
Topic: The Musculo-Skeletal System

Reading: Chapter 39

Main concepts:

- Muscles and the skeleton work together to produce locomotion.
 - Muscles contain contractile fibers that cause them to contract; the skeleton provides support for the body and a place to anchor muscles that cause movement.
 - Three types of muscle tissue:
 - Skeletal: striated muscle capable of voluntary movement.
 - Smooth: non-striated muscle not directly under conscious control.
 - Cardiac: striated muscle cells connected end-to-end, capable of electrical coordination.
 - Muscle cells (fibers) contain myofibrils.
 - Myofibrils contain two types of protein fibers: “thick,” made up of strands of myosin protein, and “thin,” made up of strands of actin protein with tropomyosin and troponin proteins.
 - Myosin strands have small “heads” that literally crawl along the actin strands. This is the basis of muscle contraction.
 - Each movement of the myosin “head” requires one ATP, which is why muscles use up a lot of the body’s ATP.
 - This function of muscular movement requires the input of calcium ions.
 - Two types of muscle fibers:
 - Slow-twitch: Slow to contract. Contain abundant mitochondria, and store myoglobin (an oxygen-storing protein similar to hemoglobin), which make these fibers dark. They are useful for endurance activities, such as long-distance running. “Dark meat” on a turkey.
 - Fast-twitch: Contract quickly. These have fewer mitochondria and less blood supply, but make better use of glycolysis to operate in low oxygen conditions. These cells are lighter in color, and are useful for activities requiring a burst of energy, such as sprinting or weight lifting. “White meat” on a turkey.
 - The nervous system controls contraction of muscles through specialized neuromuscular junctions that form a motor unit.
 - Exercise increases the amount of actin and myosin within muscle cells, but does not increase the actual number of muscle cells.
 - Skeletons in the animal kingdom are of several types:
 - Hydrostatic skeleton: Earthworms rely on water pressure inside of their bodies to provide support.
 - Exoskeletons: non-living material that encase the body of an organism. Found primarily in the arthropods.
 - Endoskeletons: found in vertebrates, the endoskeleton is living tissue that is lightweight and can repair itself.
 - Primary functions of the vertebrate skeleton:
 - Support
 - Locomotion
 - Production of blood cells
 - Calcium, phosphorous, and energy storage
 - The vertebrate skeleton is made of living tissue
 - Bone and cartilage are made up of cells surrounded by a matrix. Because the cells are at a distance from their blood supply, getting nutrients to them is slower. Damaged tissue must not only replace cells, but the matrix as well. This is why bone and cartilage heal slowly.
 - The matrix in cartilage is collagen protein.
 - In bone, the matrix is made of collagen protein and minerals (calcium and phosphorous).
 - Bone continuously replaces itself, about 10% per year.
 - Bone mass is added if a person is active, and removed if a person becomes inactive. Thus an athlete has more bone mass than an office worker, and lifetime fitness is the best preventative of osteoporosis.
 - Muscles and bones together create movement.
 - Muscles are attached to bones by tendons; bones are attached to bones by ligaments.
 - Joints in the skeleton allow movement
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- Hinge joints: knee
- Ball and socket joints: femur and pelvis
- Gliding joint: vertebrae, wrist
- Muscles work in antagonistic pairs
 - The flexor pulls one bone toward another. The biceps in the arm are flexors.
 - The extensor pulls one bone away from another. The triceps in the arm are flexors.
 - The origin of a muscle is where it attaches to the bone that does not move. Biceps have their origin on the humerus.
 - The insertion of a muscle is where it attaches to the bone that moves. Biceps have their origin on the ulna.
 - Muscles only contract; they do not push.

Common misconceptions:

- Many people believe that they can build muscle mass by eating lots of protein. However, muscles only grow if there is a need for them to grow, and the need is in response to exercise. Muscle that are exercised (and given time to rest and repair themselves) will add mass. Because the average American diet is already rich in protein, it's rare that people would need to add protein to their diets to grow muscle. Athletes and body builders, however, can benefit from a moderate amount of added protein because of the constant repair needed on muscles that are extremely active.
- Many women take calcium tablets to prevent osteoporosis. But this alone may not be enough. While calcium is a necessary mineral, most therapists recommend both supplementation and exercise. Without exercise, the body has no need to add bone mass, which prevents or helps reverse osteoporosis. (In addition, the body needs Vitamin D to absorb calcium. Many companies are now adding small amounts of Vitamin D to calcium supplements.)
- Some people believe osteoporosis is only a women's disease. It's true that women are more affected by it, but men, too, can develop osteoporosis as they age. Men can benefit from regular exercise and a good diet to prevent osteoporosis.

Reading notes:

- List and describe the three types of muscle tissue and where they are found in the human body.
- Describe the types of protein strands in muscle fibers and state their function.
- Describe, on the cellular level, how muscles contract.
- Describe the neuromuscular junction and the motor unit. State why these are important.
- Describe how calcium and ATP are used in muscular contraction.
- List the differences between the hydrostatic skeleton, exoskeleton, and endoskeleton.
- List and describe the tissues that make up the endoskeleton.
- List and describe the cells that make up bone.
- Describe how broken bones repair themselves.
- Describe how muscles and bones work together to produce locomotion.
- State the causes of osteoporosis and how it can be prevented.

Useful websites:

- "The appendicular skeleton" http://www.wisc-online.com/objects/index_tj.asp?objID=AP13404 and "the axial skeleton" http://www.wisc-online.com/objects/index_tj.asp?objID=AP12904 are interactive lessons for anyone who would like to learn the names of bones.
 - "Muscle cell contraction" http://www.wisc-online.com/objects/index_tj.asp?objID=AP2904 is an animated tutorial explaining how muscle fibers function and how the nervous system interacts with muscles.
 - "Botulinum Toxin" http://www.mdvu.org/multimedia/videoclips/btx_moa.html is a Quicktime movie that explains how botulism can cause death, and what happens if you have Botox injections.
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