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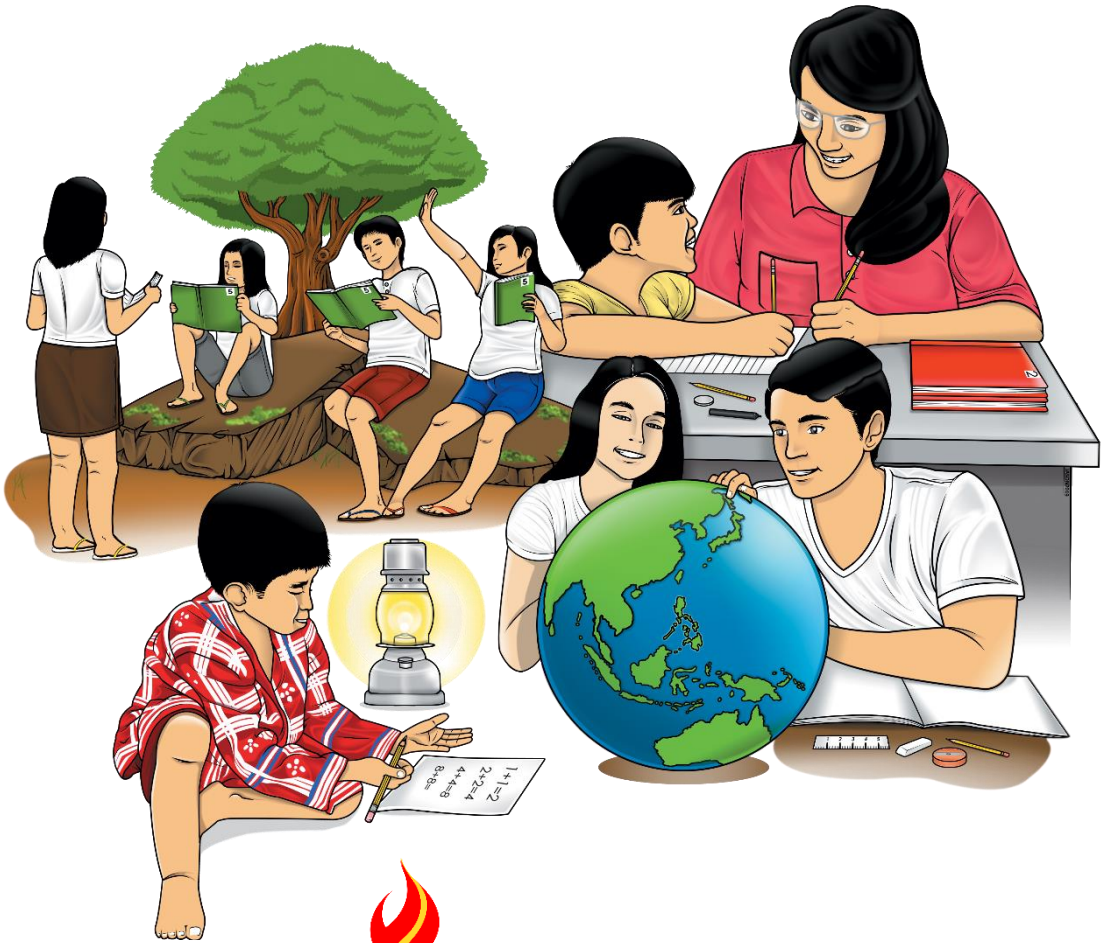
Science

Quarter 2 - Module 6:
Carbon Compounds



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Science

Quarter 2 - Module 6:
Carbon Compounds

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Introductory Message

This Self-Learning Module (SLM) is prepared so that you, our dear learners, can continue your studies and learn while at home. Activities, questions, directions, exercises, and discussions are carefully stated for you to understand each lesson.

Each SLM is composed of different parts. Each part shall guide you step-by-step as you discover and understand the lesson prepared for you.

Pre-tests are provided to measure your prior knowledge on lessons in each SLM. This will tell you if you need to proceed on completing this module or if you need to ask your facilitator or your teacher's assistance for better understanding of the lesson. At the end of each module, you need to answer the post-test to self-check your learning. Answer keys are provided for each activity and test. We trust that you will be honest in using these.

In addition to the material in the main text, Notes to the Teacher are also provided to our facilitators and parents for strategies and reminders on how they can best help you on your home-based learning.

Please use this module with care. Do not put unnecessary marks on any part of this SLM. Use a separate sheet of paper in answering the exercises and tests. And read the instructions carefully before performing each task.

If you have any questions in using this SLM or any difficulty in answering the tasks in this module, do not hesitate to consult your teacher or facilitator.

Thank you.

What I Need to Know

In this module, lessons on the uniqueness of the carbon atom in a compound will be carefully taken up. This shall include the structures, and common properties of carbon-containing compounds particularly, hydrocarbons: alkane, alkene, alkyne.

Specifically, the following lessons are:

Lesson 1: Carbon and Its Bond
Lesson 2: Saturated and Unsaturated Hydrocarbons

After going through this module, you are expected to:

1. explain how the structure of a carbon atom affects the types of bond it forms (S9MT-IIg17); and
2. explain how the structure of saturated and unsaturated carbon atoms affects the type of bonds it forms (S9MT-IIg17).

Specifically, after going through this module, you will be able to:

1. discuss the uniqueness of the carbon atom in terms of its structure;
2. identify the structure of saturated and unsaturated carbon atom compounds or commonly known as hydrocarbons;
3. determine the name of the structure of saturated and unsaturated hydrocarbons;
4. examine the trend of the properties of hydrocarbons in terms of the increasing number of carbon atoms;
5. classify the hydrocarbon compounds into saturated and unsaturated; and
6. classify unsaturated compounds into alkenes, and alkynes.

What I Know (Pretest)

Multiple Choice: *Choose the best answer. Write the corresponding letter of your choice on your answer sheet.*

1) An organic (carbon molecule) bond represents ____?
   a. a transfer of protons
   b. a transfer of electrons
   c. a pair of shared protons
   d. a pair of shared electrons

2) To which element can carbon bond to?
   a. H b. N c. O d. all of these

3) Carbon atom forms how many bonds?
   a. 1 b. 2 c. 3 d. 4

4) Which of the following pairs, is highly flammable?
   a. gasoline; acetone
   b. water; ethanol
   c. oil; vinegar
   d. LPG; kerosene

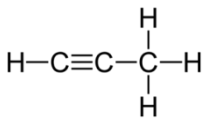
5) Princess wants to remove her nail polish. What must she use?
   a. gasoline
   b. vinegar
   c. ethanol
   d. acetone

6) Most organic compounds have boiling and melting point which are _____as compared to inorganic compounds.
   a. higher
   b. lower
   c. constant
   d. varied

7) What is the common use of methane?
   a. disinfectant
   b. artificial ripening agent
   c. fertilizer
   d. fuel

8) Which alkane would likely to have a very low boiling point?
   a. butane b. hexane c. pentane d. propane

9) To which group of hydrocarbons does the molecule with the structure given:



   a. alkane b. alkene c. alkyne d. propylene

10) How many types of bonds are there in the given hydrocarbon compound:

$$H_2C = CH - CH_3$$

   a. 1 b. 2 c. 3 d. 4

Lesson

1

Carbon and Its Bond

What I Need to Know

At the end of the lesson, you will be able to:

1. explain how the structure of a carbon atom affects the types of bond it forms. (S9MT-IIg17)

What's In

Carbon is not a difficult element to spot in your daily life. For instance, if you have used a pencil, you have seen carbon in its graphite form. Similarly, the charcoal briquettes on your barbeque are made out of carbon, and even the diamonds in a ring or necklace are a form of carbon (in this case, one that has been exposed to high temperature and pressure). What you may not realize, though, is that, about 18% of your body by weight is also made of carbon. In fact, carbon atoms make up the backbone of many important molecules in your body, including proteins, DNA, RNA, sugars, and fats.

Carbon is a very common "ingredient" of matter. The reason? Carbon can combine with itself and with many other elements to form a great diversity of compounds. The compounds can also range in size from just a few atoms to thousands. There are millions of known carbon compounds, and the only element that can form so many different compounds.[1] Carbon forms organic compounds with other many atoms like hydrogen, oxygen, nitrogen, and halogens, which can form complex structures. The structural formula is preferred instead of using the molecular formula because it shows the exact ways in which the atoms are connected in a form of bond.

In this lesson, you will get to know how unique the carbon atom is. This lesson will answer particularly how the structure of the carbon atom affects the types of bond it forms: single bond (C-C), double bond (C=C), and triple bond (C≡C). The structural formulas of carbon and other atoms will show you the exact way of connecting them using a short, straight line, known as a bond.

What's New

A. Describe your observations from the following pictures below:

1. Burning of salt and sugar
   http://www.mcutter.com/nat/experiment626/)

_____ _____

2. A traditional cooking setup
   (https://cybernag.files.wordpress.com/2018/05/three-stone-stove.png)

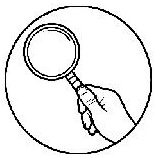
_____

B. Show the Lewis symbol of the following atoms: (Sci 9 LRM, 2014, pp 115)

Element	Family or Group	Lewis Symbol
1. Lithium	1	Li ▪
2. Fluorine		
3. Oxygen		
4. Nitrogen		
5. Carbon		
6. Hydrogen		

C. Identify the type of Covalent Bonds (Sci9 LRM, 2014, pp122)

Compound	Chemical Formula	Lewis Structure	Type of Covalent Bond (polar / nonpolar)
1. Water			
2. Methane			
3. Ethane			
4. Methanol			



What Is It

The compounds which contain carbon forms with H, N, O, and few other elements are usually called organic compounds. All these are obtained from plants and animals and their changed remains like coal and petroleum. Sugars, starches, oils, and proteins are examples of carbon compounds obtained from plants and animals. While hydrocarbons, such as hexane and benzene, are examples of carbon compound obtained from coal and petroleum.

Organic compounds have low thermal stability and usually decompose, easily char, and burn when heated. Thus, organic compounds have lower melting points and boiling points due to its weaker bonds -which is the covalent bond.

Salt (NaCl) is classified as inorganic compound and it has a higher melting point as compared to sugar ($C_{12}H_{22}O_{11}$). Sugar easily melts in the presence of flame or fire and eventually changes into black color. This is an evidence that organic compound has a weaker bond, its chemical properties changes like the color, odor and taste.

http://www.mcutter.com/nat/experiment626/ 05/21/2020, 20:00

Lewis Structure of Carbons and Hydrogens

The only distinguishable characteristic of organic compounds is that all contain the element carbon. Carbon is the most common element present in all biodegradable

materials. Carbon has a unique ability to bond together, and may form long chains and rings.

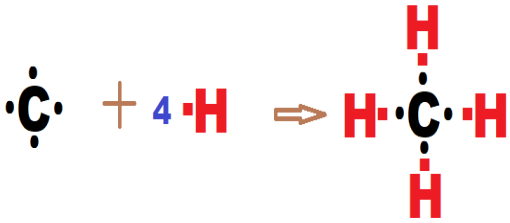
The ground-state electron configuration (lowest-energy arrangement) of an atom is a description of the orbitals that the atom's electrons occupy. The Carbon ($_6C^{12}$) atom with electron configuration of $1s^2\ 2s^2\ 2p^2$ has four (4) electrons on its valence shell (outer shell). While hydrogen ($_1H$) with electron configuration of $1s^1$has one (1) valence electron.

G.N. Lewis in 1916 proposed a shared-electron bond and now called a Covalent Bond. The carbon bonded to other atoms, not by losing nor gaining, instead, by sharing its electrons.

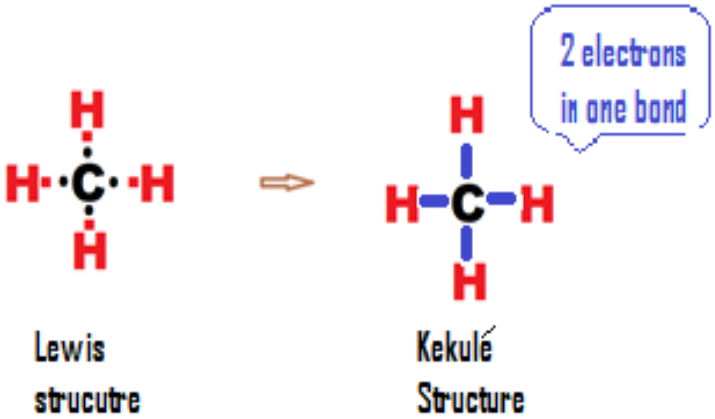
The four (4) valence electrons of carbon represent the
4 dots of carbon in its Lewis structure:

So, with one dot for hydrogen atom:

A stable molecule results when a valence octet of electrons (Octet Rule) has been achieved for all atoms in a molecule, as shown below:

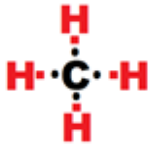
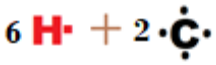
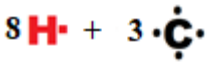


Carbon has 4 valence electrons that can form a maximum of four covalent bonds. Bonds are usually represented by a short, straight line connecting the atoms, with each bond representing a shared pair of electrons.



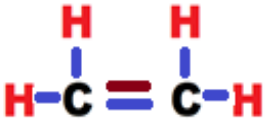
What's More

A. Illustrate the Lewis and Kekule (Line) structure of the following molecules. The first one has been done for you.

Atoms	Molecular structure	
	In Lewis	In Kekule (line-bond)
		
		
		

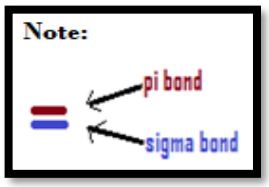
Bonds are usually represented by a short, straight line connecting the atoms, with each bond representing a shared pair of electrons. Each carbon atom in the following compounds forms four (4) bonds:

four single bonds to carbon



double bond between carbons

triple bond between carbons

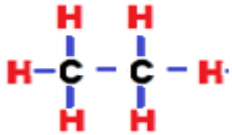


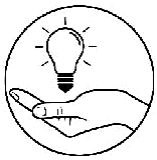
Electron sharing occurs when two atoms approach and their atomic orbitals overlap. Bonds that have circular cross-section and are formed by head-on overlap of atomic orbitals are called sigma(σ) bonds. Bonds form by sideways overlap of p-orbitals are called pi(π) bonds.

Two (2) carbon atoms can form a covalent bond by sharing a pair of electrons, which will either form into a structure of saturated hydrocarbon and unsaturated hydrocarbon. A detailed discussion on Hydrocarbons will follow in the next lesson.

What's More

A. Show a possible structural formula of molecules by connecting each atom:

Atoms involved	Structural Formula (line-bond)
Ex: 6 Hydrogen 2 Carbon	
4 Hydrogen 1 Carbon	
4 Hydrogen 2 Carbon (involves double bond)	
6 Hydrogen 3 Carbon (there is one-double bond between two C atoms)	
2 Hydrogen 2 Carbon (involves triple bond)	
4 Hydrogen 3 Carbon (there is one-triple bond between two C atoms)	



What I Have Learned

Sentence Completion/Word Pool. Pick your answers from the given word pool.

Cue words:				
carbon four (4)	Octet	three (3)	covalent	
multiple	organic	diamond	pi-bond	sharing

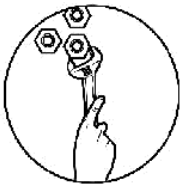
____(1)___ as element is present in sample like charcoal, paper and even in a precious stone like _____(2)_____.

___(3)_____ compounds are carbon compounds which properties depend on the number of bonds formed. The ___(4)___ bonds found in organic or carbon molecules are formed by ____(5)_____ of electron pairs between atoms. The primary bond that holds between carbon atoms is sigma bond, while the multiple bond (double or triple) formed by ____(6)____.

Atoms with four (4) or more valence electrons like carbon form as many bonds as they need electrons to fill their valence shells and thereby reach a stable ___(7)___.

It is important to always count the number of bonds of each particular atom. Carbon should have __(8)____ bonds. Hydrogen has only one (1) bond, oxygen with two (2) bonds, nitrogen could have ____(9)____ bonds, and only one (1) bond for halogens.

Carbon, oxygen and nitrogen, with more than one bond, could possible formed ___(10)___ bond (double or triple bond).



What I Can Do

Activity No. 1: Carbon Compounds Modelling

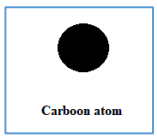
Objective: In this activity, you will be able to reproduce your own model of carbon molecules.

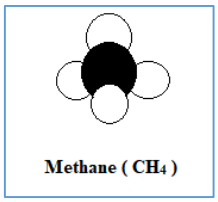
Materials: balls, sticks or straw, glue or masking tape

Procedure:

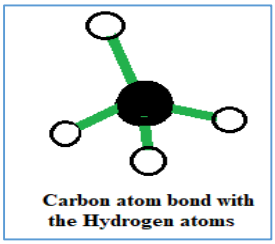
1. Using the molecules given, student/s will make way to somehow copy the ball and stick model of some carbon molecules.
2. The carbon atom is black while the hydrogen atom will be a white ball.
3. Use the straw or stick for the bond that holds between atoms of carbon and hydrogen.

For Methane (CH_4)



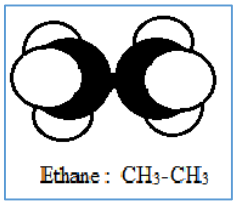


This is the model of the methane molecule with plastic balls.

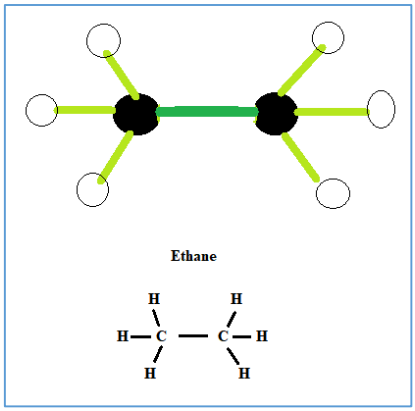


This model represents the carbon atom and the directions where the chemical bond is formed. Use the stick as the bond, and at its end joined with a hydrogen (a white ball).

For Ethane (C_2H_6)



hydrogen atom



Ethane is formed by two carbon atoms (black balls) that are joined with a bond (stick). Each end of the bonds is attached to a (white ball).

Lesson

2

Saturated and Unsaturated Hydrocarbons

What's In

As you learned from Lesson 1, a carbon atom is unique that it has four valence electrons which enables it to form four covalent bonds with atoms of other elements and other carbon atoms.

Since there are numerous compounds of carbon, these are convenient to organize them into groups according to their structural similarities. The simplest and most commonly encountered class of organic compounds is the *hydrocarbons*.

The structures of hydrocarbons affect their properties, such as physical state and boiling point.

What I Need to Know

At the end of the lesson, you will be able to:

1. explain how the structure of saturated and unsaturated carbon atoms affects the type of bonds it forms. (S9MT-IIg17)

Specifically, after going through this module, you will be able to:

1. discuss the uniqueness of the carbon atom in terms of its structure;
2. identify the structure of saturated and unsaturated carbon atom compounds or commonly known as hydrocarbons;
3. determine the name of the structure of saturated and unsaturated hydrocarbons;
4. examine the trends of the boiling point and physical state of hydrocarbons relative to the increase in number of carbon atoms;
5. classify the hydrocarbon compounds into saturated and unsaturated; and classify unsaturated compounds into alkenes and alkynes

What's New

In your everyday activities, you may have come across articles or items that you find very useful and make daily living comfortable. In this lesson, hydrocarbons will be further discussed and it is hoped that appreciation will be one of the end realizations elicited from you.

The activity below will give you common example of hydrocarbons and their special uses. Unscramble the ***bold italic letters*** and look for the correct words in the word search below. Encircle your answers.

- Things like Styrofoam food containers you get from a 24-hour convenience store to grab something to eat are now normal occurrences. Food containers such as these are made of an unsaturated hydrocarbon called ***eytrsen***.
- ***Themnae,*** a major component of natural gas, is used for home heating in cold countries.
- ***Netehe*** is a plant hormone that plays important roles in seed germination and ripening of fruits.
- ***Yntehe*** is a highly reactive molecule used in oxyacetylene torches.
- ***Utbnea***, used as fuel for cigarette lighters and portable stoves, is also a propellant in aerosols, a heating fuel, a refrigerant, and used in the manufacture of a wide range of products.

*

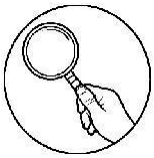
F	B	P	Q	V	G	B	E	H	G
Z	G	X	P	M	J	T	F	E	A
S	A	X	E	A	H	X	Q	N	P
U	T	V	U	E	J	E	D	Y	O
Z	S	Y	N	K	N	N	C	H	L
B	R	E	R	A	I	A	V	T	Y
I	M	X	T	E	S	H	H	E	T
K	R	U	B	C	N	T	K	E	T
F	B	F	K	Q	Q	E	T	K	I
I	C	I	H	X	J	M	Z	O	I

wordsearch was created fromhttps://worksheets.theteacherscorner.net/make-your-own/word-search/#top

COLORING IS FUN!

In the next activity, you will match the correct number from column A to the corresponding prefix in column B. You are to color the boxes containing prefixes in Column B with the color of the number in column A.

A	B
	mono- di- tri- Tetra- Pent- hex- Hept- oct- non-



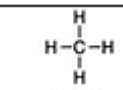
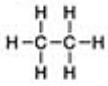
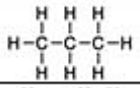
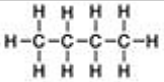
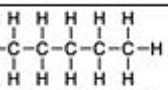
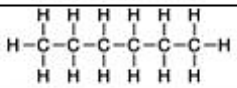
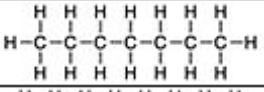
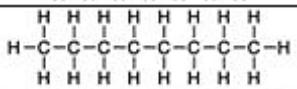
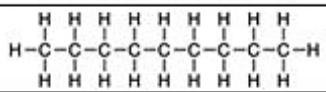
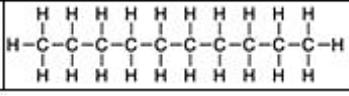
What Is It

SATURATED HYDROCARBONS: Alkanes

Alkanes, whose general formula is C_nH_{2n+2}, also called paraffin (meaning, 'low affinity'), are hydrocarbons that contain only single bonds. They are classified as saturated hydrocarbons (with all carbon atoms linked by single bonds). Therefore, for an alkane with five (5) carbon atoms, the formula would be C_5H_{12}. The simplest alkane is methane, CH_4, a major component of natural gas and is used for some heating in cold countries.

Table 1 shows the hydrocarbons' names and their corresponding molecular structure, expanded and condensed structural formulas, which are very important in understanding their individual makeup and differences. Study the table thoroughly and answer the succeeding guide question.

Table 1. Alkanes

ALKANES				
No. of C atoms (n)	Molecular Structure	Name of Hydrocarbon	Expanded Structural Formula	Condensed Structural Formula
1	CH_4	methane		CH_4
2	C_2H_6	ethane		$CH_3–CH_3$ or CH_3CH_3
3	C_3H_8	propane		$CH_3–CH_2–CH_3$ or $CH_3CH_2CH_3$
4	C_4H_{10}	butane		$CH_3–CH_2–CH_2–CH_3$ or $CH_3CH_2CH_2CH_3$
5	C_5H_{12}	pentane		$CH_3–CH_2–CH_2–CH_2–CH_3$ or $CH_3CH_2CH_2CH_2CH_3$
6	C_6H_{14}	hexane		$CH_3–CH_2–CH_2–CH_2–CH_2–CH_3$ or $CH_3CH_2CH_2CH_2CH_2CH_3$
7	C_7H_{16}	heptane		$CH_3–CH_2–CH_2–CH_2–CH_2–CH_2–CH_3$ or $CH_3CH_2CH_2CH_2CH_2CH_2CH_3$
8	C_8H_{18}	octane		$CH_3–CH_2–CH_2–CH_2–CH_2–CH_2–CH_2–CH_3$ or $CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_3$
9	C_9H_{20}	nonane		$CH_3–CH_2–CH_2–CH_2–CH_2–CH_2–CH_2–CH_2–CH_3$ or $CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$
10	$C_{10}H_{22}$	decane		$CH_3–CH_2–CH_2–CH_2–CH_2–CH_2–CH_2–CH_2–CH_2–CH_3$ or $CH_3CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_2CH_3$

Guide Question:

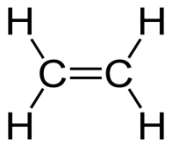
1. In the table above, the names of the alkanes are written using a system that tells us the exact number of carbon atoms in the hydrocarbon compound. How is this method done? On the succeeding table, please write down your observation by providing the added group of words (affix) for each hydrocarbon compound name. The first one has been done for you.

# of carbon atoms	Compound Name	Affix
1	methane	Meth-
2		
3		
4		
5		

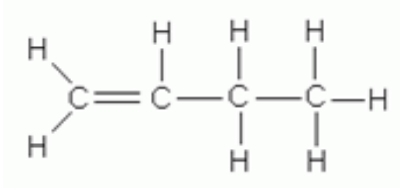
6		
7		
8		
9		
10		

UNSATURATED HYDROCARBONS: Alkenes and Alkynes

Alkenes, also called olefins, are unsaturated hydrocarbons containing one or more double bonds (C=C). As a result, it contains less hydrogen atoms bonded to the carbon atoms and follows the general formula: C_nH_{2n} in an alkene, the formula of a three-carbon atom with one double bond then would be C_3H_6. Ethene is the simplest alkene with the chemical formula, C_2H_4 a plant hormone that plays important roles in seed germination and ripening of fruits.



ethene

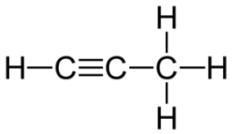


1-butene

Figure 1. Samples of Alkenes

Alkynes, containing one or more triple bonds, (C≡C) have the general formula of C_nH_{2n-2}. The simplest alkyne, a highly reactive molecule used in oxyacetylene torches is acetylene or ethyne, C_2H_2.

ethyne



propyne

Figure 2. Samples of Alkynes

SELF-CHECK: Classify the following compounds as alkene or alkyne based on the given structure.

1. $CH_3CH = CHCH_3$ _____
2. $HC \equiv C - CH_3$ _____
3. $H_2C = CH - CH_3$ _____
4. $H_3C - CH_2 - C \equiv C - CH_3$ _____

The table below shows the physical properties of each hydrocarbon in terms of its phase, boiling point and melting point. Observe the changes of the properties as the number of carbon atoms (Recall Table 1) in the hydrocarbon compound increases.

Table 2. Physical Properties of Hydrocarbons

Name	Structure	Phase	Boiling Point (°C)	Melting Point (°C)
ALKANES				
Methane	CH_4	Gas	–162	–182
Ethane	CH_3-CH_3	Gas	–89	–183
Propane	CH_3-CH_2-CH_3	Gas	–42	–188
Butane	CH_3-CH_2-CH_2-CH_3	Gas	–0.5	–138
Pentane	CH_3-CH_2-CH_2-CH_2-CH_3	Liquid	36	–130
Hexane	CH_3-CH_2-CH_2-CH_2-CH_2-CH_3	Liquid	69	–95
Heptane	CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3	Liquid	98	–91
Octane	CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3	Liquid	126	–57
Nonane	CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3	Liquid	151	–54
Decane	CH_3-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3	Liquid	174	–30
ALKENES				
Ethene	CH_2=CH_2	Gas	–104	–169
Propene	CH_2=CH-CH_3	Gas	–47	–185
1-Butene	CH_2=CH-CH_2-CH_3	Gas	–6	–185
1-Pentene	CH_2=CH-CH_2-CH_2-CH_3	Liquid	30	–165
1-Hexene	CH_2=CH-CH_2-CH_2-CH_2-CH_3	Liquid	63	–140
1-Heptene	CH_2=CH-CH_2-CH_2-CH_2-CH_2-CH_3	Liquid	94	–119
1-Octene	CH_2=CH-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3	Liquid	121	–102
1-Nonene	CH_2=CH-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3	Liquid	146	–94
1-Decene	CH_2=CH-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3	Liquid	171	–87
ALKYNES				
Ethyne	CH≡CH	Gas	–85	–81
Propyne	CH≡C-CH_3	Gas	–23	–103
1-Butyne	CH≡C-CH_2-CH_3	Gas	8	–126
1-Pentyne	CH≡C-CH_2-CH_2-CH_3	Liquid	40	–90
1-Hexyne	CH≡C-CH_2-CH_2-CH_2-CH_3	Liquid	71	–132
1-Heptyne	CH≡C-CH_2-CH_2-CH_2-CH_2-CH_3	Liquid	100	–81
1-Octyne	CH≡C-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3	Liquid	126	–79
1-Nonyne	CH≡C-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3	Liquid	151	–50
1-Decyne	CH≡C-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_2-CH_3	Liquid	174	–44

Guide Questions:

1. Examine the data in Table 2 and identify the trends (**increasing or decreasing**) of the properties of the three (3) hydrocarbon groups with regard to the number of carbon atoms. Write your observations below.
    a. Alkanes

        Phase: _____

        Boiling Point Trend: _____

        Melting Point Trend: _____

    b. Alkenes

        Phase: _____

        Boiling Point Trend: _____

    Melting Point Trend: _____

    c. Alkynes

        Phase: _____

        Boiling Point Trend: _____

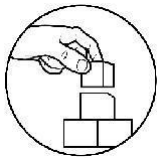
        Melting Point Trend: _____

2. What do you think will be the boiling and melting points of the next longer alkane, alkene, and alkyne after dec- (10 carbon atoms)? Will it be greater than the value for decane, decene and decyne?

    _____

    _____

    _____



What's More

Hydrocarbon structures can also be determined through its name based on the IUPAC (*International Union of Pure and Applied Chemistry).*

HYDROCARBON NOMENCLATURE

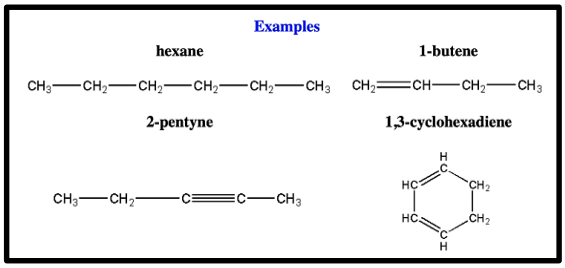
The International Union of Pure and Applied Chemistry (IUPAC) has established rules to systematize the naming of hydrocarbon molecules. The process of naming is shown below.

Table 3. Steps in Naming Hydrocarbons

Determine the following					**Steps in Naming**			
Carbon Compounds	*Classes of Hydrocarbons*	*Type of Bonds*	*Suffix*		No. of Carbon Atoms	Prefix	Suffix	Combine prefix+suffix
Saturated Hydrocarbon	Alkane	Single	-ane		2	Eth-	-ane	ethane
Unsaturated Hydrocarbon	Alkene	Double	-ene		3	Prop-	-ene	propene
	Alkyne	Triple	-yne		4	But-	-yne	butyne

In naming, you should first count the number of carbon atoms in the compound and look for the equivalent prefix. These prefixes are then added to the –ane, -ene or -yne final syllable according to the bond present in the compound. The first few prefixes for these are:

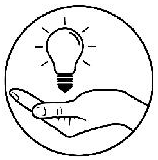
No. of carbon atoms	Prefix
1	meth-
2	eth-
3	prop-
4	but-
5	pent-
6	hex-
7	hept-
8	oct-
9	non-
10	dec-



Note: There are aromatic compounds (cyclic hydrocarbons) whose naming rules you shall take up in more advanced classes in the future

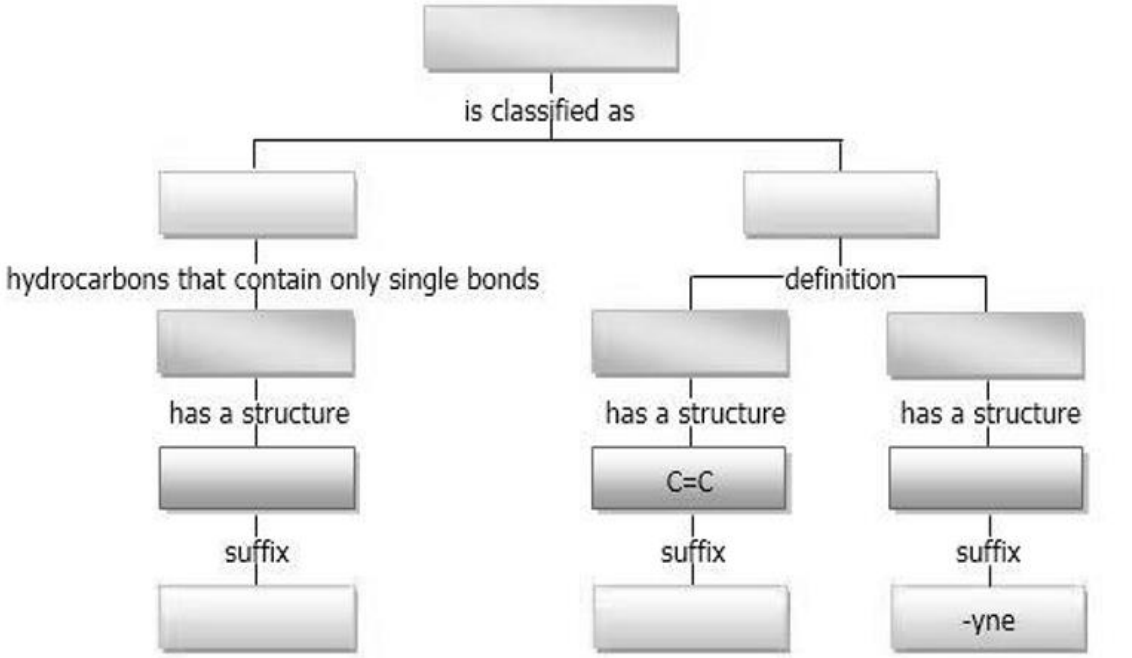
SELF-CHECK: Name the five hydrocarbons below following the IUPAC rules.

1) $CH_3–CH_2–CH_2–CH_2–CH_2–CH_2–CH_3$ _____
2) $CH_2=CH–CH_2–CH_2–CH_3$ _____
3) $CH_3–CH_2–C\equiv C–CH_2–CH_2–CH_2–CH_2–CH_3$ _____
4) $CH_3–CH_2–CH=CH–CH_2–CH_3$ _____
5) $CH_3–CH_2–CH_2–CH_2–CH_2–CH_2–CH_2–CH_2–CH_2–CH_3$ _____



What I Have Learned

Complete the concept map below by providing the missing terms. Choose from the word pool below



-ene	Unsaturated	Alkene	C–C	-ane
Alkyne	C≡C	Saturated	Alkane	Hydrocarbon

What I Can Do

Let's Investigate!

In your daily activities, you usually encounter common products containing hydrocarbon compounds at home or anywhere. Classify the corresponding pictures to the class of hydrocarbon it belongs to

Complete the table by writing the name of the product on the first column and then classify the product as to the kind of hydrocarbon group it belongs to by checking the appropriate column.

Products	Alkane	Alkene	Alkyne
1.			
2.			
3.			
4.			
5.			

Summary

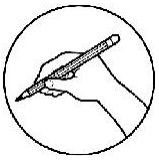
Carbon atom is a unique kind of element that has four (4) valence electrons, which enables it to form four covalent bonds with atoms of other elements and other carbon atoms.

The simplest and most commonly encountered class of carbon compounds are the *hydrocarbons*. These are classified into two groups based on their structure: the saturated carbon-hydrogen compounds known as alkanes that indicate a single bond between the carbon-carbon atoms; and the unsaturated hydrocarbons which are further classified into alkenes and alkynes.

Alkenes are unsaturated hydrocarbons with a double bond present between one of the carbon-carbon atoms (C=C) in the compound while alkynes contain a triple bond (C≡C) between the carbon atoms.

The type of bonds present in the compound affects the physical properties of the hydrocarbons. The increasing number of carbons in the compound indicates a high boiling point as it exists in a liquid state; on the other hand, as the number of carbon atoms decreases in the compound with the presence of a double or triple bond, the boiling point decreases as its phase changes to gaseous form.

Long chained hydrocarbons are polymers and many of them occur naturally. Other polymers are synthetic. This means that they are produced in labs or factories. Synthetic polymers are created in synthesis reactions in which monomers bond together to form much larger compounds. Plastics are examples of synthetic polymers.



Assessment: (Post-Test)

Multiple Choice: Choose the best answer. Write the corresponding letter of your choice on your answer sheet.

1) Carbon atom forms how many bonds?

a. 1 b. 2 c. 3 d. 4

2) To which element can carbon bond?

a. H b. N c. O d. all of these

3) An organic (carbon molecule) bond represents_____?

a. a transfer of protons
b. a transfer of electrons
c. a pair of shared electrons
d. a pair of shared protons

4) Most organic compounds have boiling and melting point which are _____ as compared to inorganic compound.

a. higher
b. lower
c. constant
d. varied

5) Which of the following pairs is highly flammable?

a. gasoline; acetone
b. water; ethanol
c. oil; vinegar
d. LPG; kerosene

6) Princess wants to remove her nail polish. What must she use?

a. gasoline
b. vinegar
c. ethanol
d. acetone

7) Which alkane would likely to have a very low boiling point?

a. butane b. hexane c. pentane d. propane

8) What is the common use of methane?

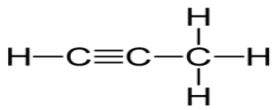
a. disinfectant
b. artificial ripening agent
c. fertilizer
d. fuel

9) How many types of bonds are there in the given hydrocarbon compound:

$$H_2C = CH - CH_3$$

a. 1 b. 2 c. 3 d. 4

10) To which group of hydrocarbons does the molecule with the structure below?



a. alkane b. alkene c. alkyne d. none of these

Answer Key

UNSATURATED HYDROCARBONS: Alkenes and Alkynes

SELF-CHECK
1) Alkene
2) Alkyne
3) Alkene
4) Alkyne

HYDROCARBON NOMENCLATURE

SELF-CHECK
1) Heptane
2) 1-Pentene
3) 3-Nonyne
4) 3-Hexene
5) Decane

POST TEST
1) D
2) D
3) C
4) B
5) D
6) D
7) D
8) D
9) B
10) C

Pre-Assessment
1) D
2) D
3) D
4) D
5) D
6) B
7) D
8) D
9) C
10) B

LESSON 2
What's New
- Styrene
- Methane
- Ethene
- Ethyne
- Butane

SATURATED HYDROCARBONS: Alkanes

# of carbon atoms	Compound Name	Affix
1	methane	Meth-
2	ethane	Eth-
3	propane	Prop-
4	butane	But-
5	pentane	Pent-
6	hexane	Hex-
7	heptane	Hept-
8	octane	Oct-
9	nonane	Non-
10	decane	Dec-

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