Biology Lecture 8 - Muscle, Bone and Skin

Muscle

Functions
1. Body movement
2. Stabilization of body position
3. Substance movement throughout body
4. Generating heat

Skeletal Muscle
VOLUNTARY (SNS), MULTINUCLEATED, STRIATED
Muscle --*tendon*--> bone --*ligament*--> bone
Muscles can only CONTRACT so each movement has two muscles: agonist/antagonist
Sarcomere: muscle cell, contains thin (actin) and thick (myosin) filaments
-> Z line/I band associated with actin, A band/H zone associated with myosin
Sarcoplasmic reticulum surrounds many sarcomeres arranged in fibers
Sarcolemma wraps SR, sarcomeres, etc to form a muscle
Type I/slow twitch: high *myoglobin* so looks red. Slow to fatigue, but slow contraction velocity
Type II/fast twitch: low myoglobin so looks white. Fast to fatigue, but fast contraction velocity
Muscle cells don't divide, just grow more/thicker/longer sarcomeres

MUSCLE CONTRACTION:
1. Initially actin/myosin unbound b/c *tropomyosin* blocks binding site on actin
2. Neuron sends signal to muscle at neuromuscular synapse, releasing ACh
3. ACh causes action potential in muscle cells, which spread out quickly via *T-tubules*
4. Due to AP, sarcoplasmic reticulum releases many Ca^{2+} ions into muscle cell
5. Ca^{2+} ions cause *troponin* to move tropomyosin, allowing myosin to bind to actin
    a. At this stage, myosin is attached to ADP+Pi in a high energy "cocked" position
6. Release of ADP+Pi causes the *power stroke* where myosin moves along actin
7. ATP binds causing release of actin from myosin
8. ATP Is hydrolyzed to ADP+Pi causing myosin to become high energy/"cocked" again
9. Repeat 5-8 as necessary

Cardiac Muscle
INVOLUNTARY (ANS), SINGLE NUCLEUS, STRIATED
Each sarcomere is attached to the next by *intercalated discs*
Muscle cells attached to each other by *gap junctions* within intercalated discs
Action potential has a plateau after depolarization b/c of slow calcium channels

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Smooth Muscle
INVOLUNTARY (ANS), SINGLE NUCLEUS, NOT STRIATED
Thick/thin filaments attached to *intermediate filaments* which pull *dense bodies* together
Can have multiple cells connected by gap junctions per neuron (*single unit*)
... or each cell connected to its own neuron (*multiunit*)

Bone

Functions
1. Support
2. Protection
3. Helps with movement
4. Stores minerals
5. Stores energy
6. Produces blood cells

Bone Cells
Osteoblasts: BUILD bone around themselves, then differentiates into osteocytes
Osteocytes: differentated osteoblasts, help exchange nutrients/waste with blood
Osteoclasts: EAT bone, similar in structure to white blood cells

Bone Structure
Spongy bone near ends have *red bone marrow* where blood cells are made
Compact bone in middle have *yellow bone marrow* which store fat in adipocytes
Haversian canals are created by osteoclasts, and contain blood/lymph vessels
Osteoblasts form bone in circles around Haversian canals called *lamellae*
Volkmann's canals are perpendicular to Haversian canals, supply blood/lymph horizontally
Canaliculi are tiny canals between osteocytes
Haversian system/osteon: all of the above together
Hydroxyapatite: mineral that forms bone containing Ca and PO_4; building/breaking down bone will decrease/increase blood Ca^{2+} and HPO_4^- levels respectively

Cartilage
No blood vessels or nerves, made primarily of collagen
Reduces friction/absorbs shock in joints

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Joints
Fibrous joints: two bones tightly bound, no movement (i.e. skull)
Cartilaginous joints: two bones semi tightly bound by cartilage, little movement
Synovial joints: allows for wide range of movement
-> Bones separated by cartilage-surrounded capsule containing *synovial fluid*

Skin

Functions
1. Regulate body temperature due to capillaries, hair
2. Protects body from environment
3. Gets information from environment via sensory organs
4. Excrete water, salt, urea
5. Helps with immune system
6. Capillaries store blood
7. Create Vitamin D when exposed to UV radiation

Structure
Epidermis: upper layer, no blood vessels, help waterproof our body
-> Skin cells created in bottom layer of epidermis, as they go upwards they lose organelles and start mass producing keratin, after which they fall off our body
Dermis: connective tissue, has blood vessels/nerves/glands/hair follicles
-> Contains collagen, elastic fibers
-> Glands include *sebaceous* glands which create oil, sweat glands which create sweat