STUDENT GUIDE
EVALUATE LESSON 24

Food and Agriculture Center for Science Education

Part 1: Our Motivation

Record what we were trying to explain about the Anchor Phenomenon.

We are going to revisit our Anchor presentation to determine what new scientific information we can communicate to the audience about how milk helps with recovery from exercise, including the new information that we have figured out about how milk nutrients are available to help the body recover from different intensity workouts.

Part 2: Communicating Scientific Ideas

Create a presentation with your group that communicates the answer to our Driving Question, ***How can milk help athletes recover from physical exercise?*** to an audience of your choosing. Here, you should add the new content from Module 3 to the presentation you created in Lesson 14.

Presentation Format Requirements:

- Videos cannot exceed 4 minutes.
- Written reports cannot exceed 3 pages.
- Presentation is designed for the same chosen audience and with the same format you selected in Modules 1 and 2.
- Prepare a script of your presentation before adding multiple media formats.

Presentation Development Steps:

- Develop a script/outline.
- Have the teacher review your script/outline.
- Develop your presentation.
    - If doing a written presentation, create the formal writing product.
    - If doing a video presentation, rehearse and record the video product.
- Receive peer feedback on your presentation.
- (Optional - can be done here or in the final Performance Task) Revise your presentation based on peer feedback.

Be sure to use the Look Fors provided below to guide your presentation. Mark each Look For after you include it.

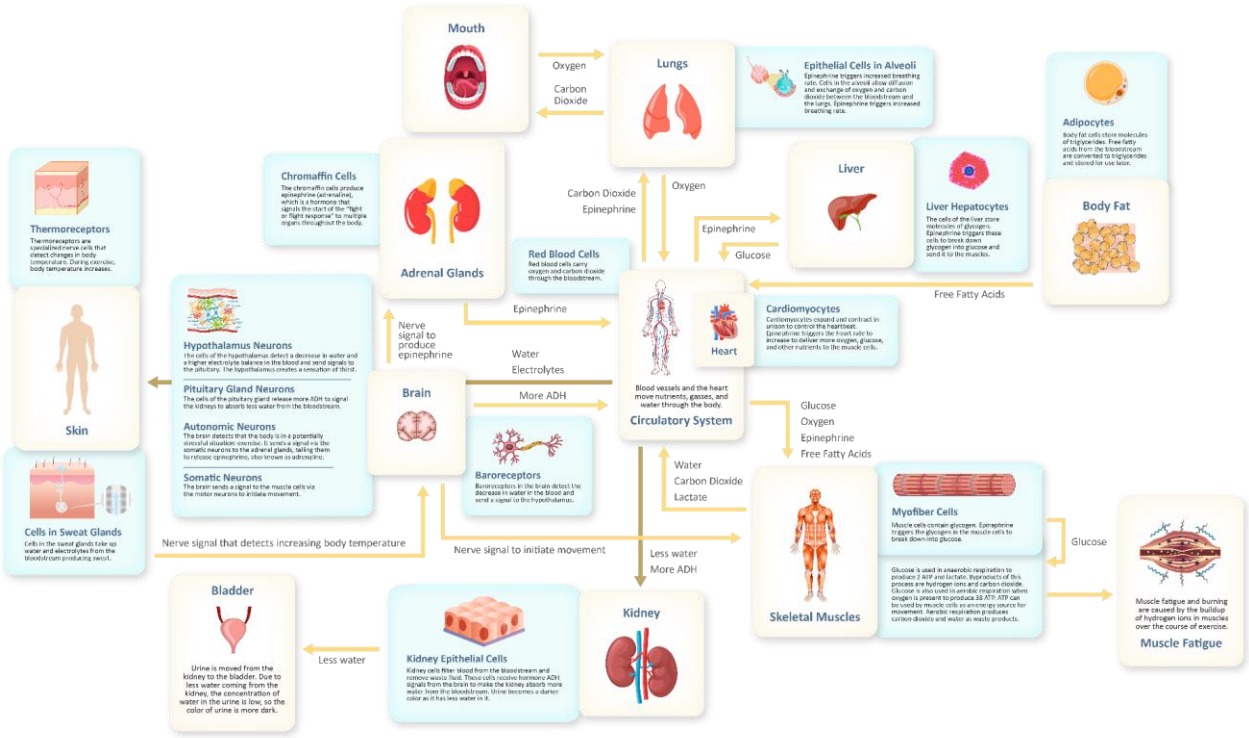
Included	Look Fors
	Include multiple methods of communication, including models and evidence from the module (video plus graphics/diagrams, written report plus graphics/diagrams, or video with narration of a slideshow). ● You can use the class consensus model, data sets, and/or models from any other resources from the module.
	Clearly communicate scientific information in a way that is appropriate for your chosen audience.
	Describe how the energy for exercise comes from aerobic and anaerobic respiration and how this energy is expended during exercise and recovered with milk.
	Describe how the function of multiple kinds of specialized cells contributes to the processes of cellular respiration and anaerobic respiration.
	Describe how much of the study of exercise and recovery involves tracking how various molecular factors in the body change or remain stable.

In the space below, prepare your presentation script or written report.

Written report

Now let's talk about why you get fatigued during exercise and what you can do to help recover from that fatigue and keep going. One thing to know going into this is that when scientists study how the body responds to exercise, they typically do so by describing the changes that happen to a lot of different molecules in the body. So we'll be discussing a lot of molecular details in this part of the presentation.

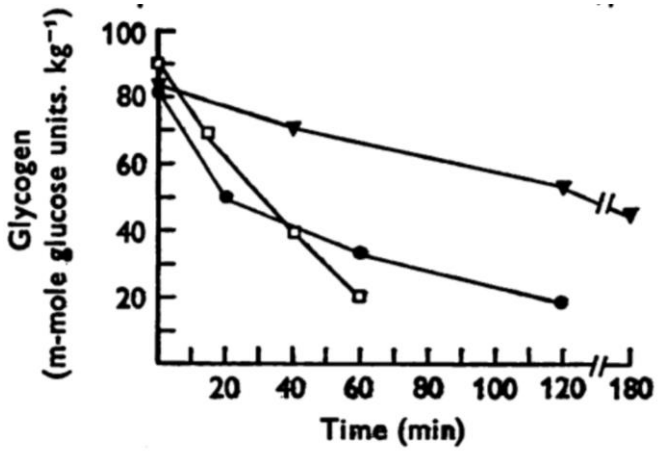
Exercise requires a lot of energy! Your body transforms stored molecules or molecules in the food you eat into cellular energy. Let me show you how this works on this model.



To make energy to power your muscles to move rapidly during exercise, muscle cells need glucose. Glucose is used in the process of anaerobic respiration early in intense exercise. This process occurs without oxygen present and produces 2 ATP, which is the cellular energy your muscles use for movement. When exercise continues, oxygen moves in from your lungs, through the epithelial cells, into your bloodstream, and finally to the muscles, where the myocytes take it in to use in aerobic respiration. This process uses glucose to produce 38 ATP to power the muscle cells for rapid movement during exercise.

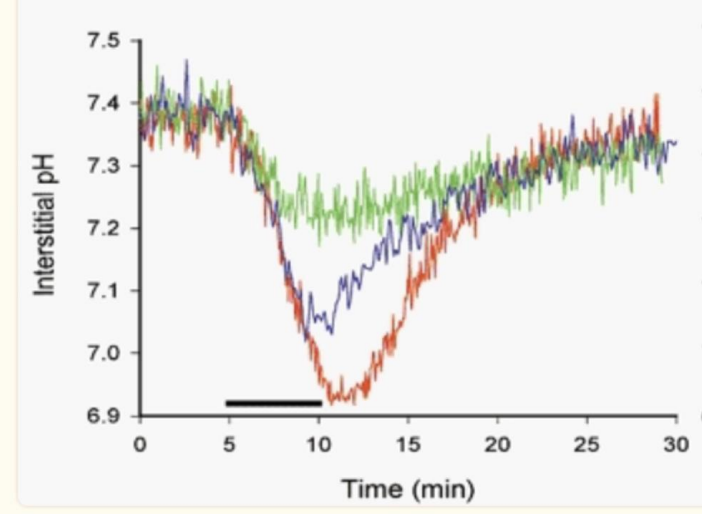
Muscle cells get this glucose from a couple of different places. First, they can get it from the bloodstream, but that glucose runs out very quickly.

Next, they can get it from glycogen or a form of stored glucose. As you can see in the model, when the body needs to make energy quickly to power your exercise, the brain sends a signal along the autonomic neurons to the chromaffin cells in the adrenal glands to produce epinephrine and pass it to the bloodstream. There, it moves to the hepatocytes in the liver and to the myocytes in the muscles to tell these organs to start breaking down their glycogen into glucose, which can be used by the muscles in anaerobic and aerobic respiration to generate more energy. The figure below from Gollnick, Piehl, and Saltin demonstrates that muscle glycogen stores in the myocytes decrease rapidly with intense exercise (open square line), meaning that glycogen is being broken down into glucose, which is used in the myocytes to produce ATP.



Now, as you keep exercising, you start to get fatigued, and your muscles start to feel like they are burning. This burning and fatigue comes from the change in pH of the muscles during exercise.

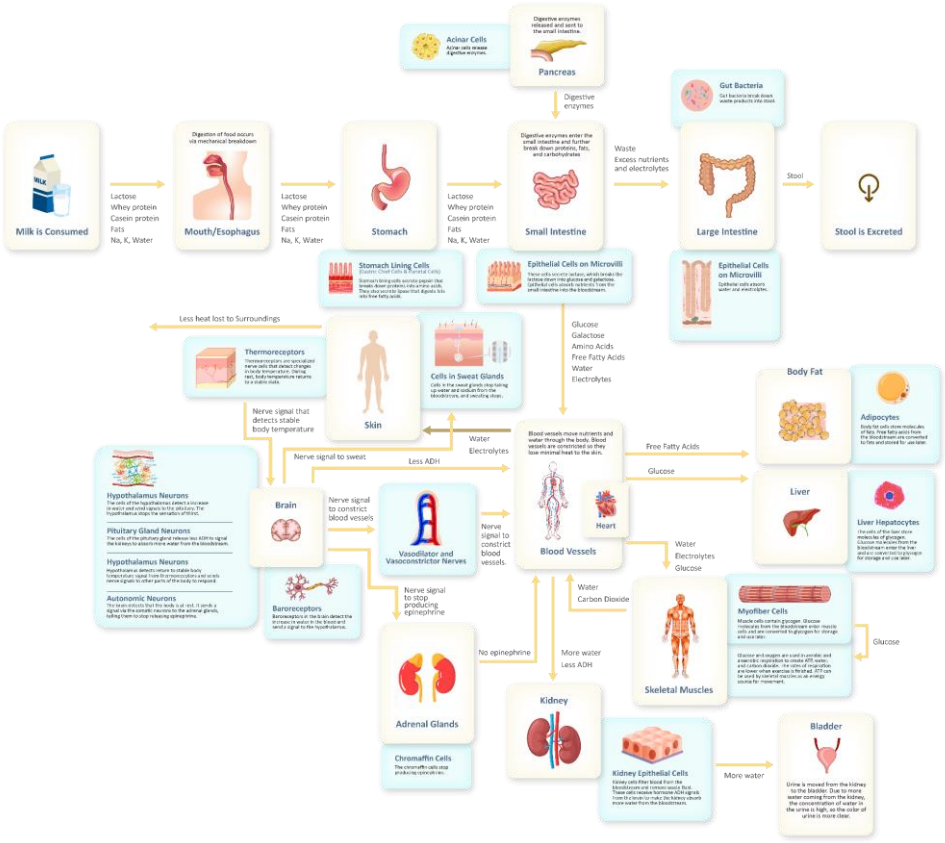
Below is a graph of the Interstitial pH in human skeletal muscle during and after dynamic-graded exercise by Street, Bangsbo, and Juel. Each color was a different intensity of workout. Red was the most intense. You can see pH in the interstitial space of the muscle dropped, especially during high intensity exercise.



When the pH of the muscles drops, the brain receives an alert of pain/burning from the skeletal muscle as a way of telling you to slow down! When you stop and rest, the pH of the muscle returns to its normal level so you can keep going.

Now, let's say an athlete was doing very long endurance workouts. They would not be able to maintain the high intensity, but their bodies could keep exercising for a very long time because the body can modify fatty acids to use as a fuel source for a process called beta oxidation in the myocytes. This is a process the body uses to create ATP from fats.

What can you do to help your body have enough energy to keep going? Well, let me show you in this model.



Drinking milk after an intense workout helps the body restore its fuel sources. After the nutrients in milk are digested and absorbed, glucose arrives in the bloodstream. There it can enter the liver hepatocytes and the muscle myocytes, which allows the liver and muscle glycogen stores to be replenished. This way, an athlete has a supply of glycogen that is available for their next intense workout to be made into ATP

Part 3: Sharing Presentation Drafts and Receiving Feedback on Our Presentations

As part of the process of preparing your presentation, you will work with another group to rehearse your presentations, then get feedback from your peers and give them feedback.

Pair with another group, then decide which group will rehearse first. After each group finishes their presentation, have a discussion about your observations. Use reasoning and evidence to support your ideas.

When the other group presents:
Respectfully provide feedback to your peers on their presentation. Use the "Peer Feedback Form" handout to document your feedback.

When your group presents:
Listen to the other group's feedback on your presentation and thank them for their suggestions. Be open to receiving critiques on your presentation. Then, as a group:

- Consider each item of feedback from your peers.
- Discuss the suggestions you want to incorporate in your presentation and explain why/why not. Use reasoning and evidence as you talk through ideas.
- (Optional - can be done here or in the final Performance Task) Make any revisions to your script or written report as agreed upon through group consensus.

Use the space below to record your group's discussion.

Suggested Improvement or Additional Science Ideas/Evidence	Reasoning for Incorporating/Not Incorporating