Chapter 9 Part 1- Muscles and Muscle Tissue Notes

Muscle- from Latin *mus* = “little mouse”

Overview:

* Muscles make up nearly \_\_\_\_\_\_\_\_ of the body’s mass
* Can transform \_\_\_\_\_\_\_\_ (chemical energy) into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy which can exert \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Terms

* Prefixes for muscle- \_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_,

Types of muscle tissue:

Only \_\_\_\_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ muscle cells are elongated and called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ fibers.

**Skeletal Muscle Tissue [Key Words🡪 Skeletal, Striated, Voluntary]**

* Skeletal muscle tissue is packaged into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (organs attached to bone and skin)
* Skeletal muscle \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of all muscle and have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (stripes).
* Skeletal muscle is also called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ muscle and under conscious control. It \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ rapidly, tires easily & is very powerful.

Sketch skeletal muscle tissue:

**Cardiac Muscle Tissue [Key Words🡪 Cardiac, Striated, Involuntary]**

* Cardiac muscle tissue is only found in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* It is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (has stripes) & \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (not consciously controlled)

Sketch cardiac muscle tissue:

**Smooth Muscle Tissue [Key Words🡪 Smooth, Non-striated, Involuntary]**

* Smooth muscle tissue is found in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* It is not \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (striped) & \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (not consciously controlled)

Sketch smooth muscle tissue:

All muscles share 4 characteristics:

Muscles have several important functions as well:

Also :\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Skeletal Muscle Anatomy**

A skeletal muscle is made up of muscle fibers, nerves, blood vessels, and connective tissues.

Skeletal muscle is an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ made of different tissues and 3 major features:

A.

B.

C.

A. Nerve and Blood Supply

* Each muscle receives
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Skeletal muscle has nerves supplying every \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Contracting fibers also require huge amounts of \_\_\_\_\_\_\_\_\_\_\_\_ & \_\_\_\_\_\_\_\_\_\_\_\_\_ as well as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ removal.

B. Connective Tissue Sheaths

In an intact muscle, several different connective tissue sheaths wrap individual muscle fibers. Together these sheaths support each cell as well as reinforce and hold together the muscle, preventing the bulging muscles from bursting during strong contractions.

Sheaths (external to internal)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | | Name | Surrounds? | Type of Connective Tissue |
| External layer | |  |  |  |
|  | |  |  |  |
| Inner layer |  |  |  | |

**Fascicle**= a bundle of muscle fibers

Sketch the arrangement

C. Attachments

* Muscles span \_\_\_\_\_\_\_\_\_\_\_\_ and attach to \_\_\_\_\_\_\_\_\_\_\_\_\_ in at least \_\_\_\_\_\_\_ places
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- attach to movable bone
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- attach to immovable or less movable bone
* Attachment can be:
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (fleshy)- epimysium fused to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of bone or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ of cartilage
  + \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- connective tissue extends beyond muscle as ropelike \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or sheetlike \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Muscle Fiber Microanatomy**

* Skeletal muscle fibers are described as \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ just beneath its \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or plasma membrane. Their diameter is up to 10X that of an average cell and they can be up to 30 cm in length.
* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or cytoplasm of a muscle cell, is similar to that of other cells but contains many \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for glycogen storage and \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ for 02 storage.
* In addition to the usual organelles, a muscle cell also contains 3 highly modified structures:

**Myofibrils**

* densely-packed rodlike elements
* single muscle \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ can contain 1000s
* make up approx.. \_\_\_\_\_\_\_\_\_\_ % of muscle cell volume
* run parallel to the length of a muscle fiber

Myofibrils contain 4 features:

1). \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- “stripes”, A bands (dark) & I bands (light)

2). \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- smallest contractile unit of muscle fiber

3). \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- actin (thin) & myosin (thick)

4.)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Sketch a sarcomere (fig C). Label: actin, myosin, Z disc, I band, A band, H zone, M line

**Sarcomere-** smallest \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ unit of muscle fiber

* Contains \_\_\_\_\_\_\_\_\_ band with half an \_\_\_\_\_\_\_\_\_ band at each end; area between \_\_\_\_\_\_\_ discs
* Individual sarcomeres align \_\_\_\_\_\_ to \_\_\_\_\_\_\_\_ along \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Myofilaments-**  orderly arrangement of \_\_\_\_\_\_\_\_\_\_\_\_ & \_\_\_\_\_\_\_\_\_\_ within sarcomere

|  |  |  |  |
| --- | --- | --- | --- |
|  | Shape | Extend | Anchored/Connected |
| Actin |  |  |  |
| Myosin |  |  |  |

* The banding pattern (striations) of a myofibril arises from an orderly arrangement of smaller myofilament within the sarcomeres.
* Thick filaments contain myosin & extend the entire length of the \_\_\_\_\_\_ band. They are connected in the middle of a sarcomere at the \_\_\_\_\_\_\_ line.
* The lateral thin filaments contain actin & extend across the \_\_\_\_\_\_\_\_\_ band & partway into the \_\_\_\_\_\_\_ band. They are anchored by the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Molecular Composition of Myofilaments**

Muscular contraction depends on the myosin- and actin-containing myofilaments

Myosin is composed of \_\_\_\_\_ heavy and \_\_\_\_\_\_ light polypeptide chains. Heavy chains are intertwined and form \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Light chains form \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

During contraction, heads link \_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_\_ filaments together to form \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Actin –** fibrous protein in \_\_\_\_\_\_\_\_\_\_\_\_\_ filaments; 2 intertwined actin filaments form the backbone of each thin filament.

Thin filaments also contain several regulatory proteins bound to them:

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- rod-shaped, help stabilize actin; blocks myosin binding sites in relaxed fiber
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- globular 3 polypeptide complex

Also contain several other proteins that help form structure of myofibrils:

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ filament- composed of protein called \_\_\_\_\_\_\_\_\_\_\_\_\_, resists excessive stretching
2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_- links thin filaments to proteins of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. Other proteins that bind filaments or sarcomeres together to maintain alignment are: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, & \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Skeletal muscle fibers contain 2 sets of intracellular tubules that help regulate muscle contraction… Sarcoplasmic Reticulum & T-Tubules**

**Sarcoplasmic Reticulum**

The sarcoplasmic reticulum is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_; runs \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_; functions in regulation of intracellular \_\_\_\_\_\_\_\_\_\_\_\_ levels; stores & releases \_\_\_\_\_\_\_

**T Tubules**

T Tubules are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_; increases the muscle’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_; allows \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to reach deep into the interior of muscle fibers

**Sliding Filament Model of Contraction**

Contraction is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to generate \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Contraction ends when \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ become inactive

State the Sliding Filament Model of Contraction\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Cross-bridges are formed when \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This causes the sliding (contraction) process to begin.

What causes the shortening of muscle fibers? List the steps:

1)

2)

3)

4)

5)

For a skeletal muscle to contract, 4 steps must occur:

1.

2.

3.

4.

Steps 1 & 2 occur at \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Steps 3 & 4 are called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ coupling because they link \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

* Skeletal muscles are stimulated by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ neurons
* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ travel from CNS to skeletal muscle then divide into many branches as they enter muscle
* Axon branches end on \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ & form the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
* Each muscle fiber has 1 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ & 1 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (end of axon) & muscle fiber are separated by gel-filled space called \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Membrane-bound \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ vesicles are stored within \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that contain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* Infolding of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ (junctional folds) contain \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ receptors.
* The NMJ consists of 1)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, 2)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, 3)\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_