TEACHER GUIDE EXPLORE 2 LESSON 21

Module Questions: Why are there so many changes to my body during exercise? How does milk help with recovery from these changes?

What We Figure Out:

We analyze and interpret data from two different studies to figure out that carbohydrates in recovery beverages, such as milk, can help restore muscle glycogen that has been depleted as a result of exercise.

3D Learning Objective: Students compare findings in two data sets to determine how drinking a recovery drink leads to changes in the body that help it recover from exercise by replenishing the glucose that cells use in aerobic and anaerobic respiration.		Time estimate: 50 min	Materials: Lesson 21 Stu Lesson 21 Stu	udent Guide udent Handout Data Set
Targeted Elements				
SEP:	DCI:			CCC:
DATA-H4: Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations.	LS2.B-H1: Photosynthesis and cellular respiration (including anaerobic processes) provide most of the energy for life processes.		piration provide esses.	SC-H1: Much of science deals with constructing explanations of how things change and how they remain stable.



Food and Agriculture Center for

Science Education

Directions

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Part 1: Our Motivation

USE OF PHENOMENA

Between Lessons 16-20, students will focus on the topic of exercise from the Module Phenomenon. In Lessons 21-22, they will focus on the topic of recovery from the Module Phenomenon. In Lesson 23, they will investigate a related phenomenon. They will return to the Anchor Phenomenon in Lesson 24 and revise their presentations to help their peers understand how milk can help them recover from exercise.

Ask students to recall the predictions they made at the end of Lesson 20 in Part 3: Updating the Effects of Exercise and Recovery Models regarding how they think drinking milk could help in recovery from the effects of exercise from the Module Phenomenon. Invite a few students to share what they recall. Listen for responses such as:

- Our body uses milk to replenish the glucose it used to generate energy during intense exercise.
- Our body uses the protein in it to help recovery in some way.
- Glucose molecules from glycogen are used in aerobic and anaerobic respiration during intense exercise, and digested milk has glucose molecules that could replace them.

Build off student responses to share that these ideas seem like informed predictions from what we know so far about how aerobic and anaerobic respiration use glucose and about how this glucose comes from liver and muscle glycogen. Ask students how they think they could determine if these predictions are true. Use a Think-Pair-Share to invite students to share a few ideas. Student responses may vary.

- 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.

Listen for ideas such as:

- We could use a model to visualize the recovery process.
- We could look at data to see how drinking milk for recovery impacts glucose and/or glycogen in the body.

Confirm for students that in this lesson, students will investigate how drinking a recovery beverage impacts glycogen levels in the muscle. Next, point to the questions on the Driving Question Board related to milk and recovery from exercise. Share a few selected questions that align with what students will investigate in the upcoming lesson. Example student questions or ideas could include:

- How does milk help us recover to perform for a second workout?
- Are glucose and proteins the reason milk helps with recovery?
- Do we get energy from milk?

TEACHER SUPPORT

Throughout Part 1, it is possible that students may focus on the impact of proteins on recovery instead of glucose or the combination of glucose and proteins. If this is the case, ask students to return to their explanations from Lesson 20 and look for mentions of molecules in milk they are familiar with. This should prompt them to focus on glucose and glycogen. Share with students that they can place their ideas and/or questions about how protein helps in recovery on the Driving Question Board, and those questions will be investigated in Module 4.

Students can record these questions on their Lesson 21 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.

Part 2: Analyzing and Interpreting Data

Share with students that to investigate how drinking milk could help restore glucose and glycogen in the body after exercise, they will analyze the methods and data from two scientific studies that asked similar questions. Distribute the Lesson 21 Student Handout Data Set and share that students will compare the two studies to determine if their setup and findings are similar. Students can record their answers on their Lesson 21 Student Guide Part 2: Analyzing and Interpreting Data.

TEACHER SUPPORT

The studies chosen use a carbohydrate-protein beverage instead of milk. For this to feel like it is coherent to students, you can share with students that we don't have access to data on how milk impacts glycogen levels, but we do have data on how beverages that contain similar molecules, such as sugars, proteins, and fats, which can help inform us about what might also happen with milk. Additionally, you can also share that using carbohydrate-protein beverages has some advantages in scientific studies. Scientists can isolate and test specific variables. For example, researchers might be interested in the general effects of carbohydrates and proteins on recovery, not necessarily

the specific components found in a single food source like milk. Carbohydrate-protein beverages can also be carefully controlled to ensure consistent amounts of carbohydrates and proteins across participants in the study. This helps to isolate the effects of these nutrients on recovery.

Allow students time to analyze the methods of the two experiments and the data presented. As students work, circulate the room to listen to students' thinking. Ask pressing questions such as:

- Were the two studies asking the same question? If not, how were they different?
- How were the two experiments designed? What methods were used? How are the designs similar/different?
- What do the studies and data indicate about recovery from intense exercise in general? How is this related to milk?

SEP SUPPORT

DATA-H4: Compare and contrast various types of data sets (e.g., self-generated, archival) to examine consistency of measurements and observations. In this lesson, we continue with the progression of reducing scaffolds for students to engage in this practice. In Lesson 18, students were asked a series of questions to help them analyze the methods used in both studies and the data collected and to compare the outcomes of both studies. Here, we reduce the number of prompts to two and ask students to analyze the design of the studies and the outcomes together and then, analyze if the studies are consistent in their findings. This approach removes the scaffold of multiple prompts that were present in previous lessons. If a student is struggling, remind them of previous prompts, including those below.

- What question were scientists trying to answer for each data set?
- Summarize the methods used and the data they collected.
- What did Study 1 find? What did Study 2 find?
- Are the findings consistent? Why or why not?

CCSS SUPPORT

HSN.Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.

To support students in interpreting the data presented, ask students to consider what question the scientist is trying to answer for each data set and how they might be sharing that data for us to view. If students need additional support, allow them to discuss with a peer to make sense of it together.

Students compare findings in two data sets to determine how drinking a recovery drink leads to changes in the body that help it recover from exercise by replenishing the glucose that cells use in aerobic and anaerobic respiration.

Assessment Artifacts:

• Students' comparison of findings between the two data sets to determine if the findings of the studies are consistent (Lesson 21 Student Guide Part 2: Analyzing and Interpreting Data).

Look Fors:

- Students compare and contrast the methods and the outcomes of the data sets to determine the consistency of measurements and observations (DATA-H4).
- Students determine that glycogen levels can change and be replenished by drinking a recovery beverage (LS2.B-H1, SC-H1).

Assessment Rubric:

	Emerging	Developing	Proficient
Sample Student Response	Both studies seemed to find that glycogen could be recovered after exercise.	The first study found that all of the beverages replenish glycogen, and the carb-protein drink had a larger and faster response than the others. The second study found that all of the drinks increased the amount of muscle glycogen between the end of exercise and the end of recovery. The carb and carb-protein were higher at the end than the carb-aa drink, but not by a lot. The carb and carb-protein ended at about the same levels.	The two investigations were similar. The goal of each was to determine which kind of recovery beverage recovered muscle glycogen the most. Both involved cycling, and both had a long cycling workout followed by sprints to exhaustion. The first study used MRI to measure muscle glycogen levels, and the second used muscle biopsies. MRI took more measurements throughout recovery vs. biopsies which just compared the start of recovery to the end of recovery. Both studies found that drinks with carbohydrates helped replenish muscle glycogen stores. From this perspective, we can say that the findings of the two studies are very consistent.

How to Achieve This Level	Student completes 0 out of 2 Look Fors	Student completes 1 out of 2 Look Fors	Student completes 2 out of 2 Look Fors

To Provide Additional Support for Students:

Consider the following supports for students as they analyze the data sets:

- Ask students to revisit previous questions on their Lesson 21 Student Guide related to how to interpret the design, methods, and objectives of experiments.
- Encourage students to use a more focused approach, such as, "What is similar/different" between the design, methods, objectives, and outcomes of the two studies.
- 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.

After students have analyzed the methods and data, hold a whole-class discussion for students to share what they have found. Facilitate the conversation so that students agree that:

- The two investigations were similar. The goal of each was to determine which kind of recovery beverage recovered muscle glycogen the most. Both involved cycling, and both had a long cycling workout followed by sprints to exhaustion.
- The first study used NMRI to measure muscle glycogen levels, and the second used muscle biopsies. NMR took more measurements throughout recovery vs. biopsies which just compared the start of recovery to the end of recovery.
- Both studies found that drinks with carbohydrates helped replenish muscle glycogen stores. From this perspective, we can say that the findings of the two studies are very consistent.

Take a moment to reflect on how the scientists used the lens of stability and change when designing these studies. Use a Think-Pair-Share to have students record and share their reflections.

- 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.

Facilitate the conversation such that students agree that:

• Scientists measured how glycogen levels in the body change in response to drinking a recovery beverage after a workout. This is a similar example to what we have seen previously because, yet again, we see that scientists are measuring the changes in the quantity of a factor in the body.

Confirm and build on student responses to share that this is another example of a common approach in exercise science. To see how the body responds to exercise and how it recovers, scientists often measure changes to levels of different molecular markers in the body.

CCC SUPPORT

SC-H1: Much of science deals with constructing explanations of how things change and how they remain stable. In this lesson, students construct/review their explanations about the Module Questions. Just as students have done in previous lessons, they will see in this data set that scientists often measure changes to the levels of various molecules in the body when studying how the body responds to exercise and how it recovers from exercise.

Finally, remind students that the class was analyzing the effect of these recovery beverages in place of studies on milk, which were unavailable. Ask students what they think the results from these studies mean about how milk could be used to recover glycogen. Students can record their responses on their Lesson 21 Student Guide Part 2: Analyzing and Interpreting Data. Use a Think-Pair-Share for students to share their ideas. Student responses may vary.

- 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.

Facilitate the conversation such that students agree that:

- The carbohydrates in milk, which are broken down into glucose and galactose, could help the body recover by providing excess glucose molecules in the bloodstream that can be stored as glycogen in the muscle cells.
- The data in the first study suggests that recovery beverages that have carbohydrates and proteins appear to be more effective at replenishing muscle glycogen stores. However, that was not a specific finding of study for the second data set.

Conclude the lesson by suggesting that students return to their explanations of the Module Phenomenon and to their Class Consensus Recovery Model and add these findings. Share that students will do this in the next lesson.