

Chapter Sixteen: Compounds

- **13.1 Chemical Bonds and
Electrons**
- **13.2 Chemical Formulas**
- **13.3 Molecules and Carbon
Compounds**

Chapter 13.3 Learning Goals

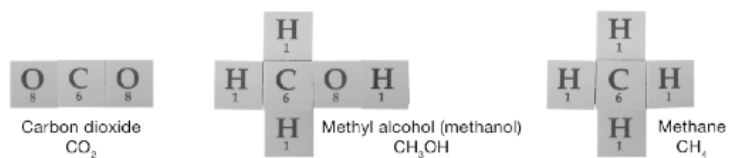
- Explain the significance of carbon in the structure of many different molecules.
- Describe the importance of carbon to living organisms.
- Compare and contrast the structure and function of carbohydrates, lipids, proteins, and nucleic acids.

Investigation 13C

Carbon and its Chemistry

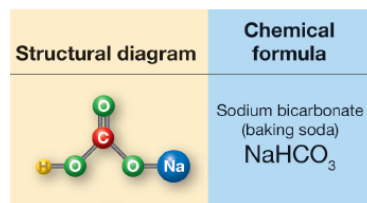
▪ **Key Question:**

What are some common molecules that contain carbon?



13.3 Molecules and Carbon Compounds

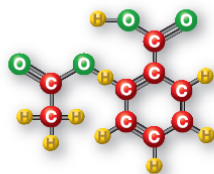
- In addition to the elements from which it is made, the shape of a molecule is also important to its function and properties.
- We use structural diagrams to show the shape and arrangement of atoms in a molecule.



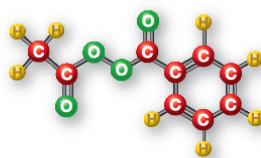
13.3 Structural diagrams

- Two substances have the same formula as aspirin, but not its pain relieving properties.

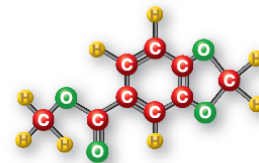
Three Different Molecules, Same Chemical Formula



Acetylsalicylic acid
(aspirin)
 $C_9H_8O_4$

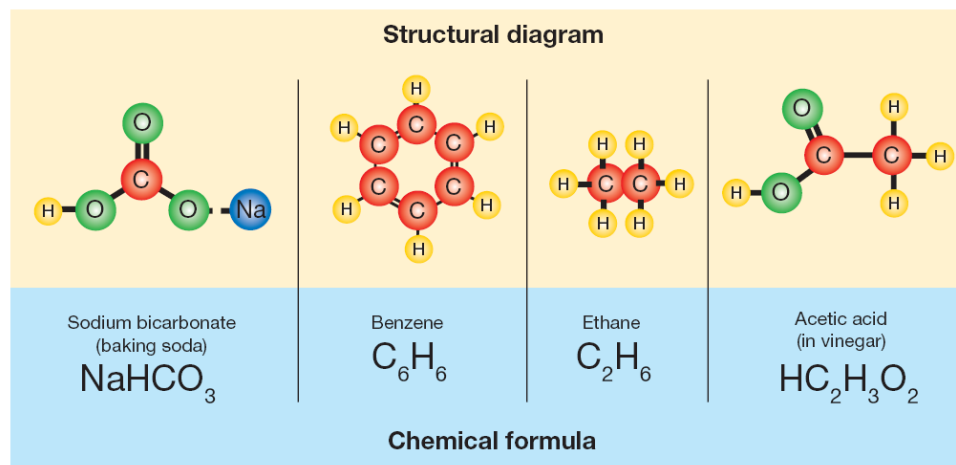


Benzodioxole-5-carboxylic acid
methyl ester
 $C_9H_8O_4$



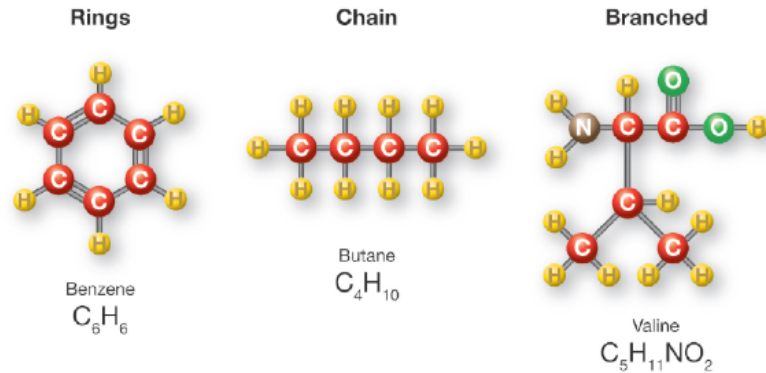
Acetyl benzoyl peroxide
 $C_9H_8O_4$

Chemical Formulas and Structure Diagrams



13.3 The chemistry of carbon

- Carbon molecules come in three basic forms: straight chains, branching chains, and rings.
- All three forms are found in important biological molecules.



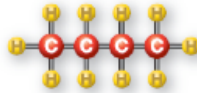
Carbon Molecules

Rings



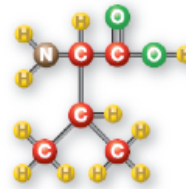
Benzene
 C_6H_6

Chain



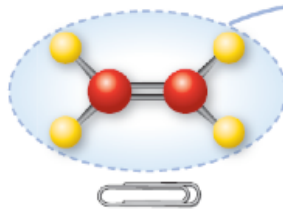
Butane
 C_4H_{10}

Branched

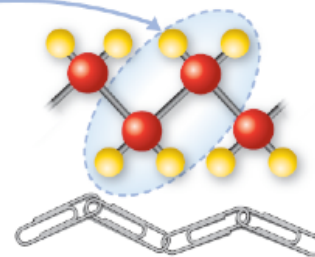


Valine
 $C_6H_{11}NO_2$

Ethylene



Plastic

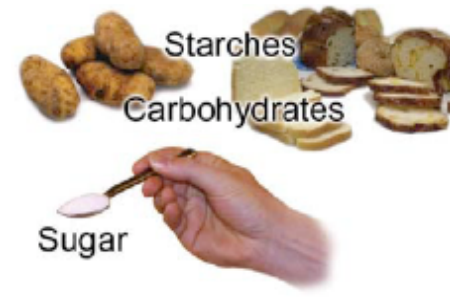


13.3 Organic compounds

- **Organic chemistry is the branch of chemistry that specializes in carbon compounds, also known as organic molecules.**
- **Plastic, rubber, and gasoline are important carbon compounds.**
- **Scientists classify the organic molecules in living things into four basic groups: carbohydrates, proteins, fats, and nucleic acids.**

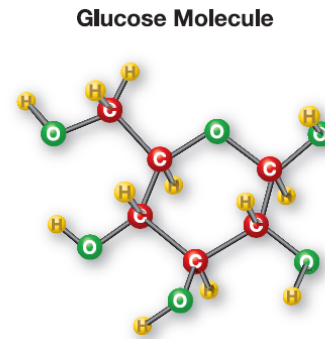
13.3 Carbohydrates

- Carbohydrates are energy-rich compounds made from carbon, hydrogen, and oxygen.
- Carbohydrates are classified as either sugars or starches.



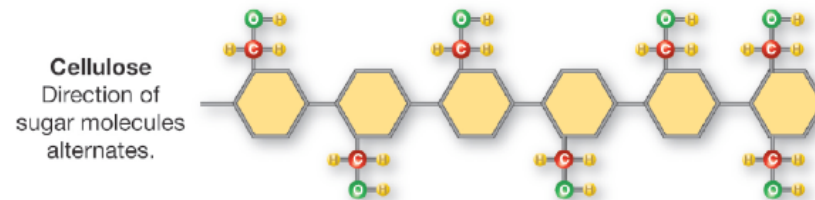
13.3 Carbohydrates

- Carbohydrates are mainly composed of carbon, hydrogen, and oxygen in a ratio of about 1:2:1.
- Glucose, $C_6H_{12}O_6$, is a simple sugar.
- Table sugar is a carbohydrate called **sucrose**.



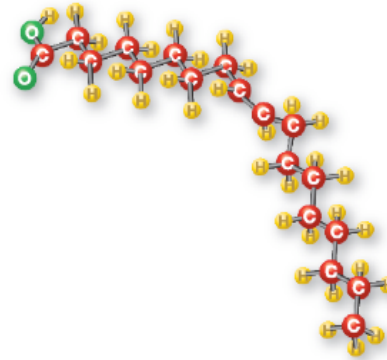
13.3 Carbohydrates

- **Starches are long chains of simple sugars joined together.**
- **Cellulose is the primary molecule in plant fibers, including wood.**



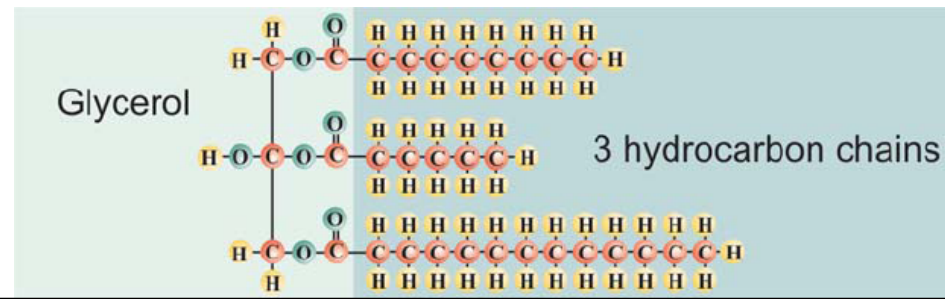
13.3 Lipids

- Like carbohydrates, lipids are energy-rich compounds made from carbon, hydrogen, and oxygen whose ratio is much less than 1:2:1.
- Lipids include fats, oils, and waxes.



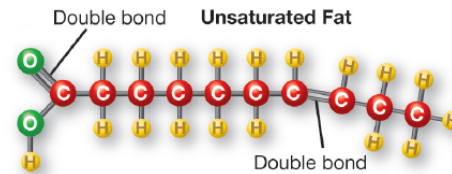
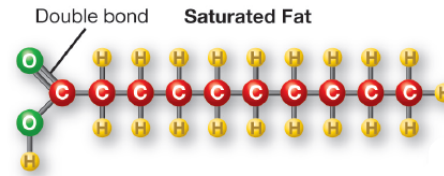
13.3 Lipids

- A typical fat molecule has a two-part structure:
 - glycerol
 - fatty acid chains



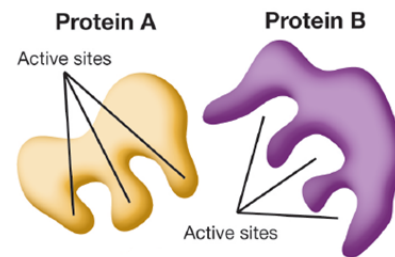
13.3 Saturated or unsaturated fat?

- In a saturated fat, carbon atoms are surrounded by as many hydrogen atoms as possible.
- An unsaturated fat has fewer hydrogen atoms than it could have.



13.3 Proteins

- **Proteins** are basic molecular building blocks of cells and all parts of animals.
- **Proteins** are among the largest organic molecules.



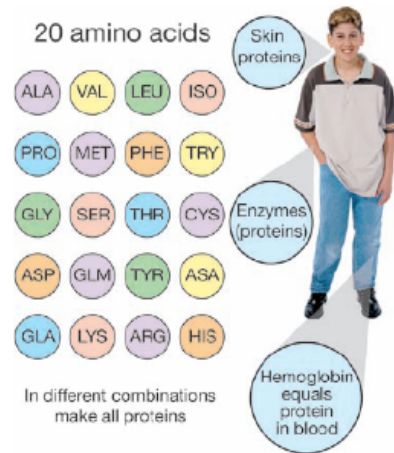
13.3 Enzymes

- Only certain parts of a protein are chemically active.
- The shape of a protein determines which active sites are exposed.



Proteins have complex shapes that fit other proteins or molecules in the body

13.3 Proteins



Protein molecules are made of smaller molecules called amino acids.

Your cells combine different amino acids in various ways to make new and different proteins.

13.3 Nucleic Acids

- **Nucleic acids are compounds made of long, repeating chains called nucleotides.**

Each nucleotide contains:

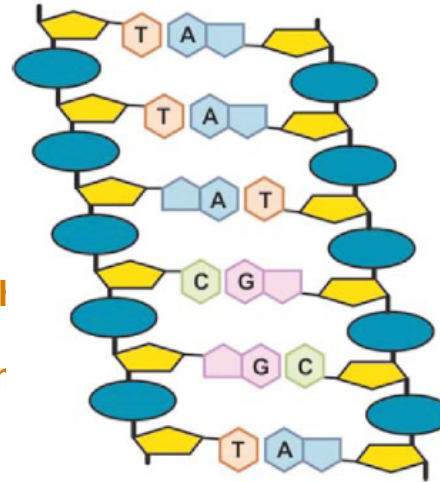
1. a sugar molecule
2. a phosphate molecule, and
3. a base molecule.



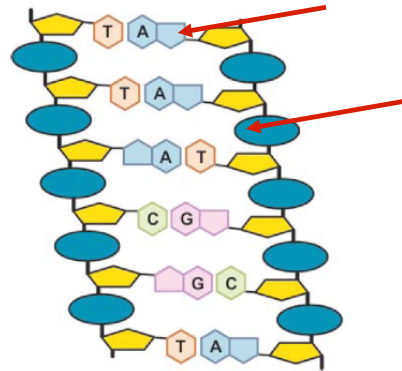
13.3 DNA and nucleic acids

- DNA is a nucleic acid .
- A DNA molecule is put together like a twisted ladder.

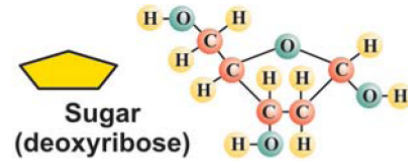
This model shows a short piece of flattened DNA ladder. A DNA molecule is usually twisted as much longer.



13.3 DNA

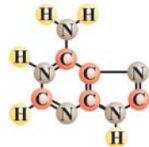
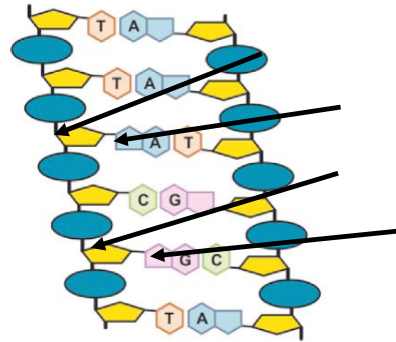


- Each side of the ladder is made of:
 - 5-carbon sugars called deoxyribose
 - and phosphate groups.

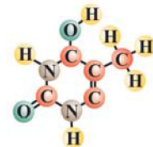


13.3 DNA

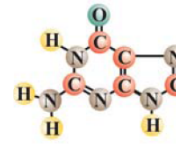
- There are four nitrogen bases in two matched pairs.



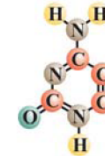
Adenine



Thymine



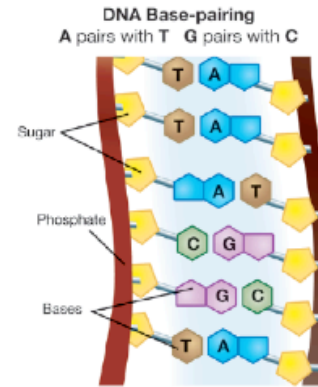
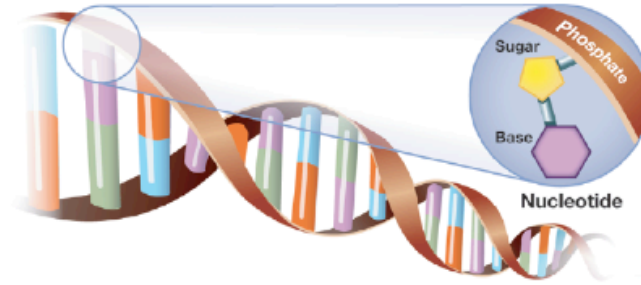
Guanine



Cytosine



DNA and Nucleic Acids



The Spin on Scrap Tires



- As the number of cars on the road increases each year, so does the number of scrap tires. For many years, the only disposal options were to throw scrap tires into landfills or burn them, which caused air pollution. Today, scientists and engineers are coming up with innovative ways to put a new spin on discarding old tires.