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# Functional Groups

**SUPPLEMENTARY LEARNING MATERIAL (SLeM)**

**Most Essential Learning Competencies (MELCs)**

- ❖ List down functional groups and their names

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## HOW TO USE THIS SUPPLEMENTARY LEARNING MATERIAL (SLeM)

Before you start answering the SLeM, I want you to set aside other **tasks** that will disturb you while enjoying the lessons. Read carefully the instructions below to successfully enjoy the objectives of this kit. *Have fun!*

1. Follow carefully all the contents and instructions indicated in every part of this SLeM.
2. Write on your notebook the concepts about the lessons. *Keep in mind that **Writing develops and enhances learning.***
3. Perform all the provided activities in the SLeM.
4. Let your facilitator/guardian assess your answers.
5. Analyze conceptually the posttest and apply what you have learned.
6. Enjoy studying!

## PARTS OF THE SUPPLEMENTARY LEARNING MATERIAL

- **Expectations** - This will provide what you will be able to know after completing the lessons in the SLeM.
- **Pre-test** - This will assess your prior knowledge and the concepts to be mastered throughout the lesson.
- **Looking Back** - This section will measure the skills that you learned and understood from the previous lesson.
- **Brief Introduction**- This section will give you an overview of the lesson.
- **Activities** - These are activities designed to develop your critical thinking and other competencies that you need to master. This can be done solely or with your partner depending on the nature of the activity.
- **Remember** - This section summarizes the concepts and applications of the lessons.
- **Checking your Understanding** - This will verify how you learned from the lesson.
- **Post-test** - This will measure how much you have learned from the entire SLeM.

## FUNCTIONAL GROUPS



### EXPECTATIONS

This Supplementary Learning Material will help you to

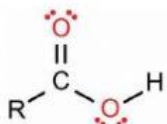
- define functional groups;
- identify and spot the difference among these functional groups
- explore and investigate common properties of these functional groups.
- appreciate the importance of functional groups in our daily life.



### PRETEST

**Directions:** Write the letter of the correct answer on your answer sheet.

1. This functional group shows up in so many alcohols it has come to be known as the alcohol group. It's really called:

- a. hydroxyl    b. oxyhol    c. HO group    d. carboxyl
2. Which functional group(s) are basic (accept H<sup>+</sup> ions)?
    - a. carboxyl groups                      b. hydroxyl groups
    - c. sulfhydryl groups                     d. amino groups
  3. This functional group is the general version of the previous hydroxyl group.
    - a. ether            b. ester            c. either            d. esther
  4. This functional group is derived from ammonia where one or more of the hydrogen atoms are replaced.
    - a. amine            b. amide            c. nitrile            d. nitro
  5. This variation of the ketone group is called:
    - a. aldehyde    b. anhydride    c. hydroxyl    d. carboxol
  6. This functional group is found in many fats and natural oils. This group is
    - a. ether            b. alkoxy            c. ester            d. dioxyl
  7. The correct shorthand to symbolize a carboxyl group is:
    - a. -NH<sub>2</sub>            b. -COOH            c. -OH            d. -C=O
  8. Which of the following functional groups is acidic (ionizes to liberate H<sup>+</sup> ions)?
    - I. H<sub>3</sub>PO<sub>4</sub>            II. -COOH            III. -OH
    - a. I only    b. I and III    c. II only    d. I and II
  9. A carbon, nitrogen and an oxygen gather together. This party is known as:
    - a. carnox    b. amino acid    c. amide            d. nitroxyl
  10.  This structure is known as
    - a. carbonyl    b. acetyl            c. carboxyl    d. hydroxyl



## LOOKING BACK TO YOUR LESSON

Direction: Differentiate Alkanes and Alkenes simply by completing the table below. Refer to these statements describing the properties of Alkanes and Alkenes to complete the table.

I.	It burned with a more sooty yellow flame	It burned with less sooty yellow flame
II.	The reddish-brown colour of bromine water remains unchanged	The reddish-brown colour of bromine water decolourised
III.	The purple colour of acidified potassium manganate (VII) solutions was decolourised	The purple colour of acidified potassium manganate (VII) solutions remained unchanged

### Difference between Alkanes and Alkenes

PROPERTIES	ALKANES	ALKENES
I. Reaction with oxygen, O <sub>2</sub> gas		
II. Reaction with bromine, Br <sub>2</sub> water		
III. Reaction with acidified potassium manganate(VII), KMnO <sub>4</sub> solution		



### BRIEF INTRODUCTION

Do you know the important role of organic compounds in your life? Carbon is the main element in organic compound, and why is carbon so basic to life? The reason is carbon's ability to form stable bonds with many elements, including itself. This property allows carbon to form a huge variety of very large and complex molecules. Wow! That's awesome, isn't it? Your previous lesson was about organic compounds consisting entirely of hydrogen and carbon and these are called **hydrocarbons**. basically Alkane, Alkene and Alkyne. Can you tell the difference of these three organic molecules?

The characteristics of organic molecules can be changed dramatically by replacing one or more of the hydrogen with functional groups. **What are functional groups?** If you think there's some sort of bond, then check out and perform the succeeding activities. *Are you ready?*

### What are functional groups?

#### Functional Groups

- specific group of atoms within molecules that are responsible for the characteristic chemical reactions of those molecules.
- attached to the carbon backbone of organic molecules.
- determine the characteristics and chemical reactivity of molecules.
- collections of atoms in organic chemistry molecules that contribute to the chemical characteristics of the molecule and participate in predictable reactions.
- contain oxygen or nitrogen or sometimes sulfur attached to a hydrocarbon skeleton.
- **R** in each structure is a wildcard notation for the rest of the molecule's atoms.

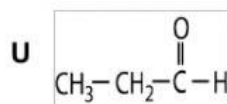
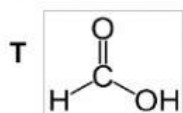
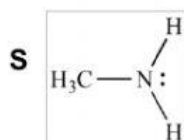
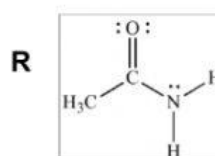
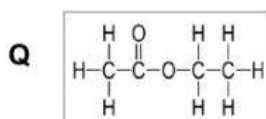
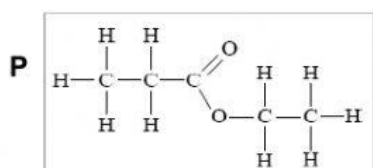
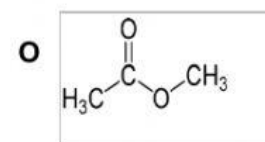
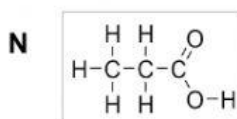
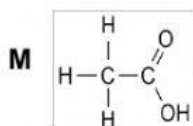
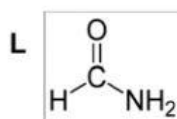
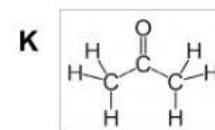
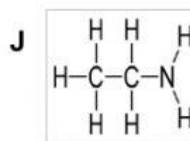
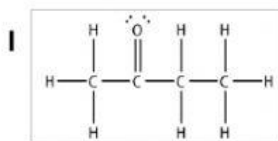
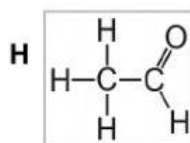
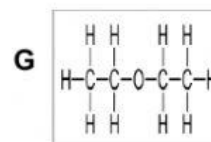
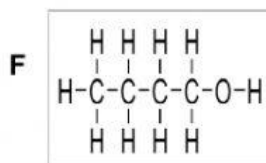
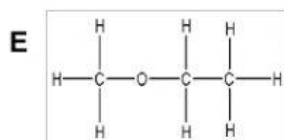
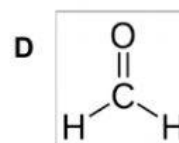
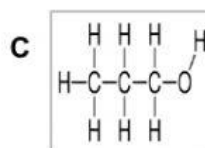
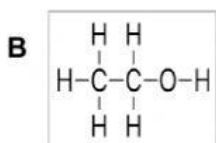
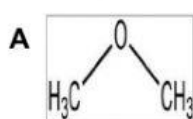


## Activity 1: SPOT THAT ELEMENT/S

**Objective:** Define functional group.

**Materials:** Coloured highlighter

**Direction:** Group the following molecules according to their similarities in structure. Organize these molecules in the table just by writing the letter that represent them. Do not forget to indicate the categories or classifications that made you decide why these molecules belong to the group. Have fun doing this activity. Good luck!



**NOTE:** Pay less attention to the number of carbon atoms. Give more attention to the elements or group of elements attached to carbon chain and to the type of bonds present in the structure.

Complete the table

CATEGORIES / CLASSES					
organic compound with _____ attachment	organic compound with _____ attachment	organic compound with _____ attachment	organic compound with _____ attachment	organic compound with _____ attachment	organic compound with _____ attachment

**Questions:**

1. What makes these molecules not hydrocarbons?

2. What is a functional group?

**Most Common Organic Functional Groups**

<p><b>I. Alcohol (Hydroxyl Group) •</b></p> <ul style="list-style-type: none"> <li>❖ any organic compound in which a hydroxyl group (<b>-OH</b>) is bound to a carbon atom of an alkyl or substituted alkyl group.</li> <li>❖ The general formula for a simple acyclic alcohol is <math>C_nH_{2n}+OH</math>.</li> <li>❖ Hydroxyls are often written as OH on structures and chemical formulas.</li> <li>❖ According to the IUPAC nomenclature system, an alcohol is named by dropping the terminal “-e” of the parent carbon chain (alkane, alkene, or alkyne in most cases) and the addition of “-ol” as the ending. If the location of the hydroxyl group must be specified, a number is inserted between the parent alkane name and the “-ol” (propan-1-ol) or before the IUPAC name (1- propanol). If a higher priority group is present, such as an aldehyde, ketone or carboxylic acid, then it is necessary to use the prefix “hydroxy-” instead of the ending “-ol.”</li> </ul> <p><b>II. Ether Group</b></p> <ul style="list-style-type: none"> <li>❖ consists of an oxygen atom forming a bridge between two different parts of a molecule. Ethers have formula <b>ROR</b>.</li> <li>❖ In IUPAC method, the form is: <b>[short alkyl chain][oxy][long alkyl chain]</b>. For example, the IUPAC name for ethyl methyl ether would be methoxyethane.</li> <li>❖ In cyclic ethers, the stem of the compound is known as a oxacycloalkane. The “<b>oxa</b>” is an indicator of the replacement of the carbon by an oxygen in the ring. An example is oxacyclopentane, a five-member ring in which there are four carbon atoms and one oxygen atom.</li> </ul>
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### III. Aldehyde Group

- ❖ made up of carbon and oxygen double-bonded together and hydrogen bonded to the carbon.
- ❖ Aldehydes have formula **R-CHO**.

### IV. Ketone Group

- ❖ a carbon atom double bonded to an oxygen atom that appears as a bridge between two other parts of a molecule.
- ❖ Another name for this group is the **carbonyl functional group**.

### V. Carboxylic Acid Group

- ❖ Also known as the **carboxyl functional group**.
- ❖ The carboxyl group is an ester where one substituent R is a hydrogen atom.
- ❖ The carboxyl group is usually denoted by **-COOH**

### VI. Ester Group

- ❖ The ester group is another bridge group consisting of a carbonyl group connected to an ether group.
- ❖ Esters have formula **RCO<sub>2</sub>R**.
- ❖ Ester names are derived from the parent alcohol and acid. For example, the ester formed by ethanol and ethanoic acid is known as ethyl ethanoate; "ethanol" is reduced to "ethyl," while "ethanoic acid" is reduced to "ethanoate."
- ❖ Other examples of ester names include methyl propanoate, from methanol and propanoic acid, and butyl octanoate, from butane and octanoic acid.

### VII. Amine Group

- ❖ derivatives of ammonia (NH<sub>3</sub>) where one or more of the hydrogen atoms are replaced by an alkyl or aryl functional group.

### VIII. Amide Group • combination of a carbonyl group and an amine functional group.

### IX. Thiol Group

- ❖ similar to the hydroxyl group except the oxygen atom in the hydroxyl group is a **sulfur** atom in the thiol group.
- ❖ It is known as a **sulfhydryl** functional group.
- ❖ have formula **-SH**.

### X. Phenyl Group

- ❖ This group is a common ring group. It is a **benzene ring** where one hydrogen atom is replaced by the **R substituent** group.
- ❖ often denoted by the abbreviation **Ph** in structures and formulas. • Has a formula **C<sub>6</sub>H<sub>6</sub>**.



## Activity 2: AMAZING MOLECULAR STRUCTURE

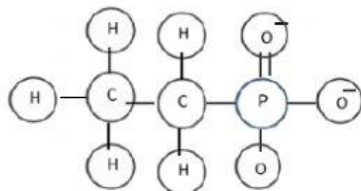
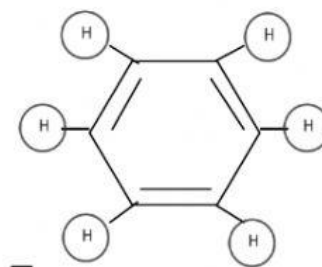
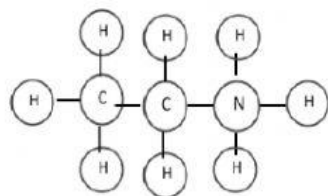
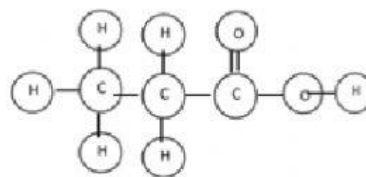
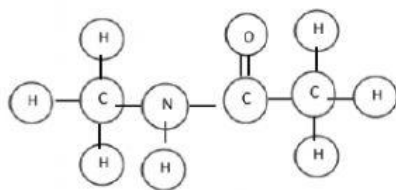
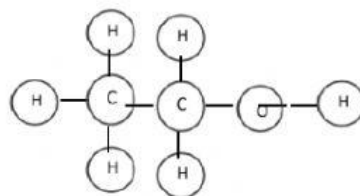
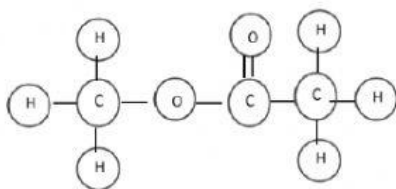
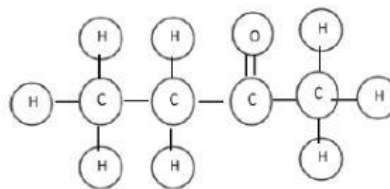
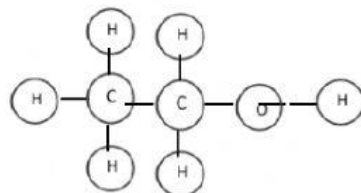
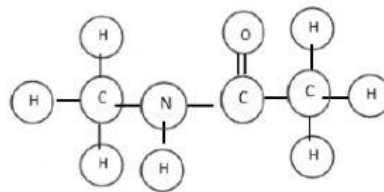
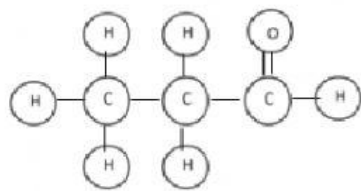
**Objective:** Identify and spot the difference among the functional groups.

**Materials:** crayon pencil amazing molecular structure worksheet

**Direction:**

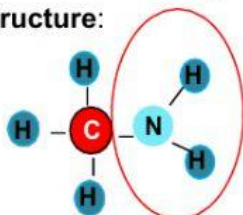
- Drag and drop the skeletal structure to the appropriate boxes
- Name and click the structure to spot the functional groups.





Organic compound: **CH<sub>3</sub>NH<sub>2</sub>**

Skeletal Structure:



Name of the functional group: **Amine**

To spot: **-NH<sub>2</sub> ( 1-N and 2-H)**

Organic compound: **CH<sub>3</sub>CH<sub>2</sub>CHO**

Skeletal Structure:

Name of the functional group: \_\_\_\_\_

To spot: \_\_\_\_\_

Organic compound: **CH<sub>3</sub>CH<sub>2</sub>COCH<sub>3</sub>**

Skeletal Structure:

Name of the functional group: \_\_\_\_\_

To spot: \_\_\_\_\_

Organic compound: **CH<sub>3</sub>COOCH<sub>3</sub>**

Skeletal Structure:

Name of the functional group: \_\_\_\_\_

To spot: \_\_\_\_\_

Organic compound: **CH<sub>3</sub>CONHCH<sub>3</sub>**

Skeletal Structure:

Name of the functional group: \_\_\_\_\_

To spot: \_\_\_\_\_

Organic compound: **CH<sub>3</sub>CH<sub>2</sub>OH**

Skeletal Structure:

Name of the functional group: \_\_\_\_\_

To spot: \_\_\_\_\_

Organic compound: **CH<sub>3</sub>CH<sub>2</sub>COOH**

Skeletal Structure:

Name of the functional group: \_\_\_\_\_

To spot: \_\_\_\_\_

Organic compound: **CH<sub>3</sub>CH<sub>2</sub>SH**

Skeletal Structure:

Name of the functional group: \_\_\_\_\_

To spot: \_\_\_\_\_