

SI A&P - Full Discipline Demo - Fetal Pig

Physiology of the Muscle System

Final Report - Answer Guide

Institution	Science Interactive University
Session	SI A&P - Full Discipline Demo - Fetal Pig
Course	SI A&P - Full Discipline Demo - Fetal Pig
Instructor	Sales SI Demo

Test Your Knowledge

Match each term with the best description.

⚡ Synapse

⚡ Motor unit

⚡ Resting membrane potential

⚡ Neuromuscular junction

⚡ Action potential

A rapid sequence of changes in the voltage across the membrane of a cell

A state of stable voltage across a cell membrane

Site where the terminal end of a motor axon meets the motor end plate of a muscle fiber

Individual neuron and all of the muscle fibers it innervates

Gap between the neuron's axon terminal and the muscle fiber

1

2

3

4

5

Correct answers:

- 1 Action potential 2 Resting membrane potential
3 Neuromuscular junction 4 Motor unit 5 Synapse

Categorize each statement as true or false.

⚡ During complete tetanus, muscle fiber contraction remains continuous and uninterrupted until the signal stops or fatigue occurs.	
⚡ Muscle fatigue results from the buildup of lactic acid in muscle tissue.	
⚡ An electromyogram plots the muscle cell voltage in millivolts (mV) on the y-axis, with time on the x-axis.	
⚡ In a nerve conduction study, the period between stimulation and the beginning of the muscle contraction is called the relaxation phase.	
True	False
1	2

Correct answers:

1

During complete tetanus, muscle fiber contraction remains continuous and uninterrupted until the signal stops or fatigue occurs.

An electromyogram plots the muscle cell voltage in millivolts (mV) on the y-axis, with time on the x-axis.

2

Muscle fatigue results from the buildup of lactic acid in muscle tissue.

In a nerve conduction study, the period between stimulation and the beginning of the muscle contraction is called the relaxation phase.

Exploration

Membrane voltage, or potential, is generated first by the movement of sodium ions (Na⁺) into the cell, and later the movement of potassium ions (K⁺) out of the cell.

- ☐ True
- ☐ False



Muscle fibers innervated by the same motor neuron may contract as multiple units.

- ☐ True
- ☐ False



A twitch is a single contraction and relaxation period consisting of a ____.

- ☐ latent period
- ☐ contraction phase
- ☐ relaxation phase
- ☐ All of the above



Muscle cells utilize anaerobic pathways during vigorous exercise.

- ☐ True
- ☐ False



A(n) ____ is used to test how well and how fast electrical signals are transmitted to the muscles through motor neurons.

- ☐ electromyogram
- ☐ electroencephalogram
- ☐ nerve conduction study
- ☐ urinalysis



Exercise 1

What effect did repeating the exercise over time have on the muscles used? Reference Data Table 1 and Graphs 1 and 2 in your explanation.

Repeating the exercise decreased the number of repetitions that could be performed and increased the level of exertion required to perform the repetitions as recorded in Data Table 1 and illustrated in Graphs 1 and 2 respectively.

How well do you think the exercised muscles would work after 30 minutes of rest instead of 30 seconds of rest between trials?

After 30 minutes of rest, the muscles should work much better because more ATP and calcium will be available again.

Were you using aerobic or anaerobic pathways throughout this exercise? Explain your answer.

Both pathways were used throughout this exercise. During the physical exertion, especially near the end of the trials, the muscles felt as though they were burning. The burning sensation was due to lactate produced by glycolysis.

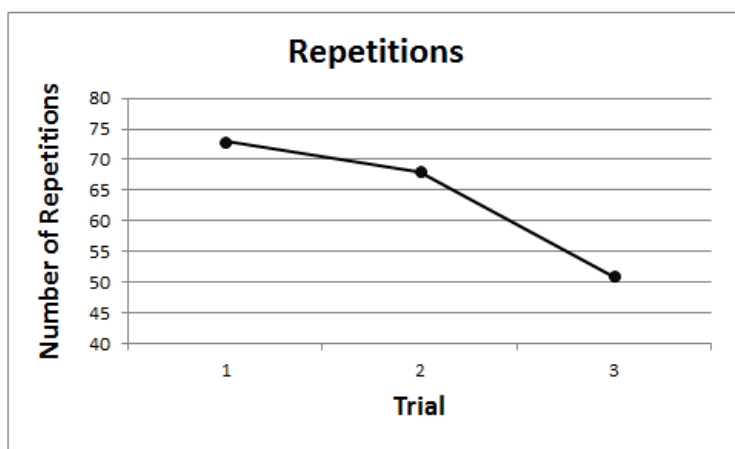
What is the biochemical explanation for muscle fatigue?

Muscle fatigue can occur for several reasons, the most common reason being ATP depletion. ATP is a molecule that binds to the myosin head, causing it to release from the cross-bridge and move into its cocked, high-energy state. This movement results in the muscle contraction. Without ATP, the myosin heads are not able to move forward, and contraction becomes difficult. This is when fatigue occurs.

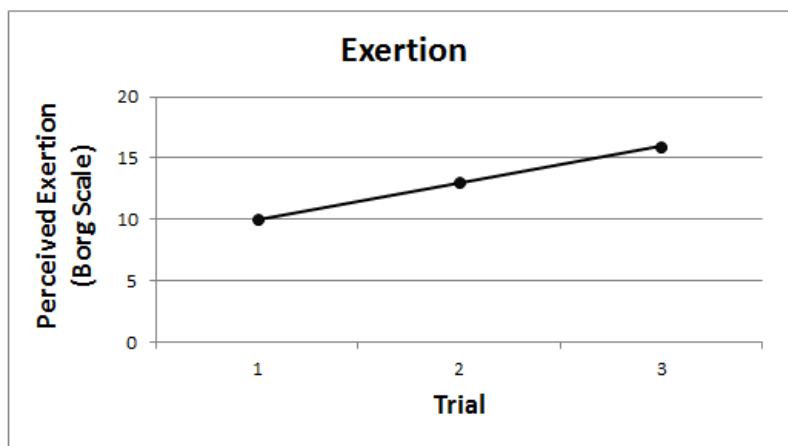
Data Table 1: Data from Forearm Exercise
(SAMPLE ANSWER BELOW)

	Trial 1	Trial 2	Trial 3
Repetitions Completed during Trial	73	68	51
Rating of Perceived Exertion	10	13	16

Graph 1: Repetitions
(SAMPLE ANSWER BELOW)



Graph 2: Exertion
(SAMPLE ANSWER BELOW)



Exercise 2

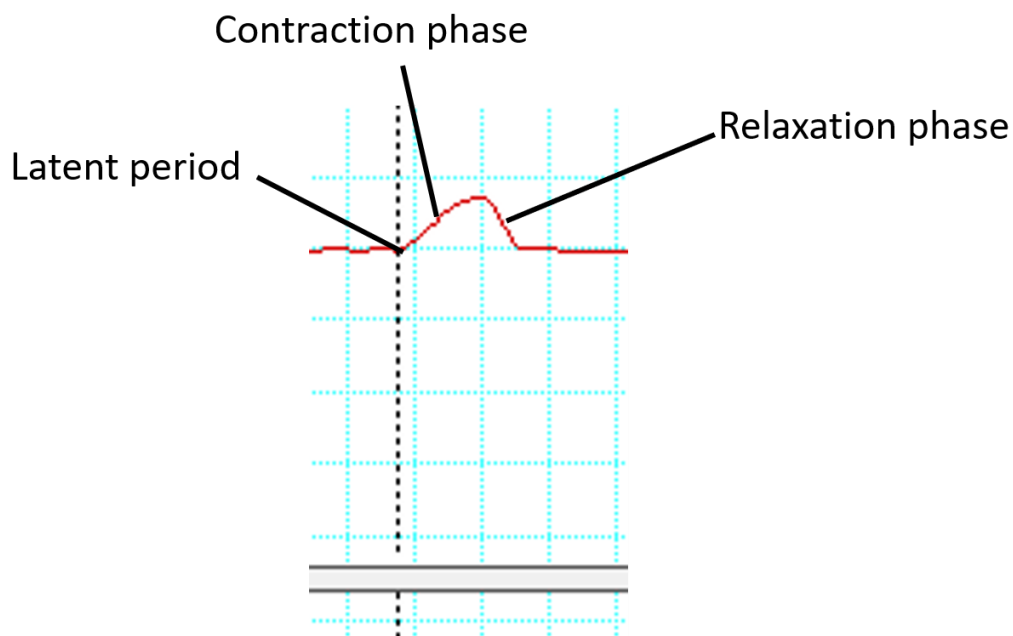
Describe what occurs to the triceps muscle when the biceps muscle is contracted. Even though these muscles are antagonists, why might this be beneficial?

The triceps muscle also contracts when the biceps contracts. This phenomenon called coactivation may be helpful to stabilize the arm.

Does the graph in Figure 8 show a muscle twitch, wave summation, or tetanus? Explain your answer.

The muscle in Figure 8 is experiencing tetanus. This is evident by the multiple deliveries of stimulation to the muscle resulting smooth muscle force graph that does not possess peaks associated with each individual stimulus.

Photo 1: Nerve Conduction Study
(SAMPLE ANSWER BELOW)





Competency Review

The movement of ____ across the plasma membrane causes the membrane potential to change.

- ☒ ions
- ☐ proteins
- ☐ lipids
- ☐ water

✓

When muscle cells and neurons are at rest, the electrical charge inside the cell is more negative than the electrical charge outside the cell.

- ☒ True
- ☐ False

✓

A neuron and all of the muscle fibers it innervates are collectively referred to as a ____.

- ☐ neuromuscular junction
- ☐ synapse
- ☒ motor unit ✓
- ☐ tetanus

Signals from the brain travel along the motor neurons in the form of action potentials

- ☒ True ✓
- ☐ False

During ____, muscle fiber contraction remains continuous and uninterrupted until the signal stops or fatigue occurs.

- ☐ twitch
- ☐ wave summation
- ☐ incomplete tetanus
- ☒ complete tetanus ✓

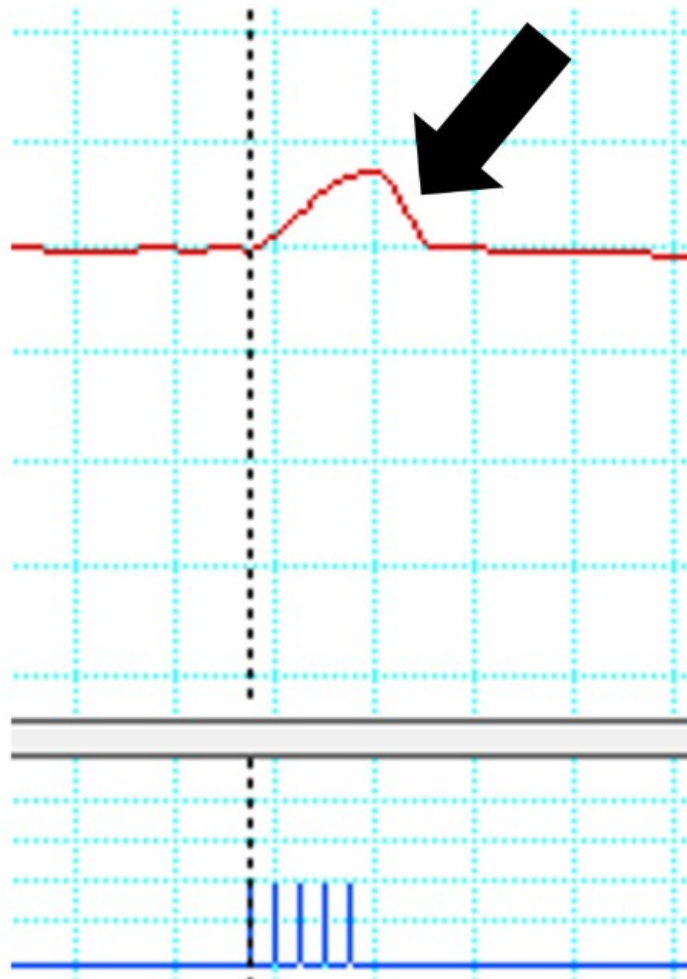
Greater fluctuations in mV displayed on an EMG indicate more activity occurring in the muscle cell.

- ☒ True ✓
- ☐ False

When performing a stress ball exercise, perceived effort increases with the number of trials performed.

- ☒ True ✓
 - ☐ False
-

The arrow in the nerve conduction study graph indicates the ____ of a muscle contraction.



- ☐ latent period
- ☐ contraction phase
- ☒ resting phase
- ☐ complete tetanus



Extension Questions

Professional track athletes can complete a 55-meter sprint in under 10 seconds. Apply your knowledge of muscle physiology to explain why runners do not need to breathe during the sprint. (SAMPLE ANSWER BELOW)

During this sprint, which takes less than 10 seconds, the runner does not need any oxygen because she is using an anaerobic pathway [mainly phosphocreatine (PCr)].

