Unit 2 Part 2

Biochemistry

Chemical Formulas

- A chemical formula represents the chemical makeup of a compound.
- It shows the numbers and kinds of atoms present in a compound.
- It is a kind of "shorthand" that scientists use.

$CH_3COCHCHOCHClCHNH$

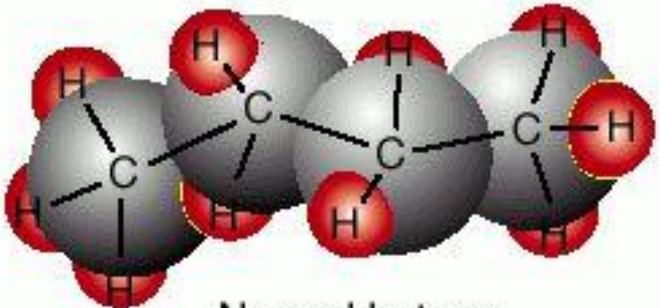
Formula Examples

- The chemical formula for sugar is $C_6H_{12}O_6$
  - This means that in one molecule of sugar there are six carbon atoms, twelve hydrogen atoms and six oxygen atoms.
- H_2O (water)
- SO_2 (sulfur dioxide)
- CO_2 (carbon dioxide)

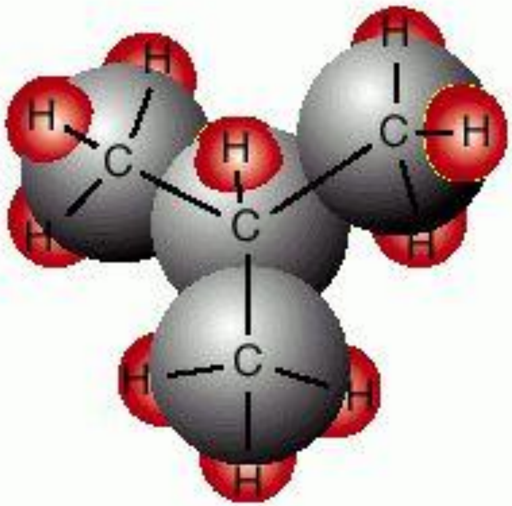
Structural Formulas

- A formula can also show the kinds, numbers, and arrangement of atoms.
- This is called a **structural formula**.
- Here is the structural formula of Hydrogen.

H—H

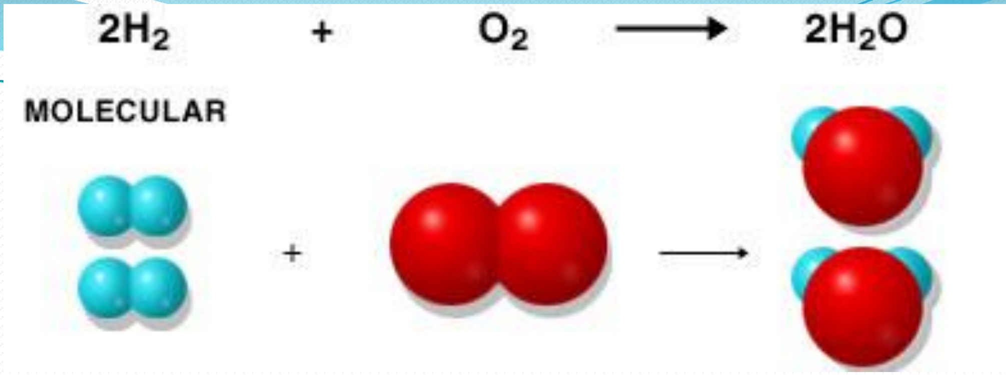


Normal butane



Isobutane

Equations



- Equations are used to describe chemical reactions.
- The substances that start the reaction are called the reactants.
  - The reactants are placed on the left side of the equation.
- The substances formed by the reaction are called the products.
  - The products are placed on the right side of the equation.
- The arrow means “to make” or “to form”.

Equations

- Reactions may be represented either by words or formulas.
  - The **word equation** for aerobic respiration is:

(enzymes)

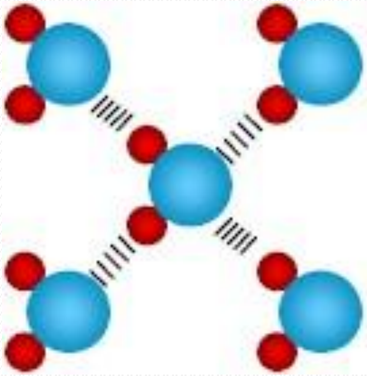
SUGAR + OXYGEN → ENERGY + CARBON DIOXIDE + WATER

- An equation using formulas instead of words is called a chemical equation.
  - The **chemical equation** for aerobic respiration is:

$$C_6H_{12}O_6 + O_2 \rightarrow 6H_2O + 6CO_2$$

Organic and Inorganic Compounds

- Living things are made up of inorganic and organic compounds.
- Compounds that do not contain both carbon and hydrogen are called **inorganic compounds.**
- The principal inorganic compounds found in living things are:
  - water
  - salts
  - inorganic acids
  - Inorganic bases

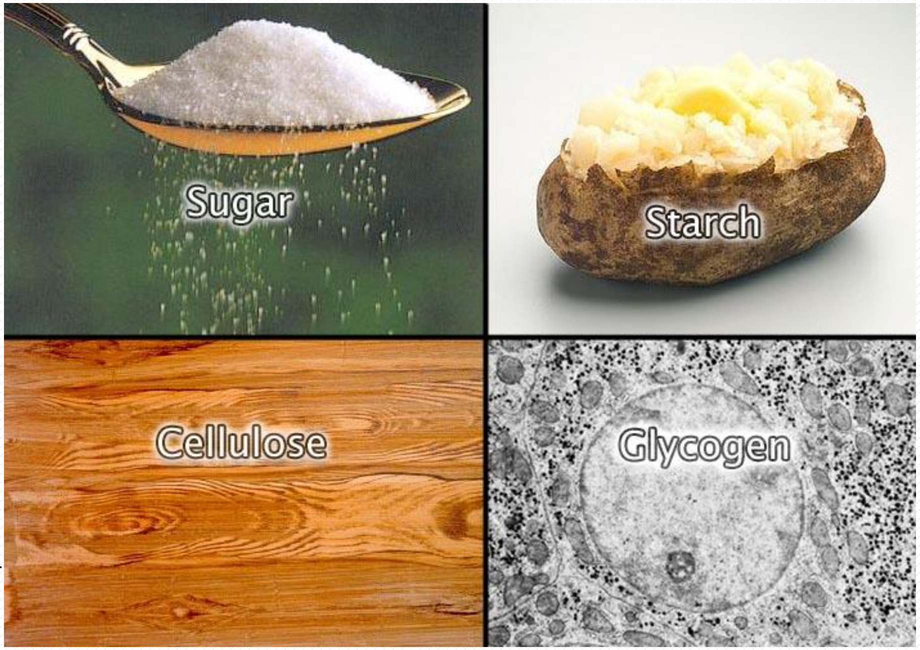


Organic and Inorganic Compounds

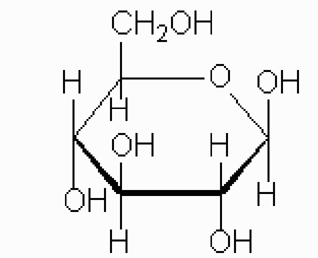
- **Organic compounds** are compounds that contain both carbon and hydrogen.
- The classes of organic compounds found in living things are:
  - Carbohydrates
  - Proteins
  - Lipids
  - Nucleic acids

Carbohydrates

- **Carbohydrates** are the main source of energy for cell activities.
  - starch and sugar

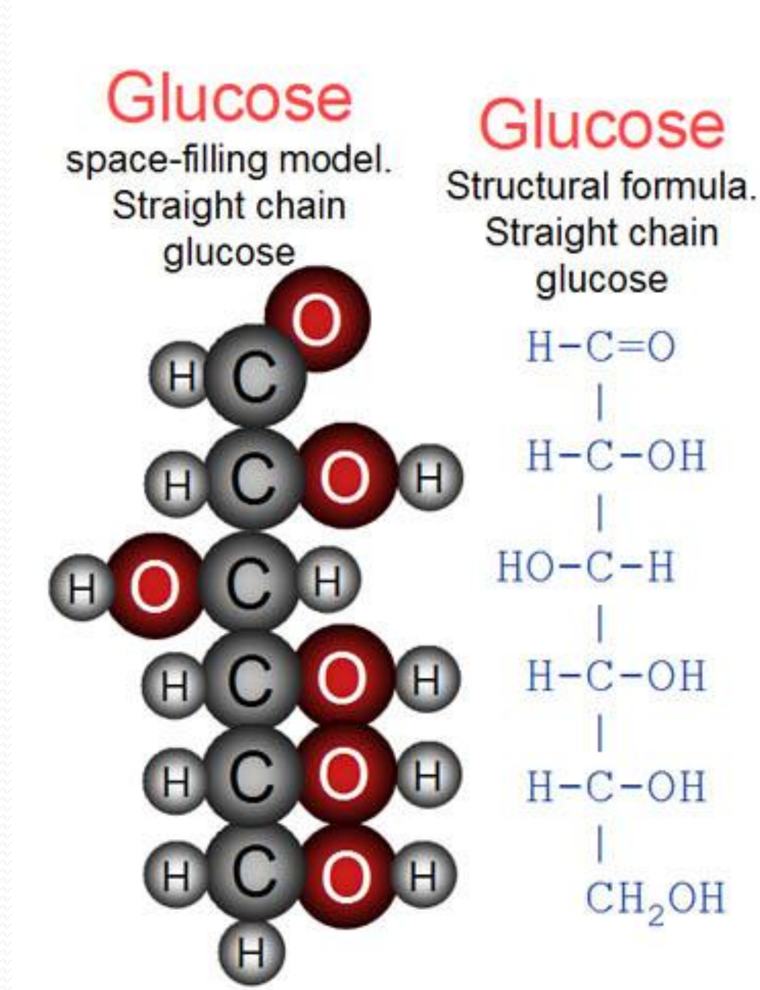


- Carbohydrates are made up of the elements carbon, oxygen, and hydrogen.
- Generally, there are twice as many hydrogen atoms as oxygen atoms in carbohydrates (2:1 ratio).



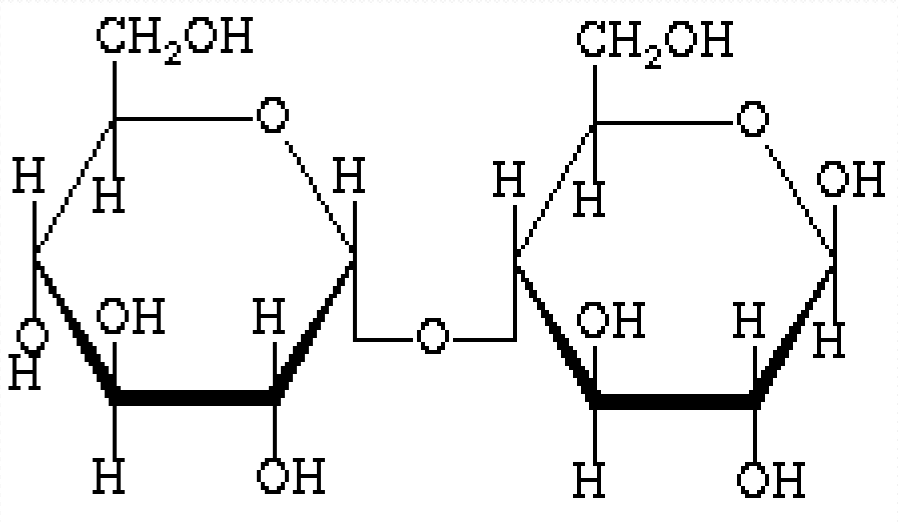
Carbohydrates

- The simplest carbohydrates are called **monosaccharides** or simple sugars.
- They are called the "**building blocks**" of carbohydrates.
- A common monosaccharide is **glucose** ($C_6H_{12}O_6$).
  - Glucose is formed during **photosynthesis**.



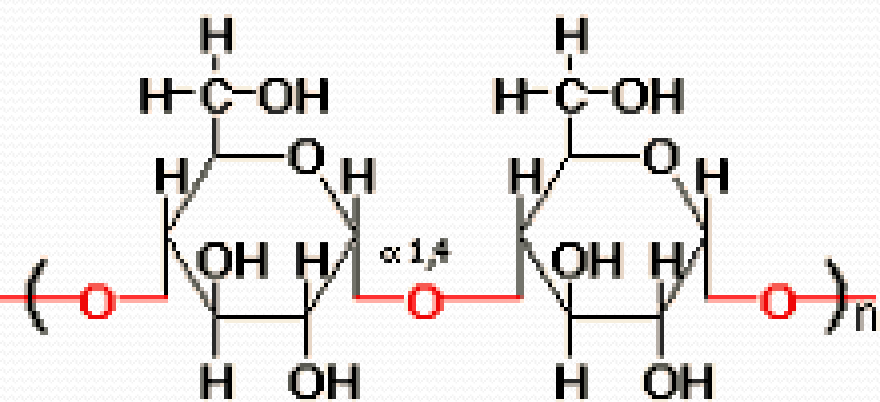
Carbohydrates

- When two simple sugars combine, they form a **disaccharide** or double sugar.
  - **<u>Maltose</u>** ($C_{12}H_{22}O_{11}$) is an example of a common disaccharide. Maltose is formed when two glucose molecules chemically combine.

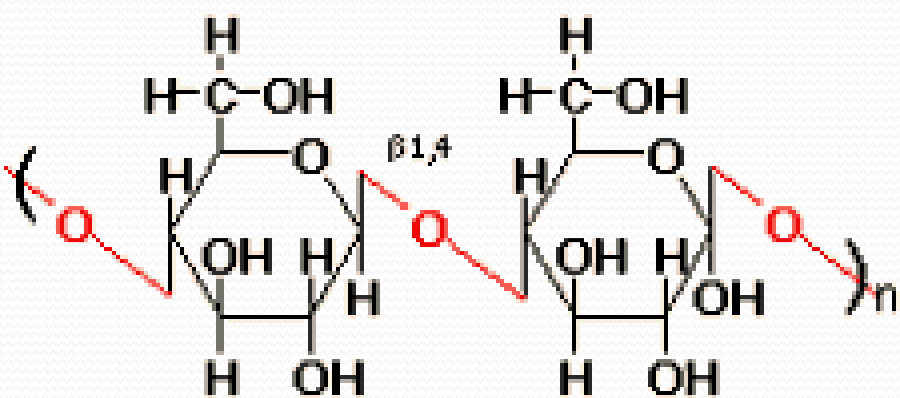


Carbohydrates

- Long chains of monosaccharides (sugar molecules) bonded together form **polysaccharides**.
- Important polysaccharides found in living things are starch and cellulose.



Starch



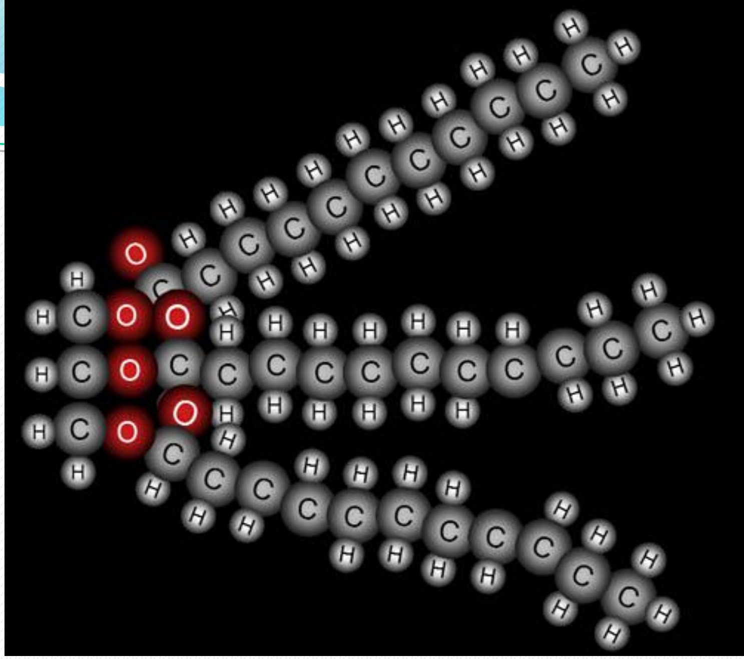
Cellulose

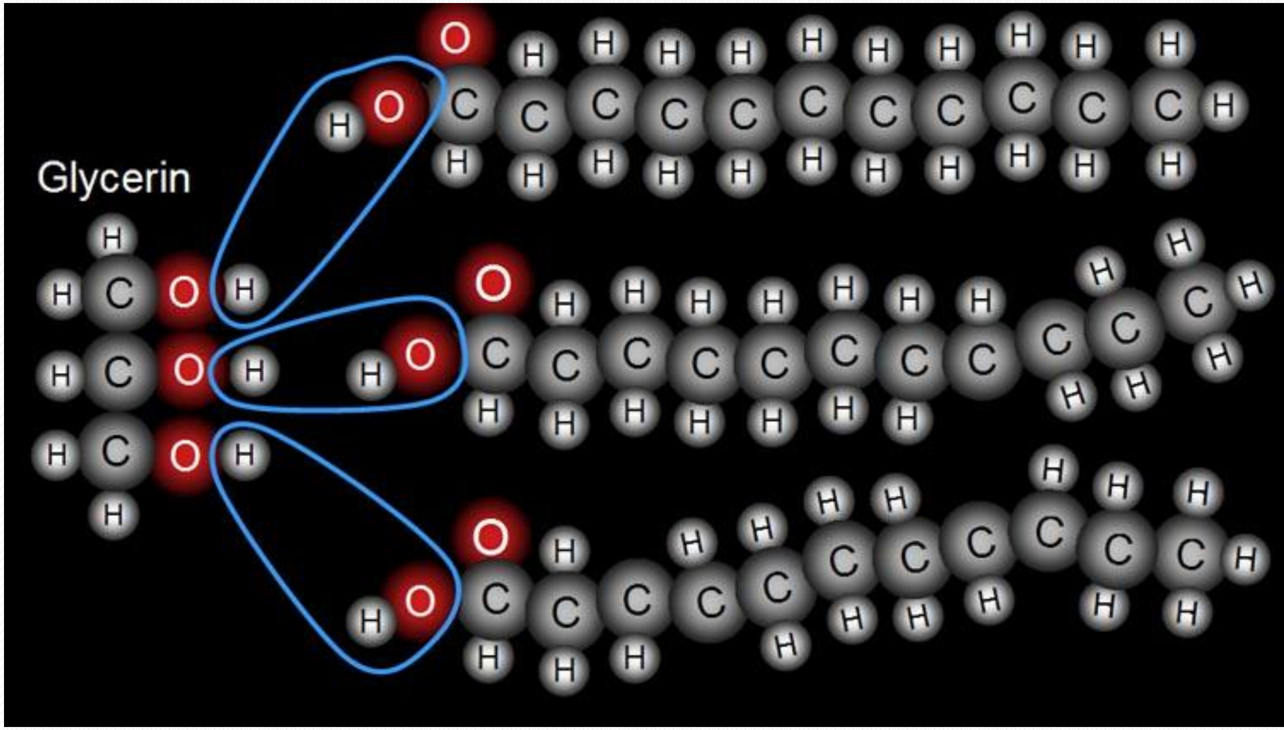
Lipids

- **Lipids** include fats and oils.
  - **Fats** are solid at room temperature.
  - **Oils** are liquids at room temperature.
- In living organisms, lipids form part of the structure of cell membranes.
- Extra food that is not immediately needed as a source of energy is changed to fat and stored.
- Lipids are a source of stored energy in living organisms.

Lipids

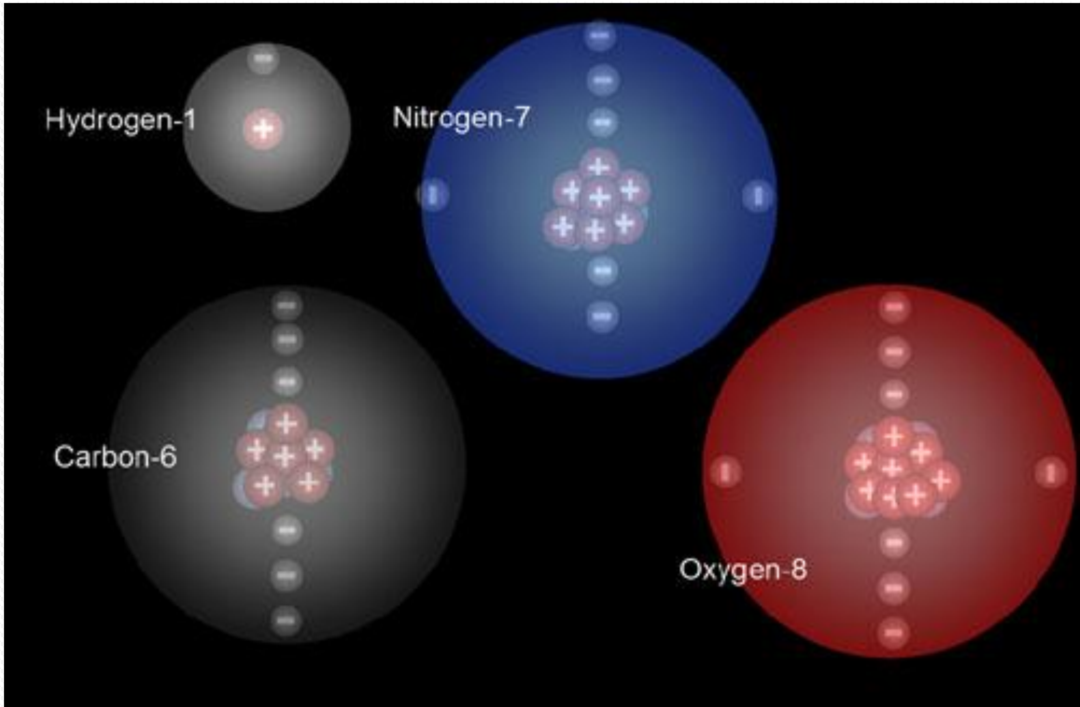
- Lipids, like carbohydrates, contain the elements carbon, hydrogen, oxygen, and phosphorus.
- The **<u>building blocks</u>** of lipids are **fatty acids** and **glycerol**.





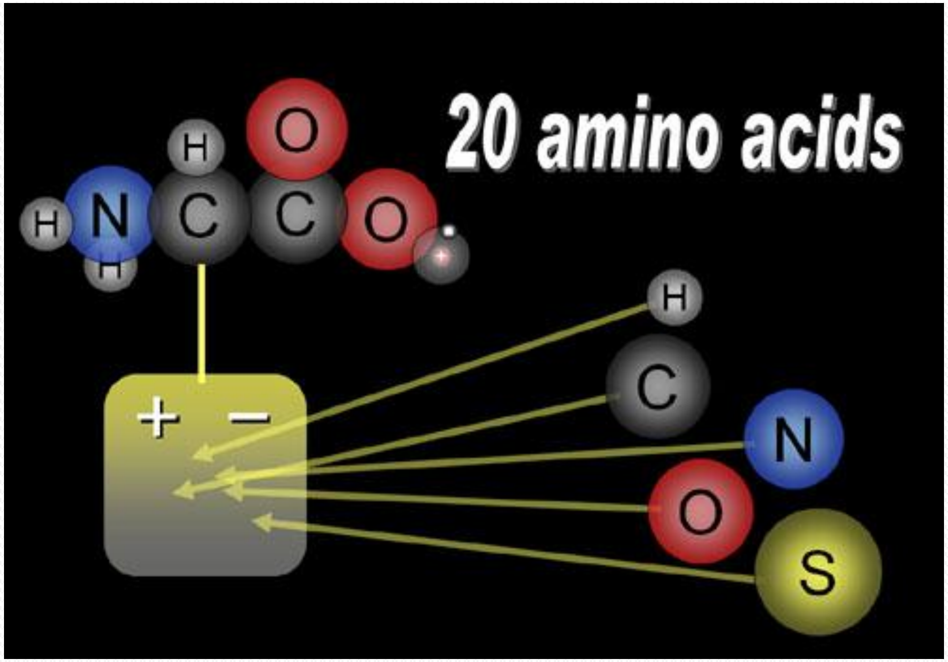
Proteins

- **Proteins** form important cell products such as enzymes, hormones, and hemoglobin.
- Proteins also play an important role in cell repair and growth.
- **Proteins** are made up of carbon, hydrogen, oxygen, and nitrogen.
- Some proteins also contain sulfur.



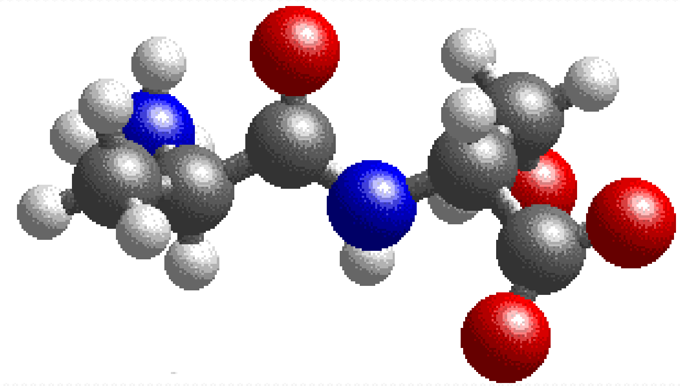
Proteins

- Proteins are composed of simpler units (building blocks) called **amino acids**.
- There are **20** amino acids found in living things.
- Amino acids can be joined together in any sequence and combination.
- Because of this, there are a very large number of different proteins.

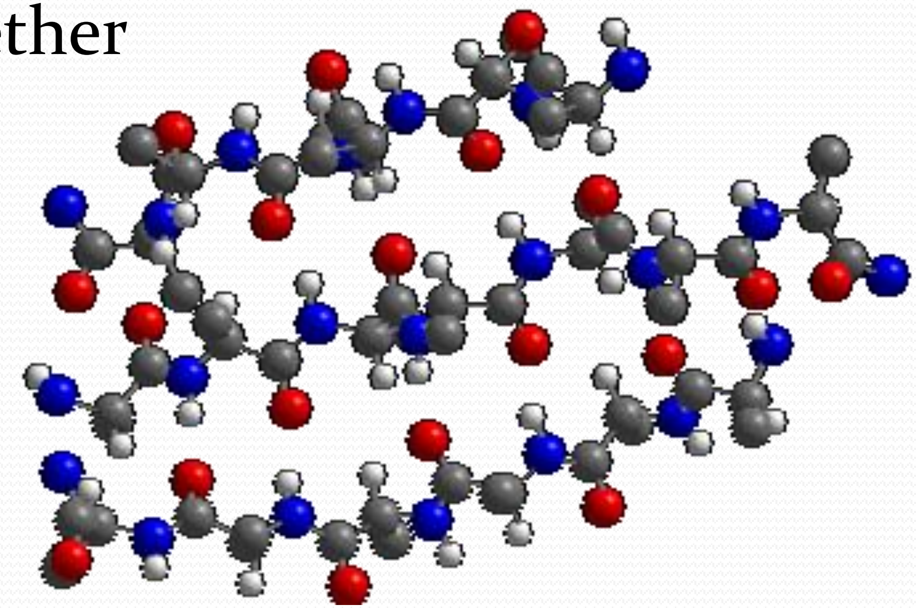


Proteins

- Two amino acids bonded together form a **dipeptide**.

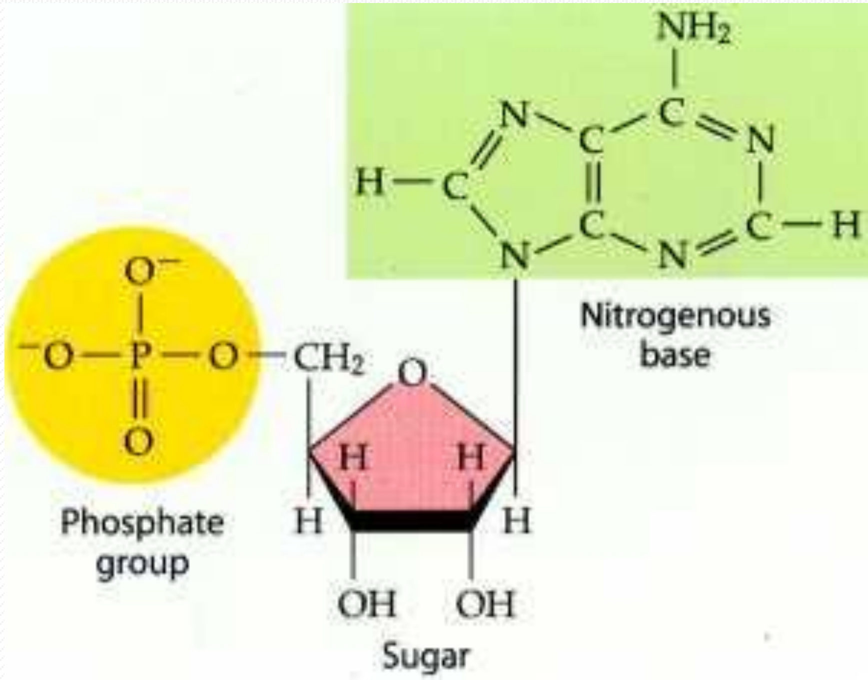


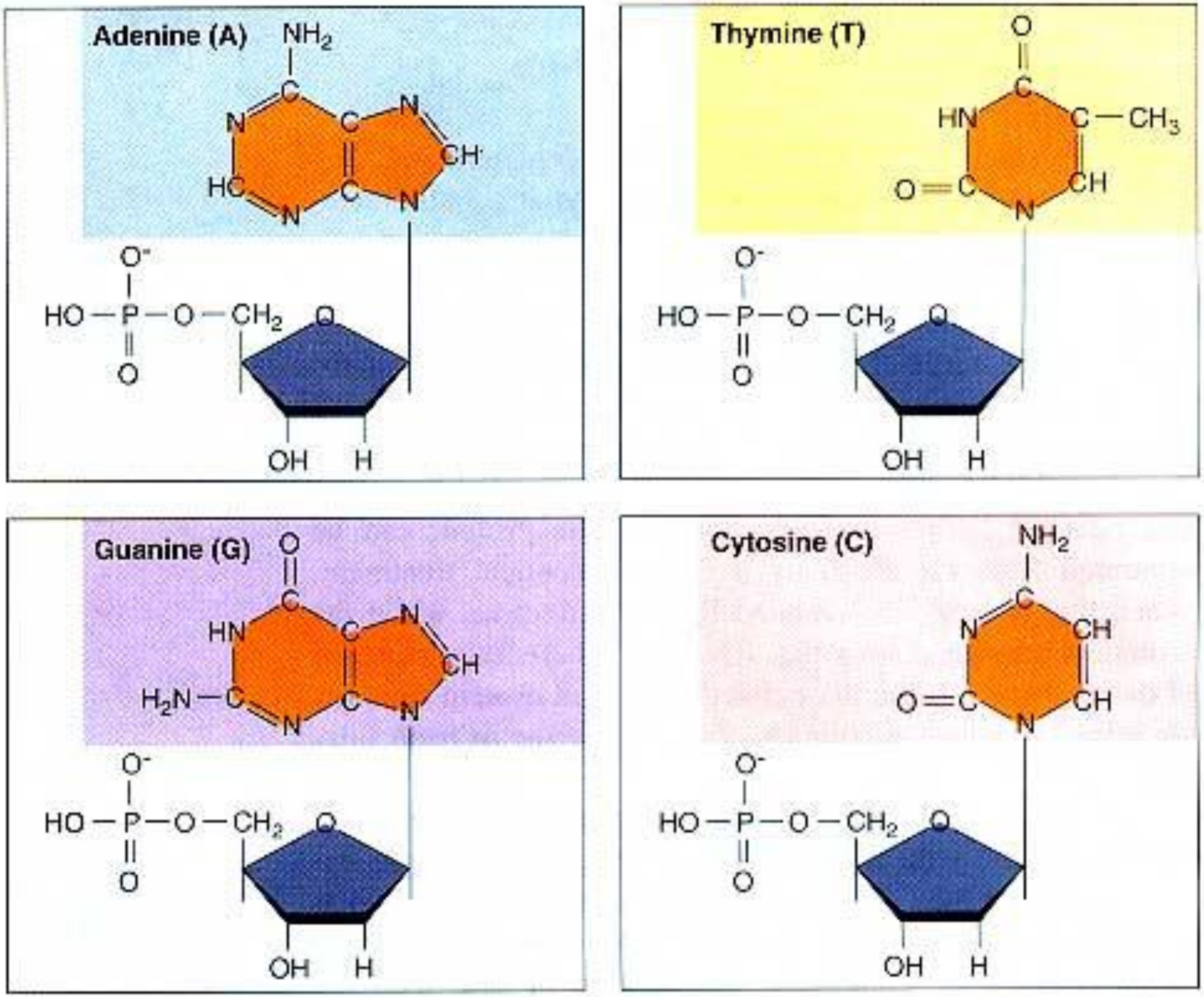
- Many amino acids bonded together form **polypeptides**.
- Proteins are made up of long polypeptide chains.



Nucleic Acids

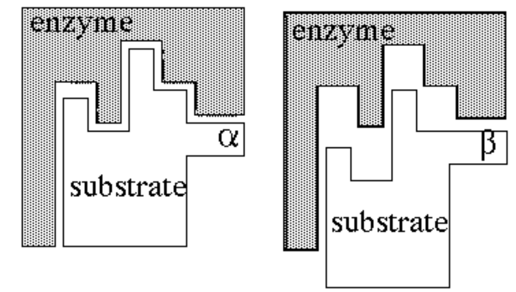
- **Nucleic acids** are very large molecules made up of carbon, hydrogen, oxygen, nitrogen and phosphorus.
- The simplest unit or building block of nucleic acids is the **nucleotide**.
- Nucleotides are composed of
  a sugar molecule,
  a nitrogen base, and
  a phosphate group.





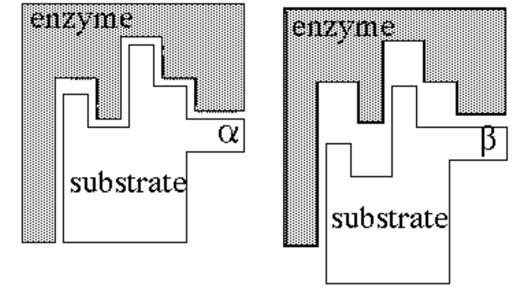
The four nucleotide subunits that make up DNA

The nucleotide subunits of DNA are composed of three elements: a central five-carbon sugar, a phosphate group, and an organic, nitrogen-containing base.



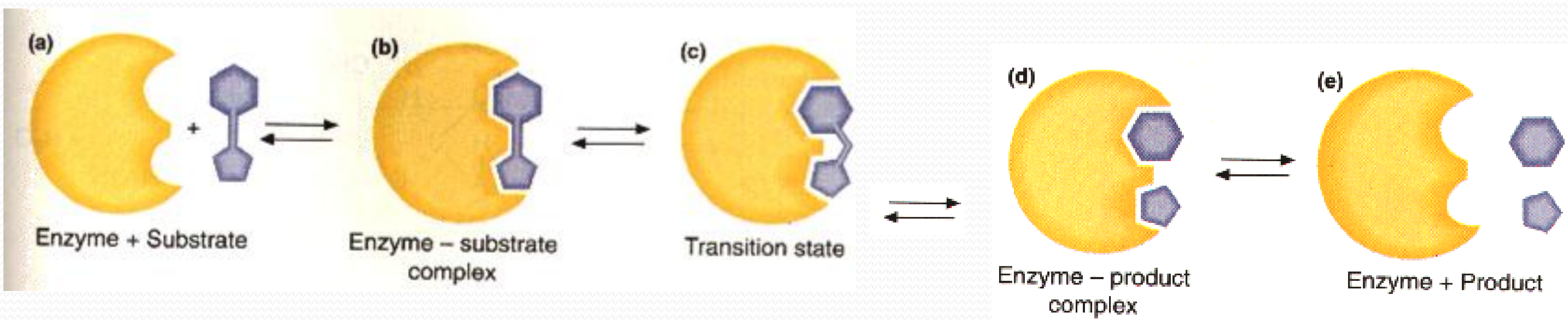
Enzymes

- Each chemical reaction that occurs in a living thing is controlled by an enzyme.
- An enzyme is a protein that lowers the amount of energy needed to make these chemical reactions happen (activation energy.)
- The enzyme is neither permanently changed nor used up by the reaction they catalyze.
- Enzymes will only work with certain substrates (reactants)
- The substrate must fit in the enzyme's active site.



Enzymes

- In organisms, enzymes allow the chemical reactions of metabolism to take place more efficiently than they otherwise would at body temperature.
  - For example, amino acids are produced from protein digestion. The enzymes needed for this reaction are not changed but must be present for the reaction to occur.

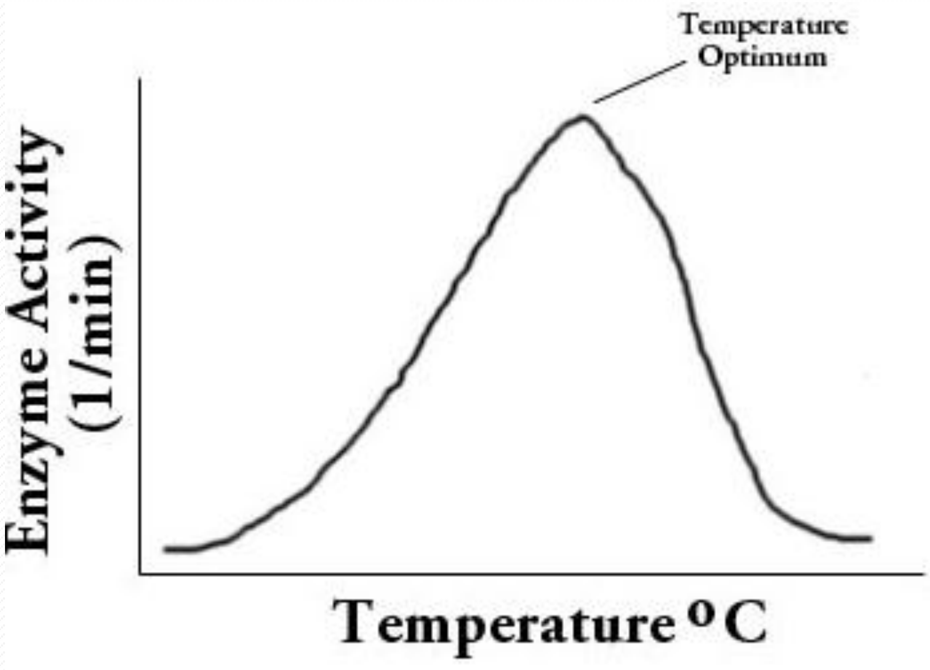


Enzymes

- The rate of enzyme action is influenced by several factors:
  - Temperature
  - Relative concentrations of enzyme and substrate
  - pH
- Each enzyme has an optimum temperature and pH, a temperature or pH at which it functions most efficiently and its rate of activity (action) is the greatest.

Enzymes and Temperature

- At temperatures below the optimum, the rate of enzyme activity (action) is low.
- Enzyme activity increases with increasing temperature up to the optimum temperature.
- Above the optimum temperature, the rate of enzyme activity decreases.



Enzymes and pH

- At pH levels below the optimum, the rate of enzyme activity (action) is low.
- Enzyme activity increases with increasing pH up to the optimum pH.
- Above the optimum pH, the rate of enzyme activity decreases.