

## MUSCULAR SYSTEM

### MUSCLES

- Muscle is a type of tissue (muscular tissue) which is composed of contractile cells or fibers.
- The contraction of muscle causes the movement of an organ or parts of the body.
- The study of muscles is known as myology.

#### Functions of Muscles

1. It provides movements of the body parts or organs.
2. It provides stability and posture to the body parts.
3. It helps in production of heat.
4. It helps in circulation of blood.
5. It helps to digestion.

#### Types of Muscles

The muscles are of three types:

No	Types	Examples
1.	Skeletal muscles	Triceps, biceps, deltoid, brachialis, brachioradialis, coracobrachialis, pectoralis major, latissimus dorsi, teres major, supraspinatus, serratus anterior etc.
2.	Smooth muscles	It is present in the wall of internal organs such as stomach, intestine, urinary bladder, blood vessels, ureter, gastrointestinal tract, respiratory tract etc.
3.	Cardiac muscle	It is present only in wall of heart. (Myocardium).

### SKELETAL MUSCLES

- Muscle that connected at either or both ends of bone and moving parts of the skeleton is known as skeletal muscles.
- It is also known as voluntary muscles, striped muscles, striated muscles or somatic muscles.
- Examples: Triceps, biceps, deltoid, brachialis, brachioradialis , coracobrachialis etc.

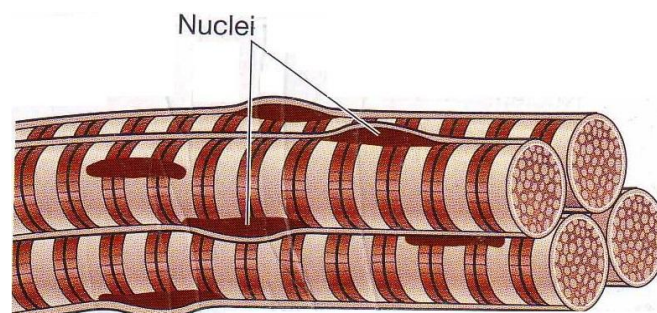
#### Composition of Skeletal Muscle

The skeletal muscle is formed by:

- 75% : Water
- 20% : Proteins
- 5% : Organic substances, other than proteins and inorganic substances

#### Structure of Skeletal Muscle

- The skeletal muscles are composed of large number of muscle fiber (group of muscle fiber).
- The groups of muscle fiber form bundles known as fascicule.
- The muscle fiber is covered by cell membrane known as sarcolemma.
- The muscle fiber contains myofibrillar structure known as myofibrils.
- The myofibril is composed of two bands such as thick band known as myosin and thin band known as actin.



**Fig: structure of skeletal muscle**

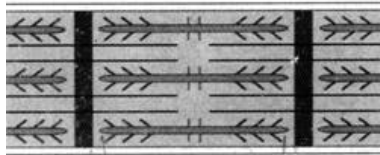
#### Functions of Skeletal Muscle

1. It gives shape and appearance (outlook) to the body.

2. It protects the vital organs of the body.
3. It keeps the joints in proper position.
4. It produces movements of the body.
5. It helps in venous return and lymphatic drainage.

### Contraction of Skeletal Muscle

- The contraction of muscle fibers is brought about by sliding movement of actin filaments over the myosin filaments.
- Calcium ion is the most important element for the contraction muscle, in the presence of calcium ions and energy from ATP, actin and myosin intact forming actinomyosin.
- The actinomyosin helps in contraction of muscle.
- During muscle contraction, chemical energy is changed into mechanical energy.
- The shortest duration of contraction of muscle is seen in eye.
- The recording of muscle contraction is known as myogram.



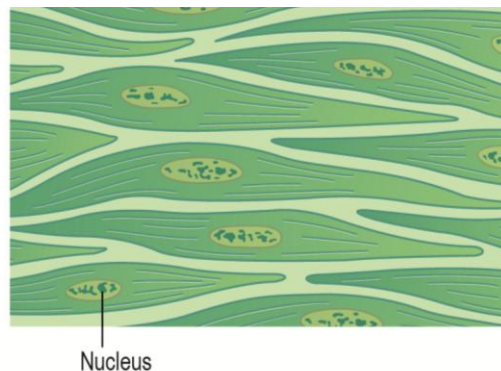
*Fig. Skeletal muscle contraction*

### SMOOTH MUSCLES

- The muscle that contract without conscious control (involuntary control) is known as smooth muscles.
- It is also known as unstriated muscles, plain muscles, involuntary muscles or non skeletal muscles.
- Examples: It is present in the wall of internal organs such as stomach, intestine, urinary bladder and blood vessels, ureter, gastrointestinal tract, respiratory tract etc.

### Structure of Smooth Muscle

- The smooth muscle is made up of thin-elongated muscle cells.
- The muscle fibers are covered by plasma lemma.
- The nucleus is single, elongated and centrally placed. Normally, two or more nucleoli are present in the nucleus.
- The smooth muscle fibers are very small, measuring about 2-5 microns in diameter and 55-200 microns in length.
- Each muscle fiber contains myofibrils. The myofibrils are made up of muscles proteins, but there are no dark and light bands present.
- The smooth muscle contraction is very slow, involuntary under the control of autonomic nervous system.



Nucleus

### Functions of Smooth Muscle

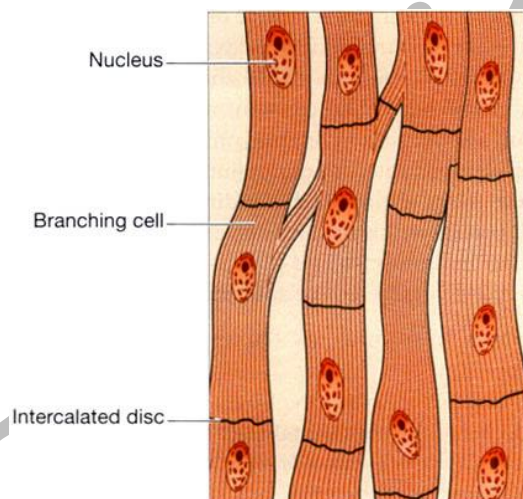
1. It performs movements of wall of internal organs like stomach, intestine, blood vessels, respiratory tract, digestive tract, urogenital tract etc.

## CARDIAC MUSCLE

- The cardiac muscle is a type of muscle (muscular tissue) present in the middle layer of heart wall.
- It is also known as heart muscle or myocardium.

### Structure of Cardiac Muscle

- The cardiac muscle cells are short, cylindrical and branched structure.
- The muscle cell contains centrally situated nucleus.
- The muscle cells are inter connected with each other by special zigzag junctions known as intercalated disc.
- The cardiac muscle consists of cylindrical fibers interconnected by oblique bridge and forming continuous contractile network.
- The cardiac muscles are myogenic and these muscles are not initiated by nervous system. But, the heart rate, force of contraction and blood pressure are regulated by autonomic nervous system.
- The cardiac muscles have power of rhythmic contraction and relaxation throughout the life and do not get tired.



### Functions of Cardiac (heart) Muscle

- It plays role in contraction of atrium and ventricles of the heart.
- It plays role in circulating the blood and its contents throughout the body as a consequence.

### DIFFERENCES BETWEEN SKELETAL, SMOOTH AND CARDIAC MUSCLE

No.	Skeletal muscle	Smooth muscle	Cardiac muscle
1.	It is present in limbs, body walls, tongue and pharynx.	It is present in wall of internal organs such as stomach, intestine, urinary bladder, blood vessels, ureter, gastrointestinal tract, respiratory tract etc.	It is present in middle layer of heart wall.
2.	It is rough cylindrical in shape.	It is spindle in shape.	It is cylindrical in shape
3.	It is multinucleated.	It is uninucleated.	It is uninucleated.
4.	It is covered by sarcolemma.	It is covered by plasma lemma.	It is covered by plasma lemma.
5.	The nerve supply from somatic nervous system.	The nerve supply from autonomic nervous system.	The nerve supply from autonomic nervous system.
6.	It has rapid contraction.	It has slow sustained contraction.	It has rhythmic (Automatic) contraction.

7.	The mode of working is voluntary.	The mode of working is involuntary.	The mode of working is myogenic (automatic or rhythmic.)
8.	The blood supply is rich.	The blood supply is poor.	The blood supply is rich.
9.	The energy demand is high and at a time.	The energy demand much less and constantly.	The energy demand is high and constantly.
10.	Get tired easily.	Don't get tired easily.	Do not get tired.

### MOTOR UNIT

The single motor neuron and all the muscle fibers it stimulates is known as motor unit.

### NEUROMUSCULAR JUNCTION

Junction between the terminal branch of the nerve fiber and muscle fiber is known as neuromuscular junction.

### MUSCLE OF TONGUE

Each half of the tongue contains two types of muscles:

a. **Extrinsic Muscles**

The extrinsic muscles are:

- Genioglossus muscle
- Styloglossus muscle
- Palatoglossus muscle
- Hyoglossus muscle

b. **Intrinsic Muscles**

The intrinsic muscles are:

- Superior longitudinal muscle
- Inferior longitudinal muscle
- Transverse muscle
- Vertical muscle

### MUSCLE OF MASTICATION

The muscles of mastication are as follows:

- Masseter
- Temporalis
- Medial pterygoid
- Lateral pterygoid

### INTERCALATED DISC

The muscle cells are inter connected with each other by special zigzag junctions known as intercalated disc.

### ACTIN, MYOSIN AND SARCOMERE

1. **Actin:** Actin is thin filaments with a diameter of  $20\text{\AA}$  and a length of 1 micron.
2. **Myosin:** Myosin is thick filaments with a diameter of  $115\text{\AA}$  and a length of 1.5 microns.
3. **Sarcomere**
  - The structural and functional unit of skeletal muscle is known as sarcomere.
  - It is also known as basic contractile unit of muscle.
  - The average length of each sarcomere is  $2-3\mu$ .

