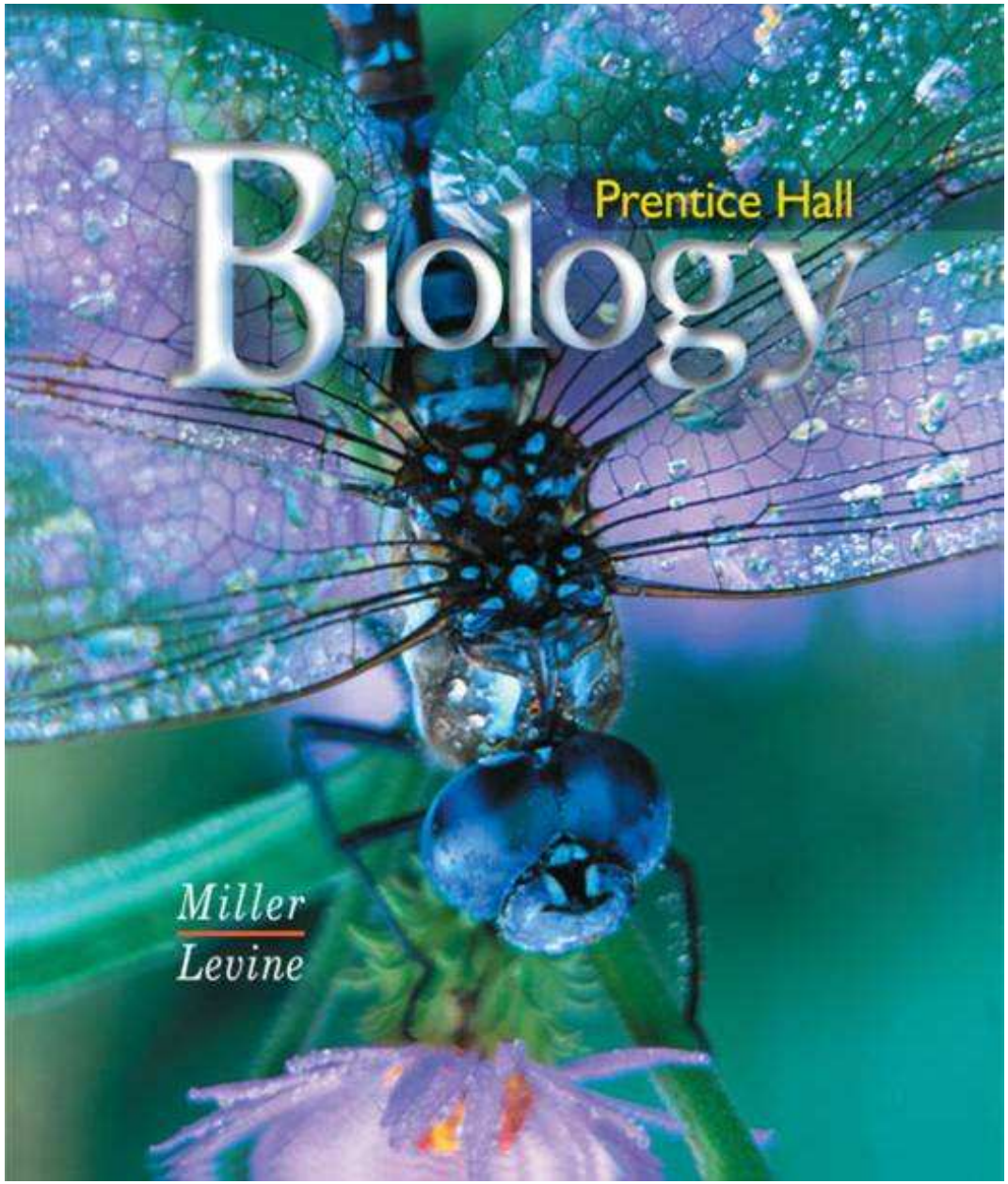


2–3 Carbon Compounds

The Chemistry of Carbon

Organic chemistry is the study of all compounds that contain bonds between carbon atoms.

Carbon atoms have four valence electrons that can join with the electrons from other atoms to form strong covalent bonds.

A carbon atom can bond to other carbon atoms, giving it the ability to form chains that are almost unlimited in length.

Living organisms are made of molecules that consist of carbon and other elements.

Chains of carbon can even close upon themselves to form rings.

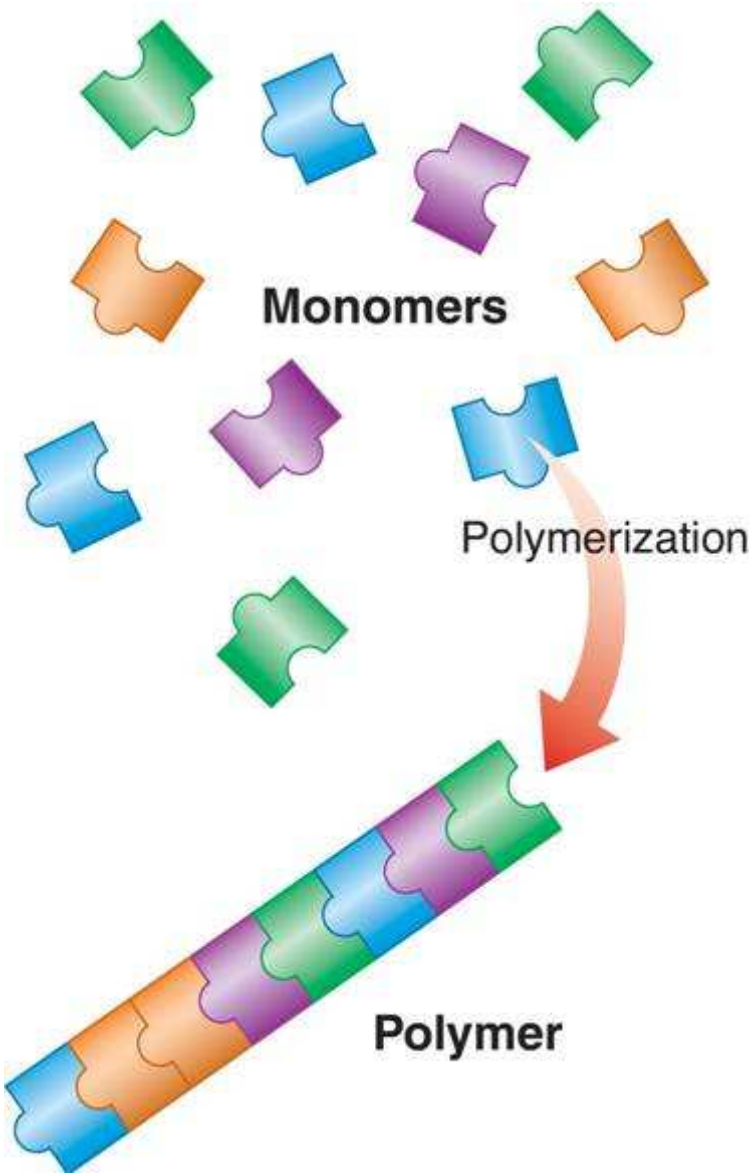
Carbon has the ability to form millions of different large and complex structures.

Macromolecules

Macromolecules are formed by a process known as polymerization.

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

Monomers in a polymer may be identical, or the monomers may be different.



Four groups of organic compounds found in living things are:

- **carbohydrates**
- **lipids**
- **nucleic acids**
- **proteins**

Carbohydrates

Carbohydrates are compounds made up of carbon, hydrogen, and oxygen atoms, usually in a ratio of 1 : 2 : 1.

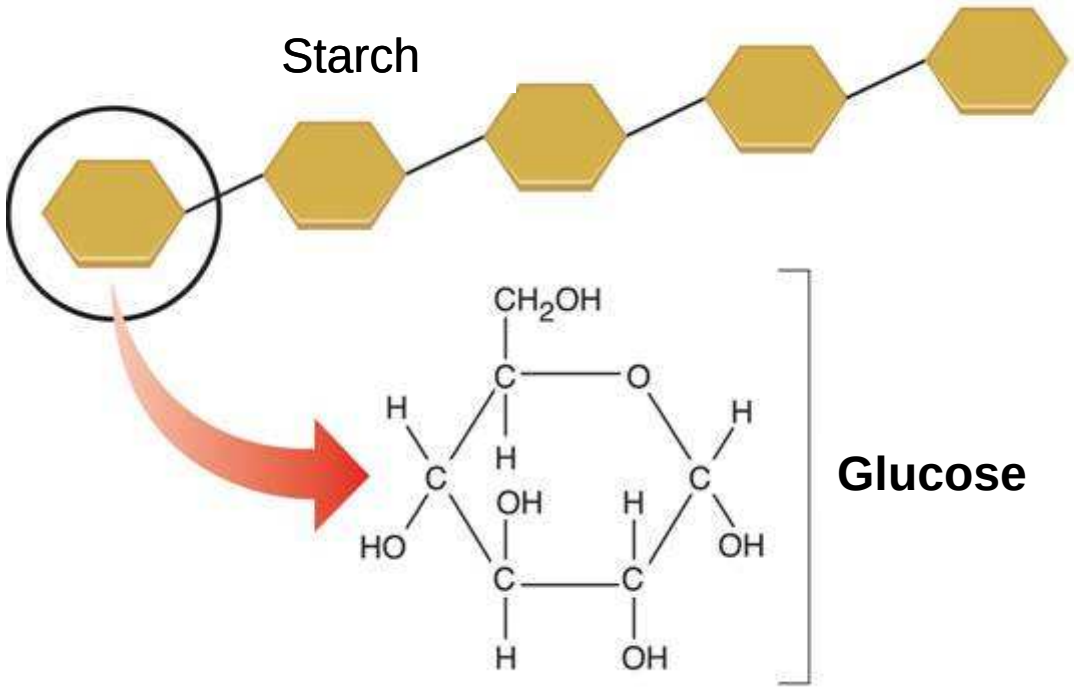
What is the function of carbohydrates?

Living things use carbohydrates as their main source of energy. Plants and some animals also use carbohydrates for structural purposes.

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

Living things store extra sugar as complex carbohydrates known as starches.

Starches and sugars are examples of carbohydrates that are used by living things as a source of energy.



Single sugar molecules are called **monosaccharides**.

Monosaccharides include glucose, galactose (a component of milk), and fructose (found in many fruits).

The large macromolecules formed from monosaccharides are called **polysaccharides**.

Lipids

Lipids are generally not soluble in water.

Lipids are made mostly from carbon and hydrogen atoms.

The common categories of lipids are:

- fats
- oils
- waxes
- steroids

What is the function of lipids?

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

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

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.

The term *saturated* is used because the fatty acids contain the maximum possible number of hydrogen atoms.

If there is at least one carbon-carbon double bond in a fatty acid, it is unsaturated.

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

Lipids that contain unsaturated fatty acids tend to be liquid at room temperature.

Nucleic Acids

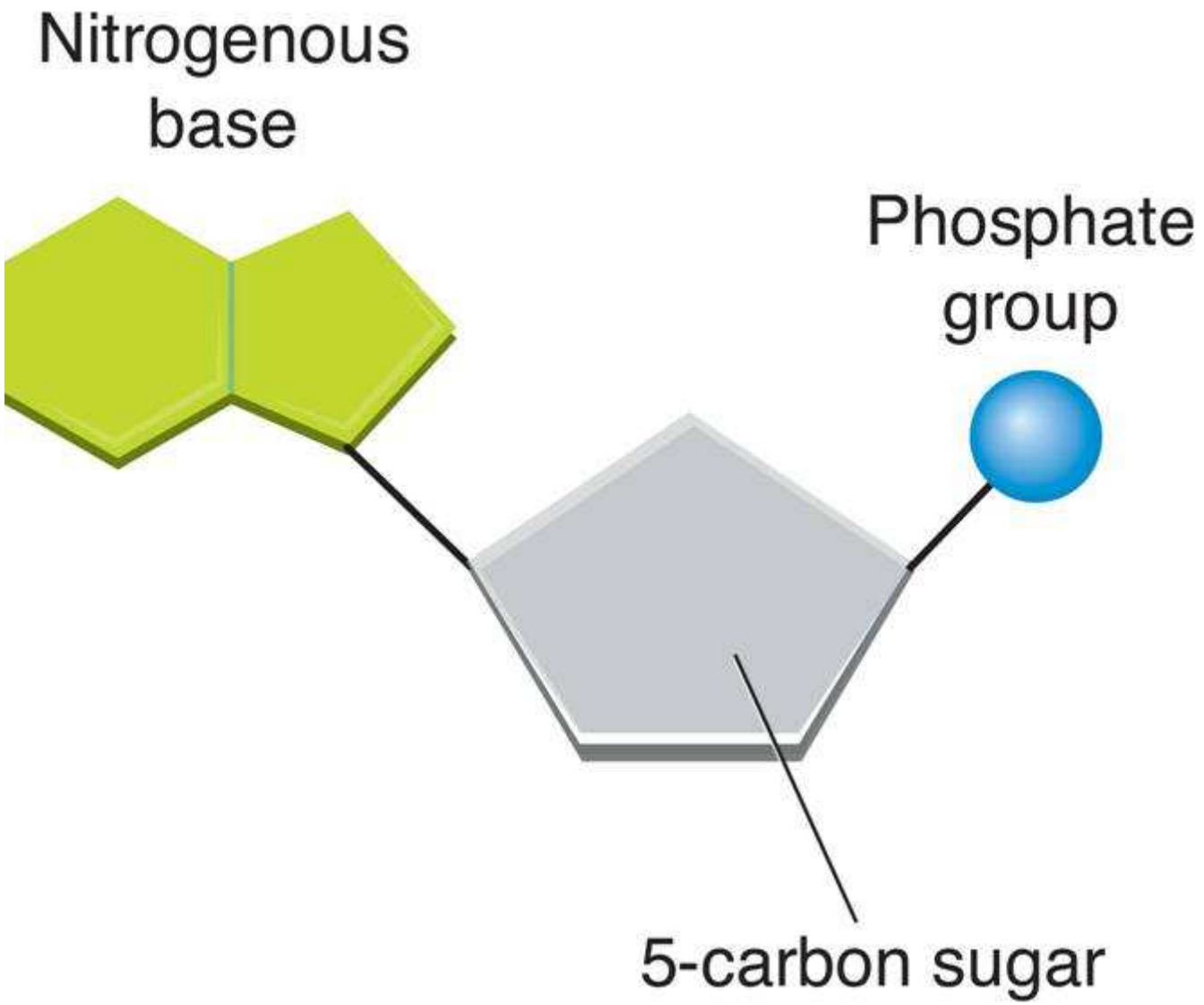
Nucleic acids are macromolecules containing hydrogen, oxygen, nitrogen, carbon, and phosphorus.

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

Nucleotides consist of three parts:

- a 5-carbon sugar
- a phosphate group
- a nitrogenous base

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



What is the function of nucleic acids?

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

There are two kinds of nucleic acids, **ribonucleic acid (RNA)** and **deoxyribonucleic acid (DNA).**

RNA contains the sugar ribose.

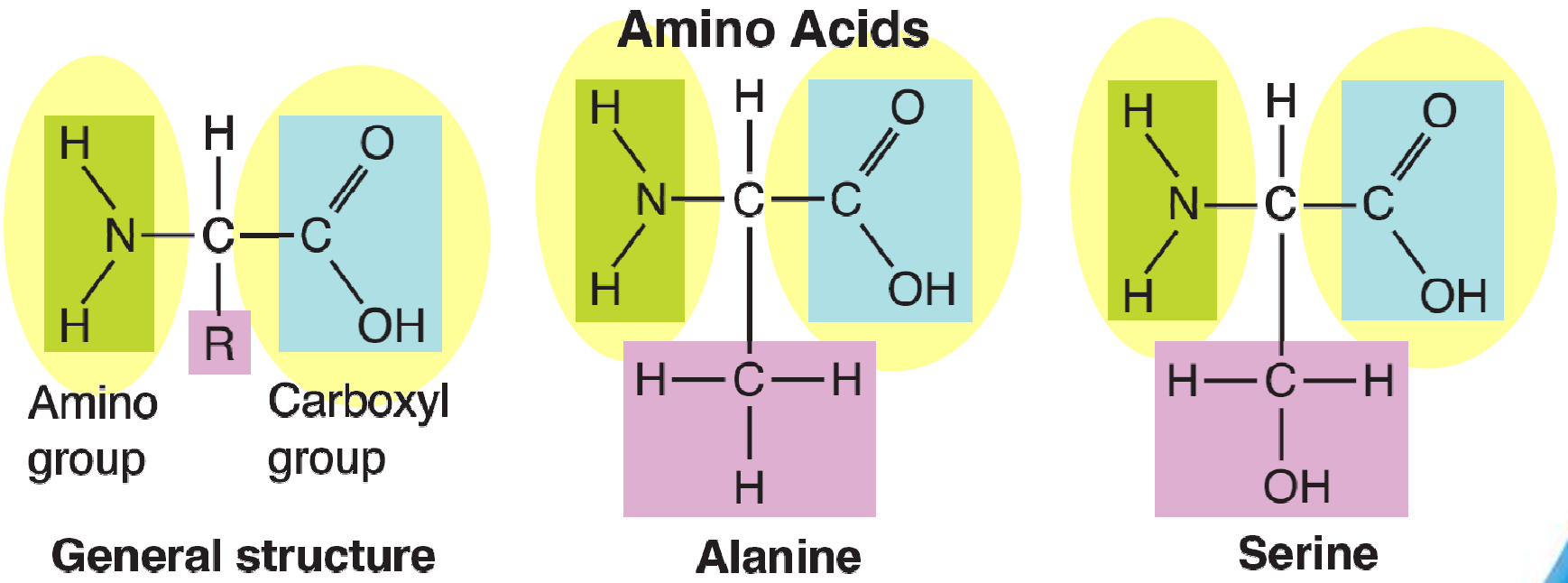
DNA contains the sugar deoxyribose.

Proteins

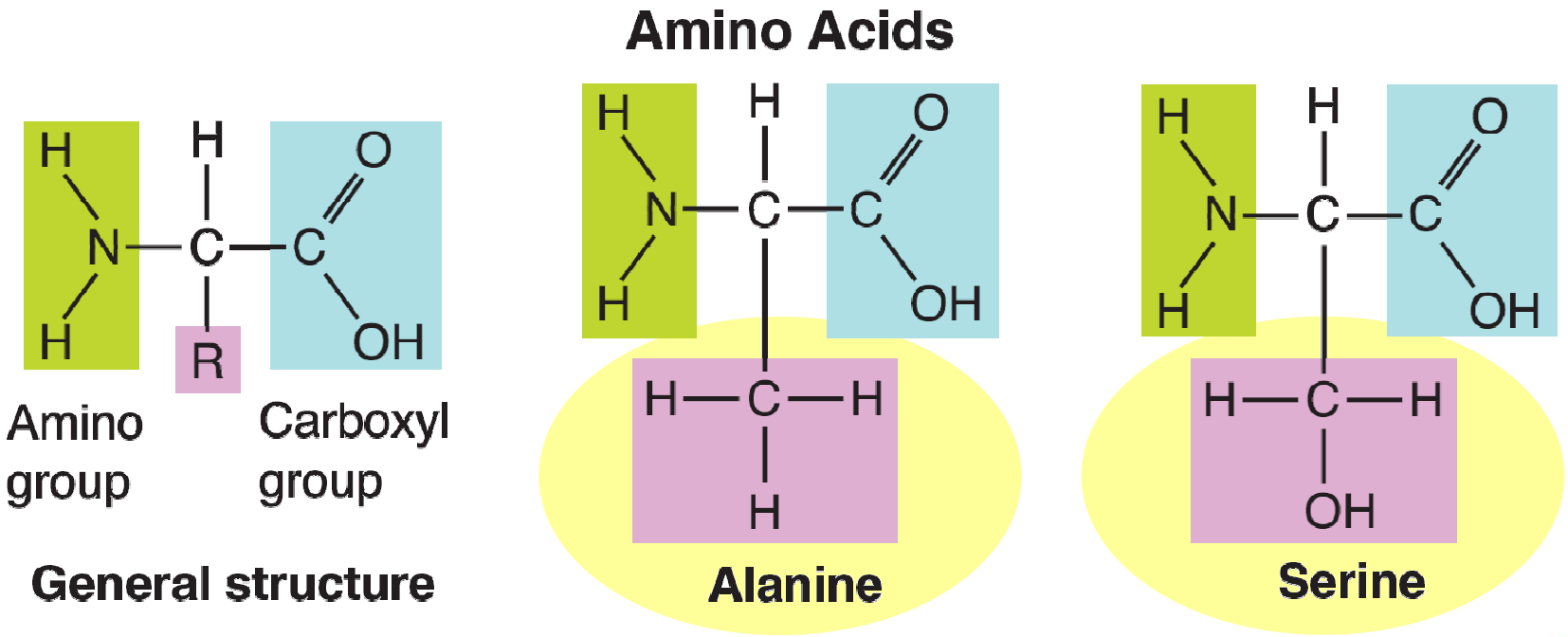
Proteins are macromolecules that contain nitrogen, carbon, hydrogen, and oxygen.

Proteins are polymers of molecules called **amino acids**.

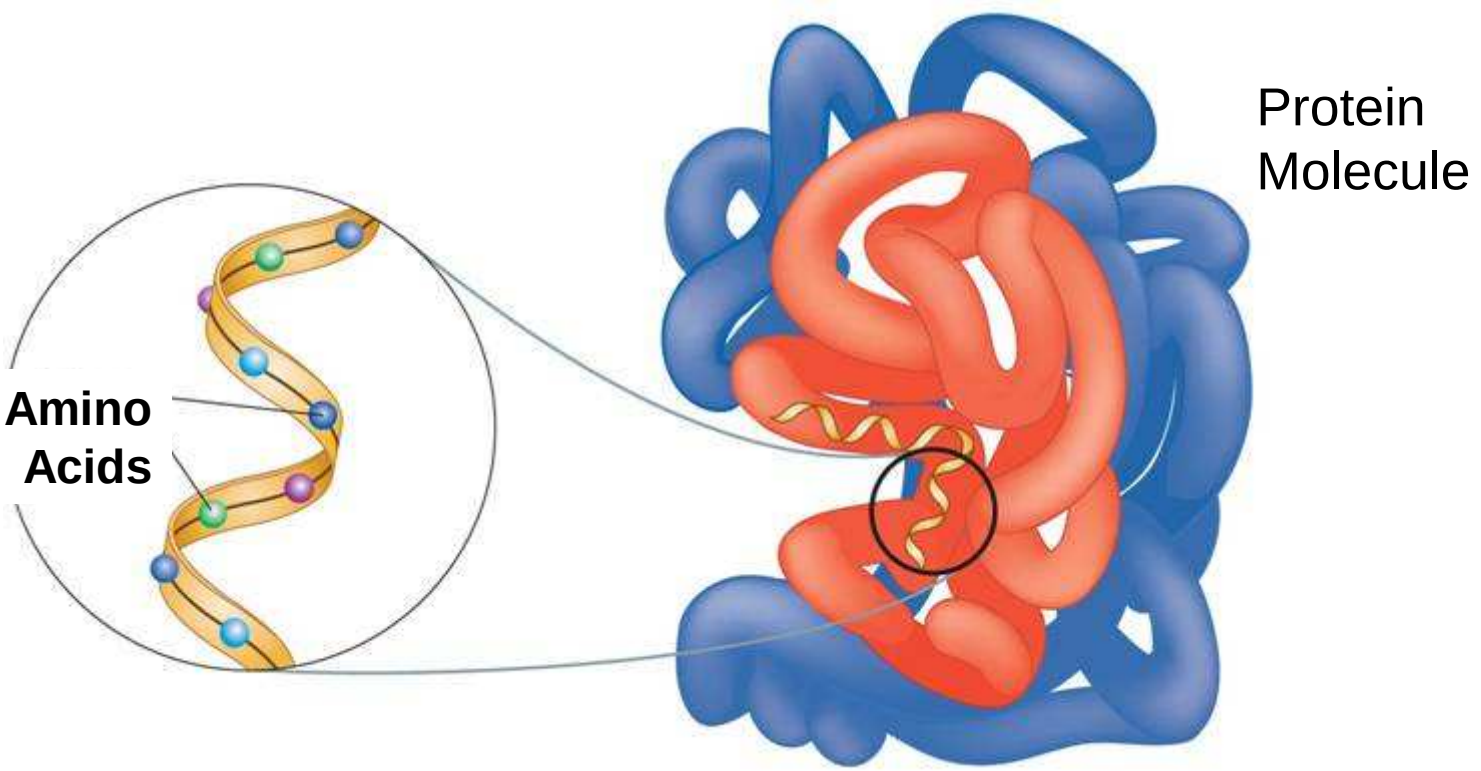
Amino acids are compounds with an amino group ($-NH_2$) on one end and a carboxyl group (-COOH) on the other end.



The portion of each amino acid that is different is a side chain called an R-group.



The instructions for arranging amino acids into many different proteins are stored in DNA.



What is the function of proteins?

Some proteins control the rate of reactions and regulate cell processes.

Some proteins are used to form bones and muscles.

Other proteins transport substances into or out of cells or help to fight disease.

Proteins can have up to four levels of organization:

1. Amino acids have a specific protein chain.
2. The amino acids within a chain can be twisted or folded.
3. The chain itself is folded.
4. If a protein has more than one chain, each chain has a specific arrangement in space.

2–3 Section QUIZ

Continue to:

Section QUIZ

- or -

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2–3 Section QUIZ

1 Large carbohydrate molecules such as starch are known as

a. lipids.

b. monosaccharides.

c. proteins.

A d. polysaccharides.

2–3 Section QUIZ

2 Many lipids are formed from glycerol and

A a. fatty acids.

b. monosaccharides.

c. amino acids.

d. nucleic acids.

2–3 Section QUIZ

3 Proteins are among the most diverse macromolecules because

a. they contain both amino groups and carboxyl groups.

A b. they can twist and fold into many different and complex structures.

c. they contain nitrogen as well as carbon, hydrogen, and oxygen.

d. their R groups can be either acidic or basic.

2–3 Section QUIZ

4 Which of the following statements about cellulose is true?

a. Animals make it and use it to store energy.

b. Plants make it and use it to store energy.

c. Animals make it and use it as part of the skeleton.

A d. Plants make it and use it to give structural support to cells.

2–3 Section QUIZ

5 A major difference between polysaccharides and proteins is that

a. plants make polysaccharides, while animals make proteins.

b. proteins are made of monomers, while polysaccharides are not.

A c. polysaccharides are made of monosaccharides, while proteins are made of amino acids.

d. proteins carry genetic information, while polysaccharides do not.

END OF SECTION