Carbon Connections

Read, mark, and model how structure shapes organic molecules

CHE.12 "Enrichment: Students will understand that the bonding characteristics of carbon allow the formation of many different organic molecules with various sizes, shapes, and chemical properties..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline two statements that explain how carbon bonds create different structures, then circle three clues you could use to name or classify a molecule.

What a Molecule's Name Reveals

1. At a refinery, two fuels can contain the same kinds and numbers of atoms yet behave differently. Each carbon atom makes four covalent bonds, counting a double bond as two and a triple bond as three. Carbon can join other carbon atoms in chains, branches, and rings; hydrogen fills unused bonding positions. Changing where the carbons connect changes a molecule's shape, even when its formula stays the same. Changing a single bond to a double bond can also change how readily a molecule reacts. To explain an organic molecule, trace which atoms connect before relying on its name.

2. Hydrocarbon names are compact maps. Chains of one, two, three, or four carbons begin with meth-, eth-, prop-, or but-. The ending -ane means only single carbon-to-carbon bonds; -ene means a double bond, and -yne a triple bond. Choose the longest carbon chain, then number it from the end nearest a double or triple bond. Give that bond's starting number in the name. A branch gets a number and a name, as in 2-methylpentane, with its methyl branch on carbon 2. A benzene ring contains six carbons in a stable ring with delocalized electrons; an attached methyl group gives methylbenzene.

3. Organic molecules can also contain oxygen or nitrogen. A functional group is a set of bonded atoms that helps predict chemical behavior. In an alcohol, -OH bonds to a carbon without a double-bonded oxygen; in an ether, oxygen links two carbons. An amine has nitrogen bonded to carbon, but not directly to a carbonyl carbon. A carbonyl is a carbon double-bonded to oxygen. In a ketone, that carbon bonds to two other carbons; in an aldehyde, it bonds to hydrogen. An organic acid contains -C(=O)OH, while an ester contains -C(=O)O- linked to another carbon group. Functional groups change a molecule's properties.

2 ANSWER WITH EVIDENCE

Use the passage

1. Two molecules each have four carbon atoms and only single bonds. One has a straight chain, and the other has a branch. Why can their shapes differ?

2. A four-carbon chain has a triple bond starting at carbon 1. Name it and explain which clues you used.

3. A benzene ring has an ethyl group attached. What name follows the passage's naming pattern?

4. In $CH_3C(=O)CH_3$, which functional-group family is present? Explain why this molecule is not an aldehyde.

3 YOUR TURN

Your own words

Create two different four-carbon molecules made only of carbon and hydrogen, with a double or triple bond in at least one. Write each condensed structural formula and name, then explain in two sentences how their bonds or connections affect their names.

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PART 1 · READ AND MARK

Underline two statements that explain how carbon bonds create different structures, then circle three clues you could use to name or classify a molecule. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Two molecules each have four carbon atoms and only single bonds. One has a straight chain, and the other has a branch. Why can their shapes differ?	**Their carbon atoms connect in different arrangements, so the molecules have different shapes despite having the same number of carbons.**
2	A four-carbon chain has a triple bond starting at carbon 1. Name it and explain which clues you used.	**But-1-yne. But- indicates four carbons, 1 locates the triple bond, and -yne indicates a triple bond.**
3	A benzene ring has an ethyl group attached. What name follows the passage's naming pattern?	**Ethylbenzene.**
4	In $CH_3C(=O)CH_3$, which functional-group family is present? Explain why this molecule is not an aldehyde.	**It is a ketone because the carbonyl carbon bonds to two other carbons. An aldehyde's carbonyl carbon bonds to hydrogen.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

$CH_3CH_2CH_2CH_3$: butane
$CH_3CH=CHCH_3$: but-2-ene
Both molecules have four carbon atoms, so their names begin with but-. The first has only single carbon-to-carbon bonds, while the second has a double bond starting at carbon 2, which changes its ending and adds a bond number.

Accept other valid pairs of distinct four-carbon hydrocarbons if at least one contains a double or triple bond. Check that each formula, name, and explanation agree.