

Cheatography

Muscular System 2 Cheat Sheet

by katwalker11 via cheatography.com/132666/cs/26919/

Functions of the Muscular System

skeletal muscle make up "flesh" of the body, maintain posture, voluntary movement, aid in breathing/eating/speech, provide facial expression, generate reflexes, produce body heat

Skeletal muscle tissue development

- Step 1 (embryonic mesoderm cells) Embryonic mesoderm cells undergo cell division (to increase number) and enlarge
- Step 2 (myoblasts) Several myoblasts fuse together to form a myotube
- Step 3 (myotube) Myotube matures into skeletal muscle fiber
- Step 4 Mature skeletal muscle fiber

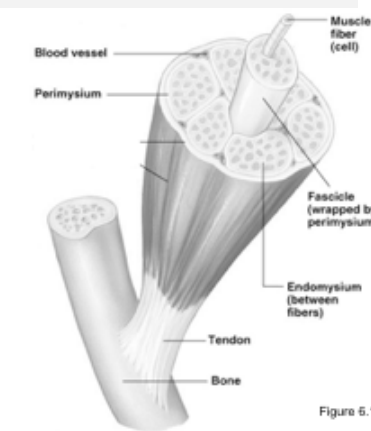
Connective Tissue of Skeletal

Endomysium around single muscle fiber
Perimysium around a fascicle (bundle) of fibers

Connective Tissue of Skeletal (cont)

Epimysium covers the entire skeletal muscle
Fascia on the outside of the epimysium
Tendon attachment, cord-like structure
Aponeurosis attachment, sheet-like structure

Connective Tissue of Skeletal

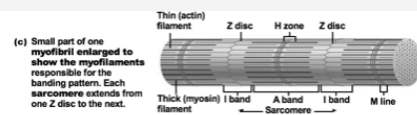


Three Types of Muscle Fibers (cont)

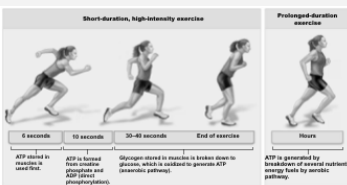
Fast oxidative fibers (intermediate) Have an **intermediate** diameter, contract quickly like fast glycolytic fibers, oxygen dependent, high myoglobin content and rich supply of capillaries, kinda fatigue resistant, more powerful than slow oxidative fibers

Fast glycolytic fibers (fast) Contain little myoglobin and few mitochondria, about twice the diameter of slow-oxidative fibers, contain more myofilaments and generate more power, depend on anaerobic pathways, contract rapidly and tire quickly

Sarcomere



Energy Sources



Three Types of Muscle Fibers

Overview of mus. contraction steps

- Step 1 Nerve impulse travels down the axon and reach axon terminal
- Step 2 Calcium VGC open > calcium influx into axon terminal
- Step 3 Exocytosis of ACh into synaptic cleft (calcium dependent event)
- Step 4 ACh interaction with Na⁺/K⁺ channels on sarcolemma > opening of the channels
- Step 5 Na⁺ influx at higher rate than K⁺ efflux > leads to depolarization
- Step 6 Spreading of the depolarization in the muscle fiber through t-tubules
- Step 7 Opening of the calcium VGC associated with the T-tubules and release of calcium into sarcoplasm
- Step 8 Interaction of calcium with regulatory protein troponin
- Step 9 Eventual muscle contraction

Slow oxidative fibers (slow)	Red color due to myoglobin, obtain energy from aerobic metabolic reactions, contain a large # of mitochondria, richly supplied w/ capillaries, contract slowly and resist fatigue, fibers are small in diameter
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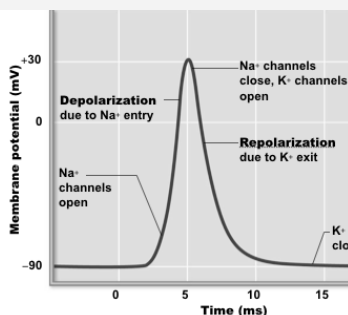
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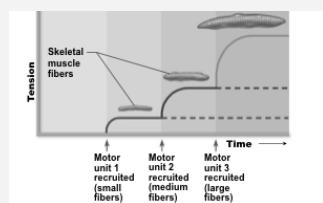
Main Steps of Muscle Contraction

1. Electrical impulse of neuron
2. Electrical impulse in skeletal muscle
3. Muscle contraction

Action Potential Graph



The Size Principle of Recruitment



Graded Muscle Response

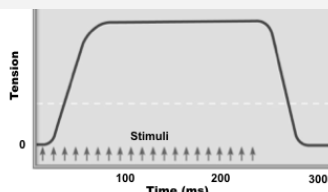
Muscle response to changes in stimulus frequency

If stimuli frequency increases, muscle tension reaches maximum

Referred to as **fused (complete) tetanus** bcuz contractions "fuse" into one smooth sustained contraction plateau

Prolonged muscle contractions lead to *muscle fatigue*

Fused (complete) tetanus mus. response



High stimulation frequency: fused (complete) tetanus. At higher stimulus frequencies, there is no relaxation at all between stimuli. This is fused (complete) tetanus.

The Muscle Twitch

Latent Period: events if excitation-contraction coupling (no muscle tension seen)

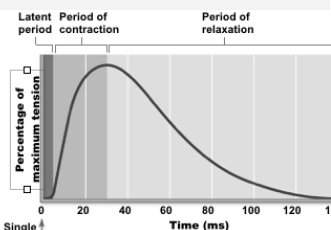
Period of contraction: cross bridge formation (tension increases)

Contraction

The Muscle Twitch (cont)

Period of Relaxation: Ca²⁺ reentry into SR (Tension declines to zero)

Isometric Twitch Myogram



(a) Myogram showing the three phases of an isometric twitch.

Muscle Relaxation

Removal of ACh by AChE

Electrical impulse from neuron must cease

ATP?

Calcium must be removed by pumps (active process vs. channel [passive])

Sliding Filament Model

What is it? The shortening of the sarcomeres in a myofibril produces the shortening of a myfibril

I Band: Narrows/shortens

H zone: Narrows/shortens

A band: Unaffected

Z disk: unaffected

In Depth Relaxation

Step 1: ACh is broken down by AChE, ending action potential generation in the sarcolemma

Step 2: The SR reabsorbs calcium ions, and the concentration of calcium ions in the sarcoplasm declines

Step 3: When calcium ion concentrations approach normal resting levels, the troponin-tropomyosin complex returns to its normal position. This change re-covers the active sites and prevents further cross-bridge interaction

Step 4: Without cross-bridge interactions, further sliding cannot take place, and the contraction ends

Step 5: Muscle relaxation occurs, and the muscle returns passively to its resting length

Graded Muscle Response

Muscle response to changes in stimulus strength

Recruitment works on *size principle*

Motor units w/ smallest muscle fibers are recruited first

Motor units with larger and larger fibers are recruited as stimulus intensity increases

Largest motor units are activated only for the most powerful contractions

Motor units in muscle usually contract asynchronously



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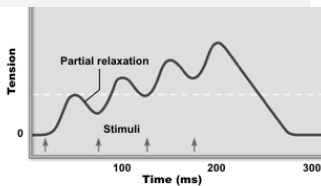
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Unfused (incomplete) tetanus mus. stim



Low stimulation frequency: unfused (incomplete) tetanus. If another stimulus is applied before the muscle relaxes completely, then more tension results. This is wave (or temporal) summation and results in unfused (or incomplete) tetanus.

Action Terminology for Muscles (cont)

Supination refers to arms;
supinate; want a
bowl of soup

Action Terminology for Muscles

Dorsiflexion Lift up toes

Plantarflexion move toes down

Inversion when sole of foot
point inward

Eversion when sole of foot
points outward

Protraction to move anteriorly;
shoulders, mandible

Retraction to move part
posteriorly

Elevation to raise part
superiorly;
shoulders

Depression to lower part; open
mouth

Rotation pivot on an axis;
shake head no,
can rotate head
and shoulder

Circumduction to draw a circle
with body part;
shoulder, head

Pronation turn hand
downward



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