  Reading “Molecules Cells Need” (15 min)
-  Modeling Molecules in a Healthy Cell (5 min)
-  Evaluating New Evidence About Elisa (10 min)
-  Evaluating Claims About Elisa (10 min)
-  Homework
-  Self-Assessment (Optional)

On-the-Fly Assessment
Self-Assessment

Chapter 2:

The storyline builds

What students investigate:

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

What they figure out:

There are three main body systems involved in metabolism: the digestive, respiratory, and circulatory systems. Each system takes in, breaks down, and delivers molecules to various cells. The digestive system breaks down starches and proteins into glucose and amino acids. The respiratory system brings in oxygen molecules from the air, which are already small enough to fit into the cells. The circulatory system transports all of these molecules to every cell in the body. In the case of Elisa, her cells are getting enough oxygen and amino acids, but not enough glucose. Her digestive system isn't breaking down starches into glucose properly, which indicates that she may have diabetes.

How they figure it out:

- Exploring medical conditions using the Sim
- Reading articles about four medical conditions that prevent our bodies from getting important molecules, including the symptoms, causes, and treatment for each condition
- Reading an article about scientist Dr. Grace O'Connell from the University of California at Berkeley who is working to help those suffering from back pain by growing new cells
- Conducting hands-on investigations
- Participating in a Classroom Body Systems Model

KEY



CLASS



HANDS-ON



HOMEWORK



MODELING



READING



SIM



SORTING



STUDENT-TO-STUDENT DISCUSSION



TEACHER



TEACHER-LED DISCUSSION









WARM-UP



WRITING

DAY 4 | LESSON 2.1





Exploring the Classroom Body Systems Model

-  Warm-Up (5 min)
-  Introducing the Classroom Body Systems Model (5 min)
-  Playing Body Systems Model Video (5 min)
-  Running the Model (20 min)
-  Debriefing the Model (10 min)
-  Homework

On-the-Fly Assessment






DAY 5 | LESSON 2.2

“Patient Stories: Problems with Body Systems”

-  Warm-Up (10 min)
-  Reading “Patient Stories” Article Set (20 min)
-  Discussing Annotations (15 min)
-  Homework






DAY 6 | LESSON 2.3

Learning More About a Condition

-  Warm-Up (5 min)
-  Rereading “Patient Stories” Article Set (15 min)
-  Modeling a Condition (15 min)
-  Comparing Models to the Sim (10 min)
-  Homework




DAY 7 | LESSON 2.4

Conducting Sim Tests

-  Warm-Up (10 min)
-  Making Comparisons with the Sim (20 min)
-  Word Relationships: Discussing Conditions (10 min)
-  Homework
-  Family Homework Experience (Optional)

DAY 8 | LESSON 2.5






Critical Juncture Assessment

-  Multiple-Choice Questions (25 min)
-  Written-Response Question #1 (10 min)
-  Written-Response Question #2 (10 min)

Critical Juncture Assessment






DAY 9 | LESSON 2.6

Playing Guess My Models

-  Warm-Up (5 min)
-  Introducing the Guess My Model Game (10 min)
-  Playing the Guess My Model Game (25 min)
-  Reflecting on the Guess My Model Game (5 min)
-  Homework

DAY 10 | LESSON 2.7

Diagnosing Elisa

-  Warm-Up (5 min)
-  Analyzing Elisa’s Test Results (25 min)
-  Writing an Argument to Support a Diagnosis (15 min)
-  Homework
-  Self-Assessment (Optional)

On-the-Fly Assessment
Self-Assessment

Chapter 3:

The storyline goes deeper

What students investigate:

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

What they figure out:

Cells use the molecules delivered from the body's systems to release the energy needed for the body to function. In order to release this 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*. Cells can grow and repair themselves by combining amino acid molecules to form larger protein molecules. This growth and repair requires energy released from cellular respiration. Since Elisa's digestive system isn't creating glucose the way it should, the process of cellular respiration can't take place. That's why she feels tired.

How they figure it out:

- Exploring the effects of activity on their own bodies
- Observing a chemical reaction that represents a model of cellular respiration
- Reading an article about cellular respiration and the processes that cells use to convert glucose and oxygen into energy
- Reading an article about the processes of growth and repair that take place as the body matures and heals itself, focusing on growth at the cellular level
- Reading an article about the banned practice of blood doping utilized by some cyclists to illegally improve their performance
- Conducting additional investigations using the Sim

KEY



CLASS



HANDS-ON



HOMEWORK



MODELING



READING



SIM



SORTING



STUDENT-TO-STUDENT DISCUSSION



TEACHER



TEACHER-LED DISCUSSION









WARM-UP



WRITING







DAY 11 | LESSON 3.1

Learning About Energy Release in the Body

-  Warm-Up (2 min)
-  Considering Claims About Energy Release (5 min)
-  Gathering Evidence from Heart and Breath Rates (10 min)
-  Gathering Evidence from the Sim (20 min)
-  Revising Claims (5 min)
-  Homework






DAY 12 | LESSON 3.2

Exploring Chemical Reactions

-  Warm-Up (5 min)
-  Observing a Chemical Reaction (15 min)
-  Reading About Cellular Respiration (10 min)
-  Observing Cellular Respiration in the Sim (10 min)
-  Reflecting on Cellular Respiration (5 min)
-  Homework

DAY 13 | LESSON 3.3

Cellular Respiration, Growth, and Repair





-  Warm-Up (7 min)
-  Reading About Cellular Growth and Repair (15 min)
-  Modeling Cellular Growth and Repair (5 min)
-  Writing About Elisa (8 min)
-  Homework

On-the-Fly Assessment

Optional Flexextension:
Investigating the Nervous System








DAY 14 | LESSON 3.4

“Blood Doping: Messing with Metabolism to Win Races”

-  Warm-Up (10 min)
-  Reading “Blood Doping” (20 min)
-  Discussing Annotations (15 min)
-  Homework

DAY 15 | LESSON 3.5

Modeling Cellular Respiration in an Athlete’s Body

-  Warm-Up (5 min)
-  Comparing a Healthy Body to an Athlete’s Body (8 min)
-  Modeling an Athlete’s Body (12 min)
-  Rereading “Blood Doping” (15 min)
-  Modeling an Athlete Who Is Blood Doping (5 min)
-  Homework
-  Self-Assessment (Optional)

Self-Assessment

Chapter 4: Application to a new storyline

What students investigate:

Jordan Jones, a fictional professional cyclist, finished 35th in a competitive bike race last year and 1st in a similar race this year. How did the athlete increase his cellular respiration and improve his performance? Was it through legal training techniques that naturally increased his body's capacity for cellular respiration, or through the illegal practice of blood doping?

What they figure out:

Scientists must communicate how their claims and evidence are supported with reasoning in a convincing scientific argument. In order to convince its reader, a written scientific argument needs to state a claim, describe specific evidence, and explain how the evidence supports the claim. A claim can sometimes be supported more effectively if you consider the combination of several different pieces of evidence.

How they figure it out:

- Reading an article that dives deeper into the controversial practice of blood doping
- Reviewing available evidence to make an argument
- Engaging in oral argumentation in a student-led discourse routine called a Science Seminar
- Writing final arguments

KEY



CLASS



HANDS-ON



HOMEWORK



MODELING



READING



SIM



SORTING



STUDENT-TO-STUDENT DISCUSSION



TEACHER



TEACHER-LED DISCUSSION









WARM-UP



WRITING





DAY 16 | LESSON 4.1

Going for Gold: A Cycling Champion's Story

-  Warm-Up (2 min)
-  Playing the Bike Race Video (3 min)
-  Introducing the Science Seminar Sequence (5 min)
-  Blood Doping and High-Altitude Training (15 min)
-  Reviewing Criteria for High-Quality Evidence (5 min)
-  Evaluating Evidence (15 min)

DAY 17 | LESSON 4.2







Analyzing Evidence

-  Warm-Up (5 min)
-  Examining Evidence About Jordan Jones's Race (10 min)
-  Discussing Evidence About Jordan Jones's Race (15 min)
-  Considering Claim 2 (15 min)

On-the-Fly Assessment

DAY 18 | LESSON 4.3




Science Seminar

-  Warm-Up (5 min)
-  Preparing for the Science Seminar (15 min)
-  Introducing for the Science Seminar (5 min)
-  Participating in the Science Seminar (20 min)
-  Homework
-  Self-Assessment (Optional)

Self-Assessment

DAY 19 | LESSON 4.4

End-of-Unit Assessment

-  Multiple-Choice Questions (25 min)
-  Written-Response Question #1 (10 min)
-  Written-Response Question #2 (10 min)

End-of-Unit Assessment

All students. All standards.

Rather than treating the standards simply as a list of topics to cover, we designed Amplify Science California to allow for truly in-depth and integrated coverage of the disciplinary core ideas (DCIs), science and engineering practices (SEPs), and crosscutting concepts (CCCs). Unlike other programs, however, ours makes the NGSS' vision of "all students, all standards" a reality by creating a unit-specific learning progression for every unit called a Progress Build.

Each Progress Build defines several levels of understanding of the unit's anchoring phenomenon, with each level integrating and building upon the knowledge and skills from lower levels. In this way, each Progress Build provides a clear roadmap for how students' understanding of the phenomenon is expected to deepen and develop with each successive chapter and lesson.

What's more, the program's system of assessments is also tied to these Progress Builds. This carefully crafted integration provides teachers with credible, actionable, and timely diagnostic information about student progress toward the unit's learning goals and grade-level performance expectations. Armed with this powerful data, teachers have the ultimate flexibility to decide when to move on and when to slow down and dive deeper.

Metabolism Progress Build

The Progress Build in this unit consists of three levels of understanding. At each level, students add new ideas and integrate them into a progressively deeper understanding of how body systems work together to provide cells in the human body with the molecules they need.

Progress Build Level 1:

Cells in the body need molecules from outside to function.

Progress Build Level 2:

Systems in the body work together to take in, break down, and deliver needed molecules to the cells.

Progress Build Level 3:

Cells can use these molecules to release energy for the body to function.

Examples of differentiation in this unit

In addition to providing unit-specific Progress Builds that break learning goals into smaller, more achievable levels of understanding, Amplify Science California makes learning accessible for all students through a variety of scaffolds, supports, and differentiation strategies for every lesson. **For a complete list of strategies, see the Differentiation section of every Lesson Brief.**

Below are a few examples of strategies embedded in this unit.

For English learners:

Scaffolded homework support for Emerging students (Example from Lesson 4.3)

Consider making the homework a scheduled (rather than suggested) activity, to provide differentiated Designated ELD instruction to ELs at the different levels of English proficiency. For students at the Emerging level, highlight the purpose of text organization and structure of scientific argument. Provide a graphic organizer that includes sections to include the claim, evidence, and elaboration. Provide scaffolding by jointly constructing Part 1 of the argument.

For students needing more support:

Assigning anemia article or asthma article (Example from Lesson 2.2)

Some students may benefit from reading about a simpler condition. In this set of articles, the anemia and asthma conditions are the least challenging to understand and explain on the Sim and Modeling Tool, since they do not involve the extra steps of breaking the molecules down. Because students will be following the same condition for a few lessons, you may want to consider distributing the articles so that students who need more support are provided with one of these articles.

For students ready for a challenge:

Critiquing the model (Example from Lesson 3.3)

If some students finish the Metabolism Sim activity early and seem to understand what the activity was about (figuring out which molecules are needed for the cells to function), challenge them to write up a critique of the Sim as a model. How is it like the human body? How is it different? What are some alternate conceptions that someone could have from using this model to better understand the human body and how it works? You may use these evaluations to help you launch into conversations with the entire class about the strengths and weaknesses of this model. You may also encourage these students to continue to add to their critiques as the unit progresses and they get to know the Sim and the content even better.

3-D Statements

In order to help teachers recognize the three-dimensional structure of every unit, chapter, and lesson, each unit contains a 3-D Statement document that makes the integration clear.

Making the 3-D statement document all the more effective, the three dimensions are color-coded for easy recognition.

Metabolism 3-D Coverage

SEPs

Science and Engineering Practices

DCIs

Disciplinary Core Ideas

CCCs

Cross-Cutting Concepts

Unit Level

As students first diagnose a patient and then engage in argumentation about an athlete's improved performance, they make connections—through the use of physical and digital models, articles, videos, and hands-on investigations—between macroscale and microscale processes in the body (scale, proportion, and quantity). Students construct explanations about how body systems work together (systems and system models) to provide the body's cells with the molecules they need for cellular respiration (energy), growth, and repair (energy and matter).

Chapter Level

Chapter 1: Molecules Needed by the Cells

Students obtain and evaluate information from a digital model and an article in order to explain that the body system functions when its cells are getting and using molecules that come from outside the body (systems and system models).

Chapter 2: Body Systems

Students work with a digital and a physical model as well as read articles to obtain information about the functions and interactions of the digestive, respiratory, and circulatory systems (systems and system models), discovering connections between microscale processes and macroscale effects (scale, proportion, and quantity).

Chapter 3: Cellular Respiration

Students obtain and evaluate information from a variety of evidence sources—including a digital model, a hands-on activity, and observations of their own bodies—about how cells release energy through cellular respiration and use this energy for growth and repair (energy and matter).

Chapter 4: Metabolism and Athletic Performance

Students analyze evidence and make oral and written arguments—using what they have learned about body systems, metabolism, and cellular respiration (systems and system models, energy and matter)—to determine whether a cyclist's dramatically improved performance over a one-year period is the result of blood doping.

To review the 3-D Statements at the lesson level, see the Lesson Brief section of every lesson.

3-D Statements

Metabolism
Teacher References

3-D Statements

Metabolism
Teacher References

Lesson 1.3: Evaluating Initial C
Students obtain information from i
function in a healthy body (scale, p

Lesson 2.1: Exploring the Class
Students create a classroom-sized
delivering molecules to cells. Stud
systems/systems and system mod

Lesson 2.2: Patient Stories: Pr
Students obtain and evaluate infor
of four metabolic conditions that a
system models).

Lesson 2.3: Learning More Abo
Students create models to represe
by the condition they read about in
microscale processes and macrost

Lesson 2.4: Conducting Sim Te
Students use a digital model to tes
(systems and system models).

Lesson 2.5: Critical Juncture A

Lesson 2.6: Playing Guess My I
Students create models that show
system models).

Lesson 2.7: Diagnosing Elisa
Students analyze and interpret dat
construct written arguments base
her body systems' ability to deliver
models).

Lesson 3.1: Learning About Enc
Students collect and analyze evide
digital model) to observe what is h
order to discover that glucose molecu
and oxygen molecules are needed in
cells for energy release (energy an
matter).

Key
Practices **Disciplinary Core Ideas** **Crosscutting Concepts**

Unit Level
As students first diagnose a patient and then engage in argumentation about an athlete's improved performance, they make connections—through the use of physical and digital models, articles, videos, and hands-on investigations—between macroscale and microscale processes in the body (scale, proportion, and quantity). Students construct explanations about how body systems work together (systems and system models) to provide the body's cells with the molecules they need for cellular respiration (energy), growth, and repair (energy and matter).

Chapter Level
Chapter 1: Molecules Needed by the Cells
Students obtain and evaluate information from a digital model and an article in order to explain that the body system functions when its cells are getting and using molecules that come from outside the body (systems and system models).

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Students work with a digital and a physical model as well as read articles to obtain information about the functions and interactions of the digestive, respiratory, and circulatory systems (systems and system models), discovering connections between microscale processes and macroscale effects (scale, proportion, and quantity).

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Students obtain and evaluate information from a variety of evidence sources—including a digital model, a hands-on activity, and observations of their own bodies—about how cells release energy through cellular respiration and use this energy for growth and repair (energy and matter).

Chapter 4: Metabolism and Athletic Performance
Students analyze evidence and make oral and written arguments—using what they have learned about body systems, metabolism, and cellular respiration (systems and system models, energy and matter)—to determine whether a cyclist's dramatically improved performance over a one-year period is the result of blood doping.

Lesson Level
Lesson 1.1: Pre-Unit Assessment
Lesson 1.2: Welcome to Medical School
Students use a model of the human body to make observations at the molecular scale (scale, proportion, and quantity) in order to investigate where the molecules that the body takes in through eating and breathing go once they are in the body.

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