Muscular system

1. Muscular system

The muscular system is the series of muscles throughout the body that moves the skeleton, maintains posture through steady contraction, circulates blood throughout the body and generates heat through cell metabolism.

2. Types of muscle

Skeletal Muscle	Cardiac Muscle	Smooth Muscle
Striated; actin and myosin arranged in sarcomeres	Striated; actin and myosin arranged in sarcomeres	Not striated; more actin than myosin; actin inserts into dense bodies and cell membrane
Well-developed sarcoplasmic reticulum and transverse tubules	Moderately developed sarcoplasmic reticulum and transverse tubules	Poorly developed sarcoplasmic reticulum; no transverse tubules
Contains troponin in the thin filaments	Contains troponin in the thin filaments	Contains calmodulin, a protein that, when bound to Ca^{2+}, activates the enzyme myosin light-chain kinase
Ca^{2+} released into cytoplasm from sarcoplasmic reticulum	Ca^{2+} enters cytoplasm from sarcoplasmic reticulum and extracellular fluid	Ca^{2+} enters cytoplasm from extracellular fluid, sarcoplasmic reticulum, and perhaps mitochondria
Cannot contract without nerve stimulation; denervation results in muscle atrophy	Can contract without nerve stimulation; action potentials originate in pacemaker cells of heart	Maintains tone in absence of nerve stimulation; visceral smooth muscle produces pacemaker potentials; denervation results in hypersensitivity to stimulation
Muscle fibers stimulated independently; no gap junctions	Gap junctions present as intercalated discs	Gap junctions generally present

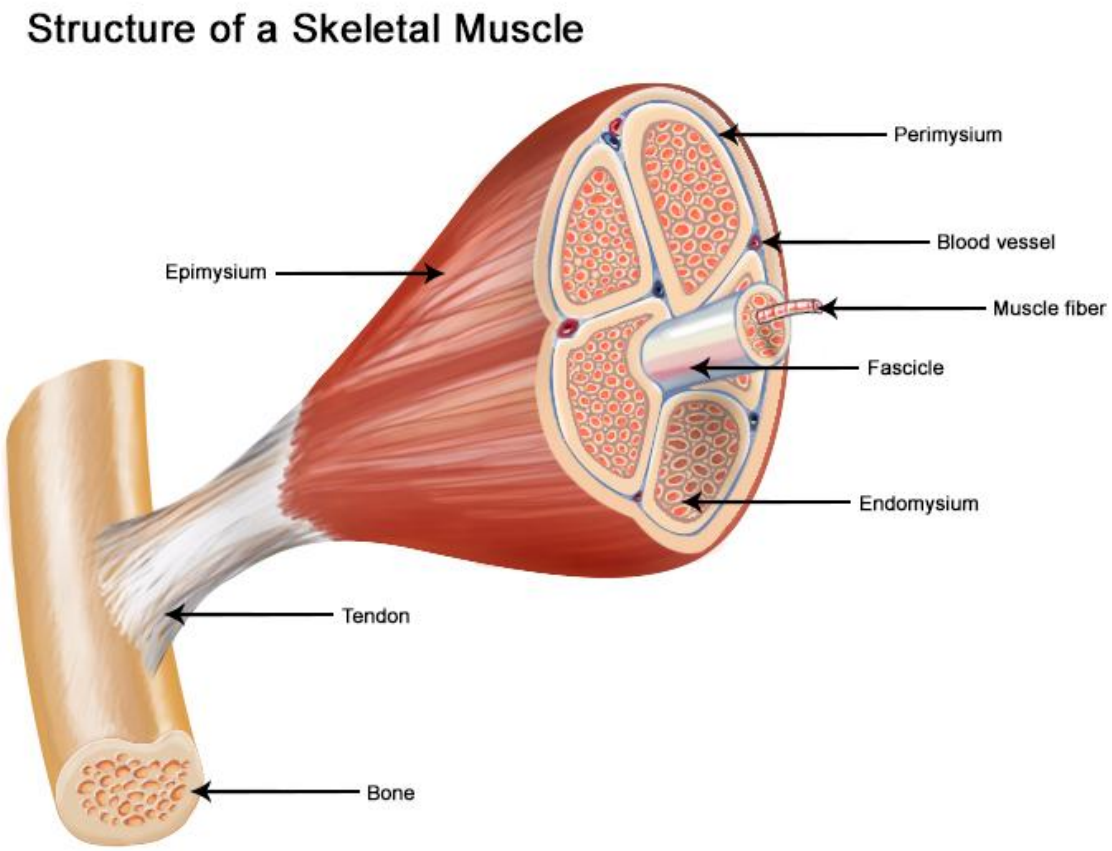
3. Skeletal muscle

Skeletal muscles form most of the human body weight. They are under the control of human will and all body movements occurring by our will are produced by skeletal muscles. They are called skeletal muscles because they are almost always found attached to the skeleton and produce movements in different parts of the skeleton.

4. Structure of skeletal muscle

- Most skeletal muscles are attached to two bones through **tendons**. Tendons are tough bands of dense regular connective tissue.
- Each skeletal muscle fiber is a **single cylindrical muscle** cell.
- Each muscle is surrounded by a connective tissue sheath called the **epimysium**.
- **Fascia**, connective tissue outside the epimysium, surrounds and separates the muscles.
- The epimysium project inward is divide the muscle into compartments.
- Each compartment contains a bundle of **muscle fibers.**
- Each bundle of muscle fiber is called a **fasciculus**.
- It is surrounded by a layer of connective tissue called the **perimysium**.

- Each individual muscle cell, called a **muscle fiber,** is surrounded by connective tissue called the **endomysium**.



5. Names of skeletal muscle

Skeletal muscles are named based on many different factors.

a. Location:

Many muscles derive their names from their anatomical region. For example, the **rectus abdominis** and the **transverse abdominis** muscles are found in the abdominal region.

b. Origin and Insertion:

Some muscles are named based upon their connection to a stationary bone (origin) and a moving bone (insertion). For example: The **occipitofrontalis** muscles (connecting the **occipital bone** to the **frontal bone**).

c. Number of origin:

Some muscles connect to more than one bone or to more than one place on a bone, and therefore have more than one origin. For example: **Biceps** (muscle with two origins) and **triceps** (muscle with three origins).

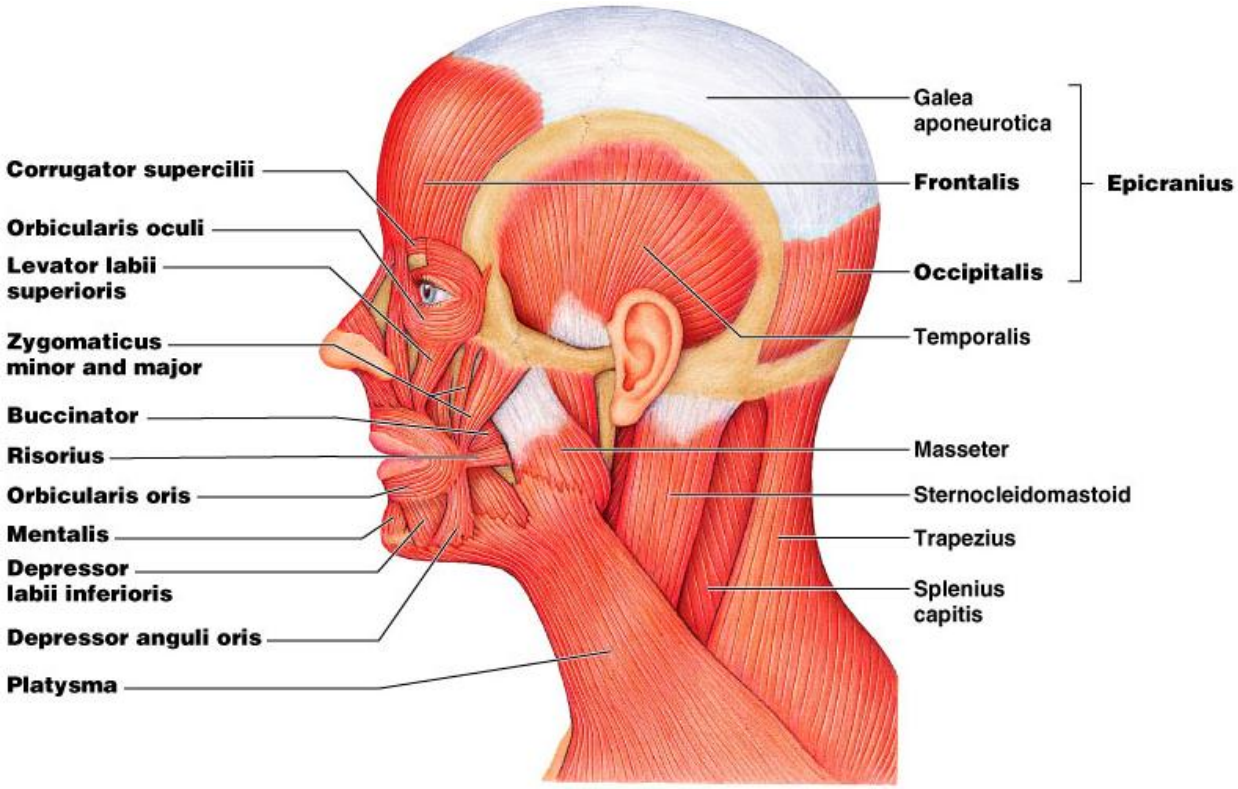
d. Size, shape and direction:

In the abdominal region, there are several sets of wide, flat muscles. The muscles whose fibers run straight up and down are the **rectus abdominis**, the ones running **transversely** (left to right) are the **transverse abdominis**, and the ones running at an angle are the **obliques**.

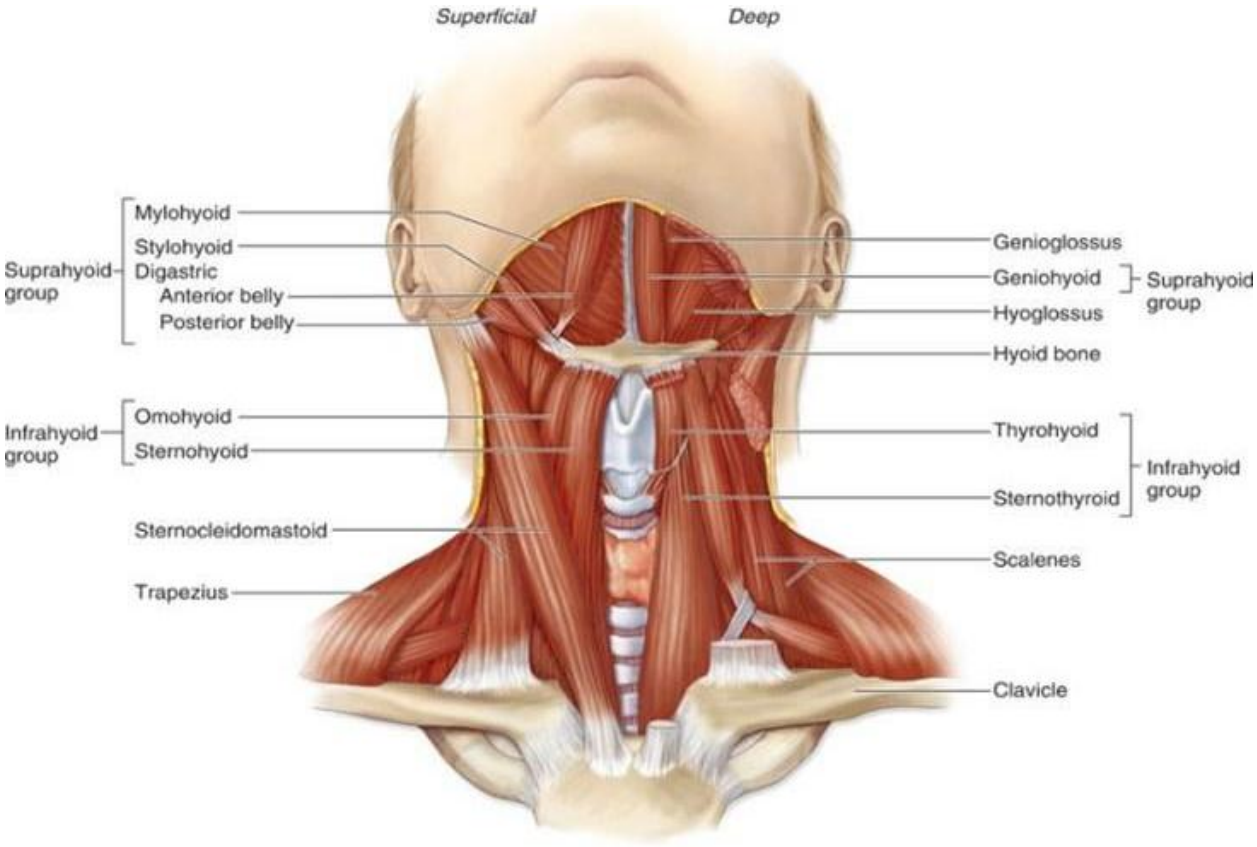
e. Functions:

Muscles are sometimes classified by the type of function that they perform. For example: The **supinator** is a muscle that supinates the wrist by rolling it over to face palm up.

6. Muscles of scalp and face



7. Muscles of anterior neck



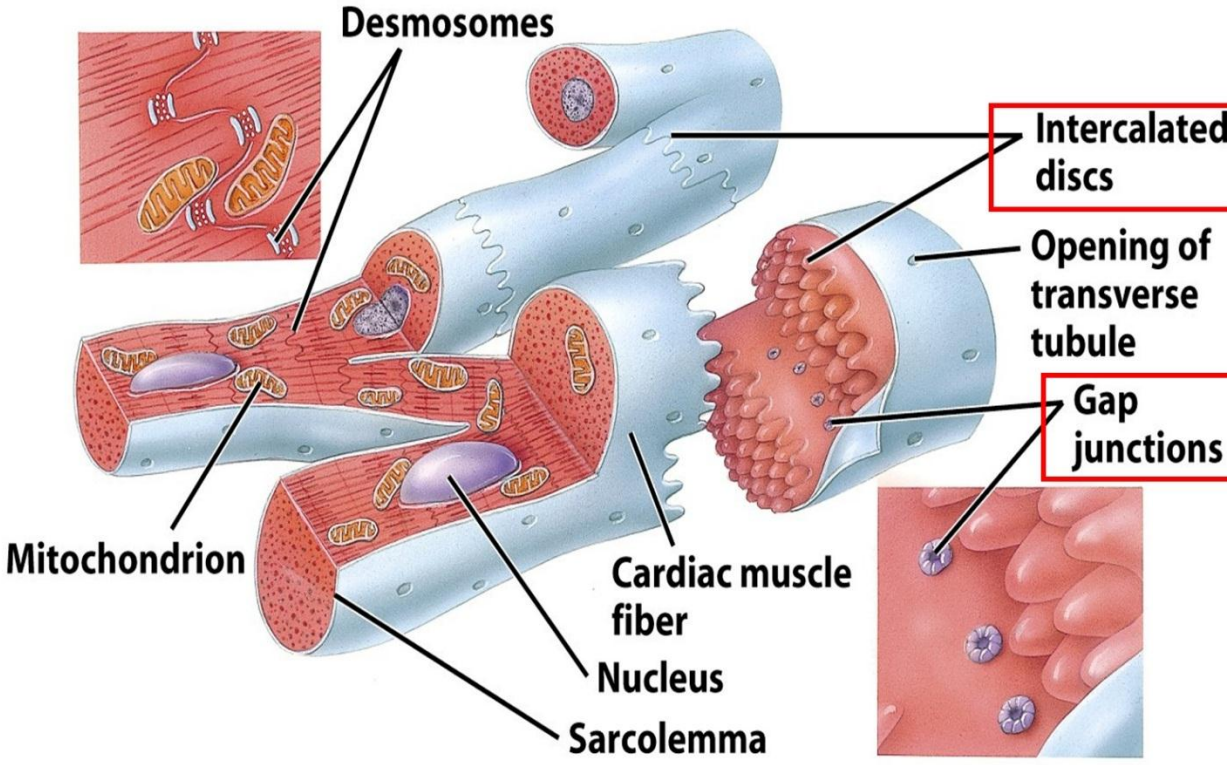
8. Cardiac muscles

Cardiac muscle tissue is an extremely specialized form of muscle tissue that has evolved to pump blood throughout the body. In fact, cardiac muscle is only found in the heart and makes up the bulk of the heart's mass. It has evolved to have incredibly high contractile strength and endurance.

9. Structure of cardiac muscle

- Cardiac muscle tissue is only found in the heart.
- Highly coordinated contractions of cardiac muscle pump blood into the vessels of the circulatory system.
- Similar to skeletal muscle, cardiac muscle is striated and organized into sarcomeres.
- However, cardiac muscle fibers are shorter than skeletal muscle fibers
- Usually contain only one nucleus, which is located in the central region of the cell.
- Cardiac muscle fibers also possess many mitochondria and myoglobin.
- Cardiac muscle fibers cells also are extensively branched and are connected to one another at their ends by intercalated discs.
- An intercalated disc allows the cardiac muscle cells to contract in a wave-like pattern so that the heart can work as a pump.

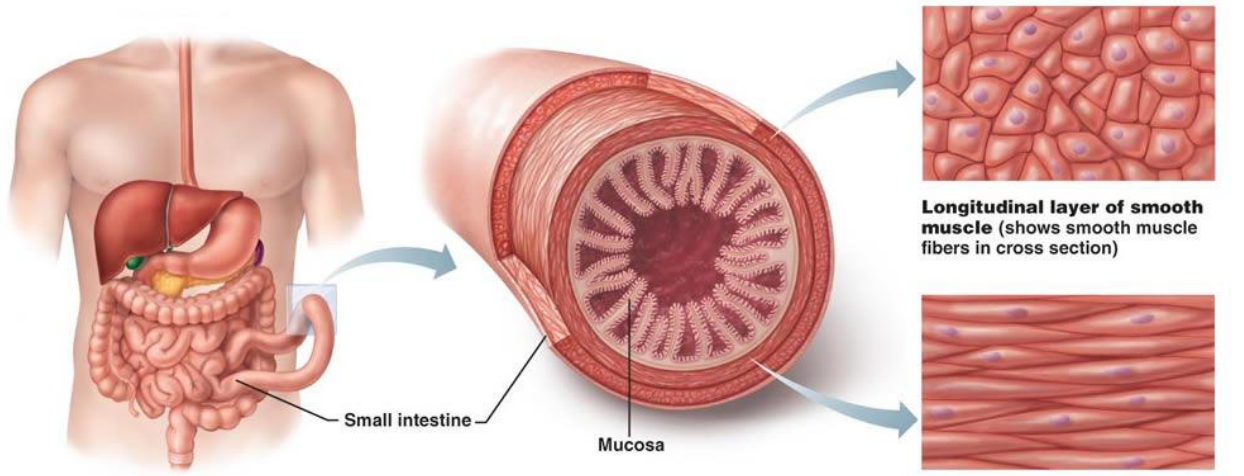
- Intercalated discs are part of the sarcolemma and contain two structures: gap junctions and desmosomes.
- A gap junction forms channels between adjacent cardiac muscle fibers that allow the current to flow from one cardiac muscle cell to the next.
- A desmosome is a cell structure that anchors the ends of cardiac muscle fibers together so the cells do not pull apart during the stress of individual fibers contracting.



Cardiac muscle fibers

10. Smooth muscles

- Smooth muscle is present in the walls of hollow organs like the urinary bladder, uterus, stomach, intestines.
- Smooth muscle fibers are spindle-shaped (wide in the middle and tapered at both ends.
- Have a single nucleus.
- They range from about 30 to 200 µm (thousands of times shorter than skeletal muscle fibers).
- Although they do not have striations and sarcomeres.
- It have actin and myosin contractile proteins, and thick and thin filaments.
- These thin filaments are anchored by dense bodies.



(a)

(b) Cross section of the intestine showing the smooth muscle layers (one circular and the other longitudinal) running at right angles to each other.