MUSCULAR TISSUE

- Muscular tissue plays a pivotal role in enabling various movements within the body. Comprising muscles, it consists of elongated, cylindrical cells known as muscle fibers. These fibers can be arranged in sheets or bundles within a muscle, bound together by connective tissue. Unlike many tissues, muscular tissue lacks intercellular substance. Within the muscle fibers, thread-like proteinaceous fibrils called myofibrils are found in the sarcoplasm, the cytoplasm of muscle cells.
- Muscle fibers possess the remarkable ability to contract and relax in response to stimuli. This coordinated action allows them to shorten during contraction and lengthen during relaxation, returning to their original uncontracted state. This dynamic process is crucial for adjusting the body to environmental changes and maintaining the positions of various body parts.

Types of Muscular Tissue

Based on their location, structure, and function, there are three main types of muscles:

- Skeletal Muscle
- Smooth Muscle
- Cardiac Muscle

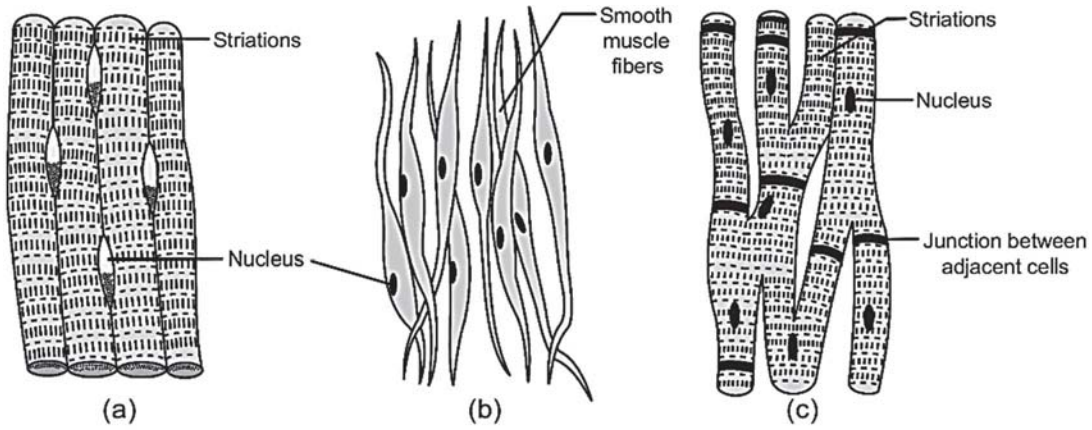

Fig.: Different types of muscle tissue :
(a) Skeletal (striated) muscle tissue, **(b)** Smooth muscle tissue, **(c)** Cardiac muscle tissue

Skeletal Muscle (Striated or Striped Muscle)

Skeletal muscles, also known as striated or striped muscles, constitute the most abundant type of muscle fibers extensively connected to bones, hence the term skeletal muscle fibers. These muscles operate under voluntary control, responding to the conscious directives of an individual, governing movements such as those involving the arms and legs.

- **Structure:** In the typical composition of a muscle, like the biceps, striated skeletal muscle fibers are encased by an outer layer known as the sarcolemma, which is both elastic and robust. Positioned irregularly just beneath the sarcolemma, multiple nuclei are present in each fiber, rendering them multinucleated and forming a structural syncytium. The cytoplasm, or sarcoplasm, of these fibers contains numerous tightly packed myofibrils. Each myofibril exhibits distinctive alternating dark and light bands, creating the characteristic striped or striated appearance that defines this muscle type. These fibers are organized into parallel bundles.

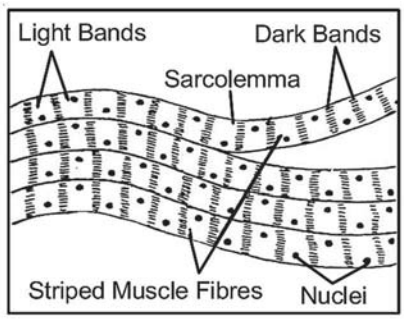

Fig.: Skeletal muscle tissue

- **Location:** Skeletal muscle is primarily found attached to bones, with prevalent locations in areas such as the arms, legs, body wall, face, and neck.
- **Function:**
  Striated muscles play a vital role in generating the force required for locomotion and other voluntary movements of the body.
  These muscles are recognized for their potency and ability to undergo rapid contractions. However, it's important to note that striated muscles can experience fatigue and necessitate periods of rest and recovery.

Smooth Muscle (Unstriped or Non-striated Muscle)

Smooth muscles, also known as unstriped or non-striated muscles, are situated in the walls of hollow visceral organs, excluding the heart, which is why they are referred to as visceral muscles. In contrast to skeletal muscles, smooth muscles operate involuntarily, meaning their actions are not directly under conscious control. Notably, smooth muscles do not have direct connections to the skeleton.

- **Structure:** Smooth muscle fibers or cells possess an elongated and spindle-shaped morphology, tapering at the ends (fusiform) and broad in the middle. These cells are interconnected by cell junctions and are bundled within a connective tissue sheath. Each muscle cell is enclosed in a simple plasma membrane. A single oval nucleus is centrally located within the cytoplasm or sarcoplasm, rendering these cells uninucleate. Longitudinally running through the cell are delicate contractile threads called myofibrils. Unlike skeletal muscles, these myofibrils lack distinct light and dark bands, hence the designation as smooth, unstriped, or non-striated muscles

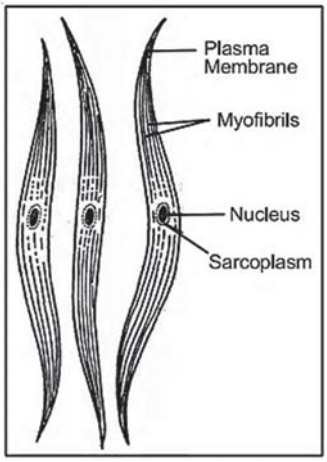

Fig.: Smooth muscle tissue

- **Location:** Smooth muscles are found in various visceral locations such as the posterior part of the esophagus, stomach, intestine, lungs, urinogenital tract, urinary bladder, blood vessels, and the iris of the eye.
- **Function:** The primary function of smooth muscles is to facilitate involuntary movements within the body, including processes such as peristalsis (the movement of food in the alimentary canal), as well as the opening and closing of various tubes within the body.

Cardiac Muscle (Involuntary Muscles or Striped Muscles)

Cardiac muscles, also known as involuntary muscles or striped muscles, are exclusively located in the heart. Unlike skeletal muscles, cardiac muscles operate involuntarily, meaning their activity is beyond conscious control.

- **Structure:** Cardiac muscles are comprised of branched fibers that join together to form an intricate network. Each fiber or cell is enveloped by sarcolemma and contains cytoplasm (sarcoplasm) housing longitudinal myofibrils and a centrally located nucleus, rendering each cell uninucleate. The myofibrils exhibit transverse faint dark and light bands that alternate with each other. Notably, these muscle fibers display densely stained cross-bands referred to as intercalated discs, featuring communication junctions at intervals. Intercalated discs are specialized regions of the cell membrane connecting two adjacent fibers. These discs serve to enhance the contraction wave and facilitate the transmission of the muscle contraction wave from one cardiac fiber to another. Consequently, all fibers contract as a coordinated unit.
- **Location:** Cardiac muscles are situated in the walls of the heart.

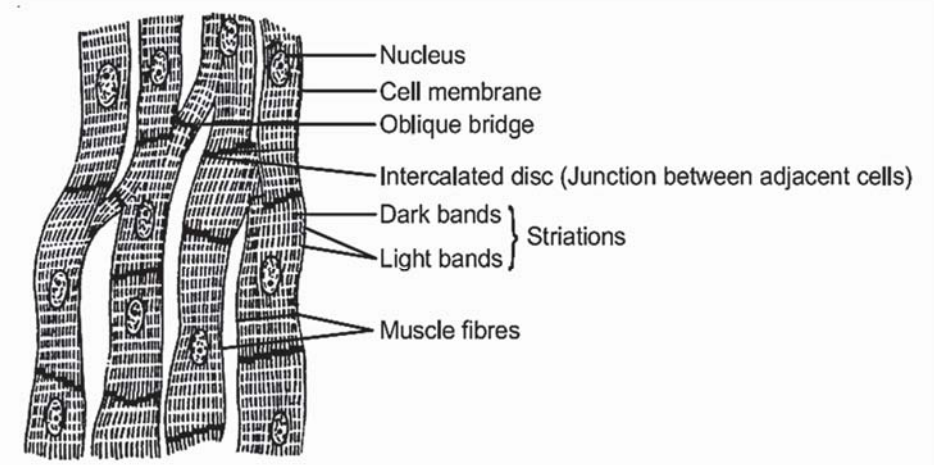

Fig.: Cardiac muscle tissue

- **Function:** The primary function of cardiac muscles is to undergo rapid and rhythmic contraction and relaxation throughout an individual's life. Remarkably, these muscles do not experience fatigue. The contraction and relaxation of cardiac muscles play a crucial role in pumping and distributing blood to various parts of the body.

Differences between Skeletal, Smooth and Cardiac muscles fibres		
Skeletal Muscle Fibres	**Smooth Muscle Fibres**	**Cardiac Muscle Fibres**
Occur in the limbs, body wall, face, neck, etc	Occur in posterior part of oesophagus, urinogenital tract, iris of eye etc	Occur in the walls of heart

Cylindrical in shape	Spindle shaped	Cylindrical in shape
Multinucleated muscle fibres.	Uninucleate muscle fibres.	Uninucleate muscle fibres.
Nuclei are peripheral.	Nucleus is central.	Nucleus is central.
Myofibrils show distinct alternate light and dark bands (striations).	Myofibrils are without light and dark bands.	Myofibrils show faint light and dark bands (striations).
Fibres are unbranched.	Fibres are unbranched.	Fibres are branched.
Intercalated discs are absent.	Intercalated discs are absent.	Intercalated discs are present.
They soon get fatigued.	They do not get fatigued.	They never get fatigued.
Voluntary in action.	Involuntary in action.	Involuntary in action.