

# The Neuromuscular Junction

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## 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

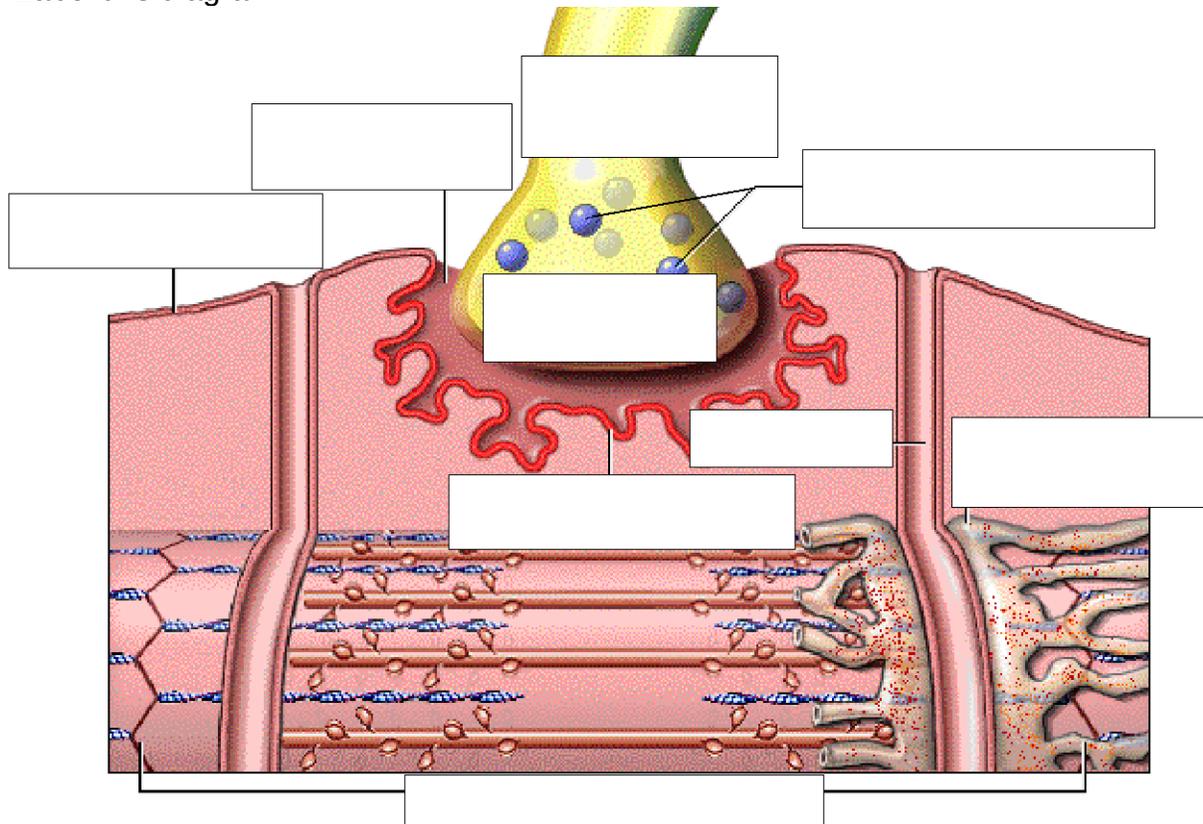
T Tubule

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  
Motor End Plate  
Terminal Cisternae & Sarcoplasmic Reticulum

Synaptic Vesicles  
T Tubule

Synaptic Cleft  
Sarcolemma  
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.