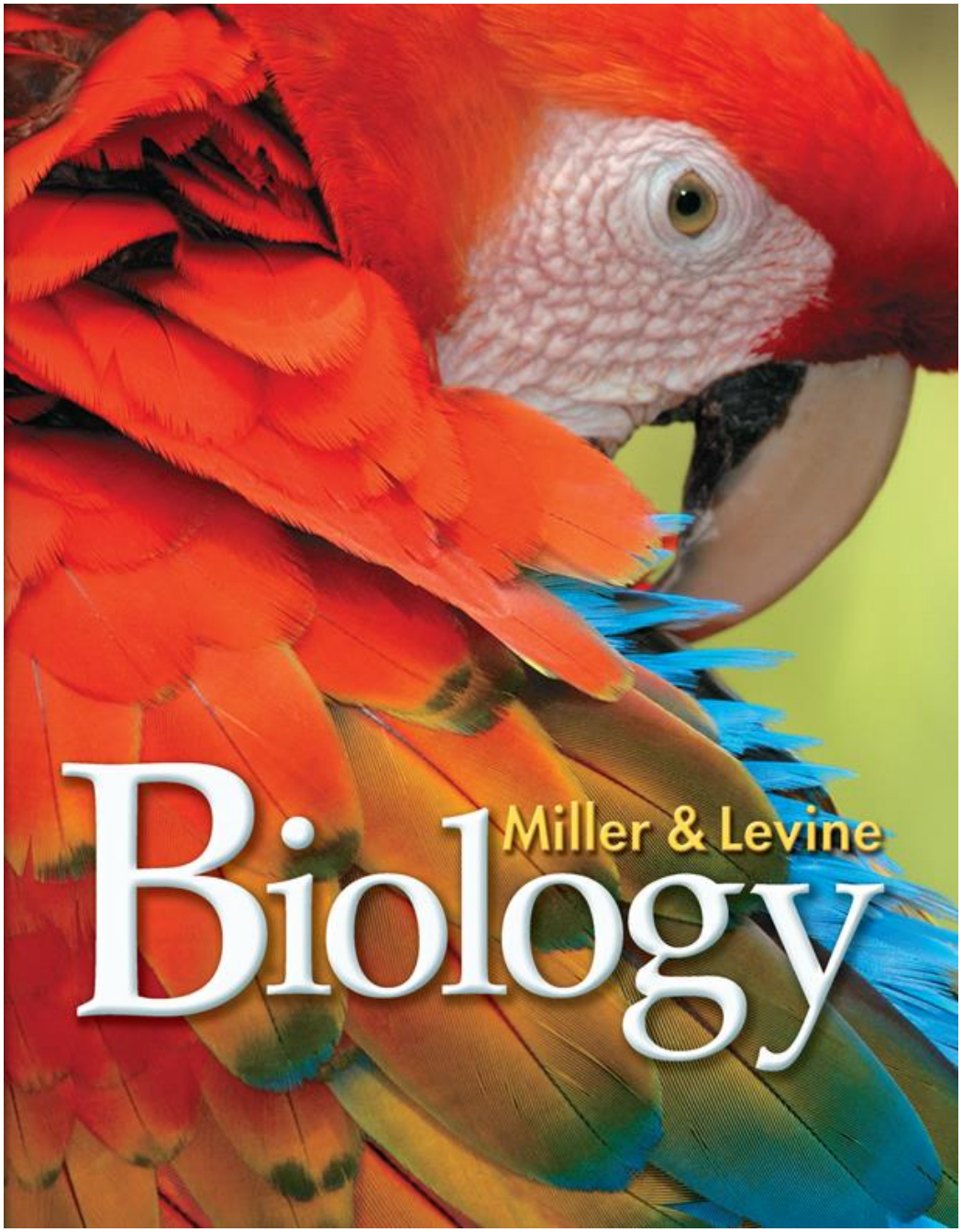


Lesson Overview

2.3 Carbon Compounds

The Chemistry of Carbon

- What elements does carbon bond with to make up life's molecules?

- Carbon can bond with many elements, including Hydrogen, Oxygen, Phosphorus, Sulfur, and Nitrogen to form the molecules of life.

The Chemistry of Carbon

Carbon atoms have 4 valence electrons, allowing them to form strong covalent bonds with many other elements.

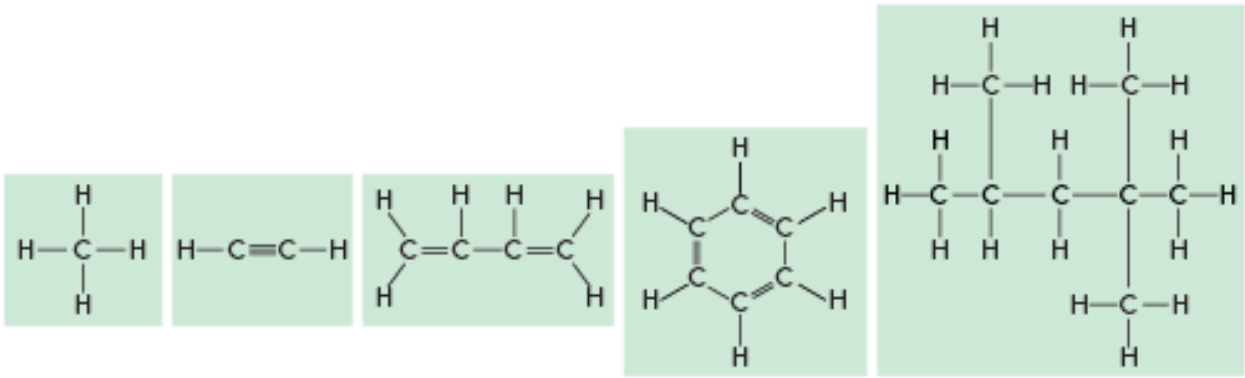
Living organisms are made up of molecules that consist of carbon and these other elements (H, N, P, S, O).

The Chemistry of Carbon

Carbon atoms can also bond to each other, which gives carbon the ability to form millions of different large and complex structures.

Carbon-carbon bonds can be single, double, or triple covalent bonds.

Chains of carbon atoms can even close up on themselves to form rings.



Macromolecules

- What are the functions of each of the four groups of macromolecules?
- Carbohydrates - main source of energy (NRG). Plants, some animals, and other organisms also use carbohydrates for structural purposes.

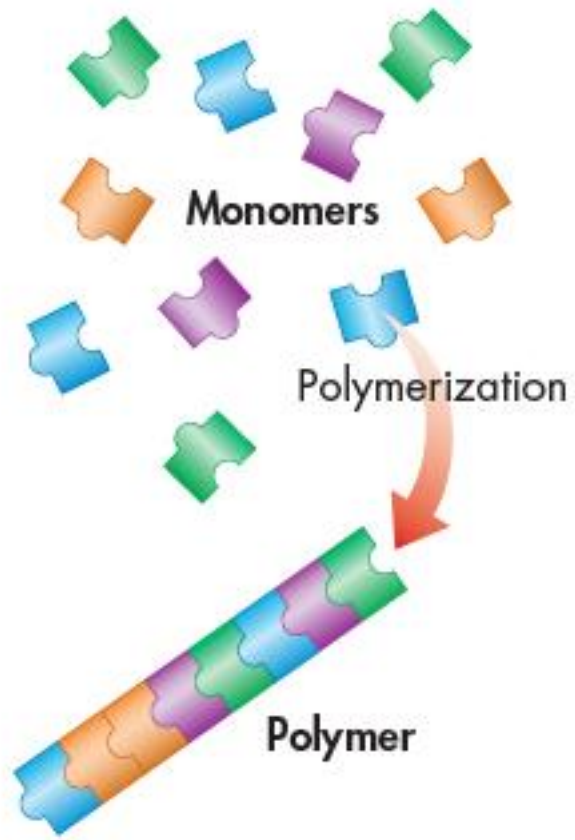
Macromolecules

- Lipids can be used to store energy. Some lipids are important parts of biological membranes and waterproof coverings.
- Nucleic acids store and transmit hereditary, or genetic, information.
- Some proteins control the rate of reactions and regulate cell processes. Others form important cellular structures, while still others transport substances into or out of cells or help to fight disease.

Macromolecules

Many of the organic compounds in living cells are macromolecules, or "giant molecules," made from thousands or even hundreds of thousands of smaller molecules.

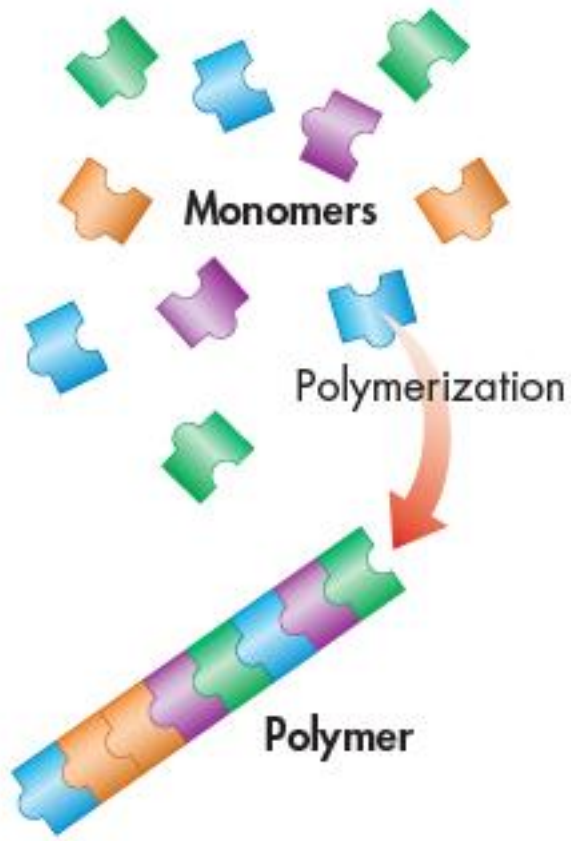
Most macromolecules are formed by a process known as polymerization, in which large compounds are built by joining smaller ones together.



Macromolecules

The smaller units, or **monomers**, join together to form **polymers**.

The monomers in a polymer may be identical or different.

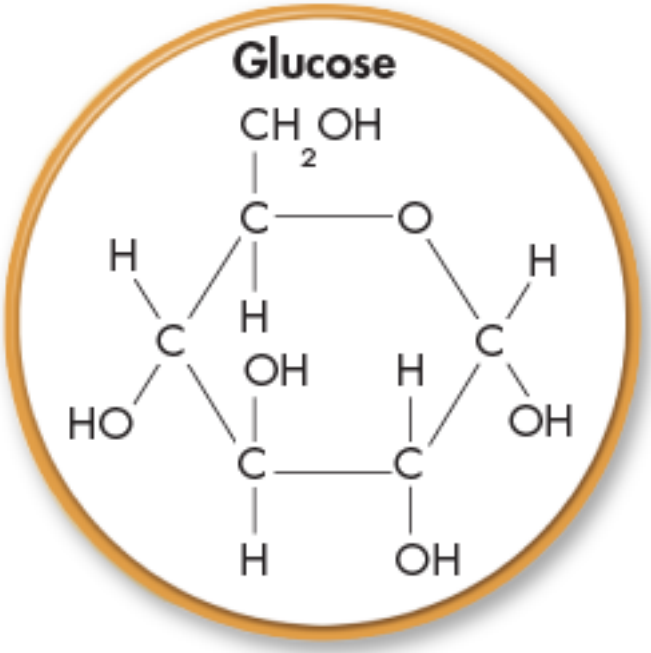


Carbohydrates

Carbohydrates are compounds made up of C, H, and O atoms, usually in a ratio of 1 : 2 : 1.

The breakdown of sugars, such as glucose, supplies immediate energy for cell activities.

Plants, animals, and other organisms also use carbohydrates for structural purposes.

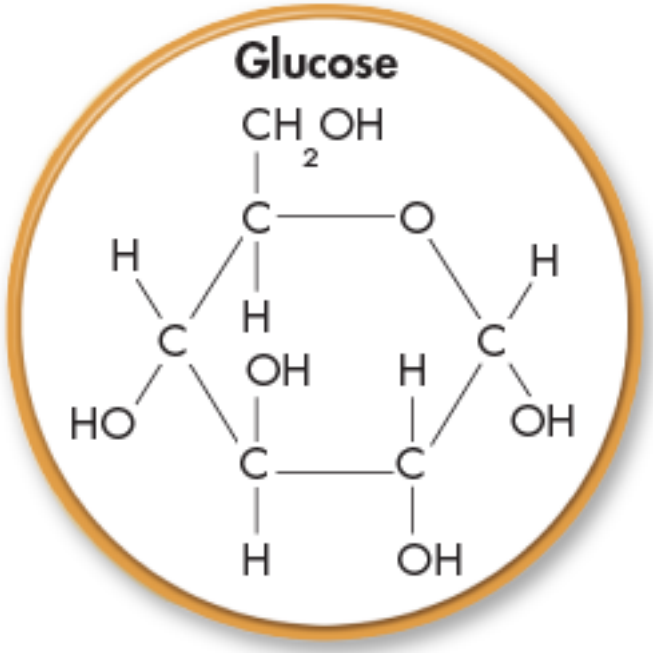


Simple Sugars

Single sugar molecules are also known as **monosaccharides**.

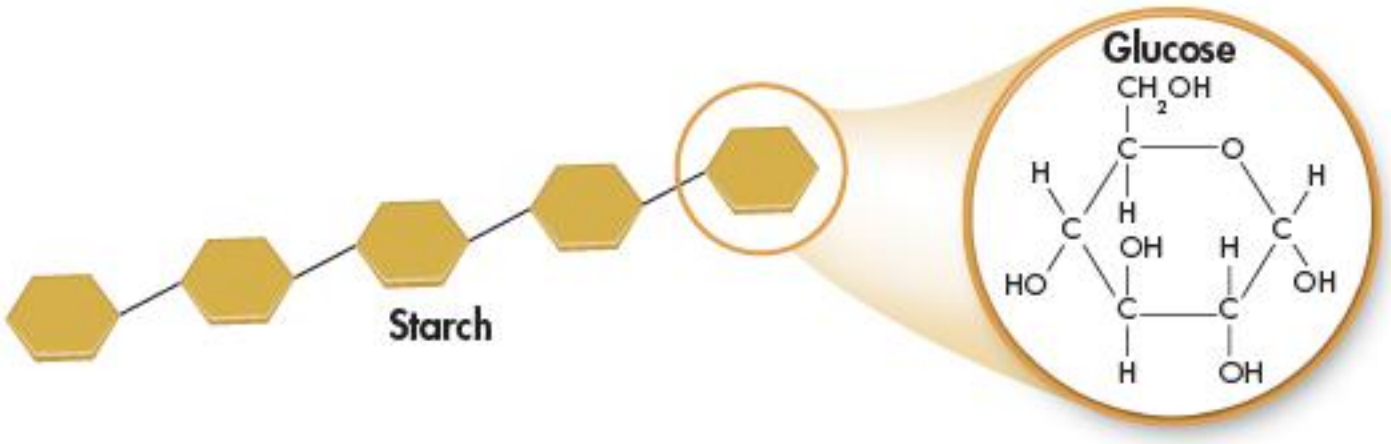
Besides glucose, monosaccharides include galactose, which is a component of milk, and fructose, which is found in many fruits.

Ordinary table sugar, sucrose, is a **disaccharide**, a compound made by joining glucose and fructose together.



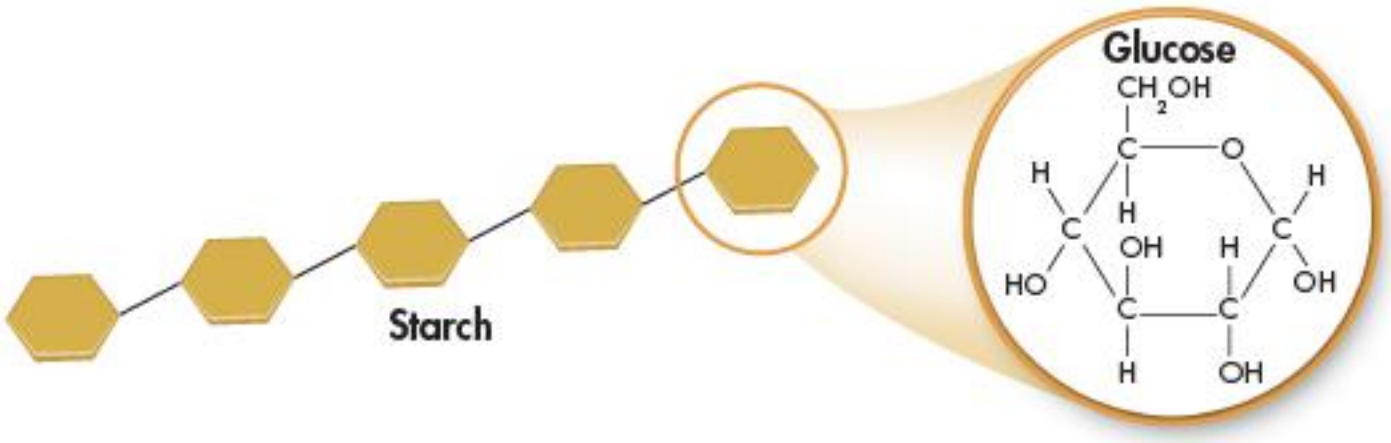
Complex Carbohydrates

The large macromolecules formed from monosaccharides are known as polysaccharides.



Carbohydrates

Many organisms store extra sugar as complex carbohydrates known as starches. The monomers in starch polymers are sugar molecules, such as glucose.



Complex Carbohydrates

Many animals store excess sugar in a polysaccharide called glycogen.

When the level of glucose in your blood runs low, glycogen is broken down into glucose, which is then released into the blood.

The glycogen stored in your muscles supplies the energy for muscle contraction.

Complex Carbohydrates

Plants use a slightly different polysaccharide, called starch, to store excess sugar.

Plants also make another important polysaccharide called cellulose, which gives plants much of their strength and rigidity.

Lipids

Lipids are made mostly from carbon and hydrogen atoms and are generally not soluble in water.

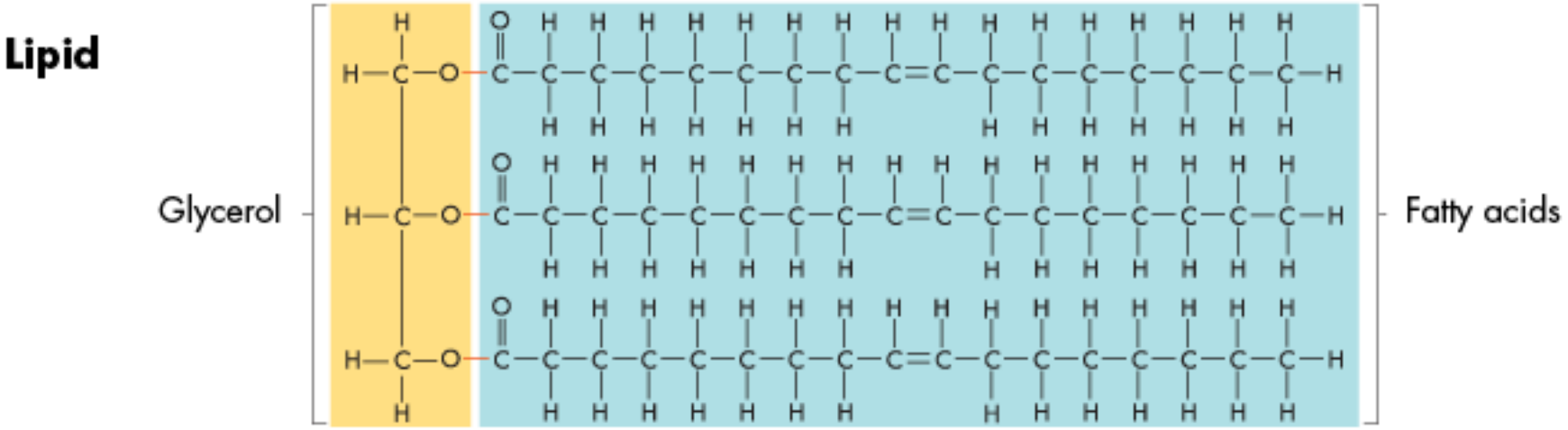
The common categories of lipids are fats, oils, and waxes.

Lipids can be used to store energy. Some lipids are important parts of biological membranes and waterproof coverings.

Steroids synthesized by the body are lipids as well. Many steroids, such as hormones, serve as chemical messengers.

Lipids

Many lipids are formed when a glycerol molecule combines with compounds called fatty acids.



Lipids

If each carbon atom in a lipid's fatty acid chains is joined to another carbon atom by a single bond, the lipid is said to be saturated.

If there is at least one carbon-carbon double bond in a fatty acid, the fatty acid is said to be unsaturated.

Lipids whose fatty acids contain more than one double bond are said to be polyunsaturated.

Nucleic Acids

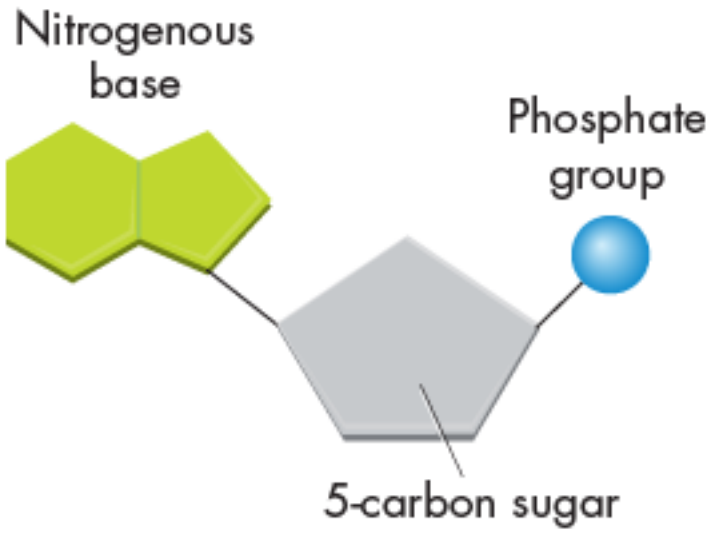
Nucleic acids store and transmit hereditary, or genetic, information.

Nucleic acids are macromolecules containing Hydrogen, Oxygen, Nitrogen, Carbon, and Phosphorus.

Nucleic acids are polymers assembled from individual monomers known as nucleotides.

Nucleic Acids

Nucleotides consist of three parts: a 5-carbon sugar, a phosphate group ($–PO_4$), and a nitrogenous base.

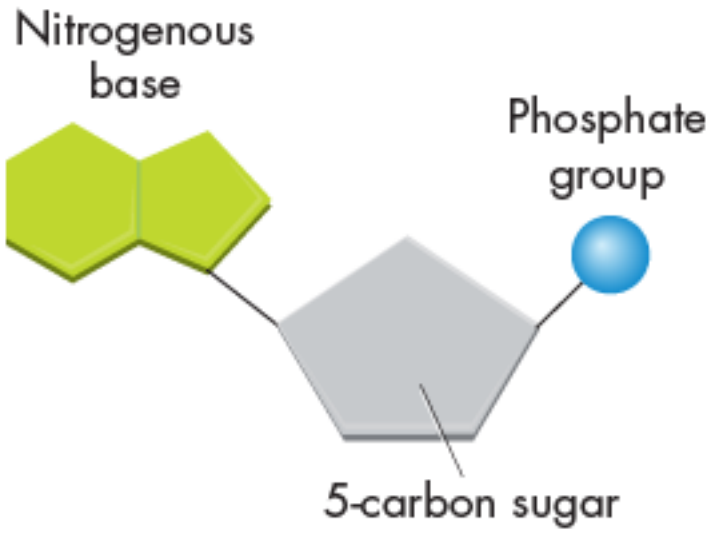


Some nucleotides, including adenosine triphosphate (ATP), play important roles in capturing and transferring chemical energy.

Nucleic Acids

Individual nucleotides can be joined by covalent bonds to form a polynucleotide, or nucleic acid.

There are two kinds of nucleic acids: ribonucleic acid (RNA) and deoxyribonucleic acid (DNA). RNA contains the sugar ribose and DNA contains the sugar deoxyribose.



Protein

Proteins are macromolecules that contain Nitrogen as well as Carbon, Hydrogen, and Oxygen.

Proteins are polymers of molecules called amino acids.

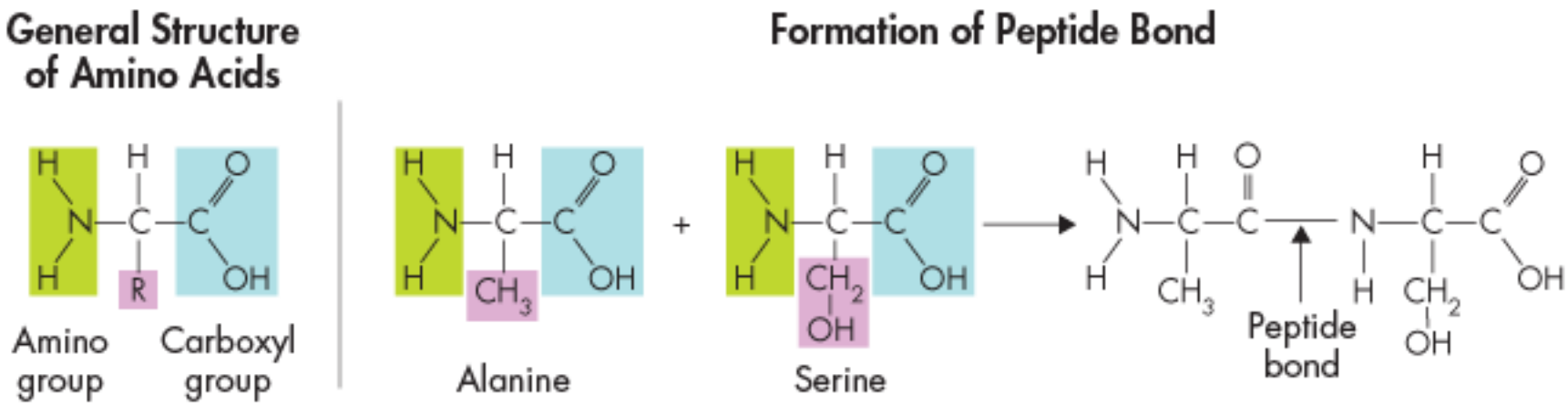
Proteins perform many varied functions, such as controlling the rate of reactions and regulating cell processes, forming cellular structures, transporting substances into or out of cells, and helping to fight disease.

Protein

Amino acids are compounds with an amino group (–NH_2) on one end and a carboxyl group (–COOH) on the other end.

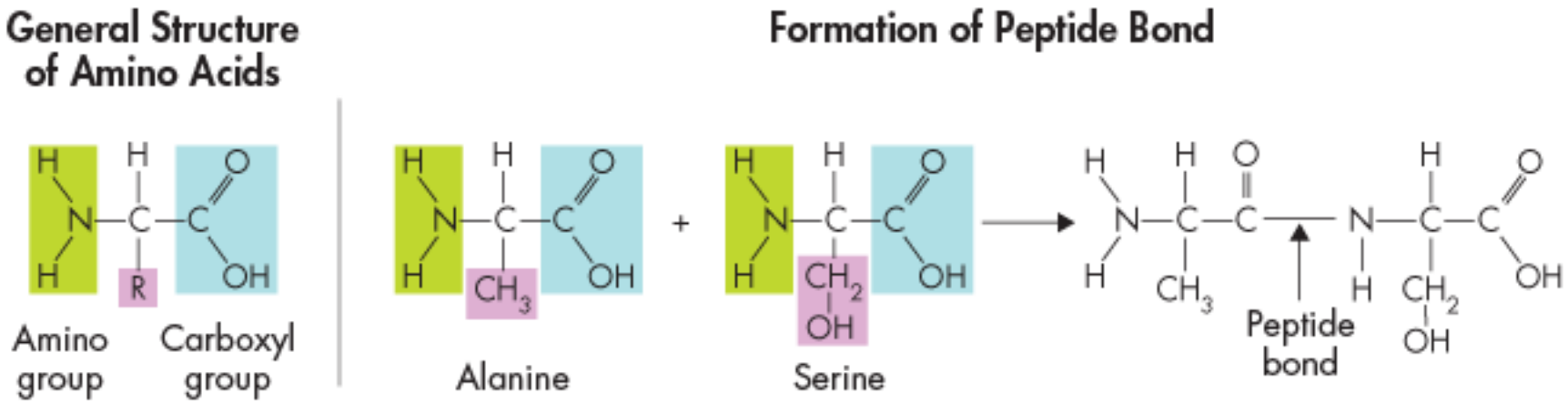
Covalent bonds called peptide bonds link amino acids together to form a polypeptide.

A protein is a functional molecule built from one or more polypeptides.



Structure and Function

All amino acids are identical in the amino and carboxyl groups. Any amino acid can be joined to any other amino acid by a peptide bond formed between these amino and carboxyl groups.



Structure and Function

Amino acids differ from each other in a side chain called the R-group, which have a range of different properties.

More than 20 different amino acids are found in nature.

This variety results in proteins being among the most diverse macromolecules.