Chapter 2 Part 3: Organic and Inorganic Compounds

• Objectives:

1) List the major groups of inorganic chemicals common in cells.

2) Describe the functions of various types of inorganic chemicals in cells.
Chemical Constituents of Cells:

A. **Organic** compounds contain both hydrogen and carbon.

B. All other compounds are considered **inorganic**.

1. **Water**
   a. Water is the most abundant compound in living things and makes up two-thirds of the weight of adults.
   b. Water is an important *solvent* so most metabolic reactions occur in water.
c. Water is important in transporting materials in the body since it is a major component of blood.

d. Water carries waste materials and can absorb and transport heat.
2. **Oxygen**
   a. Oxygen is needed to release energy from nutrients and is used to drive the cell's metabolism.

3. **Carbon Dioxide**
   a. Carbon dioxide is released as a waste product during energy-releasing metabolic reactions.
4. **Inorganic Salts**
   a. Inorganic salts provide necessary ions including sodium, chloride, potassium, calcium, magnesium, phosphate, carbonate, bicarbonate, and sulfate.
   b. These electrolytes play important roles in many of the body's metabolic processes.
C. **Organic Substances:**

1. **Carbohydrates**
   a. Carbohydrates provide energy for cellular activities and are composed of carbon, hydrogen, and oxygen.
   b. Carbohydrates are made from **monosaccharides** (simple sugars); **disaccharides** are two monosaccharides joined together; complex carbohydrates **(polysaccharides)**, such as starch, are built of many sugars.
   c. Humans synthesize the polysaccharide **glycogen**.
(a) Some glucose molecules (C₆H₁₂O₆) have a straight chain of carbon atoms.

(b) More commonly, glucose molecules form a ring structure.

(c) This shape symbolizes the ring structure of a glucose molecule.

(a) Monosaccharide  (b) Disaccharide

(c) Polysaccharide
2. **Lipids:**
   a. Lipids are organic substances that are insoluble in water and include *fats*, *phospholipids*, and *steroids*.
   b. Fats supply energy for cellular function, and are built from glycerol and three fatty acids. Fats have a smaller proportion of oxygen atoms than carbohydrates.
      i. Fatty acids with hydrogen at every position along the carbon chain are *saturated*; those with one or more double bonds are called *unsaturated* fats.
c. **Phospholipids** contain glycerol, two fatty acids, and a phosphate group, and are important in cell structures.

d. **Steroids** are complex ring structures, and include cholesterol, which is used to synthesize the sex hormones.
3. **Proteins:**
   
a. **Proteins** have a great variety of functions in the body--as structural materials, as energy sources, as certain hormones, as receptors on cell membranes, as **antibodies**, and as **enzymes** to catalyze metabolic reactions.
b. Proteins contain C, O, H, and *nitrogen* atoms; some also contain sulfur.

c. Building blocks of proteins are the *amino acids*, each of which has a carboxyl group, an amino group and a side chain called the R group.
d. Proteins have complex shapes held together by hydrogen bonds.

e. Protein shapes, which determine how proteins function, can be altered (denatured) by pH, temperature, radiation, or chemicals.
(a) Primary structure—Each oblong shape in this polypeptide chain represents an amino acid molecule. The whole chain represents a portion of a protein molecule.

(b) Secondary structure—The polypeptide chain of a protein molecule is often either pleated or twisted to form a coil. Dotted lines represent hydrogen bonds. R groups (see fig. 2.11) are indicated in bold.

(c) Tertiary structure—The pleated and coiled polypeptide chain of a protein molecule folds into a unique three-dimensional structure.

(d) Quaternary structure—Two or more polypeptide chains may be connected to form a single protein molecule.
4. **Nucleic Acids:**
   
a. **Nucleic acids** form genes and take part in protein synthesis.

b. They contain carbon, hydrogen, oxygen, nitrogen, and phosphorus, which are bound into building blocks called **nucleotides**.
c. Nucleic acids are of two major types: DNA (with deoxyribose) and RNA (with ribose).

d. RNA (ribonucleic acid) functions in protein synthesis; DNA (deoxyribonucleic acid) stores the molecular code in genes.
(a) RNA  
(b) DNA