T.U.C.O.M.

HISTOLOGY OF MUSCULAR SYSTEM (CARDIAC & SMOOTH)

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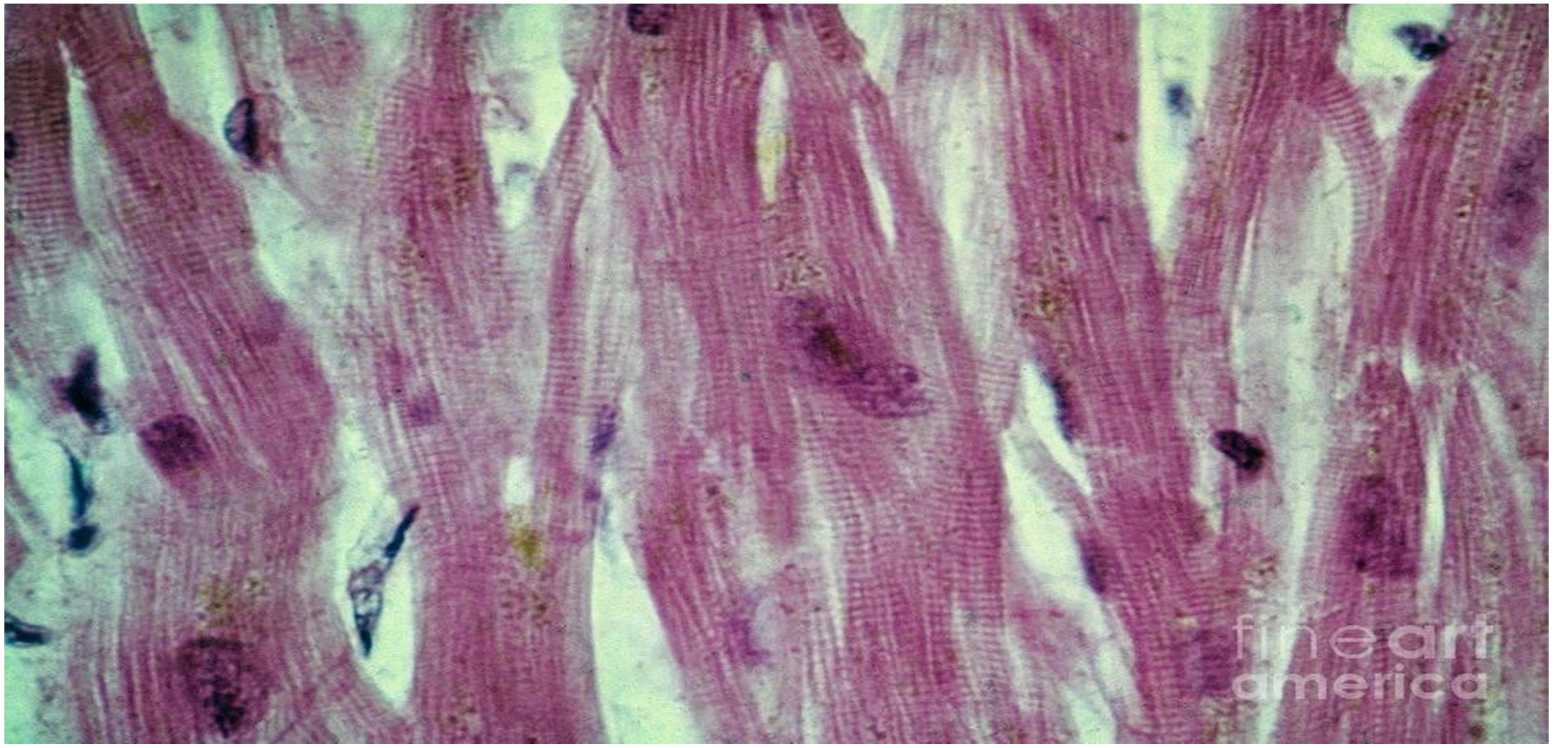
Cardiac muscle -

heart muscle, striated, cells may be branched. Cardiac muscle cells are either mono- or binucleate cells. They are connected with one and other by specialized junctional complexes called **intercalated disks**. Cardiac muscle is capable of involuntary, strong, rhythmic contractions



Unlike skeletal muscle, cardiac muscle cells are not a syncytium for the most part, though some cells may have two nuclei.

The structure of cardiac muscle cells is similar to that of striated skeletal muscle in that myofibrils and sarcomeres are

present with activity mediated by release of Ca+2 from sarcoplasmic reticulum.

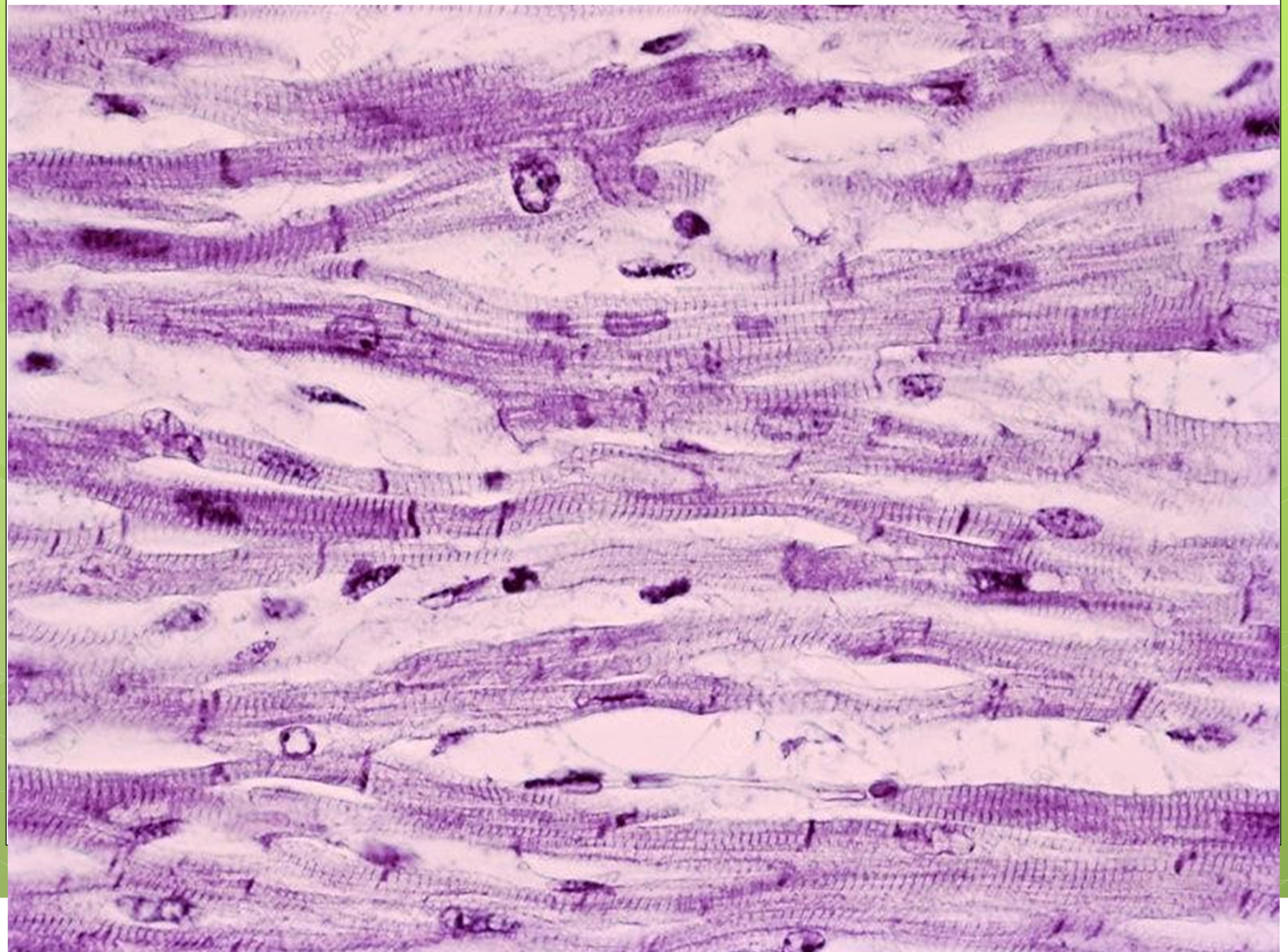
The major differences between these two muscle types are that the cardiac muscle cells are branched and are held together by intercalated disks. They are also shorter in length than skeletal muscle cells.

1. **Intercalated disks** are specialized junctional complexes that bind cardiac muscle cells together. These so-called disks are interdigitating regions of the plasmalemma of adjacent cardiac muscle cells that hold the cells together. The intercalated disks form the irregular, jagged, dark lines that are characteristic seen in appropriately stained cardiac muscle sections.
2. This junctional complex is composed of a number of structures that are organized along adjacent muscle cell plasmalemmas in a repeating array,

. **desmosomes** (macula adherens) - structures that hold cells together. Located between adjacent myofilaments. . **fascia (zonula) adherens** - where the myofilaments of the sarcomeres at the ends of myofibrils adhere to the sarcolemma. Located where myofilaments end at the muscle cell plasmalemma.

. **gap junctions** are present - connecting between muscle cells that allow transfer of ions between them. This allows the cells to coordinate their activities. Action potentials can spread quickly between the sarcoplasmic reticulum of cardiac muscle cells via gap junctions. Thus, cardiac muscle cells can coordinate their movements. The gap junctions are located along the plasmalemmas of adjacent muscle cells in the regions between myofilaments.

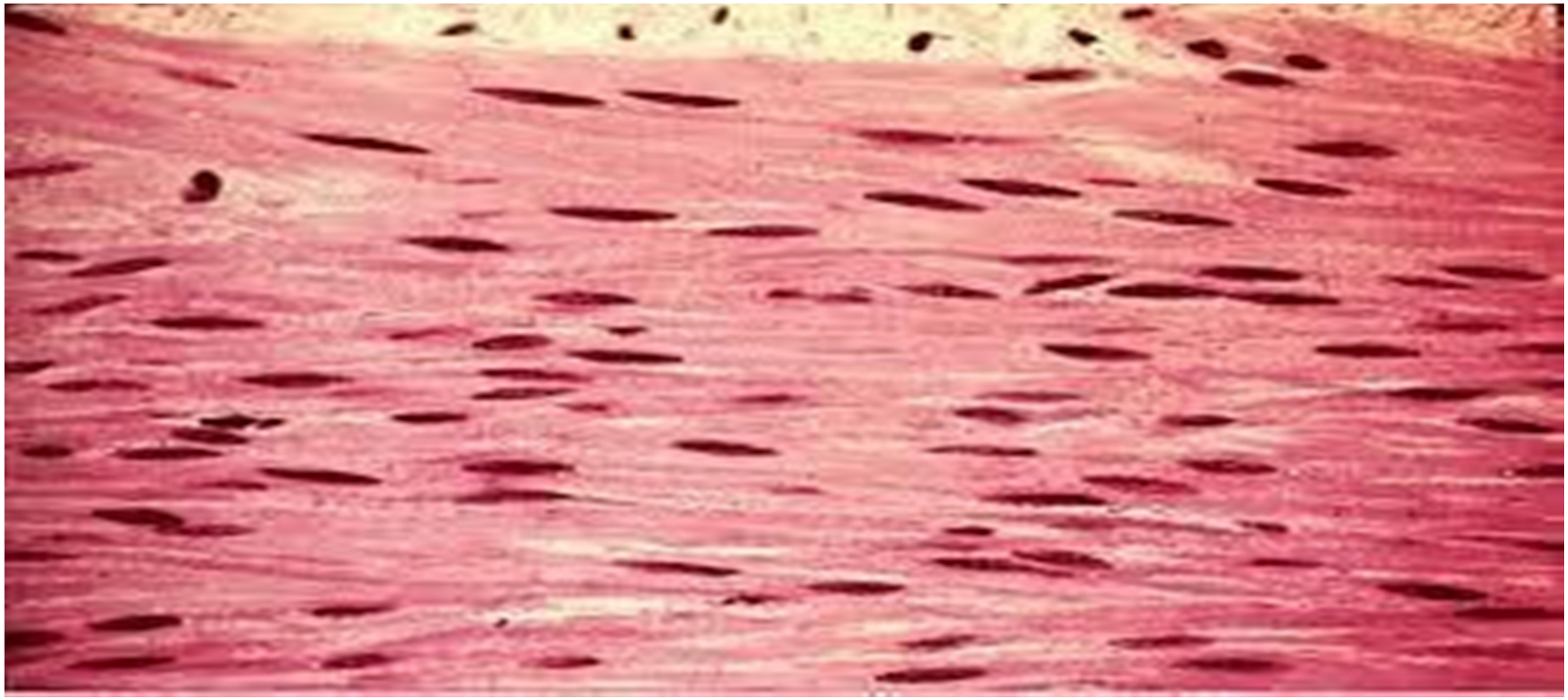
Cardiac muscle cells also have a **transverse tubule system** present, but it is not as regular as the sarcolemma system of skeletal muscle and there are fewer T-tubules.



Smooth muscle -

this muscle is not striated and is found in the walls of the visceral

organs. Mononucleate cells. In addition to contraction, smooth muscle cells synthesize collagen, elastin, and proteoglycans (like fibroblasts). These muscle cells are capable of relatively slow contractions as compared to those of striated or cardiac muscle.



This sort of muscle consists of long, overlapping, spindle shaped cells that have some characteristics that are similar to those of fibroblasts.

There are no sarcomere structures, but filaments of actin and a type of myosin are present. Thus, contraction is

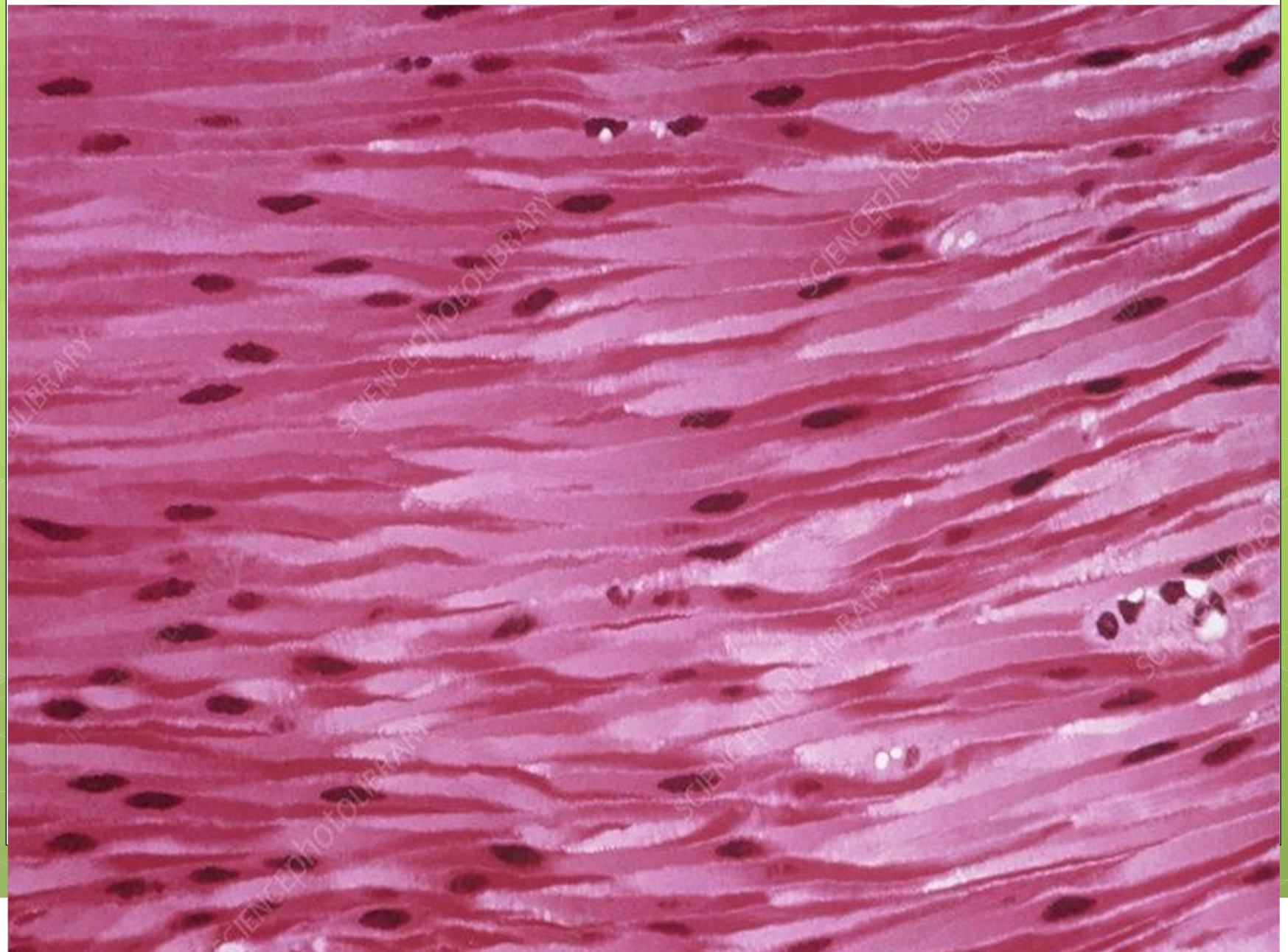
much less organized and occurs more slowly than it does in striated or cardiac muscle. Another reason for this slower contraction is that smooth muscle cells do not contain a transverse tubule system.

Since the actin and myosin filaments are not constrained by a sarcomere/myofilament arrangement, the actin and myosin filaments are able to achieve a greater degree of overlap when they contract resulting in a greater degree of contraction.

While smooth muscle cells are slow to contract, they have the ability to remain contracted for long periods of time.

The bundles of smooth muscle are organized as fascicles similar to what is seen in striated and cardiac muscle, Thus, a perimysium with endomysium between cells and epimysium deliniating bundles of fascicles can be identified. However, in sectioned tissue, this arrangement is often not very evident,

presumably because the regions of connective tissue are much thinner than those of cardiac and skeletal muscle.
The contraction of smooth muscle cells is involuntary and the neuromuscular junctions controlling contractile rhythms may be on the surrounding epimysium rather than directly on muscle cells. As a result, neurotransmitters have to diffuse across this connective tissue layer and onto the plasmalemma of the smooth muscle cells in order to initiate the action potential that causes contraction. This is another reason for the slower contraction of smooth muscle cells.
Smooth muscles exhibit spontaneous contractile activity (doesn't require nervous stimulation). Thus, the innervation that is present acts to modify the contractile activity rather than initiate it.



Smooth muscle forms the contractile portion of the wall of the digestive tract from the middle portion of the esophagus to the internal sphincter of the anus. It is found in the walls of the ducts in the glands associated with the alimentary tract, in the walls of the respiratory passages from the trachea to the alveolar ducts, and in the urinary and genital ducts. The walls of the arteries, veins, and large lymph vessels contain smooth muscle as well.

Smooth muscle is specialized for slow and sustained contractions of low force. Instead of having motor units, all cells within a whole smooth muscle mass contract together. Smooth muscle has inherent contractility, and the autonomic nervous system, hormones and local metabolites can influence its contraction. Since it is not under conscious control, smooth muscle is involuntary muscle.

Smooth muscle fibers are elongated spindle-shaped cells with a single nucleus. In general, they are much shorter than skeletal muscle cells. The nucleus is located centrally and the sarcoplasm is filled with fibrils. The thick (myosin) and thin (actin) filaments are scattered throughout the sarcoplasm and are attached to

adhesion densities on the cell membrane and focal densities within the cytoplasm. Since the contractile proteins of these cells are not arranged into myofibrils like those of skeletal and cardiac muscle, they appear smooth rather than striated.

- THANK YOU…