TEACHER GUIDE ENGAGE LESSON 25



What We Figure Out:

We observe that skeletal muscle soreness is common after exercise, such as lifting weights. Drinking milk after the workout can help reduce the perception of muscle soreness. We wonder what causes skeletal muscles to get sore after exercise, how that soreness goes away, and how milk helps with that recovery.

3D Learning Objective: Students develop an initial explanation for how feedback mechanisms can help the body recover from soreness induced by exercise.		Time estimate: 50 minutes	Materials: Lesson 25 Stu Lesson 25 <u>W</u>	udent Guide <u>orkout Video</u>		
Targeted Elements						
SEP:	DCI:			CCC:		
Pre-Assessment 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	Pre-Assessment LS1.A-H4: Feedback mechanisms maintain a living system's internal conditions within certain 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		a living thin certain llowing it to n as hin some an edback) or	Pre-Assessment SC-H3: Feedback (negative or positive) can stabilize or destabilize a system.		



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as they did in the past and will continue to do so in the future.	discourage (negative feedback) what is going on inside the living system.	
Directions		

Part 1: Our Motivation

USE OF PHENOMENA

Similarly to Modules 2 and 3, this module picks up on questions and gaps in understanding that students may have had at the end of Module 1. There, they observed how several nutrients in milk enter the bloodstream after being digested. In Module 2, they investigated what happens to the water and electrolyte content of milk to help athletes recover from exercise. In Module 3, they figured out that the glucose produced via the digestion of galactose can be a source of fuel in cellular respiration during exercise. This module will focus on the protein component of milk and how the amino acids that enter the bloodstream can be used by muscles when they recover from the effects of exercise. Accordingly, students will start this module by observing a phenomenon in which an athlete does an intense weightlifting workout and experiences significant muscle soreness. This Module Phenomenon will spark student questions and ideas about the causes of muscle soreness and how milk can help athletes recover from it.

To introduce this module to students and to make the Anchor Phenomenon clear to students, return to the Driving Question Board. Ask students what questions seem most pressing to investigate next. Facilitate the conversation such that students agree that most of the remaining questions have to do with how protein in milk helps with recovery and how muscles get sore after exercise. Confirm that, next, students will investigate these questions. Students can record these questions in Lesson 25 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 Anchor Phenomenon. Sample student questions include:

- Why are muscles sore after exercise?
- What happens to protein from milk in the body?
- How does protein help us recover from soreness?
- Why does chocolate milk help athletes' muscles recover from exercise?
- We still haven't figured out what amino acids do in the body.
- We still haven't figured out how protein helps the body recover from exercise.

Build off student questions and ideas to share that students will now observe a new phenomenon that will help them start to make progress on answering some of these questions.

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Part 2: Sharing Our Prior Experiences

Ask students to think about their prior experiences with muscle soreness. Direct them to record their response in the Lesson 25 Student Guide Part 2: Sharing Our Prior Experiences. Hold a whole-class share out for students to share some of these stories and experiences with the class.

STUDENT SUPPORT

To help connect the Module Phenomenon to students, seek out and use students' experiences. Elicit responses from all students, not just those involved in regular athletics or exercise. Consider asking questions such as:

- What other kinds of exercises, movements, or life activities have caused you muscle soreness?
- When else might you have experienced muscle soreness, even if not after a sporting event or a workout?

TEACHER SUPPORT

Be careful to distinguish muscle soreness that occurs 24+ hours after exercise from muscle burn and muscle fatigue that occurs during extended exercise. Only muscle soreness and recovery from muscle soreness are addressed in this module. Students have already figured out the causes of muscle fatigue and muscle burn in Module 3.

Build off student responses to confirm that various kinds of exercise can make someone sore, and it occurs especially after weightlifting or other forms of resistance exercise. Confirm that the soreness is located in the muscles that are involved in the exercise.

Part 3: Observing the Module Phenomenon

Introduce the <u>Workout Video</u> by telling students, "We have a variety of experiences with muscle soreness and recovery. We had a lot of questions on our Driving Question Board about why muscles get sore and how they recover. Let's take a closer look at someone who works out twice: first lifting weights and recovering without milk, and second lifting weights and recovering with milk. Let's watch and see what this athlete experiences."

Play the <u>Workout Video</u>. As students watch the video, ask them to record their initial observations of what is happening in their Lesson 25 Student Guide Part 3: Observing the Module Phenomenon.

Once all students have had a chance to record their observations, ask them to share with a partner.

Use a Think-Pair-Share Strategy to have students share what they noticed from the video.

- 1. Students are given time to think independently about their responses.
- 2. Students find an elbow partner.
- 3. Students take turns sharing their thoughts with their partner. Each student should be given time to respond.

As students share out, use a Domino Share Routine to have them build off each other's contributions.

- 1. Students participate in a free discussion or open exchange with a small group after being given time to think through their responses.
- 2. As one student shares, all other students serve in a "listener" role, noting patterns or ideas that emerge as the group continues to share.
- 3. Students continue to share ideas until all members of the group have had a chance to contribute and build upon one another's ideas.
- 4. The facilitator holds a whole-class discussion and invites students to add something that came up in the group discussion that was not already captured in responses.

In student responses, look for the following ideas:

- He was working out with squats.
- He did one workout without milk recovery, and he felt really sore afterwards.
- He did a second workout with squats and used milk for recovery for that one.
- After this workout, he said his muscles were feeling less sore than the first time.

STUDENT SUPPORT

If students need additional support finding observations from the video, consider replaying the video at specific moments when the narrator discusses her muscles getting sore or drinking milk as a recovery drink.

Confirm these observations for students. Build off student responses to introduce the Module Question for this module, *How does milk help in muscle recovery from soreness induced by intense exercise?*

Part 4: Creating and Sharing Initial Explanations

Students will generate an initial explanation in small groups, articulating their current response to the Module Question, which they will then write in their Lesson 25 Student Guide Part 4: Creating and Sharing Initial Explanations. Allow students time to create their explanations. As students work, circulate the room to elicit and probe student thinking. Ask questions such as:

- Can you tell me more about what you wrote there?
- What I see you saying is...Can you say more about that?
- What body systems do you think are relevant to muscle soreness and recovery?
- What do you think represents the homeostasis of the athlete? What change occurs to bring her body out of its stable state?

STUDENT SUPPORT

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Remind students that if they prefer to use icons, drawings, or images, they can do so and add these to their explanations.

PRE-ASSESSMENT OPPORTUNITY

Students develop an initial explanation for how feedback mechanisms can help the body recover from soreness induced by exercise.

Assessment Artifacts:

• Students' initial explanations articulating their response to the Module Question, *How does milk help in muscle recovery from soreness induced by intense exercise*? (Lesson 25 Student Guide Part 4: Creating and Sharing Initial Explanations).

Look Fors:

- Explanations describe how students think exercise causes a change in conditions (muscle soreness) (CEDS-H2, LS1.A-H4).
- Explanations describe if and how students think a feedback mechanism may help the body return to its stable state (LS1.A-H4, SC-H3).
- Explanations describe how milk helps in recovering from the change in conditions (muscle soreness) (LS1.A-H4).

Assessment Rubric:

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	Emerging	Developing	Proficient
Sample Student Response	Soreness is caused by lactic acid buildup. Muscles get less sore because they get stronger.	I think that muscles become sore due to the buildup of hydrogen ions, just like we learned in Module 3 about how muscles get fatigued and burn. Just like we have seen in other parts of the body, the muscles probably have some response that makes the soreness go away.	I think that muscles become sore due to the buildup of hydrogen ions, just like we learned in Module 3 about how muscles get fatigued and burn. Maybe there are too many of them, and they make the muscles hurt for longer. Just like we have seen in other parts of the body, the muscles probably have some response that makes the soreness go away. Milk can help this because the milk proteins get digested into amino acids, and those amino acids go from the bloodstream and probably go into the muscles to help them recover. There may be some other body system that helps them do so.
How to Achieve This Level	Student completes 0 out of 3 Look Fors	Student completes 1-2 out of 3 Look Fors	Student completes 3 out of 3 Look Fors

To Provide Additional Support for Students:

Consider the following supports for students as they create their explanations:

- Ask students to recall any prior knowledge they have about how the body recovers from muscle soreness and how proteins in foods help in recovery from soreness or other effects of exercise.
- Ask students to review the class Exercise and Recovery Models to recall where they left off in figuring out what happens to amino acids in the body that are from the proteins in milk. Then, ask students how they think these amino acids may help in recovery.
- Ask students to recall what they figured out so far about homeostasis and how they think muscle soreness, weakness, and recovery could be examples of maintaining homeostasis.
- Engage students in a peer feedback session. Provide students with the Look Fors, and use a protocol such as <u>Tell-Ask-Give</u> or norms such as <u>SPARK</u>. Students can use the Look Fors to provide feedback to each other on how they can improve selected Look Fors in their work.

SEP SUPPORT

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 as they did in the past and will continue to do so in the future. In this lesson, students can use the knowledge and evidence they have gained in the previous three modules to develop an initial explanation for how they think muscles get sore during exercise and how they recover. Students may draw from a variety of sources of evidence from the module so far to speculate about the mechanisms by which soreness and recovery of soreness occur. This is to be encouraged in this lesson. Throughout the module, students will gain more relevant evidence to help them revise their explanations.

After students create their explanations, have students engage in a Stay and Stray Strategy to share their explanations with their peers.

- 1. After small group models are complete, ask groups to have one person "stay" at their table with the explanation they created to share it with classmates from other groups.
- 2. The rest of the team members "stray" to the other groups to learn about the other group's explanations. Allot about 2 to 5 minutes per rotation.
- 3. During the rotation time, students can ask questions to help gain clarity on the decisions they made. Students can ask questions such as, "What parts of the explanation do we seem to agree on?"
- 4. At every signal to rotate to a new group, a different team member goes back to stay with the group's work, and everyone else (including the person who first stayed) moves on to view the next product. This allows everyone to see all but one product.
- 5. After visiting all groups, initial small groups regroup and share new information gathered.
- 6. Groups discuss new ideas and decide whether or not they will integrate them into their work.

TEACHER SUPPORT

Using the Stay and Stray Strategy allows students to compare and contrast their explanations with other students. This will help them observe the various ideas around the room to help open discussion on the topic and agree on and integrate new ideas. This allows them to self-evaluate the strengths and weaknesses of their explanation before implementing edits.

WW Part 5: Creating a Class Consensus Explanation

After the groups all share with each other, students will now work together to make a Class Consensus Explanation. Walk students through the Class Consensus discussion steps below so they can create an initial Class Consensus Explanation.

1. Deliberately pick a few student groups to share with the whole class. Have the first student group share their explanation.

- a. What parts of the explanation do we seem to agree on?
- b. Can anyone suggest scientific information we should add to the class explanation?

As parts are agreed upon, begin creating a Class Consensus Explanation on the board. Continue adding to the Class Consensus Explanation such that every group shares at least one descriptor to add. The Class Consensus Explanation should describe the following:

- Amino acids from proteins in milk are in the bloodstream. Protein helps you recover, so the amino acids must have something to do with recovery.
- Something happens in the muscles, and maybe the muscle cells, that has to do with soreness, weakness, and recovery.
- There might be a homeostasis response that helps the muscles recover.

TEACHER SUPPORT

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

- Summarize the two sides of the disagreement.
- Ask the students to pause and reflect on their reasoning to be on that side.
- Prompt students to re-discuss the area of disagreement again.
- If students still disagree, suggest that we can represent areas of disagreement on the class explanation 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.

In the Class Consensus Model, students will utilize the skills associated with this standard to come to an agreement on what the explanation should look like.

After a Class Consensus Explanation has been drafted, students will reflect on gaps in understanding present in the explanation. At this point, there will be gaps in the scientific mechanisms of the explanation, and this is okay because these will be addressed throughout the rest of this module. Provide feedback and guidance for students to identify gaps by asking questions like:

• What seems to be missing from our description to help us explain how muscles get sore and how milk helps recovery?

In student responses, look for the following ideas:

- We think protein in milk has to do with recovery but don't know what happens to the amino acids in the bloodstream after the protein is digested.
- We don't know what happens to muscles and/or muscle cells to make them feel sore and weak.

STUDENT SUPPORT

If students need additional support in finding gaps in the explanations, consider having students verbally describe what they think happens in the body during exercise and, as they do so, consider if any component might logically be missing. Say, "Talk me through how you get sore from exercise and how milk helps you recover." If at any stage they hesitate, this can be named as an unknown that requires additional information.

Remind students that we are in the beginning stages of the module, and in the upcoming lessons, they will set out to figure out more about the gaps they have identified in the explanation.

Part 6: Asking New Questions

As a final step in this lesson, students will create a new list of questions that can help them determine additional information they need to know to figure out how milk aids in recovery from muscle soreness. They should write these questions in Lesson 25 Student Guide Part 6: Asking New Questions. Add these questions to the "Milk Protein and Muscle Soreness" category 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 take 5 minutes to brainstorm questions about what they need to know about how dairy foods are created and distributed.
- 2. Students then look at all their questions and choose the 3-5 questions they think are most important to be answered to help them figure out the Module Question.
- 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:

- What happens to amino acids in the body?
- Do amino acids help in muscle cell recovery?
- Why does exercise make muscles sore?
- What happens in muscles that makes them sore and weak?
- What other body systems or cells play a role in muscle recovery?
- Is muscle recovery a form of homeostasis?