

Neuromuscular Junction

1. What are the three components that make up a neuromuscular junction?
2. Use nervous system classification to explain:
 - type of neuron that moves a skeletal muscle
 - where the nerve came from for a facial muscle
 - where the nerve came from for a leg muscle
 - purpose of sensory neurons on muscles
 - purpose of motor neurons on muscles
3. How many of the muscle fibers of a muscle have a motor neuron axon terminal on them?
4. Which ion rushes into the axon terminal when the action potential reaches it?
5. What is the effect of calcium entering the axon terminal?
6. Which type of neurotransmitter is always found in the axon terminals of somatic motor neurons?
7. Which type of receptors does ACh bind to on the muscle fiber?
8. When ACh binds to receptors on the muscle fiber, what happens throughout the ENTIRE muscle fiber (in BOTH directions!)
9. When you hear that a muscle fiber has depolarized, what does that mean in terms of ion exchange?
10. What is the purpose of T Tubules in muscle fibers?
11. What is stored in the Sarcoplasmic reticulum?
12. What event allows calcium to leave the SR and flood around the myosin and actin filaments?
13. What is meant by excitation-contraction coupling?
14. What does calcium bind to when it floods around the myosin and actin?
15. What is the ultimate result of calcium availability around the myosin and actin?
16. What is tetany?
17. What is summation?
18. Why is tetany a requirement for healthy skeletal muscles but would be a killer for cardiac muscle?

Answers:

Neuromuscular Junction

1. What are the three components that make up a neuromuscular junction?
Axon terminal, synaptic cleft, and a target muscle cell with receptors
2. Use nervous system classification to explain:
 - type of neuron that moves a skeletal muscle:
voluntary/somatic motor/efferent fiber
 - where the nerve came from for a facial muscle:
cranial nerve VII; off of brainstem
 - where the nerve came from for a leg muscle:
lumbar or sacral region of the spinal cord; ventral horn
 - purpose of sensory neurons on muscles:
stretch, position, and current contraction state is sent up to the spinal cord, and then up to the cerebellum and the postcentral gyrus in the parietal lobe to process these sensations
 - purpose of motor neurons on muscles:
somatic motor fibers release ACh onto skeletal muscle cells to cause them to contract
3. How many of the muscle fibers of a muscle have a motor neuron axon terminal on them?
All of them must have an axon terminal (although numerous neurons may reach the muscle)
4. Which ion rushes into the axon terminal when the action potential reaches it?
Calcium
5. What is the effect of calcium entering the axon terminal?
Exocytosis of synaptic vesicles
6. Which type of neurotransmitter is always found in the axon terminals of somatic motor neurons?
Acetylcholine
7. Which type of receptors does ACh bind to on the muscle fiber?
nicotinic cholinergic receptors
8. When ACh binds to receptors on the muscle fiber, what happens throughout the ENTIRE muscle fiber (in BOTH directions!):
depolarization, followed shortly by contraction
9. When you hear that a muscle fiber has depolarized, what does that mean in terms of ion exchange?
Na⁺ has rushed in, K⁺ has moved out
10. What is the purpose of T Tubules in muscle fibers?
To spread the action potential events all the way into the deepest parts of the cell.
11. What is stored in the Sarcoplasmic reticulum?
calcium
12. What event allows calcium to leave the SR and flood around the myosin and actin filaments?
depolarization triggers Calcium release from the SR.
13. What is meant by excitation-contraction coupling?
A muscle cell depolarizes and that causes mechanical movement of myosin and actin.
14. What does calcium bind to when it floods around the myosin and actin?
troponin
15. What is the ultimate result of calcium availability around the myosin and actin?
myosin is able to bind to actin.
16. What is tetany?
Sustained muscle contraction. It is necessary for normal skeletal muscle function. It occurs when a muscle cell is stimulated by action potentials very rapidly. It is not the same as the tetanic contractions that occur in the disease: tetanus. In that case, *Clostridium tetani* has a neurotoxin that inhibits the ability of the muscle cell to relax.
17. What is summation?
Repeated stimulation of a muscle cell results in progressively stronger contractions. This appears to be a result of the muscle cell "warming" up; i.e. the heat caused by mechanical friction increases the efficiency of the enzymes involved in muscle contraction. Also, more calcium availability means that more myosin heads can move actin at one time (similar to many more oars being put in the water to row a boat faster).
18. Why is tetany a requirement for healthy skeletal muscles but would be a killer for cardiac muscle?
Without tetany in skeletal muscle, motor actions would be jerky. In the heart, the movements are jerky (beating), and sustained contraction would mean the heart couldn't pump.