Energy Systems
Metabolism – all cells require energy to perform daily requirements of body

ENERGY
• Energy – combination of chemical reactions – food and oxygen
• Mechanical energy – human movement
• Chemical energy – converting food into chemical energy in body
• Respiration – metabolic process – food with oxygen is broken down to CO2 and H2O with liberation of chemical energy

Exercise – how well the body is able to use its energy sources accounts for differences in our abilities
• Performance Improvement?
  – Exercise Metabolism

Exercise results in an increase in metabolic rate of skeletal muscle (up to 50x’s)
• Body must transfer chemical energy into muscular work or mechanical energy

ATP – Adenosine Triphosphate
• Stored in all muscle cells
• Only energy released by ATP breakdown can be used directly by our bodies
• ATP = Adenosine + phosphate+phosphate+phosphate
• When bonds break energy is released

• Limited quantity of ATP in muscle cell
• ATP constantly used and regenerated
• Regeneration of ATP requires energy
• Energy released during breakdown of ATP represents IMMEDIATE source of energy (to be used by muscle to perform work-contraction and relaxation)
3 Energy yielding systems for the production of ATP

• 1) ATP-PC System (ATP-Phosphocreatine), also called Immediate Energy System
• 2) Anaerobic Glycolysis
• 3) Oxidative Phosphorylation, also called Aerobic System

• These provide energy for all types of activity. They overlap considerably!

• Which energy system used? Depends on the INTENSITY and DURATION of the activity

ATP-PC

• Always first energy system used in ANY activity
  – Anaerobic (without oxygen) system
  – Restored quickly (5-6 minutes)
  – Phosphocreatine is high energy phosphate that is stored in chemical energy (PC degraded and donates P to make ATP)

• PC replenished after exercise stops
• PC supports max exercise for 20-30secs
• Examples: sprints, jumps,…

Anaerobic Glycolysis

– Major source of ATP – 20-180secs
– ATP (energy) is produced without oxygen in this system
– Glucose is fuel (substrate) that comes from glycogen stored in muscle, liver and blood glucose
– Examples: 400 meter run, 100-200 meter swim,…

• Breakdown of glucose = glycolysis
• Breakdown of glycogen = glycogenolysis
• Glycogen- glucose –pyruvic acid– lactic acid (=2-3 ATP)
### Lactic Acid (LA)

- LA is associated with fatigue
  - LA releases H+ ion which increases acidity of blood lowering pH of blood
  - LA inhibits ATP production (protection too much acid = cell death)
  - LA circulates to heart, liver and other muscles and is used as a fuel to produce further ATP
  - LA is converted back to pyruvic acid and degraded via oxygen pathway

- After exercise it takes 20-60 min to fully remove LA produced during max exercise
- Mild exercise helps remove LA

### Aerobic Metabolism (Oxidative Phosphorylation)

- Oxidative Phosphorylation= 39 ATP from glucose
- ~3/4 of fuel from CHO, ~1/4 fat at max exercise
- ~2/3 fat and ~1/3 CHO at submaximal exercise
- Maximal aerobic capacity or maximal oxygen consumption (uptake or intake)
- VO2 max or Max VO2

- Examples: 1 mile run, 20 mile bike, …