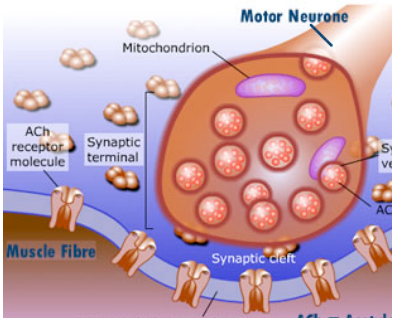
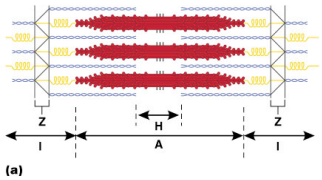
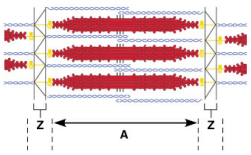
Muscular System Notes Part 2: Contraction Physiology

Questions	Notes
List the steps of muscle stimulation by a nerve impulse.	I. Physiology of Muscle Contraction • Skeletal muscles must be _____ _____ (motor neuron) to contract A. Transmission of Nerve Impulse to Muscle ○ **Step 1**: Nerve releases a _____ _____ (_____) ○ **Step 2:** Neurotransmitter causes the muscle cell membrane gates to open ○ **Step 3:** Ions (Na^+ & K^+) exchange places causing the sarcoplasmic reticulum to _____ ○ **Step 4:** This release of Ca^+ _____ as the actin filaments slide past the myosin filaments
What ion is responsible for starting a muscle contraction?	
When does a muscle contract?	B. The Sliding Filament Theory of Muscle Contraction • _____ – a muscle contracts when the thin filament in the muscle fiber slides over the thick filament • Activated by _____ and _____ (Ca^{2+}) ions •
Describe the sliding filament theory of muscle contraction.	○ **Step 1:** An influx of Ca^{2+} causes thick myosin filaments to form _____ with the thin actin filament by exposing the binding site on actin. ○ **Step 2:** The crossbridges change shape as it pulls on _____ which slides towards the center of the sacromere in the _____ ○ The distance between the Z line decreases, _____ _____.
List the steps of sliding filament theory.	○ **Step 3:** The crossbridges detach from the actin filament when _____ bonds to myosin head. ○ **Step 4:** The _____ gets ready to bond to actin again using ATP energy. ○ The cycle is repeated on another site of the actin filament.

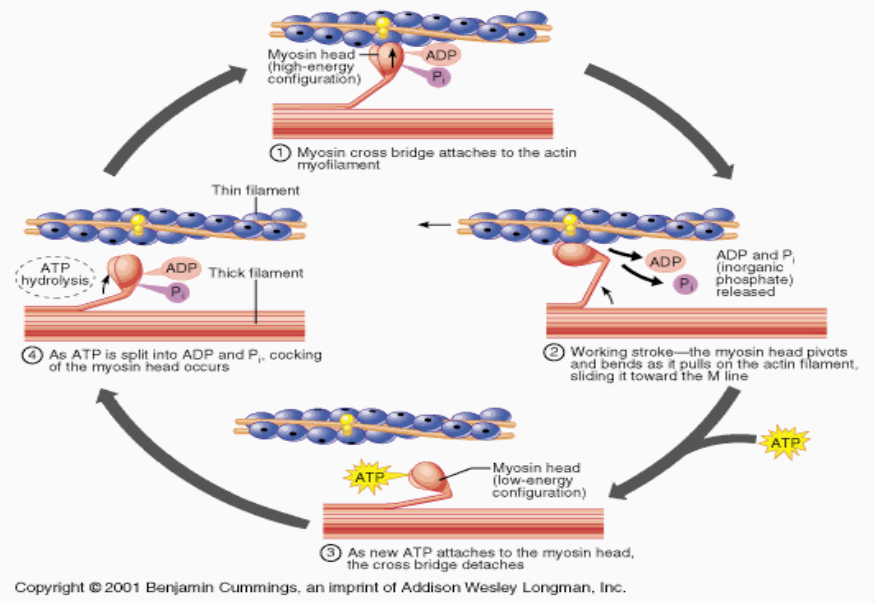






Recognize the steps of sliding filament theory in a diagram.

Sliding Filament Theory:



Recognize the M line, Z line, actin, and myosin filaments.

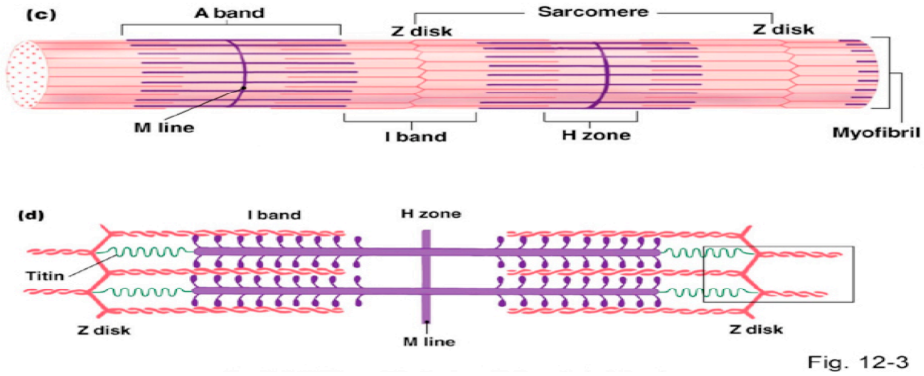


Fig. 12-3

What determines the strength of a muscle contraction?

C. Contraction of a Skeletal Muscle
- Muscle fiber contraction is "_____"
- Within a skeletal muscle, not all fibers may be stimulated during the same interval
- Different combinations of muscle fiber contractions may give differing responses
- Graded responses – different degrees of skeletal muscle shortening
- _____ = constant contraction or tetanus

What do muscles use for energy?

D. Muscle Response to Strong Stimuli
- Muscle _____ depends upon the _____ stimulated
  - More fibers contracting results in greater muscle tension
- Muscles can continue to contract unless they run out of _____ _____
  - One molecule of ATP supplies enough energy for one actin and myosin cross-bridge

II. Energy for Muscle Contraction

- _____
  - Bonds of _____ are broken to _____
  - Only 4-6 seconds worth of ATP is stored by muscles

What type of activities is creatine phosphate used for?

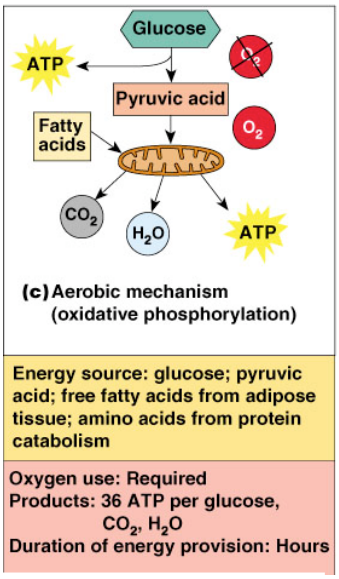
Three ways for muscle to make energy (ATP)

1. _____
   - Creatine phosphate is a high-energy compound and is the fastest way to make ATP available for muscles
   - Used for activities lasting _____
   - _____ (no oxygen needed)
   - Reaction:
     - Creatine phosphate + ADP → creatine + ATP
   - Creatine phosphate is made when a muscle is at rest

Does cellular respiration require oxygen?

2. _____
   - Mitochondria uses _____ molecules _____ in the presence of oxygen
     - Provides most of a muscle's ATP
   - _____
   - _____ (needs oxygen)
   - Used for activities lasting _____
   - Reaction:
   - **$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + energy**
   - 1 glucose = _____

How much ATP is produced during cellular respiration?



How long do activities last?

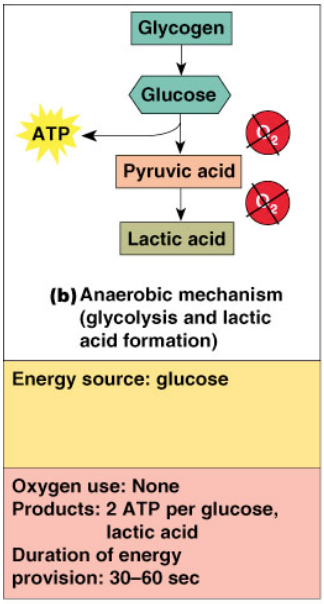
3. _____
   - Reaction that breaks down glucose without using _____
   - Used for activities lasting _____
   - _____ (no oxygen needed)
   - Reaction:
   - Glucose → pyruvic acid + 2 ATP → lactic acid
     - Lactic acid is also produced causing pain in the muscle

What molecule is broken down?

- Heavy breathing after exercise is a sign of _____

Does this require oxygen?

- A marathon runner is exhausted after crossing the finish line because they have depleted not only their oxygen but their glucose as well
- It takes up to two days to replace all of the glucose in the muscles and glycogen in the liver



Muscular System
Chapter 7