

STUDENT GUIDE

EXPLORE 3 LESSON 28



Part 1: Our Motivation

Record what we were trying to figure out that led to this investigation.

We saw that the body responds to the microtears in muscles by increasing protein synthesis in the muscles, by immune system cells moving into the bloodstream, and by specialized satellite cells activating in the muscle cells. We want to investigate this mechanism further to try to figure out how these different factors help muscles recover from their microtears.

Example Questions:

- Why does our body need to make more proteins after exercise?
- What's the deal with these "satellite cells" that show up when our muscles hurt during a workout?
- How does our body know when to crank up protein synthesis and send in more satellite cells after exercise?



Part 2: Using a Model to Explain How Muscles Recover From Soreness

As a class, you will engage in a Science Theater model to determine the mechanisms in the body that help muscles recover from soreness.

As you review your role, record a summary of the role your cells and organ will play in the muscle recovery process. Describe what function your organ has and how specialized cells contribute to its function.

How Specialized Cells Contribute:

Muscle Myocytes

The myocytes will receive a signal from the nerve cells and contract to help lift, move the muscle, and lift a weight or do whatever movement the muscle is doing. When recovering from muscle damage, the myocyte will take in amino acids from the bloodstream. Muscle microtears occur in the muscle cells and actually destabilize the system. Then, specialized cells, which are the satellite cells, come into the system to stabilize it.



Engage in the model. As you **enact** the model, record observations you make about the actions that various specialized cells take.

- Myocytes received an electrical signal from the neurons to help them contract, which resulted in damage to the myocytes.
- Satellite cells help repair damaged myocytes.
- Immune cells help to clear away damaged cells.

As you **observe** the model, record how different organs and their specialized cells function. Write or sketch your response as you choose.

Organ & Specialized Cells	Role of Organ and Specialized Cells in Recovering From Muscle Damage
Brain & Nerves	Neurons send signals to the muscles to help them contract.
Skeletal Muscles - Myocytes	Myocytes increase their levels of protein synthesis to help repair damaged proteins in the cells.
Skeletal Muscles - Satellite Cells	Satellite cells help repair damaged myocytes. Stabilize the system.
Immune Cells	Immune cells help to clear away damaged cells.
Blood Vessels	Myocytes release peptides into the bloodstream when they are damaged. Immune cells travel through the bloodstream to get to damaged muscle cells.

Explain how three negative feedback processes are used by the body to detect and repair muscle cells after they are damaged in exercise. In your response, be sure to discuss:

- the role of specific specialized cells in the feedback processes.
- what conditions change in the body to bring it out of a stable state, and how the body responds with feedback mechanisms to return it to a stable state.

Myocytes detect the damage to their own structure. This is a change to the stable state of the muscles. In response, in a negative feedback process to help the muscles return to their stable state, there are a few things that happen. First, immune cells in the bloodstream detect damaged muscle proteins and move into the muscles, actively repairing muscle cells. These cells help create additional muscle fibers, and repair damaged muscle fibers. Another change in the body is when muscle satellite cells detect damaged muscle cells, begin to undergo cell division, and form new muscle fiber cells that are incorporated into the damaged muscle fibers. Satellite cells also fuse into the damaged muscle fiber cells to repair their structure. Lastly, amino acids from the bloodstream enter the damaged muscle cells and are used in protein synthesis to form new muscle proteins. Each of these processes helps to repair the damage to the muscles done by the microtears in exercise.



Part 3: Asking New Questions

What new questions do you have that can help us make progress towards answering the Module Question, *How does milk help in muscle recovery from soreness and weakness induced by intense exercise?*

- We saw that the muscles recover from damage, but how do they get stronger after exercise?
- Do the muscles get stronger in any way after exercise?