

NOTES

for the

MUSCULAR SYSTEM



Anatomy & Physiology

2016

Johnson

I. Muscular System

A. Specialized tissue that does one thing: shorten.

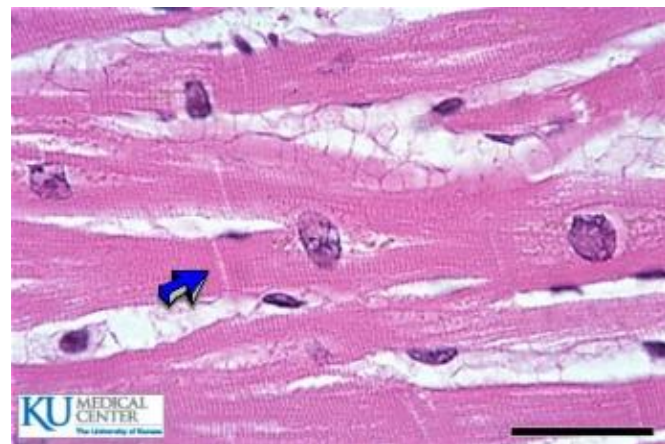
B. Functions:

1. Movement (of body, blood, food, etc.).
2. Stabilize joints.
3. Posture (tiny adjustments so you don't fall down).
4. Heat generation (75% of muscle energy lost as heat)

C. Three muscle types:

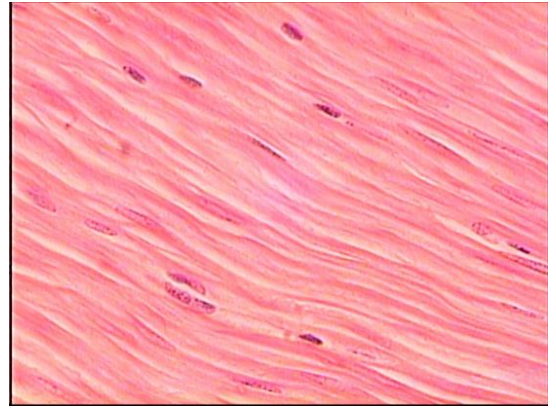
1. Cardiac Muscle

- a. Only in heart
- b. Moves blood
- c. One nucleus per cell
- d. Involuntarily controlled
- e. Striated (banded appearance)
- f. Cells synchronize their contractions through intercalated discs.



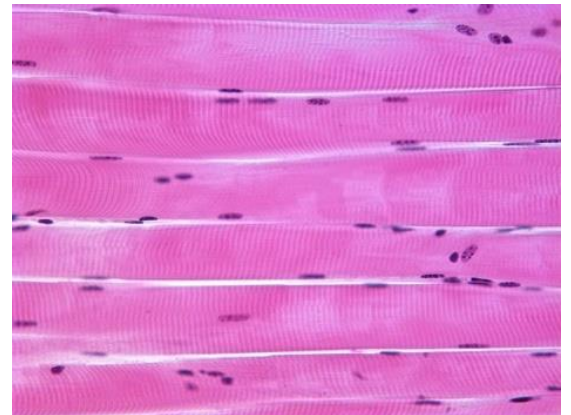
2. Smooth Muscle

- a. Walls of hollow organs.
- b. Move food & wastes.
- c. No striations.
- d. One nucleus per cell.
- e. Cells synchronize to produce “peristaltic waves”.
- f. Involuntarily controlled slow contractions.



3. Skeletal Muscle

- a. Attached to bone.
- b. Move entire body.
- c. Striated & multinucleate.
- d. Voluntarily controlled



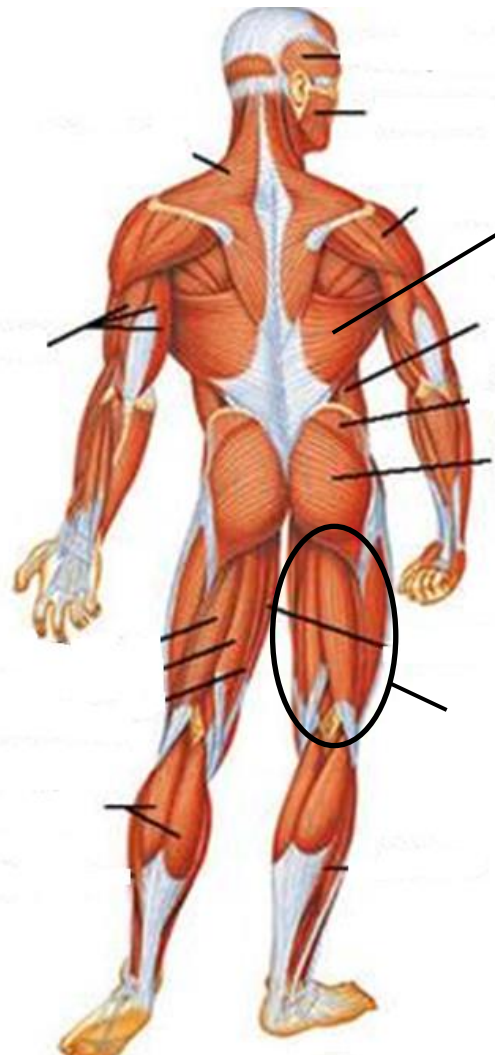
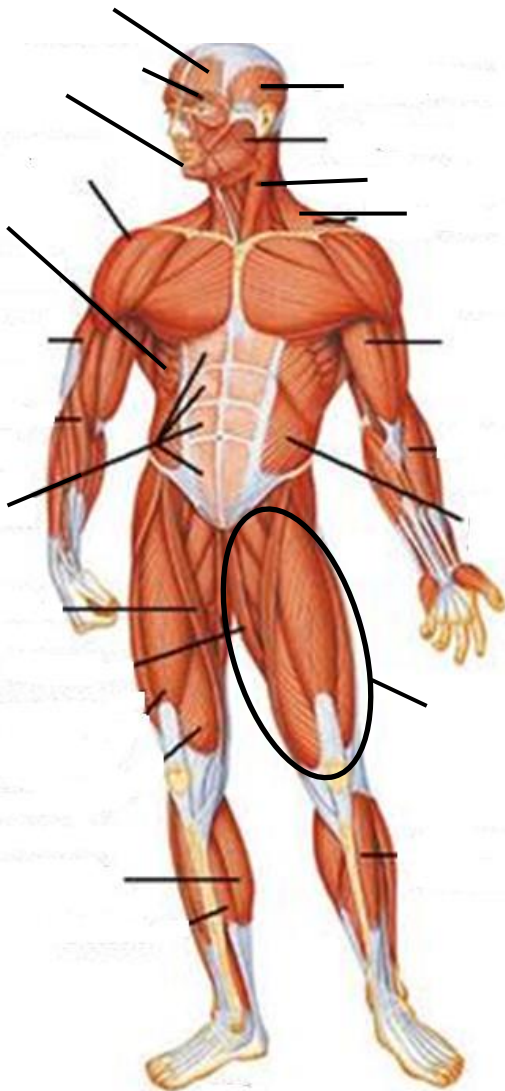
Muscles to Know (p182&184)

Anterior (p182)

- Temporalis
- Frontalis
- Masseter
- Orbicularis oris
- Orbicularis oculi
- Sternocleidomastoid
- Platysma
- Deltoid
- Pectoralis major
- External intercostals
- Biceps
- Rectus abdominis
- External oblique
- Quadriceps group
- Tibialis anterior

Posterior (p184)

- Trapezius
- Triceps
- Latissimus dorsi
- Gluteus maximus
- Hamstring group
- Gastrocnemius



D. Criteria for Naming Muscles: L.A.D.S.N.O.R.

(link to LADSNOR PowerPoint)

(Standard Deviants ~4:00min-8:00min)

	Criteria Description	Examples
L		
A		
D		
S		
N		
O		
R		

	Criteria Description	Examples
L	Location	Temporalis, Rectus abdominus, External oblique, Orbicularis oculi
A	Action	Masseter
D	Direction of Fibers	External oblique
S	Shape	Deltoid, Trapezius, Platysma
N	Number of Origins	Biceps, Triceps, Quadriceps
O	Origin & Insertion	Sternocleidomastoid
R	Relative Size	Gluteus maximus

E. Muscle Groupings

1. Muscles usually occur in pairs b/c can only pull.

2. Let's use arm curls as an example:

3. Prime Mover & Antagonist

a. **Prime Mover** – the muscle responsible for most of a movement.

EX) bicep

b. **Antagonist** – the muscle that does the reverse action of the prime mover.

EX) Tricep

4. **Synergist** – muscles that help the prime mover.

EX) other smaller upper arm muscles

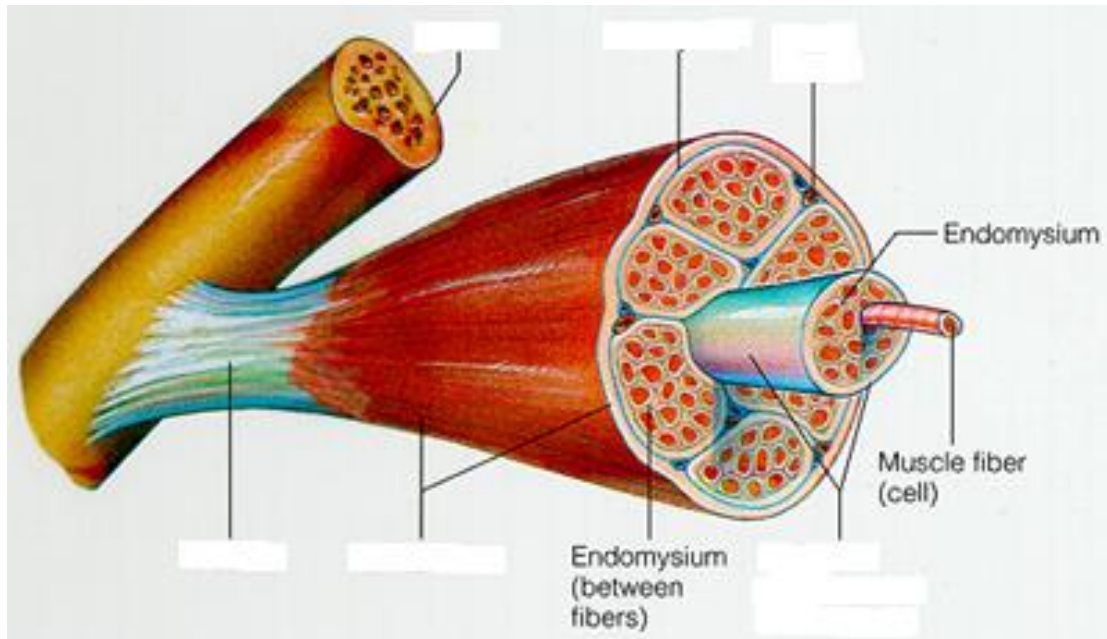
5. **Fixators** – specialized synergists that stabilize joints and/or muscle origins to prevent unnecessary movement.

EX) muscles of back, abdomen, shoulders

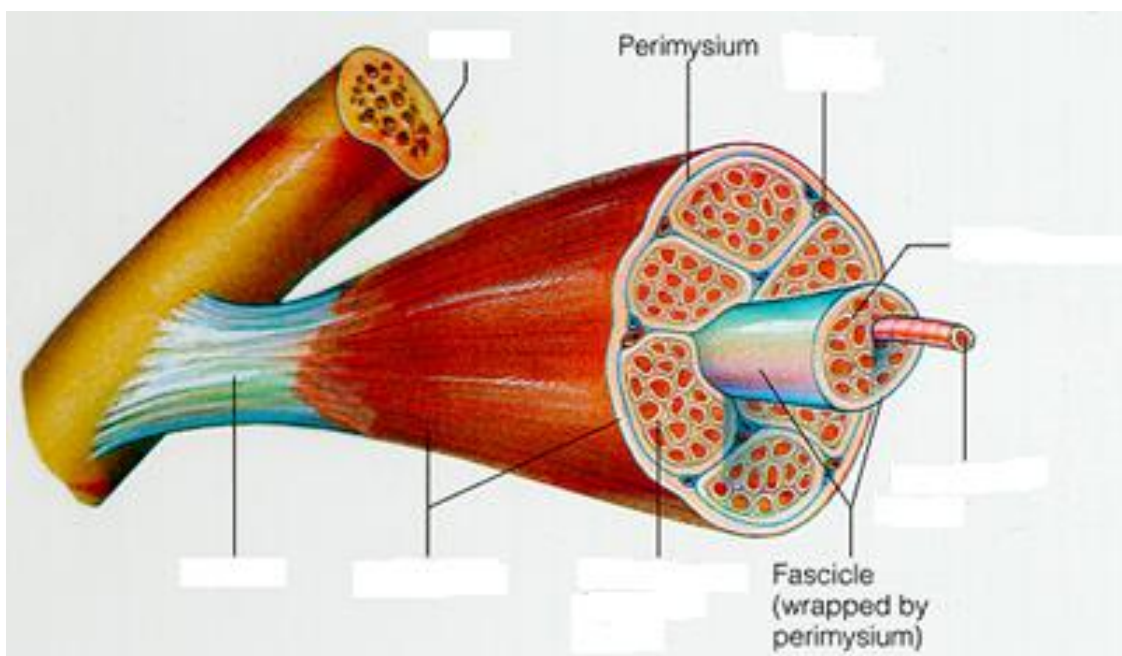
F. Structure of Skeletal Muscle

1. How a muscle is organized:

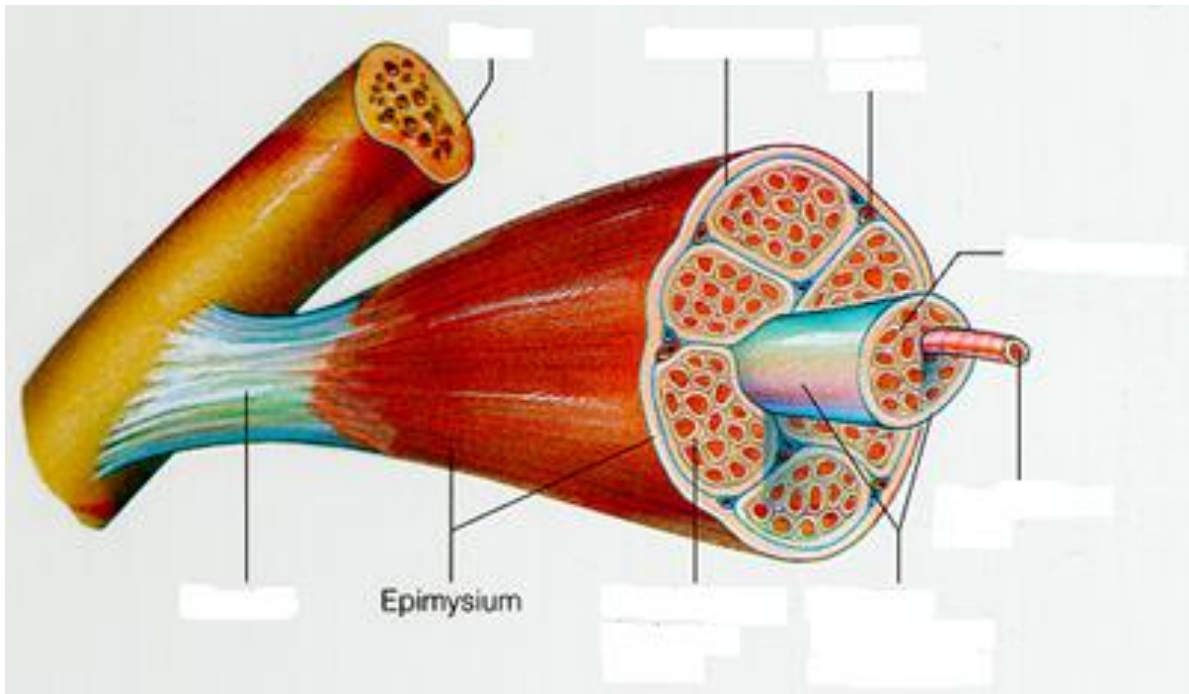
- a. Each **fiber** is wrapped in a connective tissue layer called the endomysium.



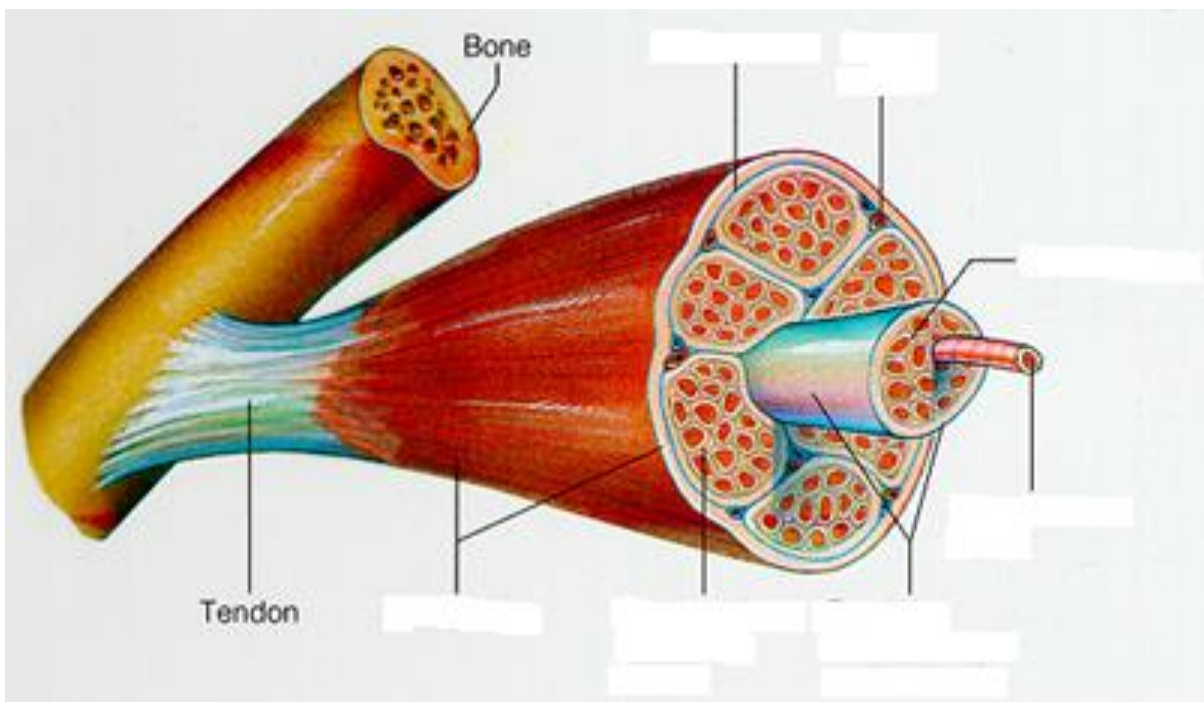
- b. The **fibers** are bundled into groupings called fascicles which are wrapped in a connective tissue called the perimysium.



- c. The **fascicles** are bundled to form a **muscle** and wrapped in a c.t. layer called the **epimysium**.

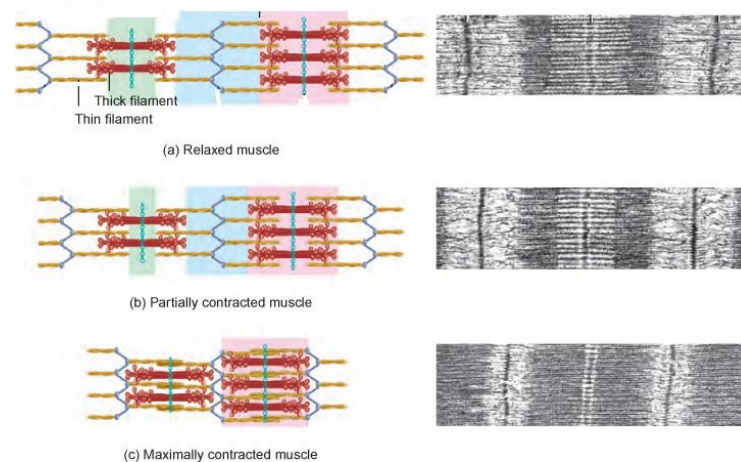
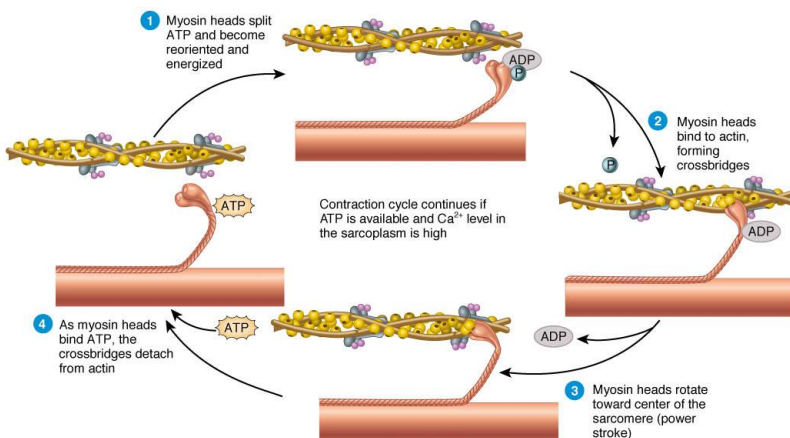
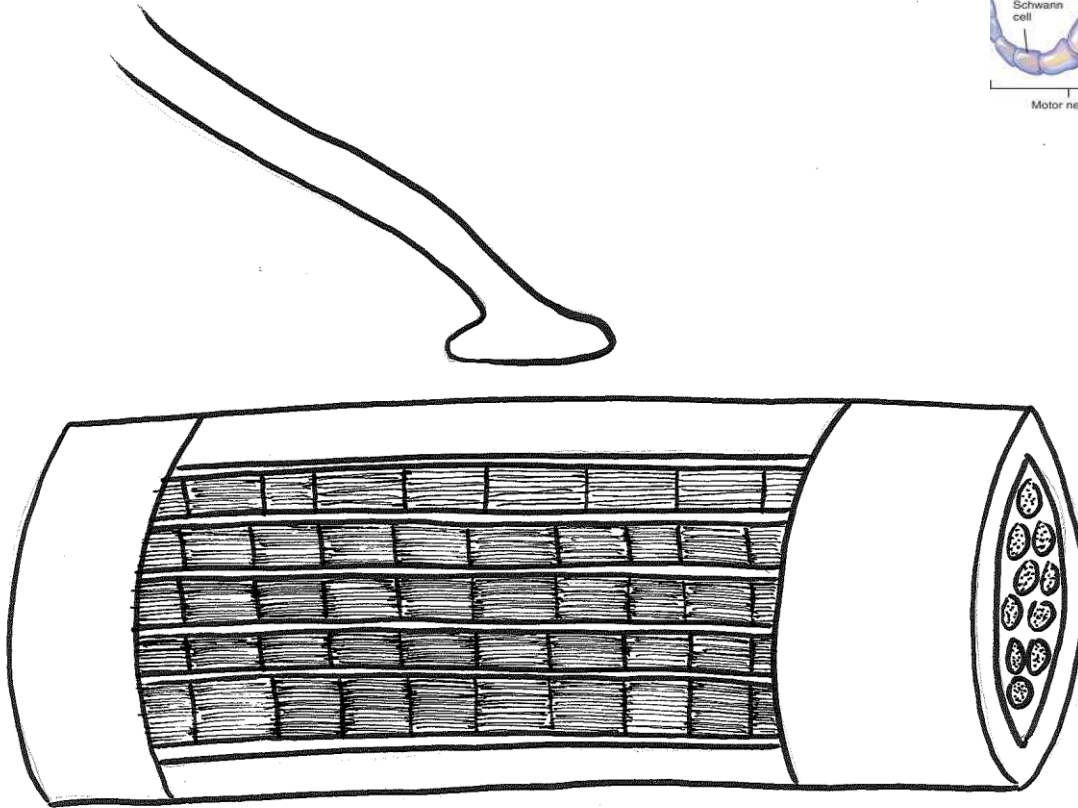
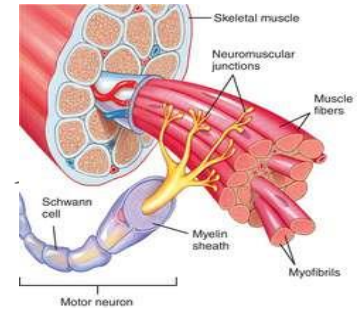


- d. The **epimysium** extends beyond the muscle to form the **tendon** that **attaches the muscle to bone**.



II. Muscle Contractions

A. Motor Unit – one nerve and the muscle cells that it stimulates.



1. Electrical impulse travels down length of the nerve to the neuromuscular junction.
2. Neurotransmitter (*acetylcholine*) released across the gap.
*if enough ACh is released, the **action potential** is reached
3. Sodium ions outside the muscle cell move into the cell, upsetting the chemical balance in the muscle cell.
3. When the balance is upset, the protein filaments **actin** and **myosin** slide past each other ([Sliding Filament Model](#)).

B. Types of Contractions

1. Isotonic Contractions

- Successful muscle shortening when stimulated by a nerve.
- Results in **movement**.
- EX) walking, lifting, etc.

2. Isometric Contractions

- Muscles do not shorten when contracting.
 - **No movement.**
 - Pushing against wall, lifting a bus, etc.
-

C. Contractions and Oxygen Use

1. Aerobic Muscle Contractions

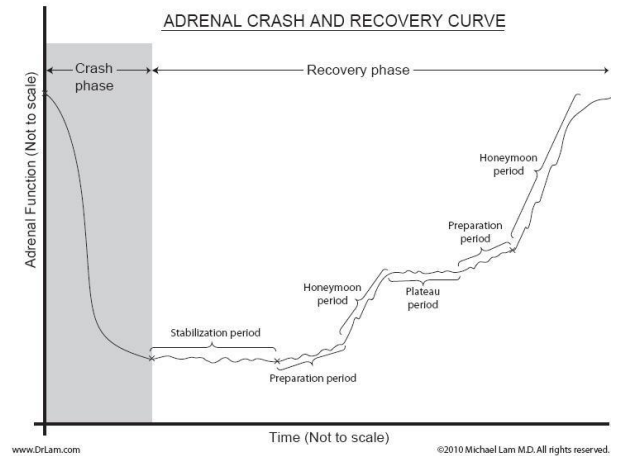
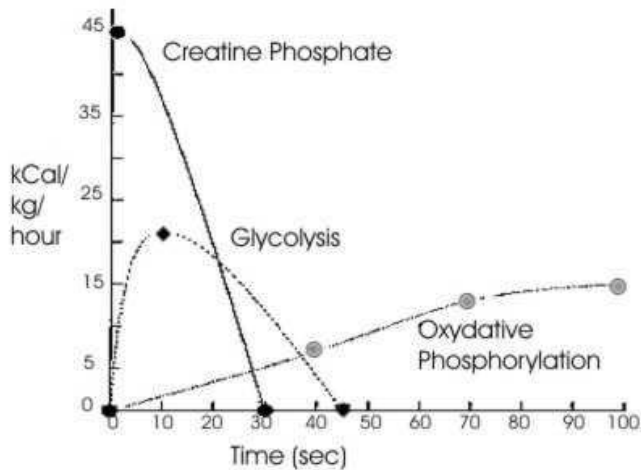
- Glucose breakdown that uses oxygen.
- Glucose use is efficient.
 - 1 glucose molecule completely broken down into 36 ATP's
- Light exercise.

2. Anaerobic Muscle Contractions

- Glucose breakdown that does not use oxygen.
- Glucose use is inefficient:
 - 1 glucose yielding only 2 ATP's
 - Excess glucose turned into lactic acid
- About 2.5 times faster than aerobic contractions.
- Fatigued after 30-40 seconds.

B. Fatigue

1. The inability for a muscle cell to contract despite being stimulated to do so by a nerve.
2. Happens when muscles are over-worked.
3. Caused by a lack of oxygen, insufficient ATP, and a buildup of lactic acid.



How does this happen?



III. Changes to Muscle Size

A. Muscle Tone – skeletal muscles are always in a state of mild contraction, even when “relaxed”.

- Maintains posture.
- Keeps them ready for contraction.

B. Hypertrophy – increase in muscle size.

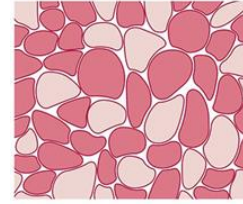
1. Increased number of fibers, connective tissue and blood vessels in response to prolonged forceful muscle activity.
2. Occurs if muscle contracts to at least 75% of its maximum tension.



3. Fast & Slow Twitch Muscle Fibers

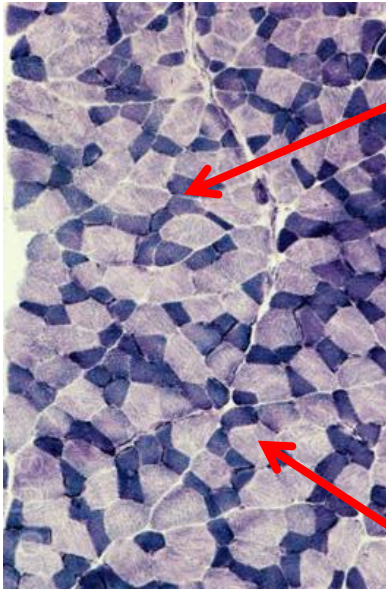
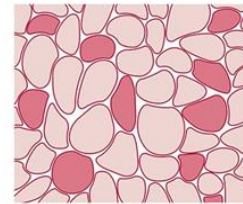
a. Slow-Twitch Muscle Fibers:

- Steady tug
- High endurance
- Aerobic energy use
- Much globin, mitochondria, blood vessels give a dark color.



b. Fast-Twitch Muscle Fibers:

- Explosive movements
- Fatigue quickly
- Anaerobic energy use
- Less globin, mitochondria, blood vessels give a lighter color



C. Atrophy – decrease in muscle size

1. Results from prolonged lack of use

2. Causes:

a. Temporary – cast limb, long bed rest, space travel, etc.

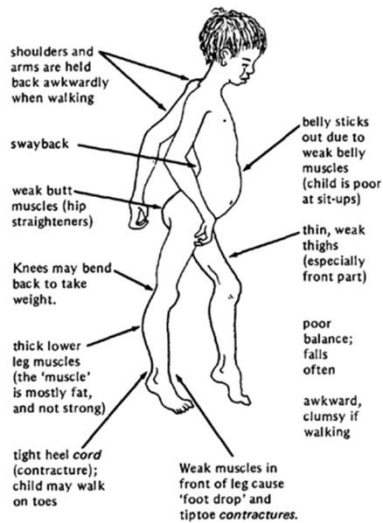
b. Permanent

- Nerve injuries
- Disease

FYI:
Diseases and permanent injuries are uncommon in the muscular system because of the massive amount of blood flow to muscles.

o Muscular Dystrophy

- congenital (inherited) disorder
- muscle fibers slowly destroyed and replaced by scar tissue.
- Diagnosed b/w 2-6 years of age (mostly boys).
- Lose ability to move.
- Usually pass away by early adulthood.



○ Fibromyalgia

- congenital (inherited) disorder
- constant aches, pains, stiffness and tenderness in muscles.
- cause unknown, but possibly low pain threshold in brain resulting in increased sensitivity to stimuli.
- mostly females (90%) under 40 years of age.

○ Tetanus

- Constant contraction of all muscles.
- Caused by toxin (tetanospasmin) produced by a certain bacterium (*Clostridium tetani*).
- Not transmitted b/w individuals.
- Death from respiratory arrest.



○ Trichinosis

- Parasitic worm embeds in skeletal muscle.
- Intense pain and weakness.
- Source: undercooked pork.



