Chapter 7

Nutrition

http://www.innerbody.com/anim/mouth.html
Nutrition

The activities by which an organism obtains, processes, and uses food to carry on their life functions

http://home.socal.rr.com/exworthy/anatrtion.htm#Nutrition
Two Types of Nutrition

1. Heterotrophic Nutrition

2. Autotrophic Nutrition
(I) **Autotrophic Nutrition**

- A type of nutrition in which an organism can make its own food

- **Ex:** green plants, algae, some bacteria
Autotroph

- An organism capable of making their own food
Photosynthesis

- The most common type of autotrophic nutrition
- In this process, organisms use energy from sunlight, carbon dioxide, and water to make its own food
Photosynthesis

PHOTOSYNTHESIS IT IS

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http://www.salineschools.com/users/diabt/diab.html
Chloroplast

- Contains a green pigment called chlorophyll
- It is in the chloroplast that light energy is trapped by chlorophyll and glucose is formed as the product (food)
Structure of Chloroplast
Formula for Photosynthesis

\[ 6 \text{CO}_2 + 12 \text{H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{H}_2\text{O} + 6 \text{O}_2 \]
ROY G BIV

The maximum amount of photosynthesis will occur when exposed to red and blue light because it is these two colors that are easily absorbed in great quantity by the chlorophyll.

For green leaves, green light is reflected and therefore has the least affect on photosynthesis.
ROY G BIV
Photosynthesis occurs in two stages:

1. Light Reaction
2. Dark Reaction
1. **Light Reaction**

- Occurs in the **grana** of the chloroplast
- First stage of photosynthesis
- Begins with the absorption of light energy by chlorophyll
- Photolysis occurs—a reaction in which H₂O molecules split into oxygen and hydrogen
- All oxygen given off during photosynthesis comes from the photolysis of water
- ATP (Adenosine triphosphate), which is a form of energy, is produced
Light Reaction

\[ \text{Light energy} \rightarrow \text{Chlorophyll (in chloroplasts)} \]

\[ \text{ADP} + \text{Pi} \xrightarrow{\text{energy}} \text{ATP} \]

\[ 2\text{H}_2\text{O} \xrightarrow{\text{energy}} 4\text{H}^+ + \text{O}_2 \]

\[ \text{dark reactions} \]
2. **Dark Reaction**

- Occurs in the **stroma** of the chloroplast
- The second stage of photosynthesis
- It is here that $\text{CO}_2$ is converted to carbohydrates by a process called **carbon fixation**
- Light is not required
- The dark reaction does not require ATP to take place
Dark Reaction

\[ \text{CO}_2 + \text{H}^+ + \text{ATP} \xrightarrow{\text{enzymes}} \text{PGAL} + \text{H}_2\text{O} \]
Factors Affecting the Rate of Photosynthesis

1. Light Intensity
2. Water
3. Carbon dioxide level
4. Temperature
Adaptations for Photosynthesis

A. **Unicellular Organisms**

1. Almost all chlorophyll-containing unicellular organisms are aquatic (live in water)

2. The raw materials for photosynthesis are absorbed directly from the water and into the cell

   Ex: algae
B. **Terrestrial Plants** (land-dwelling)

1. Occurs in **leaves** that provide the maximum surface area for the absorption of light.
Cross section of Leaf (ditto)

1. Outer most layer is the **epidermis** which is covered by a waxy coat called the **cuticle** – which prevents excess water loss

2. **Stomates**- allows the exchange of O2 and CO2 between the leaf and the external environment
3. Guard cells - control the opening and closing of the stomates

4. Palisade Layer - is where most of photosynthesis takes place

5. Vein - contain xylem and phloem (known as vascular tissue)
Chemosynthesis

- A type of autotrophic nutrition
- Does not require light as an energy source
- Energy is obtained by chemical reactions within the cell
(II) Heterotrophic Nutrition

- These are organisms that **cannot** make their own food
- Therefore they have to obtain it from the environment
- Ingestion → Digestion → Egestion
Ingestion

- The taking in of food into the body
Ingestion
Ingestion
Digestion

- The process by which large molecules are broken down into smaller molecules that can be used by the cells.
Four types of digestion:

1. **Intracellular digestion**- takes place inside the cell (no digestive tract)  
   **Ex:** simple, unicellular organisms and plants

2. **Extracellular digestion**- takes place outside of the cell and usually in a digestive tract  
   **Ex:** animals
3. Mechanical digestion - the increase in surface area of food by physically grinding and cutting food into smaller pieces. Ex: chewing food with teeth.

4. Chemical digestion - large food molecules are broken down into smaller ones by the use of enzymes (Hydrolysis).
Egestion

- The elimination of undigested food from the body in the form of feces.
- Do not confuse with excretion, which is the removal of cellular wastes and not undigested food.
Nutrients
And their Building Blocks
Carbohydrates

- main source of energy for cell activities
- glucose molecules are the building blocks of carbohydrates
Lipids

- commonly known as fats
- source of stored energy in living organisms
- The building blocks for lipids are 3 fatty acids and 1 glycerol molecule
Proteins

- along with lipids, protein molecules make up part of the cell membrane
- **amino acids** are the building blocks of proteins
Dehydration Synthesis

vs.

Hydrolysis
Dehydration Synthesis

- the process in which two molecules are joined together, with the help of enzymes, to form a larger molecule plus water

**Ex:**

glucose + glucose = maltose + water
Dehydration synthesis is a type of reaction in which two molecules are bonded together by the removal of water. Joining two monosaccharides by dehydration synthesis forms a disaccharide like maltose or sucrose. Many organic compounds are polymers that have long chains of repeating units. A polymer formed by joining many sugar molecules end to end is called a polysaccharide. Starch, glycogen and cellulose are...
Dehydration Synthesis

Figure 5.4: In the process of dehydration synthesis, two simple molecules are bonded together to form a more complex molecule, with a water molecule released. Using this process, the organic compounds in organisms are synthesized.
Dehydration Synthesis

Figure 6-9
Formation of a peptide bond. A dehydration synthesis reaction between two amino acids links them together in a peptide bond. The molecule is called a dipeptide.
Hydrolysis

- is the opposite of dehydration synthesis
- hydrolysis is the process in which large molecules are broken down into smaller ones by the addition of water and enzymes

Ex:
maltose + water = glucose + glucose
Enzymes

- Are known as a catalyst
- All enzymes end in ase
  
  Ex: substrate enzyme
  
  maltose → maltase
  
  lipid → lipase
- Enzymes regulate the rate at which reactions occur
Enzymes are large, complex proteins. They make it possible for chemical reactions to occur in living cells. They are organic catalysts, because they can affect a reaction without being changed itself. An enzyme acts upon a substrate. The names of the enzymes usually ends with the suffix ase, and the name is often derived from the substrate. For example, maltase is the enzyme that splits one maltose molecules into two glucose ones.
Lock-and-Key Model

- substrate - material to which the enzyme attaches to (see diagram)
- only certain enzymes can break down certain substrates
- after the enzyme attaches to the substrate, an enzyme-substrate complex is formed
- the substrate is then broken down into smaller molecules
Somewhere on the surface of an enzyme, there is an active site. The substrate molecules fit the shape of the active site. It then forms a temporary union with the enzyme called the enzyme-substrate complex. The substrate may then break bonds within the substrate molecule and thus separate it into two smaller molecules. This is called the lock-and-key model because the notched surface of a key can open only one lock, just like the shape of the active site of an enzyme fits the shape of only certain substrates.
Factors that Influence Enzyme Action

- **Temperature** - as you increase temperature, enzyme action will increase until an optimum temperature of 37 degrees Celsius is reached.

- **Enzyme-Substrate Concentration**
  1. High levels of enzyme + low levels of substrate = an increase in enzyme action
  2. Low levels of enzyme + high levels of substrate = a decrease in enzyme action

- **pH** - affects enzyme action. Some enzymes work better in an acidic environment compared to a basic one.