Chapter 5

Metabolism—the sum of all chemical reactions within a cell
- Catabolic—breakdown of complex organic compounds
  - release of energy
    - exergonic
    - usually hydrolytic (use H2O to break bonds)
- Anabolic—biosynthesis; building of complex compounds from simpler ones
  - requires energy
    - endergonic
    - usually dehydration (reactions release H2O)

What promotes chemical reactions?
(Collision theory)
1. rise in temperature
2. increase in pressure
3. reactants more concentrated

What promotes reactions in biological systems?
- ENZYMES—biological catalysts
  - specific substrates
  - doesn't require temperature increase to accelerate reactions
  - large globular molecule (primary, secondary and tertiary structure)
    - Apoenzyme—protein
    - Co-factor—non protein
      - If organic—coenzyme
        - NAD,NADP,FMN,FAD

Factors affecting enzyme activity:
- Temperature
- pH
- Concentration of substrate

Enzyme inhibitors:
- Competitive
- Non-competitive
- Feedback

Energy from catabolic reactions stored in high energy, unstable bonds of ATP (adenosine triphosphate) and used in anabolic reactions

ADP + energy + P === ATP===ADP + energy + P

Oxidation-Reduction: occurs in catabolism and anabolism

NAD+ to NADH + H+ (proton motive force)

(more energy than NAD)

Phosphorylation:

Substrate level

Oxidative

electron transport chain (chemiosmosis)

Photophosphorylation

Types of Bacterial Metabolism:

Respiration

Aerobic

Anaerobic

Fermentation

Photosynthesis

Respiration and Fermentation have the same 1st step:

Glycolysis (Embden-Meyerjof pathway)

One molecule of glucose converted to two molecules of pyruvic acid

Does not require O2

Endproducts: pyruvic acid + 2 ATP +NADH

Alternatives to Glycolysis

Pentose-Phosphate (hexose monophosphate shunt)

Operates with glycolysis to breakdown 5-C sugars (pentoses)

Gain of 1 ATP

Entner-Doudoroff

2 molecules of NADPH and 1 ATP

Respiration:

Aerobic

Krebs cycle [Tricarboxylic acid (TCA) or Citric acid cyle]

Yield: 4 molecules CO2

6 molecules NADH

2 molecules FADH2

2 molecules ATP

Precursor metabolites

Electron Transport System:

Carriors: flavoproteins

cytochromes

ubiquinones

Proton Motive Force/Chemiosmotic mechanism to generate ATP
Excess protons/protein channels/ATP synthase
Yield: 34 molecules of ATP

Aerobic Respiration: **Total ATP (prokaryotes)= 38**
(eukaryotes) = 34
Final electron receptor is O2

$C_6H_{12}O_6 + 6\ O_2 + 38\ ADP + 38\ P = 6\ CO_2 + 6\ H_2O + 38\ ATP$

Anaerobic Respiration: (absence of O2)
Final electron receptor is inorganic molecule (N2, N2O, SO4, CO3)
Yield: **>2 < 38 ATP**

Fermentation:
Final electron receptor: organic molecule
Yield: 2 ATP
Endproducts: Lactic Acid
Alcohol

Lipid and Protein Catabolism:
Lipids==fatty acids and glycerol (lipases)
Proteins == amino acids (proteases)
Amino acids: deamination/decarboxylation

Photosynthesis:
Conversion of light energy to chemical energy
C fixation = conversion of CO2 to sugars
Light dependent stage
Calvin-Benson Cycle

Microbes can be classified by nutritional patterns (source of energy and carbon)
Energy:
Phototrophs
Chemotrophs
Carbon:
Autotrophs
Heterotrophs
Almost all medically important microorganisms are chemoheterotrophs