

Muscle System Notes

1. There are three types of muscle
 - a. Cardiac : involuntary, striated and auto-rhythmic
 - b. Smooth : smooth and involuntary
 - i. Visceral : single unit (small arteries, stomach, uterus, bladder, intestines)
 - ii. Multi-unit: (large arteries, airways to lungs, muscles of iris, muscles attached to hair follicles)
 - c. Skeletal : striated and voluntary

2. Functions of skeletal muscle:
 - a. Produce movement
 - b. Stabilize body positions - maintaining posture
 - c. Generate heat
 - d. Store & move substances - uterus, stomach, intestines

3. Properties of muscle cells
 - a. Electrical excitability - respond to stimuli
 - b. Contractility - tissue can shorten
 - c. Extensibility - can stretch without damage
(stomach & uterus)
 - d. Elasticity - can return to original length/shape

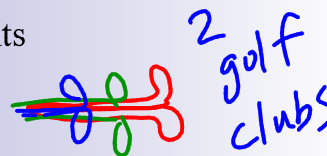
4. Connective tissue coverings of muscle
 - a. Fascia : connective tissue that covers, separates, and holds together muscles.
(Epimysium, Perimysium, & Endomysium)
outer 10-100 individual

- b. Tendons : cord-like extension of fascia
- i. Connects muscle to bone
 - ii. Fibers intertwine with the periosteum
- c. Aponeurosis : flat tendons that connect muscle to muscle

Skull

5. Skeletal muscle fibers

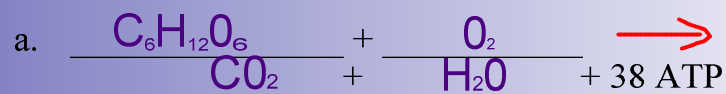
- a. Muscle fiber : mature muscle cell
- i. Many embryonic cells fuse together to form the muscle fiber
 - ii. Multinucleated
 - iii. Long (fiber) cell
 - iv. Filled w/ protein fibers
- b. Muscle fiber is made up of smaller myofibrils
- c. Myofibrils are made up of smaller myofilaments
- d. There are two types of myofilaments
- i. Myosin are thick fibers
 - ii. Actin are thin fibers
- e. Sarcomere : the microscopic of contraction
- i. From Z line to Z line
 - ii. made up of overlapping actin and myosin filaments
- f. SEE HANDOUT



6. Sliding filament model of muscle contraction

- a. Heads of myosin molecules attach to bonding sites on the actin molecules
- b. The myosin heads swivel and pull the actin towards the center of the sarcomere.
- c. The myosin heads must detach from actin for the muscle to relax.
- d. ATP is needed for muscle contraction as well as muscle relaxation

7. Energy for contraction



- i. This is called cell respiration
- ii. This occurs in the mitochondria
- iii. There are two phases of cell respiration
 1. Anaerobic: only 2 ATP are produced
 2. Aerobic: 36 ATP are produced
- b. Energy from breaking an ATP molecule is used to make creatine phosphate, a high energy molecule similar to ATP, that actually powers the muscle contraction
- c. Creatine phosphate can be stored in muscle tissues

8. Oxygen is delivered to the muscles in two ways:

- a. Hemoglobin
- b. Myoglobin

9. Muscle fatigue and oxygen debt

a. Factors that may contribute to muscle fatigue:

- i. lack of oxygen
- ii. lack of calcium
- iii. lack of acetylcholine
- iv. lack of nutrients
- v.-- lack of creatine phosphate -
- vi. build up of lactic acid

b. If the cardiovascular system can't keep up with oxygen demands, then only the anaerobic phase of cell respiration occurs

- i. Lactic acid builds up
- ii. Muscles get sore as pH drops

10. Types of muscle fibers

Red Fibers	White Fibers
Slow twitch	Fast twitch
aerobic (cardio)	anaerobic (strength)
isotonic (tension/movement)	isometric (length/strength)
more mitochondria	fewer mitochondria
more myoglobin	less myoglobin
more capillaries	fewer capillaries
thinner muscle fibers	thicker muscle fibers
contain fewer myofilaments	contain more myofilaments

11. Gross muscle anatomy

- a. Insertion : more movable muscle attachment
- b. Origin : less movable muscle attachment
- c. Agonist (prime mover) : muscle responsible for the most movement
- d. Synergists : muscles that assist the prime mover
- e. Antagonist : muscles that resist the prime mover, these will slowly relax as a prime mover contracts

12. Muscle tone and fitness

- a. Muscle tone : small amount of tension in muscle due to weak, involuntary contractions
- b. Atrophy : muscle gets smaller with disuse because the number of myofilaments decreases
- c. Hypertrophy : muscle gets bigger with exercise because the number of myofilaments increases

123

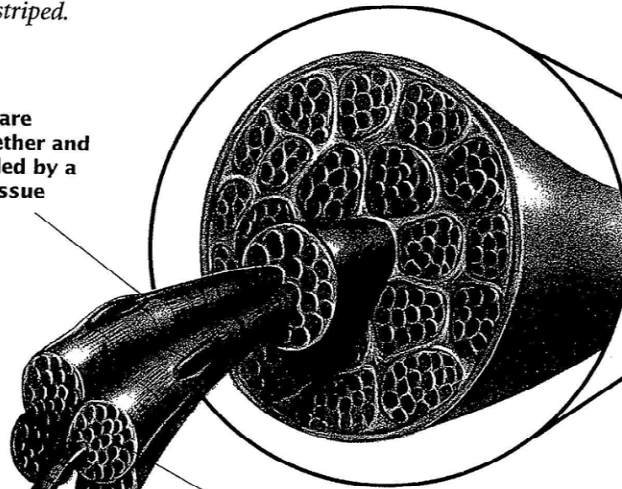
Tour of a Skeletal Muscle

BIOLOGY
Visualizing Life
Page 629

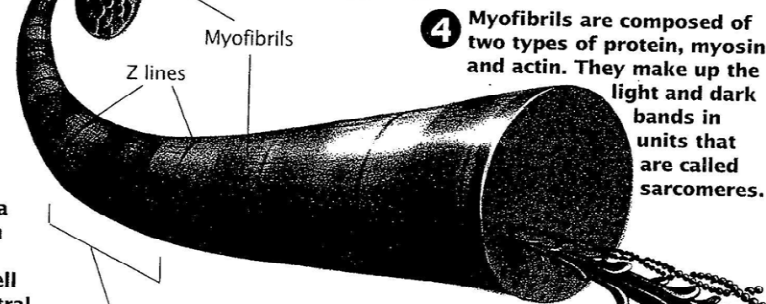
Vertebrates have three kinds of muscle: smooth muscle cells organized into sheets, cardiac muscle cells forming a lattice, and striated cells (also called skeletal muscle) that appear to be striped.

1 Skeletal muscles are made of hundreds of thousands of muscle cells, plus blood vessels, nerve fibers, and connective tissue.

2 Muscle cells are bundled together and are surrounded by a connective tissue sheath.

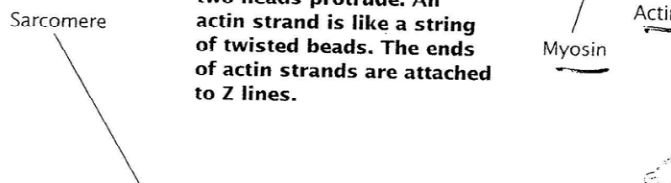


3 An individual muscle cell is a long fiber with many nuclei. Each muscle cell contains a central cable made of rodlike structures called myofibrils.

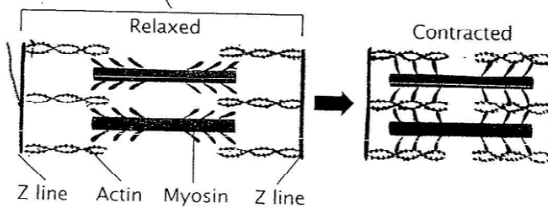


4 Myofibrils are composed of two types of protein, myosin and actin. They make up the light and dark bands in units that are called sarcomeres.

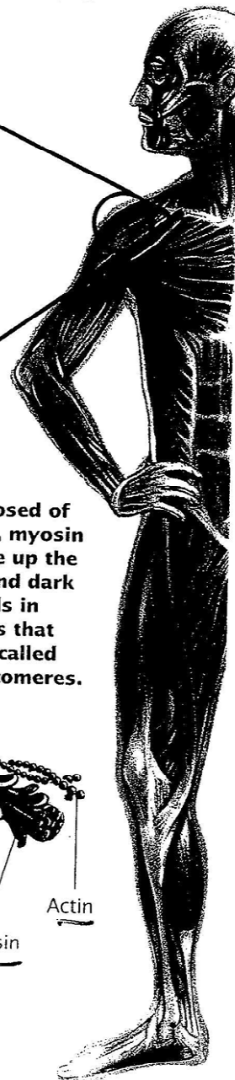
5 A myosin strand has a straight tail from which two heads protrude. An actin strand is like a string of twisted heads. The ends of actin strands are attached to Z lines.



6 When a muscle contracts, the heads of the myosin filaments "walk" along the actin filaments, pulling them toward the center of the sarcomere.



7 As this occurs simultaneously in sarcomeres throughout the cell, the muscle cell shortens.



HRW material copyrighted under notice appearing earlier in this work.