BIO 102 General Biology
Lecture Outline

Metabolism

I. Introduction
- What is metabolism?
- Catabolic reactions
- Anabolic reactions

II. Energy
- A. 3 characteristics of energy
  - No mass
  - Capacity to do work or move objects
  - Can be converted but not created or destroyed
- B. 4 types of energy
  - Chemical
  - Electrical
  - Mechanical
  - Electromagnetic (radiant)
    - Energy for metabolism is electromagnetic or chemical
- C. "Refinery"
  - Photosynthesis
  - Aerobic respiration
  - ATP- adenosine triphosphate
- D. Energy flow and nutrient cycling
  - What are nutrients?
  - Organic vs. inorganic
  - Macronutrients

III. Enzymes
- A. Chemical reactions
  - Reactants
  - Products
- B. Catalyst
  - Reaction rate
- C. Transition state
  - Activation Energy

IV. Photosynthesis
- A. Chloroplasts
  - Outer membranes / inner membranes
  - Thylakoid membranes

Stroma

B. Photosynthesis is 2 distinct sets of reactions
Light-dependent reactions (light reactions)
Light-independent reactions (dark reactions)

C. Overview of process
Photopigments capture light
Electron carriers transfer energy to form ATP and NADPH (light reactions)
Calvin-Benson cycle uses ATP and NADPH to "fix" CO_2 into glucose (dark reactions)

D. Photopigments
Each pigment captures a particular wavelength of light
Englemann's experiment

E. Light capture and electron transport
2 photosystems capture energy
Photosystem II produces ATP and passes electron to Photosystem I
Photosystem I produces NADPH
H^+ ions (protons) are moved inside thylakoids (establishes gradient)
H^+ gradient is used to make ATP

F. Calvin-Benson cycle
Uses ATP produced in light reactions to make glucose
Brings in carbon in the form of CO_2

G. Variations in photosynthesis
Stomata regulate gas and water exchange
Photorespiration
C3 plants
C4 plants
CAM plants

V. Aerobic Respiration
Overall equation

A. Aerobic respiration is 3 linked processes
Glycolysis
Citric acid (Krebs; tricarboxylic acid) cycle
Oxidative phosphorylation (electron transport phosphorylation)

B. Glycolysis
Cytoplasm
Produces 2 ATP per molecule of glucose

Produces 2 pyruvate molecules
Produces NADH to use in electron transport chain

C. Citric acid cycle
Mitochondrial inner compartment (matrix)
From every glucose molecule (or 2 pyruvate molecules):
Produces 6 CO_2
Produces 2 ATP
Produces 8 NADH
Produces 2 $FADH_2$
NADH and $FADH_2$ are used in electron transport chain

D. Oxidative phosphorylation (electron transport chain)
Mitochondrial inner membrane
From every glucose molecule:
Produces 34 ATP
Produces 6 H_2O
Involves movement of electrons and establishment of H^+ gradient
H^+ gradient is used to make ATP via ATP synthase

VI. Anaerobic Respiration
ATP production without O_2
Uses other terminal electron acceptors
ATP is produced by glycolysis
Acid or alcohol are end-products
Lactic fermentation
Alcoholic fermentation

VII. Alternate Sources of Energy & Biosynthesis