Name:_____Period:_____Date:_____
Ms. Randall (compliments of Mr. Palermo)
Inquiry activity Organic Functional Groups

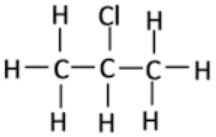
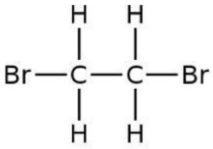
Background:

A **functional group** in an organic molecule is an atom or a group of atoms that replaces a hydrogen atom in a hydrocarbon. These replacement groups are much more reactive than the hydrogen atom that was replaced. They give the molecule its functionality, or its reactivity.

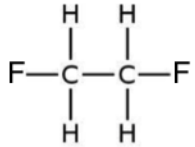
Reference Table R is very helpful to name and draw structure of organic molecules that contain a functional group. The table lists the class of compound, the functional group, the general formula and an example to help in the naming. The *R* and *R'* in the general formula stands for the hydrocarbon that makes up the rest of the molecule.

Directions: ***For each Model below, determine how the name is derived from the structural formula. Using table R in your reference table and the models, circle the functional group and name the compound.***

MODEL 1: Halide or Halocarbon (group 17)
Halides have a *halogen* (group 17 element) in place of a hydrogen atom. The name is derived by changing the ending of the halogen name to ***–o*** and adding it to the hydrocarbon name. A number is used to identify the carbon in the chain to which the halogen is attached.

Name	General Formula	Structural formula	Condensed formula
2-chloropropane	$R\text{—}X$ (X represents any halogen)		$CH_3CHClCH_3$
1,2 dibromoethane			CHBrCHBr

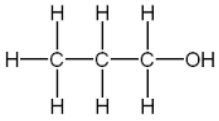
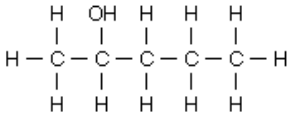
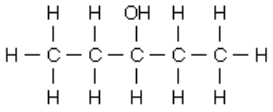
Using Reference Table R and the model above, circle the functional group(s) then name the organic molecule.



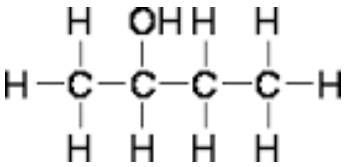
Name:

MODEL 2: Alcohols (-OH group) = ***-ol*** ending

Alcohols have a hydroxyl group (-OH). The hydroxyl group is NOT the same as a hydroxide ion…it has no charge. (Alcohols are NOT bases!) Alcohols are named just like alkanes, but the **-e** at the end is replaced with an ***-ol*** ending**.** You also need to put a number in front of the name, separated with a dash, to indicate which carbon atom the -OH group is attached. As always, use the smallest possible number.

Name	General Formula	Structural formula	Condensed formula
1-propanol	$R\text{—}OH$		$CH_3CH_2CH_2OH$
2-pentanol			$CH_3CH(OH)CH_2CH_2CH_2CH_3$
3-pentanol			$CH_3CH_2CH(OH)CH_2CH_2CH_3$

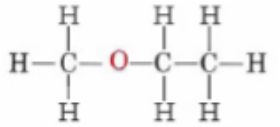
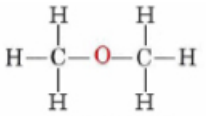
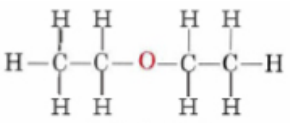
Circle the functional group then name the organic molecule.



Name:

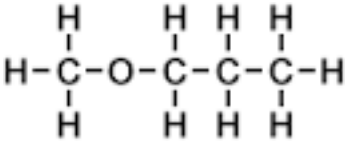
***MODEL 3: Ethers** (-O-)*

*Ethers have <u>an oxygen</u> bonded between two hydrocarbon chains. In an ether, the carbon chain on each side of the –o– is named separately with a –yl ending then the word **ether**. The hydrocarbon chains **should** be named in alphabetical order (except for the ** below.)*

Name	General Formula	Structural formula	Condensed formula
***methyl ethyl ether	$R—O—R'$		$CH_3OCH_2CH_3$
dimethyl ether			CH_3OCH_3
diethyl ether			$CH_3CH_2OCH_2CH_3$

******The *R* and *R'* in the general formula stands for the hydrocarbon that makes up the rest of the molecule. Notice that there are hydrocarbons on both sides of the oxygen atom.**

Circle the functional group then name the organic molecule.



Name:

O
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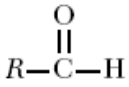
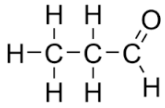
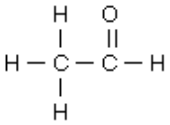
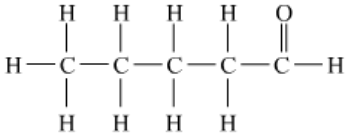
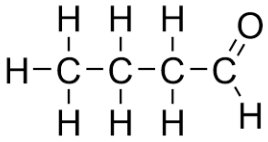
MODEL 4: Aldehydes (–C–H group or –CHO group) = ***-al*** ending

An aldehyde is an organic molecule that has an oxygen atom doubly bonded to the **end** carbon of the backbone carbon chain. The C=O group is referred to as a *carbonyl* group. An aldehyde is named like an alkane except with an ***-al*** **ending**. Since the **CHO** must be on the terminal #1 carbon atom, the position of the CHO is *not specified* in the name. *(No number is needed).*

Name	General Formula	Structural formula	Condensed formula
propanal			O || CH_3CH_2C-H
ethanal			O || CH_3C-H
pentanal			O || $CH_3CH_2CH_2CH_2C$-H

******The *R* in the general formula stands for the hydrocarbon that makes up the rest of the molecule. Notice that the functional group is on the end of the compound (carbon 1)**

Circle the functional group then name the organic molecule.



Name:

O
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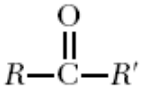
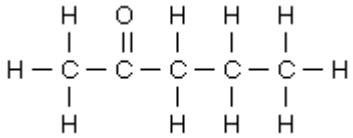
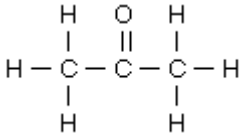
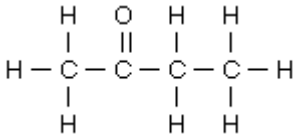
MODEL 5: Ketones (–C– group) = ***-one*** ending

Ketones are very similar to aldehydes. Aldehydes and ketones with the same number of carbons are isomers. The only difference is that the *C=O in a ketone is in the middle of a chain and* ***not on the end carbon***. To name a ketone, use the ***-one* ending** and specify the position of the C=O with a number at the beginning of the name.

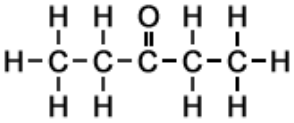
Name	General Formula	Structural formula	Condensed formula
2-pentanone			O || $CH_3CCH_2CH_2CH_3$
propanone			O || CH_3CCH_3
butanone			O || $CH_3CCH_2CH_3$

******The *R* and *R'* in the general formula stands for the hydrocarbon that makes up the rest of the molecule. Notice that there are hydrocarbons on both sides of the functional group (C=O).**

What is the difference between an aldehyde and a keytone?

Why is it not necessary to number propanone and butanone?

Circle the functional group then name the organic molecule.



Name:

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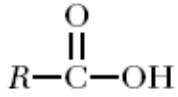
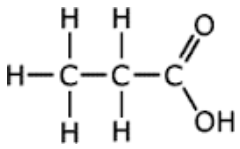
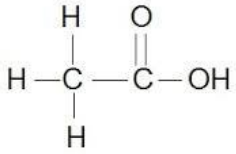
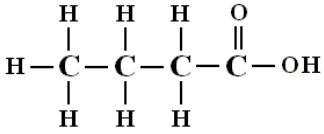
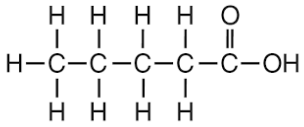
MODEL 6: Organic Acids (–C–OH or –COOH group)

Organic acids have a carboxyl group at the end of the carbon chain. The acidic H is attached to the oxygen in the carboxyl group. To name an acid, change the end of the hydrocarbon to ***–oic acid***. No number is needed because the functional group is at the ***end*** of the carbon chain.

Name	General Formula	Structural formula	Condensed formula
propanoic acid			O || CH_3CH_2C-OH *(or* CH_3CH_2COOH)
ethanoic acid			O || CH_3C-OH (or CH_3COOH)
butanoic acid			O || $CH_3CH_2CH_2C$-OH (or $CH_3CH_2CH_2COOH$)

******The *R* in the general formula stands for the hydrocarbon that makes up the rest of the molecule. Notice that the functional group is on the end of the compound (carbon 1)**

Circle the functional group then name the organic molecule.



Name:

O
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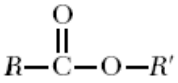
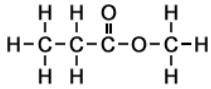
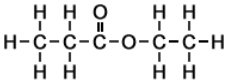
MODEL 7: Esters (–C–O– or –COO– group)

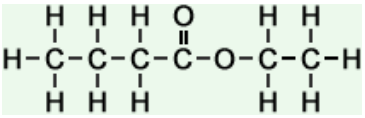
Esters are named by the right side first (side bonded to oxygen) with a ***–yl*** ending. The second part of the name come from the left side (side bonded to C=O) with the ending ***–oate***.

Name	General Formula	Structural formula	Condensed formula
methyl propanoate			O || $CH_3CH_2COCH_3$
ethyl propanoate			O || $CH_3CH_2COCH_2CH_3$

******The *R* and *R'* in the general formula stands for the hydrocarbon that makes up the rest of the molecule. Notice that there are hydrocarbons on both sides of the functional group.**

What is the difference between and ester and an organic acid?

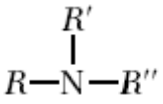
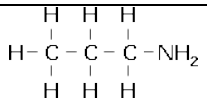
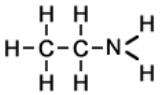
Circle the functional group then name the organic molecule.



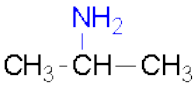
Name:

MODEL 8: Amines (-N- group)

To name an amine, drop the end ***–e*** in the hydrocarbon name and replace it with -***amine***. Be sure to number the carbon in the chain to which the -NH_2 group is attached.

Name	General Formula	Structural formula	Condensed formula
1-propanamine			$CH_3CH_2CH_2NH_2$
ethanamine			$CH_3CH_2NH_2$

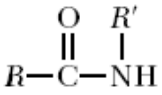
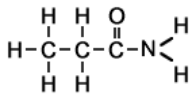
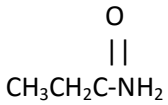
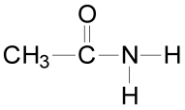
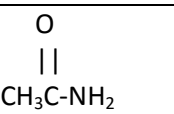
Circle the functional group then name the organic molecule.



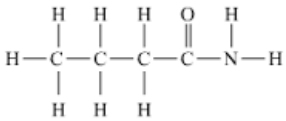
Name:

MODEL 9: Amides (–C–OH group)

To name amides, replace the –e in the name of the hydrocarbon with –amide. No number is needed as the functional group is at the end of the hydrocarbon chain.

Name	General Formula	Structural formula	Condensed formula
propanamide			
ethanamide			

Circle the functional group then name the organic molecule.



Name:

Practice:

Identify the <u>class of organic compounds</u> to which each of the following belongs. Name the compound using the IUPAC name. It may be helpful to draw structural formulas first!

CH_3COOH (*organic acid)*

ethanoic acid

$CH_3CH_2COOCH_3$

CH_3COCH_3

CH_3CH_2COOH

CH_3CH_2OH

CH_3OCH_3

$CH_3CH_2OCH_3$

$CH_3CH_2COCH_3$

CH_3CH_2CHO

$CH_3CH_2CH_2CONH_2$

Draw the structural formula for each of the following:

butanoic acid

methyl methanoate

methanal

3-pentanol