

# TEACHER GUIDE

## EXPLAIN 1 LESSON 10



**Module Questions:** *Why do we get sweaty and thirsty after exercise? Why does the color of our urine change? How does milk help us recover from these effects?*

### What We Figure Out:

We figure out that the body uses two different negative feedback mechanisms to return its body temperature to a stable state after it undergoes a change. This is an example of the body trying to maintain homeostasis, or a stable state of its normal conditions, to function properly.

### 3D Learning Objective:

Students **use evidence from a variety of sources to construct an explanation of how feedback mechanisms maintain a living system's internal conditions and stabilize the system.**

### Time estimate:

50 minutes

### Materials:

Lesson 10 Student Guide

### Targeted Elements

#### SEP:

#### CEDS-H2:

**Construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today**

#### DCI:

#### LS1.A-H1:

**Systems of specialized cells within organisms help them perform the essential functions of life.**

#### LS1.A-H4:

**Feedback mechanisms maintain a living system's internal conditions within certain**

#### CCC:

#### SC-H3:

**Feedback (negative or positive) can stabilize or destabilize a system.**



as they did in the past and will continue to do so in the future.

limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (negative feedback) what is going on inside the living system.

## Directions



### Part 1: Our Motivation

#### USE OF PHENOMENA

Between Lessons 9-12, students will focus on the Module Phenomenon. In Lesson 14, they will return to the Anchor Phenomenon to create presentations on how milk can help athletes recover from exercise.

Have students individually review their Class Consensus Explanation from Lesson 8 Student Guide Part 3: Creating an Initial Explanation. This explanation describes how students answered the Module Questions, *Why do we get sweaty and thirsty after exercise? Why does the color of our urine change? How does milk help us recover from these effects?* This individual review is to see what gaps exist in the explanation from what they have learned so far in the module.

Ask students if these explanations accurately reflect the new evidence they have about temperature regulation mechanisms. Listen for responses such as:

- We didn't explain what happens inside the body to make body temperature and sweat change during exercise and why we get hot and sweaty.

Next, point to the questions on the Driving Question Board related to sweat and getting warmer during exercise. Share a few selected questions that align with what students will investigate in the upcoming lesson. Example student questions or ideas could include:

- Why do we sweat during exercise?
- Why does the body's temperature increase during exercise and decrease after?

Students can record these questions and ideas on their Lesson 10 Student Guide Part 1: Our Motivation. This will help students understand how this lesson connects to what they were trying to figure out about the Module Phenomenon. Use students' questions to transition to the lesson by sharing that, in this lesson, we will update our initial explanations that help explain our Module Questions, *Why do we get sweaty and thirsty after exercise? Why does the color of our urine change? And how does milk help us recover from these effects?*



## Part 2: Developing an Explanation of Sweat and Temperature Changes During Exercise and Recovery

Present the body temperature graph from Lesson 9 Part 2 on the projector, and break the graph into four segments: body temperature at rest, body temperature increasing during exercise, body temperature leveling off during exercise, and body temperature decreasing during recovery. Ask students to describe what mechanisms occur to affect body temperature at each of these stages. Use a Think-Pair-Share to have students share their ideas and annotate the graph as students share. Remind students that they can use their resources from Lesson 9 to help them here. There is no need to come to a specific consensus at the moment. Students can use what the class brainstorms here to help write their explanations below.

After the class brainstorm, share with students that they will now revise their initial explanations from Lesson 8 to update their answers to the Module Questions, *Why do we get sweaty and thirsty after exercise? Why does the color of our urine change? How does milk help us recover from these effects?* As students work on their Lesson 10 Part 2: Developing an Explanation of Sweat and Temperature Changes During Exercise and Recovery, circulate the room to formatively assess their explanations and provide feedback by asking questions about their work.

### FORMATIVE ASSESSMENT OPPORTUNITY

Students **use evidence from a variety of sources to construct an explanation of how feedback mechanisms maintain a living system's internal conditions and stabilize the system.**

#### Assessment Artifacts:

- Students' revised explanations of sweat and temperature changes during exercise and recovery (Lesson 10 Student Guide Part 2: Developing an Explanation of Sweat and Temperature Changes During Exercise and Recovery).

#### What to Look and Listen For

- Students construct and revise an explanation based on valid and reliable evidence obtained from a variety of sources, including data sets and the Science Theater model from Lesson 9 (CEDS-H2).

- Students describe how they think exercise changes the body temperature conditions of the body, including temperature change and sweat (LS1.A-H4, SC-H1).
- Students describe how a negative feedback mechanism responds to body temperature change and brings body temperature back to a stable state (LS1.A-H4, SC-H3).
- Students describe how specialized cells in each organ contribute to the function of the system or organ (LS1.A-H1).

#### Assessment Rubric:

	Emerging	Developing	Proficient
<b>Sample Student Response</b>	Body temperature increases when you exercise. It does so because your body gets hot due to the muscles moving a lot. To cool down, the body makes sweat and makes the blood vessels wider to make them lose heat.	Body temperature increases during exercise because when exercising, the muscle cells expand and contract to move and also generate excess heat. Nerve cells called thermoreceptors send nerve signals to the brain that communicate that body temperature is rising. The hypothalamus detects the signal from the nerves. To respond to the change and try to bring the body temperature down, the hypothalamus sends signals via nerves to sweat glands to release sweat and cool the body. Sweat cools the body to decrease body	<p>We observed the changes in body temperature due to exercise in the scientific study from Lesson 9 Part 2. Before exercise, the body temperature starts at a normal, stable state at about 36.5° C. When exercising, body temperature increases by about 0.5-1.0° C. Then, after exercise, body temperature returns to about 36.6° C (Lesson 9 Part 2 Analyzing Changes in Body Temperature).</p> <p>These changes happen because when exercising, the muscle cells expand and contract to move and also generate excess heat. Thermoreceptors (specialized nerve</p>
		temperature back to its stable state. The hypothalamus also sends signals via nerves to the vasodilatory nerves to increase blood flow from the body's core to the body's surface. Blood flow to the body's surface makes heat move from the body to the body's surroundings, cooling the body to bring body temperature back to its stable state.	cells) in the muscles and skin sense and report the temperature increase that occurs during exercise. The thermoreceptors send nerve signals to the brain that communicate that body temperature is rising. The hypothalamus detects the signal from the nerves. To respond to the change and try to bring the body temperature down, the hypothalamus sends signals via nerves to sweat glands to release sweat and cool the body. Sweat cools the body to decrease body temperature back to its stable state. The hypothalamus also sends signals via

			nerves to the vasodilatory nerves to increase blood flow from the body's core to the body's surface. Blood flow to the body's surface makes heat move from the body to the body's surroundings, cooling the body to bring body temperature back to its stable state (Source - Lesson 9 Science Theater Cards).
<b>How to Achieve This Level</b>	Student completes 0-1 out of 4 Look Fors	Student completes 2-3 out of 4 Look Fors	Student completes 4 out of 4 Look Fors

### To Provide Additional Support for Students

As students work in groups, approach each group to look at their work. If students need additional support in developing their explanations, consider:

- Asking the following questions:
  - What is the stable state the body is trying to maintain?
  - How does the body try to return to its stable state? What does the body do?
  - What evidence from the previous lessons did you find to add to your explanation?
  - What new ideas did you add to your explanation? What are you trying to describe?
  - How is stability defined and described in your explanation? How will that help us explain feedback mechanisms in body systems?
- Providing students with time to organize the evidence they found, come up with a list of evidence as a class, and discuss which pieces of evidence are most relevant to the explanation of why we sweat and get hot in exercise.
- Using an analogy to explain how the body tries to respond to changes in temperature using a negative feedback mechanism. For example, ask students to explain how the thermostat in their homes works. The thermostat tries to maintain a constant temperature in a home. When the temperature changes, for example, when it increases, the thermostat detects a change in the temperature and turns on the air conditioning to try to bring the temperature back down to its stable state.
- Engage students in a peer feedback session. Provide students with the Look Fors, and use a protocol such as [Tell-Ask-Give](#) or norms such as [SPARK](#). Students can use the Look Fors to provide feedback to each other on how they can improve selected Look Fors in their work.



## Part 3: Updating the Class Models

Ask students to reorient to the Driving Question for the unit, ***How can milk help athletes recover from physical exercise?*** Share with students that they will now collect their ideas about 1) what changes happen to the body during exercise and 2) how the body recovers from exercise with the help of milk into two different models. Share with students that they can take the explanations they wrote in Part 2 to help inform how to build these models. Students will record their answers on their Lesson 10 Student Guide Part 3: Updating the Class Models.

To do so, display the Digestion Model from Module 1. Ask students if this model represents what is happening during exercise or during recovery with milk. Confirm that it shows the latter and share with students that we can use this model as a starting point and revise it to show our new ideas about recovery, which we will call the “Recovery Model.” Share that we will also start a new model that shows the impacts of exercise on the body, which we will call the “Exercise Effects Model.”

### TEACHER SUPPORT

Here, for the Recovery Model, students should be adding to the Class Consensus Model from Lesson 6, which should be displayed as a large mural on a class wall or digitally for projection for the entire class.

Hold a whole-class discussion in which the class builds two Class Consensus Models. Walk students through the class consensus discussion steps below so they can create the Exercise Effects Model and the Recovery Model.

1. Each group should select one or more reporters to share one part of their explanations to add to the models. Have the first group share one idea to add to the consensus models. This can be one component, arrow, relationship, or any other feature the group wants to select.
2. The next reporters can agree with, disagree with, or revise parts of the model that have already been added or can add new parts. Continue this process until both of the full Class Consensus Exercise Effects Model and the Recovery Model are built.
3. As students share, some strategies you can use to help the class build the consensus model are:
  - a. Helpful sentence starters such as:
    - i. We agree with \_\_\_\_\_’s group, and we also want to add \_\_\_\_\_.
    - ii. We disagree with \_\_\_\_\_’s group because \_\_\_\_\_
    - iii. We would like to change \_\_\_\_\_ because [evidence].
  - b. Use discussion prompts, such as asking the class:
    - i. Is there anything else that needs to be added to this component before we move on?
    - ii. How does this idea fit with what is currently on the model?

- iii. What new body systems are we introducing? Which organs are included in these systems? How can we draw a system boundary around them?
- iv. How are we showing the movement of matter in this model? The movement of energy? How are milk nutrients shown in this model?
- v. How are we showing thermoregulation mechanisms in this model?

As you build the class model, if you find disagreements, follow these steps to help resolve the disagreement:

1. Summarize the two sides.
2. Ask the students to pause and reflect on their reasoning to be on that side.
3. Prompt students to again re-discuss the area of disagreement.
4. If students still disagree, suggest that we can represent areas of disagreement on the class model with question marks or other annotations of uncertainty.

#### CCSS SUPPORT

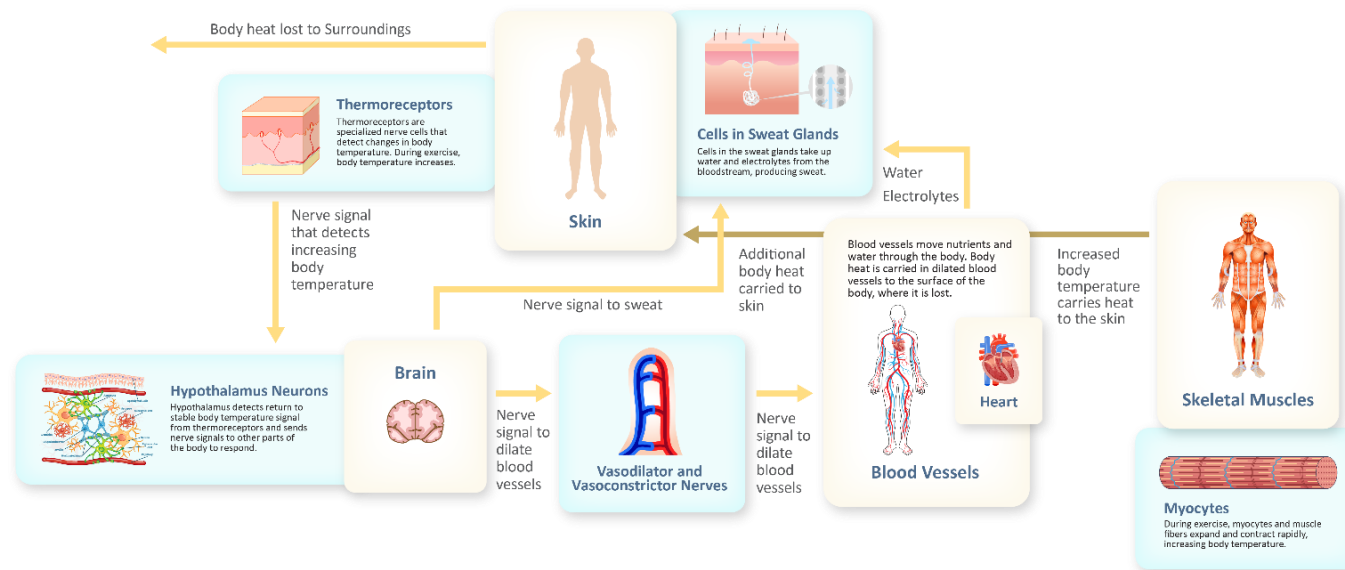
**SL 9-10.1(d):** Respond thoughtfully to diverse perspectives, summarize points of agreement and disagreement, and, when warranted, qualify or justify their own views and understanding and make new connections in light of the evidence and reasoning presented.

Because student explanations may differ, it is important to emphasize that the revisions to the model are being made based on evidence. You may want to ask students to discuss the difference between evidence vs. opinion when discussing what components to include in the Class Consensus Effects of Exercise Model and the Recovery Model.

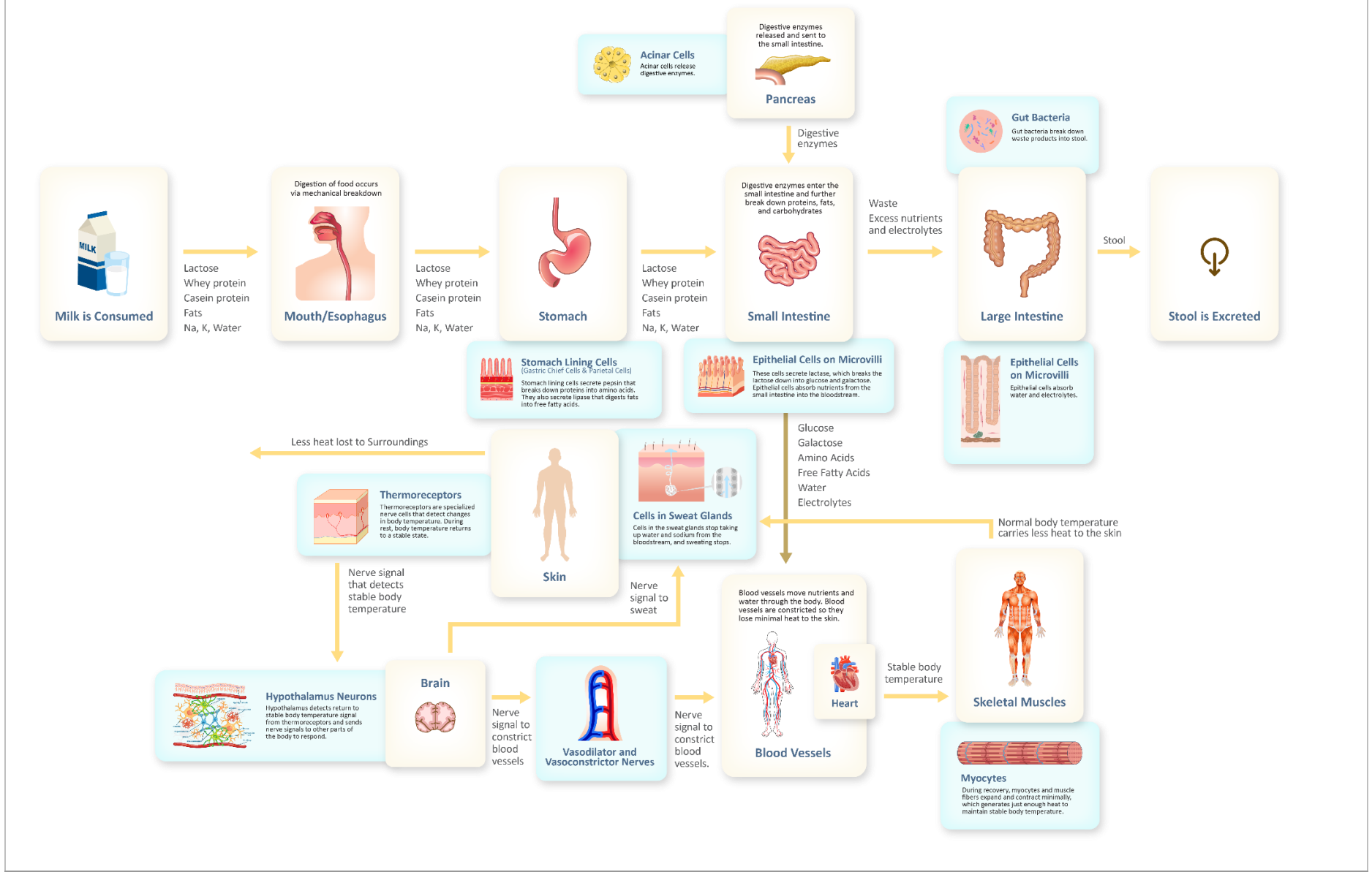
The following pages show an example of what the Class Consensus Effects of Exercise Model and Recovery Model may look like, though you will want to follow the ideas of your class rather than drive them to these exact models.

## Example Class Consensus Models

### Effects of Exercise Model



## Recovery Model



Share with students that these models will be a continuous record of changes that happen in the body in response to exercise (Effects of Exercise Model) and how milk helps the body recover from these changes (Recovery Model). Share with students that we will continue to make progress on our Module Questions first and, later, the Driving Question for the unit, which will help us continue to add to these models. Direct students to use the space on their Lesson 10 Student Guide Part 3: Updating the Class Models to record the consensus models. Alternatively, you can provide students with an image of the model or have them take an image with their personal device, if available.



#### Part 4: Asking New Questions

As a final step in this lesson, students will create a new list of questions to help them determine what additional information they need to know to help them figure out the Module Questions, *Why do we get sweaty and thirsty after exercise? Why does the color of our urine change? How does milk help us recover from these effects?* They can write these questions on their Lesson 10 Student Guide Part 4: Asking New Questions. Add these questions to the appropriate categories of the Driving Question Board so they can continue to be referenced in the coming lessons.

To facilitate students asking questions, use the Question Formulation Technique.

1. With their group, students will take 5 minutes to brainstorm questions about what they need to know about sweat, thirst, urine, and exercise.
2. Students will then look at their questions and choose the 3-5 questions they think are most important to be answered to help them figure out the Module Questions.
3. A representative from each group will then share their prioritized questions with the whole class. As students share their prioritized questions, they will add them to the Driving Question Board.

#### LOOK FOR

In student responses, listen for the following ideas:

- How is sweat related to thirst?
- How does your body control the feeling of thirst?
- Does the body have a way to control hydration, which impacts thirst and urine color?
- How does being thirsty change as you exercise?
- How does consuming milk help you feel less thirsty while working out/after working out?