

STUDENT GUIDE

ELABORATE LESSON 30



Part 1: Our Motivation

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

- How do satellite cells contribute to making our muscles stronger after we exercise?
- How do we get stronger after exercise?
- Does the recovery process help muscles get stronger after exercise?
- Do proteins from milk help you get stronger?



Part 2: Observing a New Phenomenon

Review the Lesson 30 Data Set handout. Record what you notice about the changes that occur to muscles in response to the two different exercise protocols (END and RT) in the research study.

Figure	Interpretation of the Data
Figure 1	The resistance training protocol resulted in more of an increase in the size of the muscle fibers than did the endurance training protocol.
Figure 2	The resistance training protocol resulted in more of an increase in the size of the whole muscle than did the endurance training protocol.



Figure 3	The resistance training protocol resulted in the participants being able to lift more weight for their one rep max and three rep max than the endurance training protocol.
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Do you think the results of these different experiments are consistent with one another? Why or why not?

Yes, they are consistent with each other. Each study seems to indicate that the resistance training protocol had a greater increase in the size and strength of the muscle.

Record the questions we will investigate based on the results you observed.

How do muscles increase their size and strength in response to resistance exercise? How can milk help with this process?



Part 3: Obtaining Information from Scientific Texts

Read the *How Do Muscles Grow* article. Determine what you think are the three central ideas of the text that will best help us answer our investigation questions. Record a summary of these three ideas in the space below. As you do so, be sure to:

- Summarize the text in more simple but still accurate terms.
- Describe the role of specialized cells in the muscle growth process.

Central Idea	Summary of What the Text Says About This Central Idea
Resistance training leads to microtears in muscle cells	<ul style="list-style-type: none"> • When muscles undergo intense exercise, as from a resistance training bout, the muscle fibers undergo microtears. • The microtears activate satellite cells in the muscle. • Satellite cells multiply and fuse to muscle fibers to form new muscle fiber strands.
Satellite cells contribute to muscle growth	<ul style="list-style-type: none"> • Growth factors such as hepatocyte growth factor and insulin-like growth factor stimulate satellite cells to produce gains in muscle fiber size.

Protein synthesis is helpful in muscle growth	<ul style="list-style-type: none"> • Muscle growth occurs whenever the rate of muscle protein synthesis is greater than the rate of muscle protein breakdown. • Growth hormone and testosterone can increase the uptake of amino acids into muscles. • Exercise stimulates protein synthesis for up to 24 hours after the workout.
Adaptations such as muscle growth take time	<ul style="list-style-type: none"> • It can take several weeks or months for hypertrophy to occur with consistent resistance exercise. • Muscle growth from resistance exercise could slow or reverse the muscle loss that occurs due to aging.



Part 4: Constructing an Explanation

Using the evidence you have obtained, construct an explanation that answers the questions we set out to investigate.

Muscles grow in size when they are being repaired from the microtears that occur. The muscles undergo an adaptation to increase their size to be prepared to lift the weight if it is encountered again. Molecules called growth factors help the muscle cells grow. The growth factors stimulate additional protein synthesis and stimulate additional satellite cell activity to help the muscle cells repair and grow.