4.2 Muscles Study Guide by Hisrich

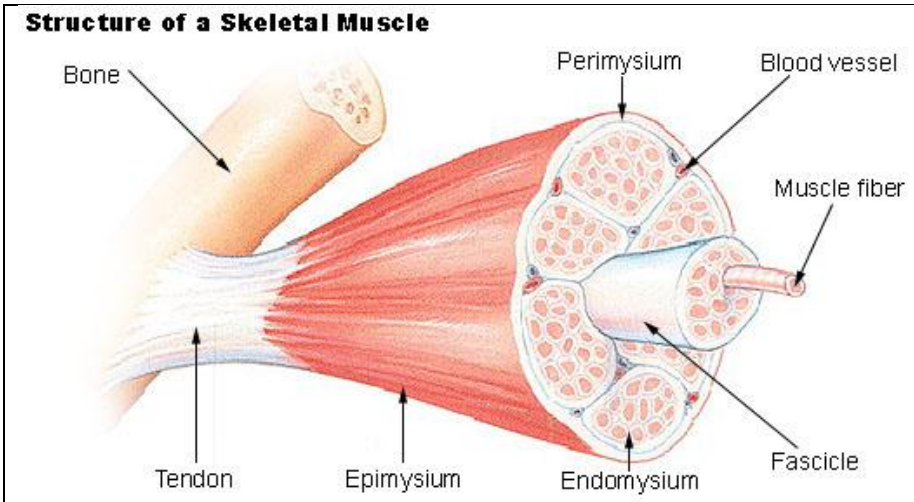
4.2. a How do muscles assist with movement of the body and of substances around the body?

Our **muscles** are what allow all movement of our bodies (and within our bodies). They help us involuntarily by helping food move down the esophagus and into the stomach (peristalsis) and helping blood move through our bodies (the heart is a muscle). They also help us move our bodies voluntarily from place to place (the muscles in our limbs). Our bodies each have about 650 muscles & are ~ 50% muscle by weight!

4.2. b How do the structure and function of the three types of muscle tissue compare?

Cardiac	**Skeletal**	**Smooth**
They are **striated muscle** fibers form the wall of the heart & function involuntarily.	They are attached to bone, mostly in the legs, arms, abdomen, chest, neck and face. They are **striated muscle** fibers (lined under microscope) & attach to bone by a tendon. They hold the skeleton together and give the body shape. They are voluntary (we control them) and contract quickly and powerfully), but they tire easily.	They are smooth (not **striated**) & are controlled automatically by our nervous system. They are also called "involuntary" muscles. They make up the walls of the stomach and intestine to help break down and move food. They also line the walls of blood vessels. They take longer to contract than skeletal muscles, but also don't tire as easily.

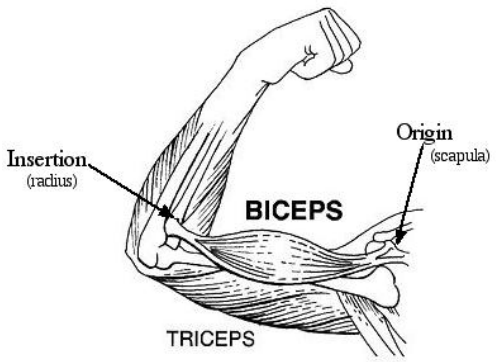
4.2.c How are muscle fibers and membranes organized to form a whole skeletal muscle?



The **epimysium** *("upon muscle")* is the outermost layer of connective tissue. The **perimysium** *("around muscle")* is made of connective tissue and forms casings for bundles of muscle fibers. The **endomysium** *("within muscle")* is connective tissue surrounding each individual muscle fiber. Each **fascicle** is a small cluster of muscle fibers, with **endomysium** between the individual fibers. Blood vessels run between the **fascicles**, bringing the tissue nutrients & removing waste. Nerves also run throughout, controlling the movement of the muscles. Together, the network of nerves and blood vessels are referred to as the **plexus**.

4.2.e How are muscles named? 4.2.d What do skeletal muscle structure and attachment to bones tell you about function?

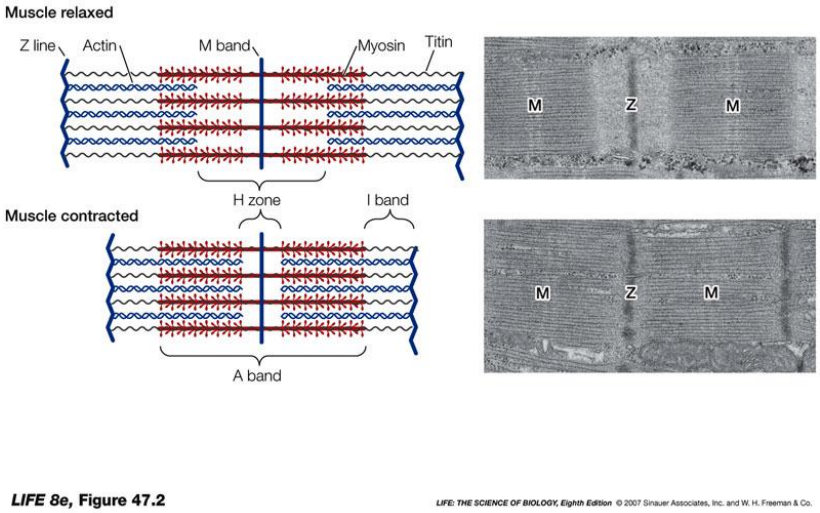
Several factors are considered when naming a muscle, including 1) Location (EX: tibialis anterior is on the front of the tibia) 2) Shape (EX: deltoid "resembles" (- oid) a "triangle" (delt)) 3) Points of attachment (EX: sternocleidomastoid—the muscle attaches to the sternum and the tendons attach to the mastoid process of the skull.) 4) Relative size (EX: gluteal or "rump" region – the gluteus maximus is bigger and the gluteus minimus smaller). 5) Number of muscle "heads" or divisions (EX: Biceps means "two-headed" and has two divisions) 6) Direction of muscle fibers (EX: the rectus abdominis muscle is located in the front of the abdomen and its fibers are oriented in a "straight" (rect), vertical direction). 7): Association with characters (EX: sartorius means "presence of" (-us) a "tailor" (sartori)! Tailors used to sit cross-legged upon the ground. The sartorius is actually located along the inner aspect of each thigh. Thus, when it contracts, it flexes (bends) the lower leg like an ancient tailor.



Muscles each have an **insertion**, where they attach to the moveable bone and an **origin**, where they attach to the stationary bone.

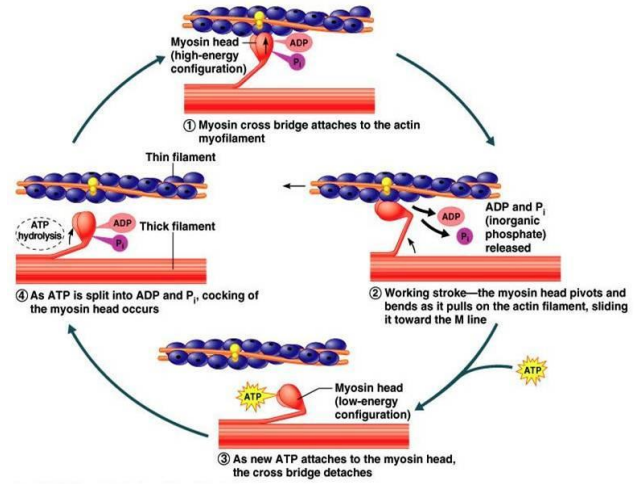
4.2.f What are the requirements for muscle contraction? 4.2.h What is a sarcomere? 4.2.i How does a sarcomere contract and lengthen to cause muscle contraction? 4.2.k How do nerves interact with muscles?

In order for muscles to **contract** (shorten and thicken), they must receive a message from the CNS to do so. The messages come through **efferent neurons** (**nerves** that move away from the CNS). The **sliding filament mechanism** explains muscle contractions. Muscle fibers contain many **myofibrils** ("muscle fibers") that allow the muscle cells to contract. The **myofibrils** contain thick and thin filaments attached to the Z disk (Z line). Thick filaments are made of **myosin** protein and thin ones of **actin** protein. The two proteins can twist around each other, shortening the **sarcomere** during contraction. **Tropomyosin** and **troponin** are proteins that control how **actin** and **myosin** interact—when they contract and twist and when they unravel and relax. **Afferent neurons** send messages back from muscles to the CNS. If there are problems with nerves, it can lead to issues with muscle function (i.e. **Carpal Tunnel Syndrome**)



LIFE 8e, Figure 47.2

4.2.g What role do calcium and ATP play in muscle contraction?



1) Calcium ions cause **troponin** and **tropomyosin** to shift, exposing **myosin** binding sites 2) **Myosin** heads connect with **actin** binding sites & move the thin filament, contracting the muscle 3) The ADP & P that caused the **myosin** heads to cock back are left behind during the power stroke 4) Introduction of ATP causes **myosin** heads to release the **actin** 5) ATP is broken down into ADP & P, causing **myosin** heads to cock back and prepare for another power stroke

4.2.j How is the condition **rigor mortis** related to muscle contraction?

After death the muscle's membranes become more permeable to calcium ions. Those ions promote the cross bridges of **actin** and **myosin**, shortening muscle fibers. ATP is needed to release the **myosin** heads from the **actin** fibers and allow muscles to relax, but ATP reserves are quickly depleted, causing muscles to remain contracted. It can take 10 minutes to hours to occur, with maximum stiffness 12-24 hours after death. Eventually tissue decays and lysosomal enzymes leak and cause muscles to relax.

4.2.l How can we assess muscle function?

Heart rate can help assess cardiac muscle function. Strength tests can help assess function of voluntary muscles.