Metabolism

When energy is expended by body – heat is liberated
Metabolism = caloric values and equivalent to amount of heat body liberates

- 40% of energy of metabolism used to produce ATP’s
- 60% energy released is converted to heat
  - (not very efficient)
- Measure energy production by measuring body’s heat production (expenditure of a fixed amount of energy = production of same amount of heat)

• Late 1800’s – chamber built (Bomb Calorimeter): insulated and airtight
  - water passed through copper tubing that lined the walls
  - heat given off radiates to walls and warms the water
  - Temperature change is recorded
  - 1 degree C = 1 kcal of energy

• Bomb calorimeter – direct measurement of energy expenditure
  - Disadvantage: expensive, slow to respond
  - Advantage: measures heat directly

• Indirect Calorimetry – amount of oxygen consumed when expressed in heat equivalents (kcal) = to heat produced by body as determined directly in calorimeter
  - Measurement of VO2 is indirect measure of energy
  - Closed circuit – inhaled gas is supplied and exhaled air is collected and then the mixed gas is measured for O2 and CO2 content
Open circuit: subject inhales air from the atmosphere while exhaled air is collected in Douglas bags – which are analyzed for O2 and CO2 content – use to calculate VO2.

- (atmosphere – 21% O2, exhale at rest 17% O2 and at max exercise exhale 14-15% O2 – the difference is the O2 used by body)
- Metabolic cart in lab, Douglas Bags, other field measures: Aerosport and K4b2 (portable VO2)

**How is Exercise Capacity Measured?**

- VO2 – measure of aerobic power
- Treadmill measure for walker/runner
- Cycle ergometer measure for cyclist
- Swimming flume measure for swimmer

**Maximal Oxygen Consumption**

**Males and Females**

![Graph showing Maximal Oxygen Consumption](image)

- Oxygen Deficit – oxygen consumption does not increase instantaneously to a steady state at start of exercise
  - It is the difference between total O2 consumed during exercise and total that would have been consumed had steady state of aerobic metabolism been reached immediately
  - More trained individual reaches steady state quicker thus smaller O2 deficit
• Excess Post Exercise Oxygen Consumption (EPOC)
  – After exercise ends, bodily processes do not immediately return to resting levels
  – Time for recovery is proportional to intensity of exercise

• Recovery
  – If exercise is submaximal – passive recovery
  – If exercise exceeds anaerobic threshold, moderate aerobic exercise during recovery facilitates lactate removal

• VO2 max –
  – As intensity increases, demand for energy via aerobic metabolism increases
  – O2 consumption increases linearly, directly proportional to intensity
  – When intensity too great, O2 consumption plateaus and no further increase despite increase in workload = VO2max

• Additional work after VO2max accomplished through anaerobic glycolysis
• VO2max provides qualitative statement of individual’s capacity for O2 utilization

• Review Question: How do we measure VO2 max