

Organic Compounds

(Chapter 19)

Student Learning Outcome: Identify organic substances, calculate alkane chemical formulas, recognize basic structures of hydrocarbons, distinguish between saturated and unsaturated hydrocarbons, identify functional groups.

1. *What is organic chemistry?*
2. *What are Hydrocarbons?*
3. *What is a functional group?*
4. *How are Alcohols, Phenols, and Ethers different?*
5. *What element is contained in an amine group?*
6. *What does a Carbonyl Group compound contain?*
7. *What are carbohydrates?*
8. *What is a polymer?*

What is organic chemistry?

- ❖ **Organic chemistry is the study of carbon compounds.**
- ❖ Over 90% of all compounds contain carbon.
- ❖ Organic molecules can have the same formula but different molecular structures.
- ❖ **Different structures have different physical and chemical properties.**
- ❖ Carbon has a unique ability to bond with itself, so carbon is found in many compounds.

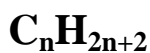
What are Hydrocarbons?

- ❖ All hydrocarbons contain only hydrogen and carbon.
- ❖ Hydrogen atoms and carbon atoms are arranged in specific structures.
- ❖ Alkane Hydrocarbons contain only single bonds between carbons and hydrogens.

Examples: CH_4 (methane), C_2H_6 (ethane), C_3H_8 (Propane)

Question: In what kinds of substances are alkane hydrocarbons found?

- ❖ All alkanes have the same general formula



Question: What would the formula be for an alkane containing 15 carbon atoms?

- ❖ Hydrocarbons with the same chemical formula can have different properties if they have a different structure.

- **n-hydrocarbons** have a chain like structure

Example: C_4H_{10}

- **iso-hydrocarbons** have a branch structure

Example: C_4H_{10}

- **neo-hydrocarbons** have an **X** structure

Example: C_5H_{12}

- ❖ **Molecules that have the same chemical formula but have a different structure are known as structural isomers of each other.**

- Molecules with the same formula can have different boiling points because of a difference in structure.

- ❖ Octane ratings are based on the abundances of the different structural isomers of Pentane.

- ✚ The straight-chain hydrocarbons burn faster
- ✚ The branching iso-hydrocarbons burn slower

neo-pentane	highest octane rating
iso-pentane	↓
n-pentane	lowest octane rating

❖ Carbon compounds with double or triple bonds are unsaturated.

✚ Alkenes → double bond

✚ Alkynes → triple bond

Examples: C_4H_{10} (2-butene) & C_6H_6 (benzene)

❖ The flat structure of the benzene ring allows it to damage cells. This is a carcinogenic (cancer-causing) molecule.

❖ Benzene (C_6H_6) is one of the top 50 chemicals produced in the United States each year. Benzene is an aromatic.

Some Examples

Gasoline
Detergents
Plastics
Glues & Adhesives
Paint Strippers
Household Cleaners
Tobacco Smoke

What is a functional group?

❖ Organic molecules have many base units upon which are built complex molecules.

❖ The base unit is a combination of atoms and is called a functional group.

❖ Each functional group has a set of molecules that have similar chemical and physical properties.

Go To: <http://sparkcharts.sparknotes.com/chemistry/organicchemistry1/section5.php>

How are Alcohols, Phenols, and Ethers different?

❖ Each contains a different functional group.

❖ **Alcohols** contain a hydroxyl group (OH) molecule bonded to a saturated carbon.

- ❖ **Phenols** contain a phenolic group which is a hydroxyl group attached to a benzene ring.
- ❖ **Ethers** contain an oxygen atom bonded to two carbons

Common Alcohols

Methanol (methyl alcohol)
Ethanol (ethyl alcohol)
2-propanol (isopropyl alcohol)

Question: Which of these is consumed in alcoholic beverages? Which is used as a disinfectant?

Common Phenols

Household cleaners like Lysol
Mouthwash and throat lozenges
Sugar substitutes

Example of Ether

Diethyl Ether
(anesthesia ether)



What element is contained in an amine group?

- ❖ **Amine group molecules have a nitrogen bonded to a saturated carbon.**
- ❖ All organic molecules that contain N tend to be alkaline because the nitrogen accepts a hydrogen ion from water.

Question: Are amines acidic or basic?

- ❖ Naturally alkaline amine molecules are called **alkaloids**.

Examples: Caffeine, Morphine, Nicotine

What does a Carbonyl Group compound contain?

❖ Carbonyl group molecules contain a C=O bond.

Example: hydroxyl group + carbonyl group = carboxylic acid



Aspirin
Ibuprofen
Penicillin

What are carbohydrates?

❖ A carbohydrate contains carbon and water.

❖ Carbohydrates are divided into 3 classes

1. Monosaccharides - single unit (simple sugar)
2. Disaccharides - two monosaccharide units
3. Polysaccharides - many monosaccharide units

Go To: <http://biology.clc.uc.edu/courses/bio104/carbohydrates.htm>

Some Examples

Glucose	$\text{C}_6(\text{H}_2\text{O})_6$	Monosaccharide
Fructose	$\text{C}_6(\text{H}_2\text{O})_6$	Monosaccharide
Sucrose	$\text{C}_{12}(\text{H}_2\text{O})_{11}$	Disaccharide
Cellulose, Starch		Polysaccharides

What is a polymer?

- ❖ Polymers are very long molecules made up of repeating sets of 4-100 atoms. (**chains of monomers**)
- ❖ Human-made polymers are commonly called plastics.

Naturally Occurring	Human Produced
DNA	Carpet
Proteins	Plastics
Complex Carbohydrates	Chewing Gum