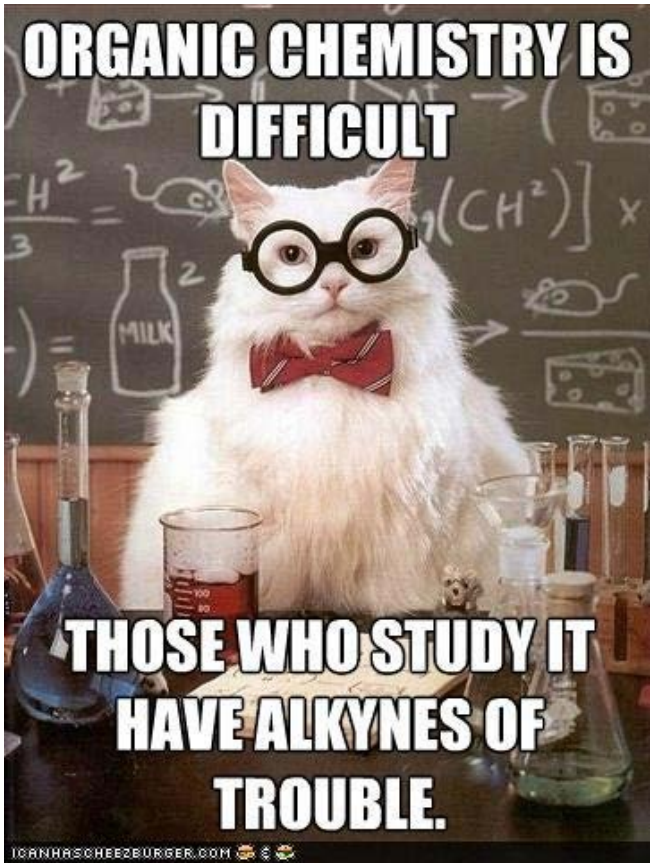
Aliphatic Hydrocarbons



Outcomes:

- Describe the structural characteristics of carbon.
- Compare/Contrast the molecular structure of alkanes, alkenes, and alkynes.

Characteristics of Carbon:

- Carbon is a unique element because of its ability to combine with other **CARBON ATOMS** and other elements to form **MANY** types of **COMPOUNDS**.
- Carbon has 4 **VALENCE ELECTRONS** that can form one to four equivalent **COVALENT** bonds.
- Carbon compounds that are made from **ONLY CARBON** and **HYDROGEN** are usually **NON-POLAR** and **INSOLUBLE** in water.

Molecular vs. Structural Formulas:

Molecular Formula

- Shows the **NUMBER** of **ATOMS** of **EACH ELEMENT** in one molecule of a substance.

Example:

- This is the **molecular** formula for **PROPANE:** C_3H_8

→ Shows us that propane has **3 CARBON** atoms and **8 HYDROGEN** atoms, but we do not know the atoms are put together.

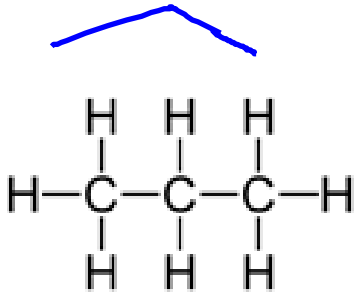
Molecular vs. Structural Formulas:

Structural Formula

- Shows the **POSITION** and **ARRANGEMENT** of **ATOMS** in a molecule.

Example:

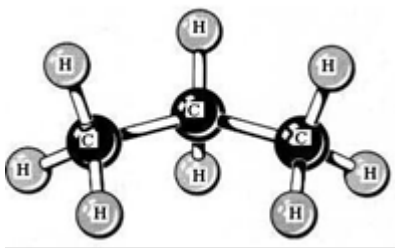
- This is the **structural** formula for **propane**:



→We can now see how these atoms are **ARRANGED**.

→The lines between each atom represent a **COVALENT BOND**.

In 3-dimensions, propane actually looks more like this:



Hydrocarbons:

Hydrocarbons are organic compounds that only contain **CARBON** and **HYDROGEN** atoms.

There are 3 major types of hydrocarbons that we will study:

ALKANES:

- Contain only **SINGLE** covalent bonds between carbons.

ALKENES:

- Contain at least one **DOUBLE** carbon-to-carbon bond.

ALKYNES:

- Contain at least one **TRIPLE** carbon-to-carbon bond.

"**ALIPHATIC**" describes hydrocarbons that have an open chain structure that is either branched or straight.

Physical Properties:

Alkanes:

1. **BOILING** point & **MELTING** point **INCREASE** as **NUMBER** of **CARBONS** increase.
2. States of matter:
   - 1-4 carbons → **GAS**
   - 5-16 carbons → **LIQUID**
   - 17+ carbons → **SOLID**
3. Alkanes generally have a **LOW MELTING** and **BOILING** point.

Alkenes:

- Resemble the **ALKANES** with the same number of carbons.

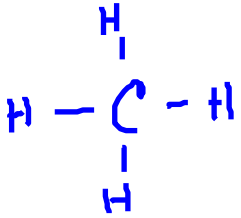
Alkynes:

- Resemble **ALKENES** with the same number of carbons.

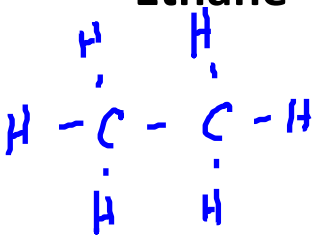
Alkanes:

- Compounds formed from **CHAINS** of carbon atoms connected by **SINGLE BONDS**.

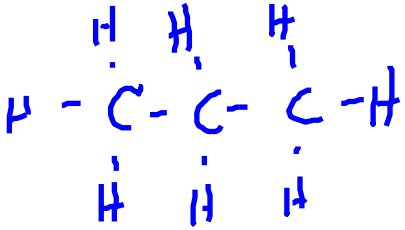
Ex) **Methane**



Ethane



Propane



- Notice that there is a relationship between the number of carbons and hydrogens…
  - They have the general formula

$$\underline{C_nH_{2n+2}}$$

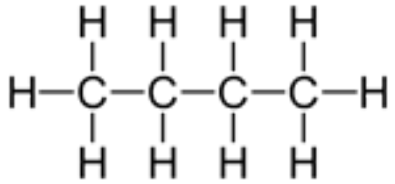
- Also called **SATURATED HYDROCARBONS** (**SINGLE BONDS**).

Naming Alkanes:

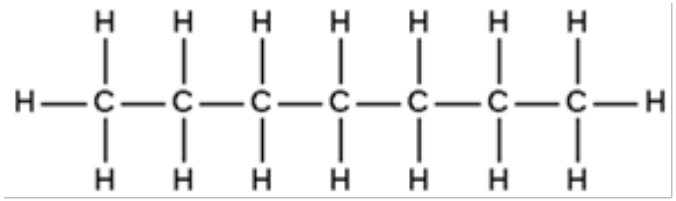
- All alkanes end in the suffix **"ANE"**.
- The **PREFIX** is determined by the **NUMBER** of carbon atoms in the chain:

# Carbon Atoms	Prefix
1	Meth
2	Eth
3	Prop
4	But
5	Pent
6	Hex
7	Hept
8	Oct
9	Non
10	Dec

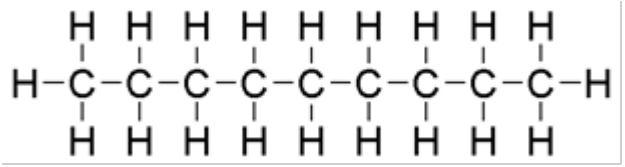
Examples:



butane



heptane



nonane

Naming Branched Alkanes:

- Sometimes **SIDE CHAINS** of carbon atoms are attached to the **PARENT CHAIN** of atoms.
- These chains are named according to the **NUMBER** of **CARBON ATOMS** in the chain, and they end in ***"YL"***.

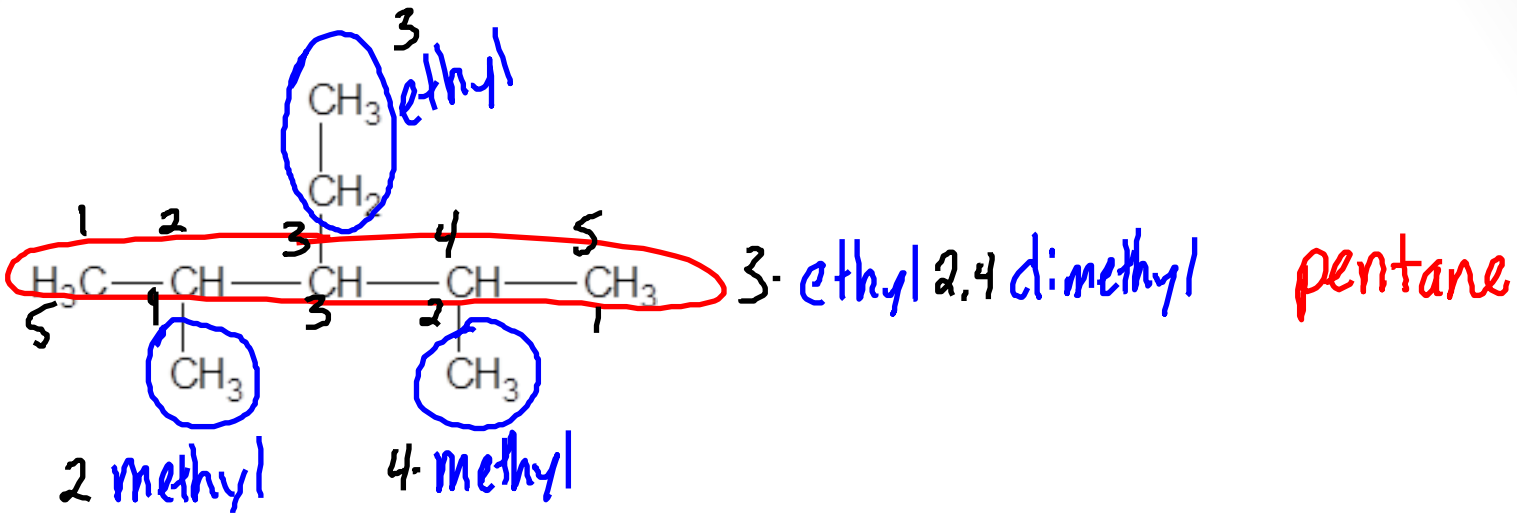
Examples:

1 carbon – **CH_3** → ***"METHYL"***

2 carbons – **CH_2CH_3** → ***"ETHYL"***

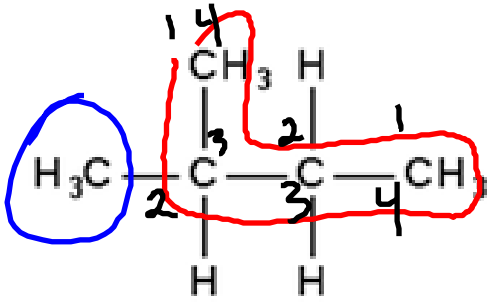
3 carbons – **$CH_2CH_2CH_3$** → ***"PROPYL"***

Naming Branched Alkanes:

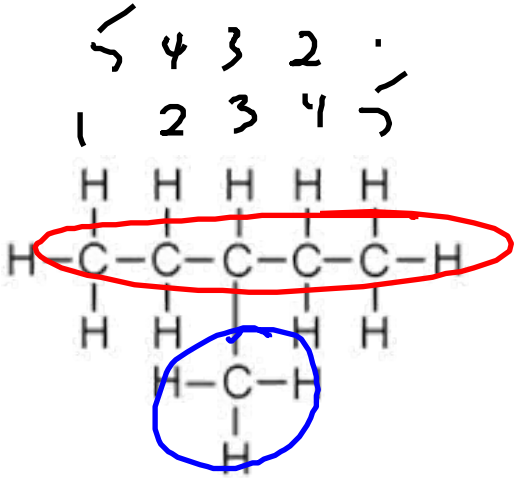


1. Find the **LONGEST CONTINUOUS** carbon chain, and name it.
2. **NUMBER** the chain at the end **CLOSEST** to the **BRANCH**.
3. Name the **BRANCH**.
4. Use the prefix (**DI, TRI, TETRA**), to represent the number of **BRANCHES** of **EACH TYPE** present.
5. Use the **NUMBER POSITION** to indicate where the branches are joined.
6. List the names of the branches in **ALPHABETICAL** order (**di, tri, tetra are not used in alphabetizing**) with their **LOCATION**, then add the name of the **PARENT CARBON** chain at the end.

Examples:

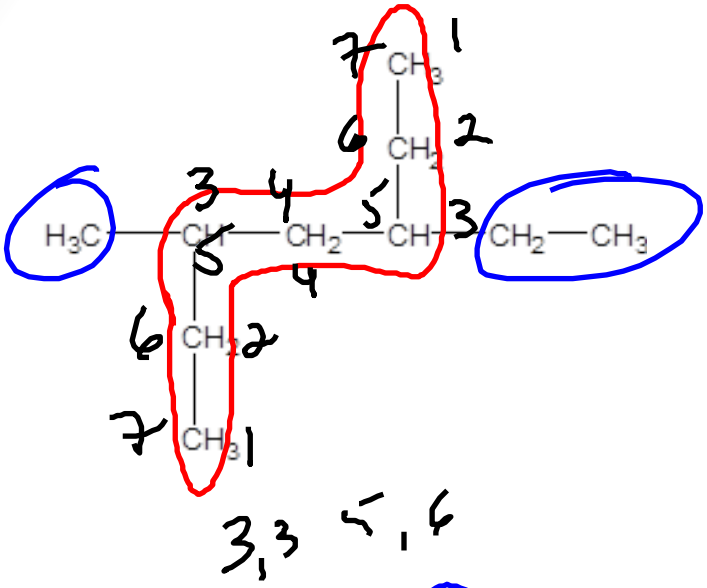


2- methyl butane



3-methyl pentane

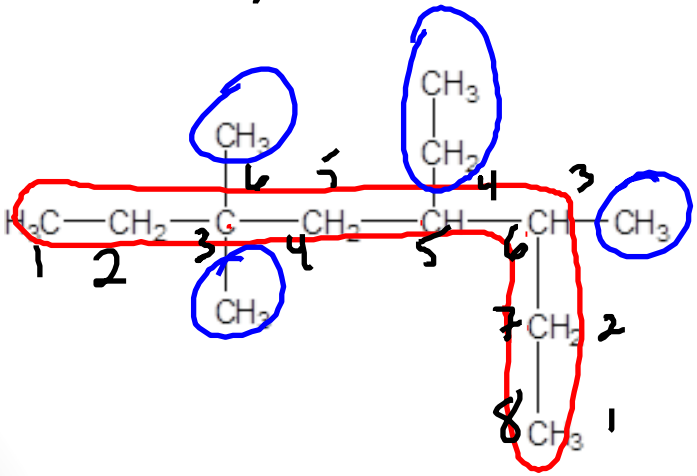
Examples:



3 ethyl 5 methyl heptane

5 ethyl 3 methyl heptane

3,3 5,6



5 ethyl 3,3,6 trimethyl octane.

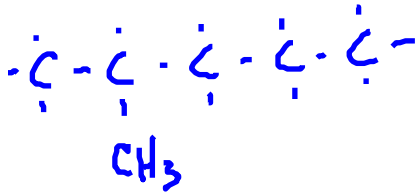
Naming Branched Alkanes:

To draw the **STRUCTURE** from the **NAME**, simply draw the **PARENT CHAIN**, then add on the **BRANCHES** in their indicated positions.

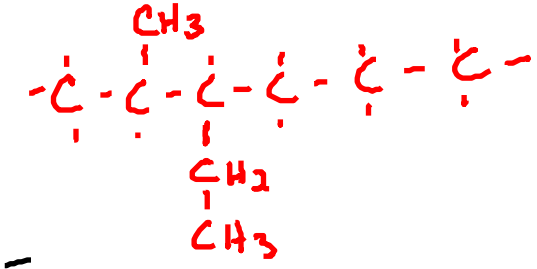
Examples:

Draw the structural formula for the following molecules:

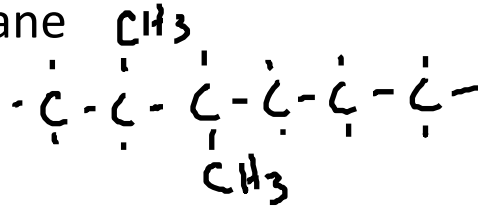
2-methy pentane



3-ethyl 2-methyl hexane



2,3 dimethyl hexane



trimethyl butane