

Department of Education
Science 9
General Classes and Uses of
Organic Compounds
Second Quarter -Week 6



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EXPECTATIONS

Hello Learner! In this module, you should be able to demonstrate understanding on organic compounds.

Recognize the general classes and uses of organic compounds; (S9MT-IIh-18)

Specifically, you will be able to:

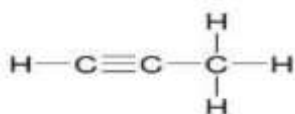
1. Differentiate molecular, empirical, and structural (expanded and condensed formula);
2. Differentiate alkanes, alkenes and alkynes based on the presence of bonds and their physical properties.
3. Name different structures of hydrocarbons (alkanes, alkenes, alkynes, alcohol, aldehydes, ester, carboxylic acid, ether, amines, amides, etc.
4. Identify different functional groups and their uses in organic compounds.



PRE-TEST

Directions: Choose the letter of the best answer.

1. Hydrocarbons are compounds consist of carbon and which of the following element?
A. Calcium
B. Hydrogen
C. Nitrogen
D. Oxygen
2. Which of the following contains a single carbon hydrogen bond?
A. Alkanes
B. Alkenes
C. Alkynes
D. Amides
5. Hydrocarbons with double or triple bonds are known to be:
A. Mono saturated
B. Saturated
B. Super saturated
D. Unsaturated
6. An alkane with only 2 carbon atoms is _____.
A. Butane
B. Ethane
C. Methane
D. Propane
8. Which alkyne will most likely have the highest boiling point?
A. Ethyne
B. Hexyne
C. Pentyne
D. Propyne
9. How many types of bonds are there in the following hydrocarbon compound?



- A. 2
B. 3
C. 4
D. 5

10. Ethene is a natural gas produced in plants, which acts as a natural ripening agent of fruits. Which of the following organic compounds has the same ability to ripen fruits?

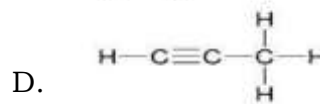
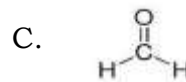
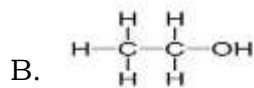
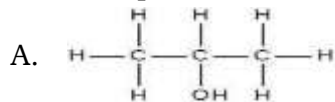
A. Acetylene

B. Butane

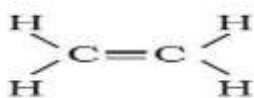
C. Ethane

D. Methane

11. Which compound is an alcohol?



12. To which group of hydrocarbon does the molecule with the structure belong?



A. Alkane

B. Alkene

B. Alkyne

D. None of the Above

13. Which hydrocarbon compound has a triple bond in the molecule?

A. Butane

B. Ethene

C. Ethyne

D. Octane



LOOKING BACK

FACT OR BLUFF?

Write FACT if the statement is correct and BLUFF if the statement is wrong.

1. Elements share electrons from their outer shell to attain stability.

2. Carbon Atom has 4 valence electrons.

3. Every compound has specific odor.

4. Viscosity is the ability of a compound to turn into gas.

5. Some compounds may contain carbon but are considered as inorganic.



BRIEF INTRODUCTION

A **hydrocarbon** is any compound consisting entirely of hydrogen (H) and carbon (C). Each hydrocarbon molecule consists of a carbon backbone with hydrogen atoms attached to the backbone.

A molecular formula represents the number of atoms of each element present in the molecule. Whereas in condensed structural formula central atoms and the atoms connected to them are written as a group. In this formula the central atoms are connected with a line. Hence it is also called as linear formula.

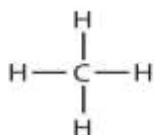
| <u>Molecular Formula</u> | <u>Structural Formula</u> | <u>Condensed Structural Formula</u> |
|--------------------------|--|-------------------------------------|
| Ethane C_2H_6 | <pre> H H H-C---C-H H H</pre> | CH_3CH_3 |
| Ethanol C_2H_6O | <pre> H H H-C---C-O-H H H</pre> | CH_3CH_2OH |
| Propane C_3H_8 | <pre> H H H H-C---C---C-H H H H</pre> | $CH_3CH_2CH_3$ |

Source: <https://study.com/academy/lesson/what-is-a-chemical-formula-definition-types-examples.html>

If there is a single bond between carbon atoms, they are called *saturated*, while *unsaturated* if there is double or triple bond between the carbon atoms. The table below shows you the hydrocarbons as categorized into saturated and unsaturated.

The different types of hydrocarbons include *alkanes*, *alkenes* and *alkynes*. Let us take them one by one:

1. Alkanes – these are the simplest hydrocarbon which contains a single bond of carbon-carbon.

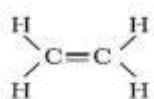


Methane

The simplest alkane is methane, with a chemical formula of CH_4 , is a constituent of Liquefied Petroleum Gas (LPG), the fuel we use for cooking.

Photo Credits: Structures and Names of Alkanes, <https://tinyurl.com/y4peybsl>

2. Alkenes - are hydrocarbons with one or more double bonds between carbon atoms. The most familiar alkenes are ethene and propene.



Ethene

Ethene aids in the ripening of fruits.

Photo Credits: Formula of Ethene, <https://tinyurl.com/y2j3o3to>

3. Alkynes – are also unsaturated hydrocarbons just like alkene due to the presence of at least one triple bond between carbon atoms. Ethyne is the simplest alkyne.



Ethyne (Acetylene) is used as fuel for welding works.

Photo Credits: Structural Formula of Ethyne, <https://tinyurl.com/y2om79x8>

Table 1. Alkanes

| Name | Phase | Condensed Structural Formula | Boiling Point (°C) |
|---------|--------|---|--------------------|
| Methane | Gas | CH ₄ | -162 |
| Ethane | Gas | CH ₃ CH ₃ | -89 |
| Propane | Gas | CH ₃ CH ₂ CH ₃ | -42 |
| Butane | Gas | CH ₃ CH ₂ CH ₂ CH ₃ | -0.5 |
| Pentane | Liquid | CH ₃ CH ₂ CH ₂ CH ₂ CH ₃ | 36 |
| Hexane | Liquid | CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃ | 69 |
| Heptane | Liquid | CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃ | 98 |
| Octane | Liquid | CH ₃ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ CH ₃ | 126 |

Table 2. Alkenes

| Name | Phase | Condensed Structural Formula | Boiling Point (°C) |
|-----------|--------|--|--------------------|
| Ethene | Gas | CH ₂ =CH ₂ | -104 |
| Propene | Gas | CH ₂ =CHCH ₃ | -47 |
| 1-Butene | Gas | CH ₂ =CHCH ₂ CH ₃ | -6 |
| 1-Pentene | Liquid | CH ₂ =CHCH ₂ CH ₂ CH ₃ | 30 |
| 1-Hexene | Liquid | CH ₂ =CHCH ₂ CH ₂ CH ₂ CH ₃ | 63 |

Table 3. Alkynes

| Name | Phase | Condensed Structural Formula | Boiling Point (°C) |
|----------|--------|------------------------------|--------------------|
| Ethyne | Gas | C_2H_2 | -84 |
| Propyne | Gas | $CH \equiv C-CH_3$ | -47 |
| 2-Butyne | Gas | $CH_3C \equiv CCH_3$ | 8.08 |
| Pentyne | Liquid | $HC \equiv CCH_2CH_2CH_3$ | 40.2 |

Source: Tables 1-3, DepEd Learners' Manual, Science 9

Functional Groups

A functional group is an atom or group of atoms that is responsible for the specific properties of an organic compound. They undergo the same type of chemical reaction in every molecule in which it is found.

| Functional Group | Description | Examples | Uses |
|------------------|---|---|--|
| Alcohols | These are hydroxyl group with the suffix "-ol" | Methyl, Ethyl, Propyl, Isopropyl Alcohol | Reagent, solvent and fuel |
| Ketones | These are carbonyl group with the suffix "-one" | Acetone, Butanone | Perfume, paint, nail polish remover |
| Aldehydes | These are aldehyde group with the suffix "-al" | Formaldehyde | Disinfectant & Preservative common in hospitals and morgues. |
| Ethers | Alkyl group attached to oxygen atom followed by the word ether. | Diethyl ether, Dimethyl ether | Solvent, anesthetic, aerosol spray propellant |
| Esters | Carboxyl group with the suffix "-oate" | Ethyl Methanoate, Methyl Butanoate | Artificial flavorings and fragrances |
| Carboxylic Acids | Carboxyl group with a suffix of "-oic acid" | Ethanoic(Acetic), Octanoic, Dodecanoic Acid | Vinegar, Coconut oil, Hand wash soaps |
| Amines | Primary Amine group with a suffix of "-amine" | Epinephrine, dopamine and histamine | Tranquilizer, Neurotransmitter, relieve allergic disorder |
| Amides | Formed from the reaction of a carboxylic acid and amine. | Penicillin | Anti-biotic |



ACTIVITIES

Activity #1: Alcohol and their uses

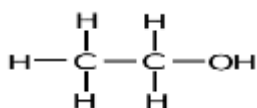
You just have learned the classes of hydrocarbons and types of bonds present in alkanes, alkenes, and alkynes and their common applications. In this activity, you will learn now about the common organic compounds, alcohol and carbonyl group. Alcohols are another group of organic compounds. These organic compounds also have very important uses. Alcohols are used as: antiseptic/disinfectant, cleaning agents, components of liquors and few are used as fuel for portable stoves.

Procedure:

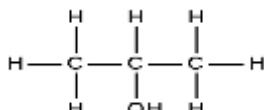
1. Inside your home, find at least three (3) household products that have alcohol component.
2. Write in the table below, the names of the products and the alcohol compounds that are found in the labels of the product and their uses.

| Name of Products | Name of Alcohol/s present in the product | Percent (%) or amount of alcohol in the product | Uses |
|------------------|--|---|------|
| 1. | | | |
| 2. | | | |
| 3. | | | |

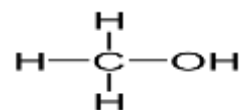
3. Use the following illustrations of the structural formula of common alcohols to answer the following questions.



Ethyl Alcohol



Isopropyl Alcohol

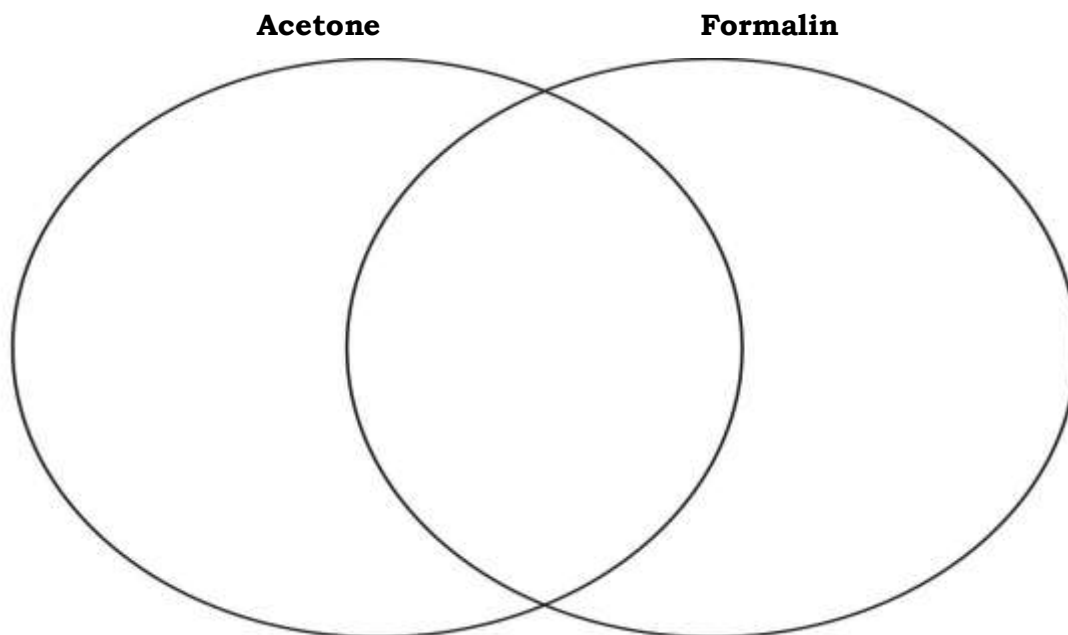


Methyl Alcohol

- a. What types of bonds are present in ethyl, isopropyl and methyl alcohol?
 - b. What accounts for the similar physical properties of alcohols?
4. What type/s of Alcohol is/are essential to use during this Covid-19 Pandemic and how important is/are those?

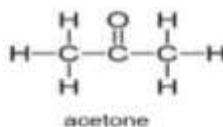
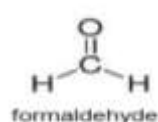
Activity #2: What is Common between Acetone and Formalin?

Using the Venn Diagram, differentiate acetone and formalin



Guide Questions:

Use the illustrations of the structural formula of acetone and formaldehyde (formalin) below to answer the questions.

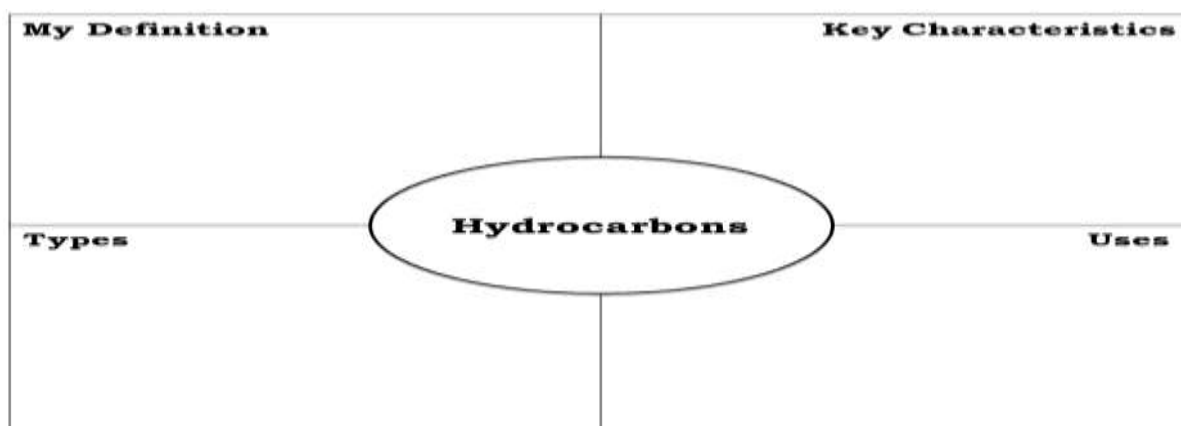


- a. What types of bonds do the common compounds have in their structures?
- b. Formalin and acetone are common carbonyl containing compounds. Why do you think they both belong in the group of carbonyl containing compounds?



REMEMBER

Directions: Complete the graphic organizer below by supplying the needed information about Hydrocarbons.



| Alkanes | Alkenes | Alkynes |
|--|---|--------------------------|
| Saturated Hydrocarbons | Unsaturated Hydrocarbons | |
| Each carbon atom is bonded to four other atoms, usually a hydrogen, through a single covalent bonds. | Carbon atoms contain either double or triple bonds. Since the compound is unsaturated with respect to hydrogen atoms, the extra electrons are shared between two carbon atoms to form the double or triple bonds. | |
| Single bond (C-C) | Double bond (C=C) | Triple bond (C≡C) |
| Also known as PARAFFINS | Also known as OLEFINS | Also known as ACETYLENES |



CHECK YOUR UNDERSTANDING

Going Organic, this Covid-19 Pandemic!

Covid-19 affects people in different ways; you can be infected by breathing in the virus if you are within close proximity of someone who has COVID-19. Health protocols must be observed to avoid and stop the spread of Corona Virus. Several products and essential items that are believed to help combat the spread of this disease are out in the market. Interestingly, most of them are made up of organic compounds.

Directions: Using the table below, list down important/essential items that minimize the spread of COVID-19. Then, identify which functional group they belong, their empirical & structural formula and their uses. Use separate sheet for your answers. Note: Be creative in writing your title for “**Going Organic, this Covid-19 Pandemic!**”

| Item | Functional Group | Structural Formula | Molecular/ Empirical formula | Uses |
|-------------------|------------------|--|---|--------------|
| Isopropyl alcohol | Alcohol | $ \begin{array}{c} \text{H} & \text{H} & \text{H} \\ & & \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{H} \\ & & \\ \text{H} & \text{OH} & \text{H} \end{array} $ | C ₃ H ₈ O, CH ₃ - CHOH-CH ₃ | Disinfectant |
| | | | | |
| | | | | |
| | | | | |



POST TEST

Directions: Encircle the letter of the correct answer.

- Acetylene is considered as the simplest form of which of the following?

A. Alkane

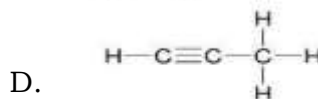
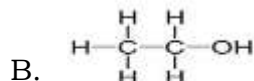
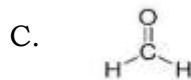
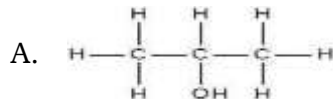
B. Alkene

C. Alkyne

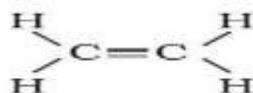
D. Amide

2. An alkane with only 2 carbon atoms is ____.
- A. Butane
B. Ethane
C. Methane
D. Propane
3. Hydrocarbons are compound consisting of two elements which are ____ & Carbon.
- A. Calcium
B. Hydrogen
C. Nitrogen
D. Oxygen

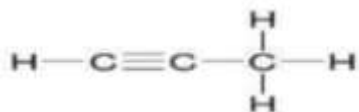
4. Which compound is an alcohol?



5. Which alkyne will most likely have the highest boiling point?
- A. Ethyne
B. Hexyne
C. Pentyne
D. Propyne
6. To which group of hydrocarbon does the molecule with the structure belong?



- A. Alkane
B. Alkene
C. Alkyne
D. None of the Above
7. How many types of bonds are there in the following hydrocarbon compound?



- A. 2
B. 3
C. 4
D. 5
8. Which hydrocarbon compound has a triple bond in the molecule?

- A. Butane
B. Ethene
C. Ethyne
D. Octane
9. The boiling points of a four-carbon alkane and a four-carbon alkene are measured. If the alkane is found to have a boiling point of -0.5°C , which of the following is most likely to be the boiling point of the alkene?
- A. Lower
B. Higher
C. The same
D. May vary
10. Ethene is a natural gas produced in plants, which acts as a natural ripening agent of fruits. Which of the following organic compounds has the same ability to ripen fruits?
- A. Acetylene
B. Butane
C. Ethane
D. Methane

References:

Department of Education: Bureau of Learning Resources (DepEd-BLR) K-12 Science 9 Learner's Module, First Edition, 2014

Aquino, Marites D., Madriaga, Estrellita A., Valdoz, Meliza P., Biong, Jonna A., Santos, Gil Nonato C. Science Links , Manila: Rex Book Store Inc. 2017

Key to correction:

Key to Corrections: 1B, 2A, 3A, 4C, 5D, 6B, 7D, 8B, 9A, 10A, 11B, 12B, 13C, 14D, 15C
Looking Back: 1Fact, 2Fact, 3Fact, 4Bluff, 5Fact
Post-test: 1C, 2A, 3B, 4B, 5D, 6A, 7B, 8D, 9A, 10C, 11D, 12B, 13B, 14A, 15C