

The Neuromuscular Junction

Graphics are used with permission of:
adam.com (<http://www.adam.com/>)
Benjamin Cummings Publishing Co (<http://www.aw.com/bc>)

Page 1. Introduction

- Motor neurons stimulate muscle cells to contract at the neuromuscular junction.

Page 2. Goals

- To examine the structure of a neuromuscular junction.
- To understand the sequence of events occurring at the neuromuscular junction following a stimulus.

Page 3. Role of Motor Neuron

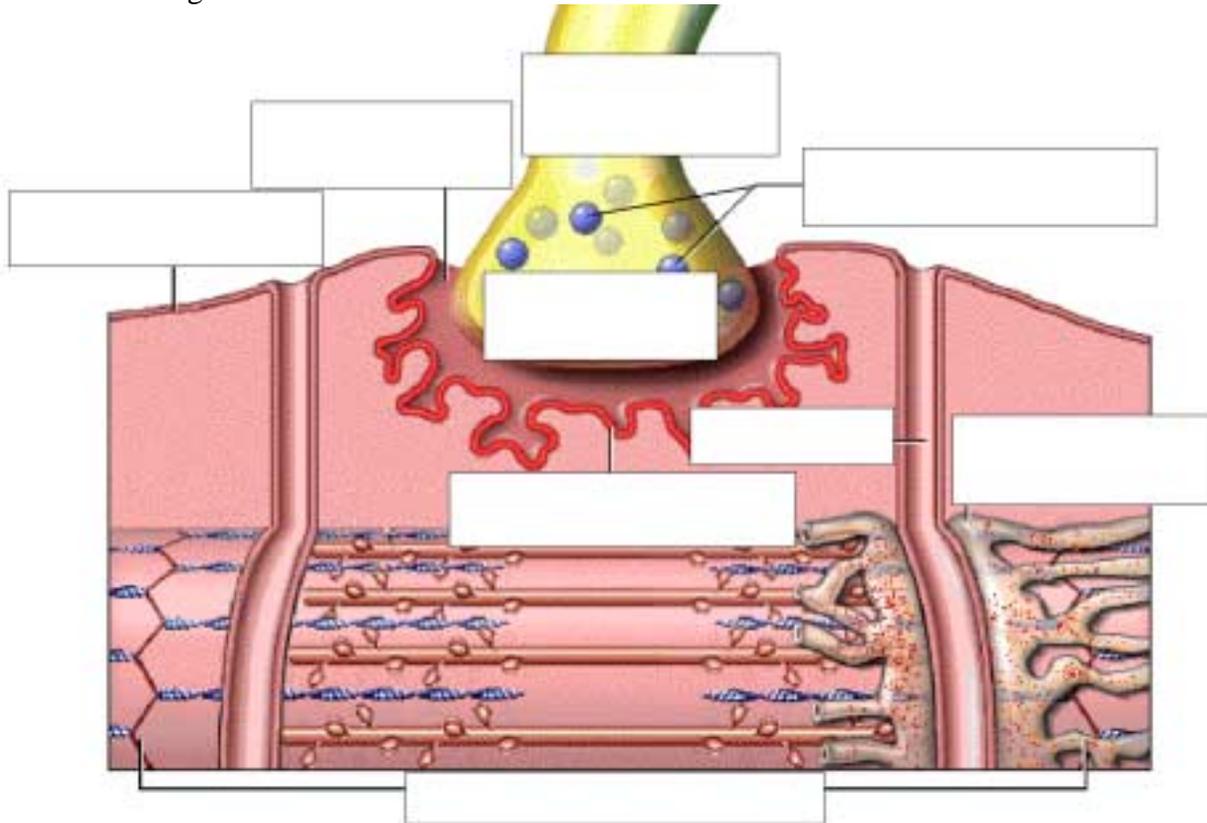
- Axons of motor neurons innervate skeletal muscle cells at the neuromuscular junction.

Page 4. Anatomy of a Neuromuscular Junction

- The following parts of a neuromuscular junction and skeletal muscle cell are described:

Axon terminal	Synaptic Vesicles	Synaptic Cleft
Motor End Plate	T Tubule	Sarcolemma
Terminal Cisternae & Sarcoplasmic Reticulum		Sarcomere

- Label this diagram:



** Now is a good time to go to quiz question 1:

- Click the Quiz button on the left side of the screen
- After answering question 1, click the Back to Topic button on the left side of the screen.
- To get back to where you left off, click on the scrolling page list at the top of the screen and choose "5. Overview of Neuromuscular Junction Activity"

Page 5. Overview of Neuromuscular Junction Activity

- The muscle cell, including the T Tubules are polarized. Stimulation of the motor end plate on a muscle cell by acetylcholine triggers depolarization resulting in contraction of the sarcomeres.

Page 6. Neuromuscular Animation

- The sequence of events in the neuromuscular animation are given.

Page 7. Summary

- Each skeletal muscle cell is individually stimulated by a motor neuron.
- The neuromuscular junction is the place where the terminal portion of a motor neuron axon meets a muscle cell membrane, separated by a synaptic cleft.
- An action potential arriving at the axon terminal brings about the release of acetylcholine, which leads to depolarization of the motor end plate.
- Depolarization of the motor end plate triggers an action potential that propagates along the sarcolemma and down the T Tubules.

Notes on Quiz Questions:

Quiz Question #1: Labeling the Neuromuscular Junction

- This question allows you to label the parts of the neuromuscular junction.

Study Questions on the Neuromuscular Junction:

1. (Page 1.) What causes skeletal muscle cells to contract?
2. (Page 1.) What is the place called where a motor neuron stimulates a muscle cell?
3. (Page 3.) How are skeletal muscle cells are electrically insulated from each other?
4. (Page 3.) What is a motor neuron?
5. (Page 3.) What part of the motor neuron carries impulses to the muscle? Describe its structure.
6. (Page 4.) Match the following terms to their description:

Axon terminal	Synaptic Vesicles	Synaptic Cleft
Motor End Plate	T Tubule	Sarcolemma
Terminal Cisternae & Sarcoplasmic Reticulum		Sarcomere

- | | |
|-------|---|
| _____ | a. Invaginations of the sarcolemma penetrating deep into the interior of the muscle cell. |
| _____ | b. The space between the axon terminal and the motor end plate. |
| _____ | c. The swollen distal end of the motor neuron axon. |
| _____ | d. The muscle cell membrane. |
| _____ | e. Structures within the axon terminal that contain the neurotransmitter acetylcholine. |
| _____ | f. The contractile unit of the muscle cell that extends from one Z line to the next. |
| _____ | g. Structures within skeletal muscle cells that serve as reservoirs of calcium ions. |
| _____ | h. A folded region of the sarcolemma at the neuromuscular junction. |

7. (Page 5.) What is a polarized membrane?
8. (Page 5.) Describe the resting membrane potential with respect the neuromuscular junction?
9. (Page 5.) Describe the T Tubules when they are at resting membrane potential.
10. (Page 5.) List the following events in the order they occur:
 - _____ a. The motor end plate is depolarized.

- _____ b. The sarcomeres contract.
- _____ c. Acetyl choline is released from the axon terminal into the synaptic cleft.
- _____ d. The depolarization triggers an action potential which propagates along the sarcolemma and the T tubules.
- _____ e. An action potential arrives at the axon terminal

11. (Page 6.) Place the following events in their proper sequence:

- _____ a. Acetyl choline is released into the synaptic cleft.
- _____ b. Action potential propagates along the sarcolemma and down the T Tubules.
- _____ c. Synaptic vesicles fuse to membrane of axon terminal.
- _____ d. Motor end plate becomes depolarized.
- _____ e. Action potential is initiated on the sarcolemma.
- _____ f. Action potential arrives at the axon terminal.
- _____ g. Calcium ions are released from the terminal cisternae.
- _____ h. Acetylcholine binds to receptor sites on the motor end plate.
- _____ i. The muscle cell contracts.
- _____ j. Calcium ions enter the axon terminal.