Chapter 9
Muscles and Muscle Tissue

Cellular Respiration - Hypertrophy

Cellular Respiration

$C_6H_{12}O_6 + 6O_2 + 6H_2O \rightarrow 6CO_2 + 12H_20$

- **Glycolysis**
  - Anaerobic respiration (no oxygen)
  - Breakdown of glucose to pyruvic acid
    - Too much pyruvic acid leads to lactic acid buildup
  - Occurs in the cytoplasm
  - Generates a net gain of 2 ATP

Cellular Respiration

$C_6H_{12}O_6 + 6O_2 + 6H_2O \rightarrow 6CO_2 + 12H_20$

- **Mitochondrial ATP production**
  - Aerobic respiration (oxygen)
  - Takes place inside the mitochondria
  - Beakdown of pyruvic acid into hydrogen and carbon dioxide
    - Hydrogen then goes on to make H_2O
  - Generates a net gain of 34 ATP

Creatine Phosphate

CP + ADP → C + ATP

- During exercise, the demand for ATP soars and is used up quickly.
- Creatine phosphate (CP) helps to quickly restore ADP into ATP
- Together this gives muscles the ability to contract maximally for about 15 s (short bursts of activity)
- Muscle cells store 4-5x's as much CP as ATP

Creatine Supplementation

- Synthesized in **body** and derived from **food**
- Adults need to ingest **2g daily** to replace what is lost through urination.
- Some studies have **shown improved** performance during intense exercise if taken a supplement
  - More muscle mass, lifting gains, sprinting performance
- Other studies have **failed** to show performance-enhancing effects
- **Ingesting extra** creatine **decreases** body's own synthesis. It is not known if given time the body can recover this natural synthesis.

Muscle Fatigue

- **Inability** of a muscle to **contract** forcefully after **prolonged activity**.
- Even before this is actually reached the person generally has the "**feeling**" to stop the activity → thought to be a **protective** mechanism to prevent muscle damage → Central fatigue
- Several factors contribute → low levels of ATP, calcium, creatine phosphate, oxygen, glycogen, other nutrients, and **build up of lactic acid**

Ex. Writers cramp

Oxygen Debt

- The extra amount of oxygen that must be taken in by the body after exercise.
- Pay back or restore metabolic conditions to resting levels
  - Convert lactic acid → pyruvic acid → glycogen stores
  - Make creatine phosphate and ATP
  - Replace oxygen from the myoglobin

Muscle Atrophy

- A- = without
- -trophy = nourishment
- Wasting away of muscles

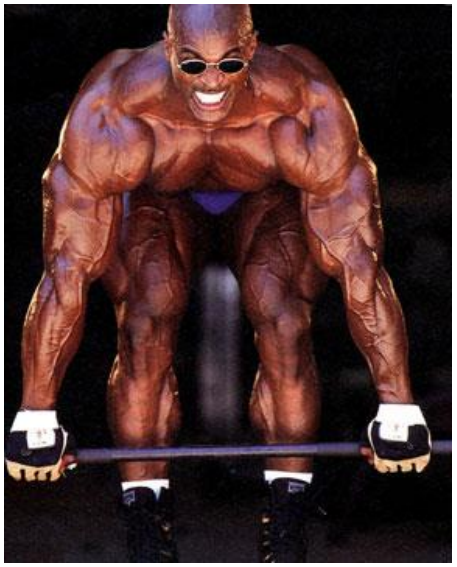
- **Muscle fiber size decreases** because of loss of myofibrils
- Not a loss of muscle cells!

Muscle Atrophy

- Occurs because muscle is not used (stimulated)
- Begins as soon as muscle is immobilized

- Muscle strength can decrease at a rate of 5% per day!
- If too much atrophy occurs, damage is permanent

Muscle Hypertrophy



- Hyper- = above/excessive
- -trophy = nourishment
- Increase in the diameter of muscle fibers

- Fibers are filled with more myofibrils, mitochondria, etc.
- Results from very forceful, repetitive activity