# Chapter 22 – Organic Chemistry

**Organic – Study of carbon containing compounds**

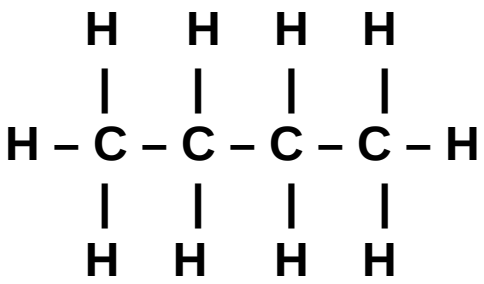
**C – 4 bonds**

**H – 1 bond**

**O – 2 bonds**

**N – 3 bonds**

**Ways to represent a $C_4H_{10}$ molecule:**

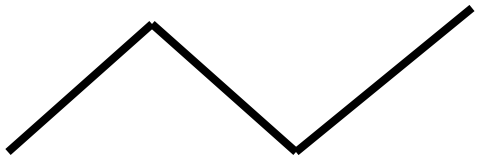


$CH_3 - CH_2 – CH_2 - CH_3$

$CH_3CH_2CH_2CH_3$

$CH_3(CH_2)_2CH_3$

C – C – C – C



**Carbons can attach to each other in chains or branches.**

**They can be:**

**saturated – bonds are all single bonds**

**Unsaturated – double or triple bonds exist. When broken, H can attach (hydrogenation)**

**Mono-unsaturated? Poly-unsaturated?**

**Alkane – organic molecule that is saturated.**

**IUPAC rules for naming alkanes:**

| | |
|---|---|
| $CH_4$ | methane |
| $C_2H_6$ | ethane |
| $C_3H_8$ | propane |
| $C_4H_{10}$ | butane |
| $C_5H_{12}$ | pentane |
| $C_6H_{14}$ | hexane |
| $C_7H_{16}$ | heptane |
| $C_8H_{18}$ | octane |
| $C_9H_{20}$ | nonane |
| $C_{10}H_{22}$ | decane |

**Rules for alkanes**

1. **ane ending on alkanes**
2. **If no branching, named after the number of carbons**
3. **If branching exists, named after longest carbon chain**
4. **Groups on chain are called substituents. If a substituent is a saturated hydrocarbon, its called an alkyl substituent, and ends w/ yl**
5. **Groups along the main chain are located and named by a number. Number the chain so that the first substituent has the lowest number.**
6. **Punctuation is important.**
   **number , number**
   **letter - number**
   **number - letter**
7. **For substituents, state their location, then the quantity, then the name.**
8. **Alphabetize the order of the substituents. di, tri,…don't count.**
9. **Halogen substituents are called: chloro fluoro bromo iodo**

**Alkene – compound with a double bond**
**Alkyne – compound with a triple bond**

**Rules for naming alkenes and alkynes:**

1. **C=C has an ene ending. 2 double bonds ends with diene. 3 double bonds = triene**

**Triple bonded carbon ends w/ yne. 2 triple bonds ends with diyne. 3 triple bonds ends with triyne**

2. **Number the chain so that double or triple bonds get the lowest number. In a tie, the bond gets lower number over a substituent.**

3. **Position of the double bond is indicated by the lowest number carbon with the bond.**

**Cyclic compounds:**

**cyclopropane?**

**Rules for naming cyclic compounds:**

1. **Number the chain so that a substituent or bond get the lowest number**

2. **If only 1 substituent is present, no numbering is needed.**

**Organic Functional Groups – determine properties of the compound. This is the reactive portion of the molecule.**

**R = any hydrocarbon**

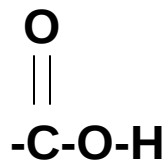
**7 functional groups (in this class…there are others)**

1. **Alcohol – has –O-H functional group**

**R-O-H**

**Named by replacing last e in the name with ol**

## 2. Organic Acid (carboxylic acid)



**Named by replacing the e ending with oic acid or**

**by adding the word carboxylic acid to the name.**

3. **Ether: R – O - R**

**named based on 2 alkyl groups on either side of O**

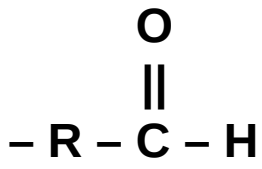
4. **Amine – contains N**

**primary secondary tertiary**

**Named by:**

1. **Name alkyl groups , then add the word amine.**
2. **Amino group named as a substituent**

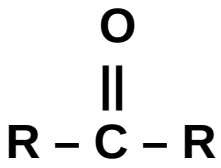
**5. Aldehyde**



1. **Name by replacing e with al on longest carbon chain**

2. **Note that the #1 carbon always has #1 designation…therefore, no number needed in the name.**

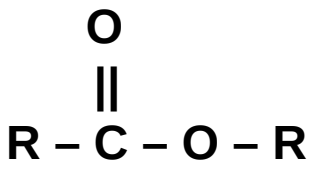
**6. Ketone**



1. **Replace e on longest chain with one**

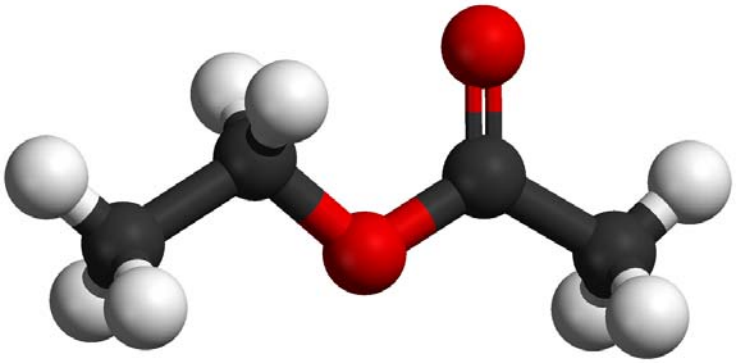
2. **Number the location of the ketone along the longest carbon chain.**

## 7. Ester

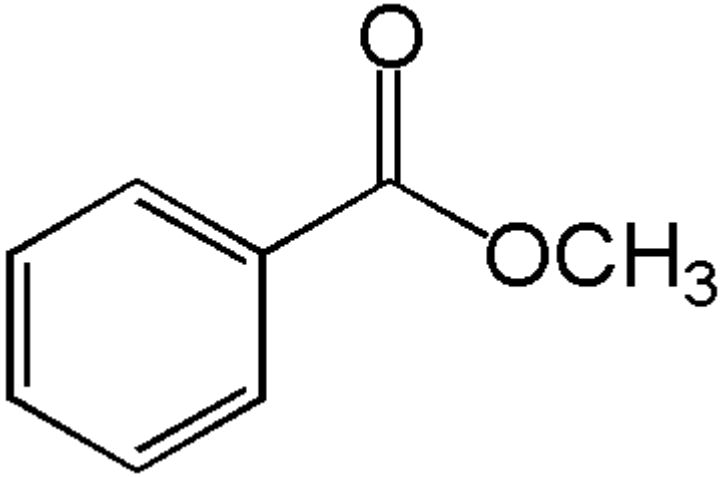



**Name the group attached to the oxygen first, as an alkyl, then change the second alkyl to end with ate.**

**Ethyl acetate**



**Methyl benzoate**



**Properties of organic groups**

**Alkanes: methane – butane are gases**
**pentane – $C_{17}$ are liquids**
**octadecane and larger are solids**

**Insoluble in water**
**Colorless**
**Odorless**
**Tasteless**
**Flammable**
**Other than flammable, not very reactive**

**Alkenes and Alkynes: More reactive**

**Slightly higher density – 2 carbons in a double bond are closer than 2 carbons in a single bond.**

**Alcohol:**

**Hydrogen bond makes the smaller alcohols miscible in water. The larger the # of carbons, the more immiscible the alcohol is in water.**

**Flammable**

**Ethers:**

- **Low boiling point (no Hydrogen bonds)**
- **High volatility**
- **Very flammable**
- **Inhalant anesthesia**
- **Solvent**

**<u>Aldehydes and Ketones</u> – Pleasant odor, used in perfumes and flavoring agents**

**(exc. Formaldehyde!)**

**Lower boiling point than alcohol, higher than ether**

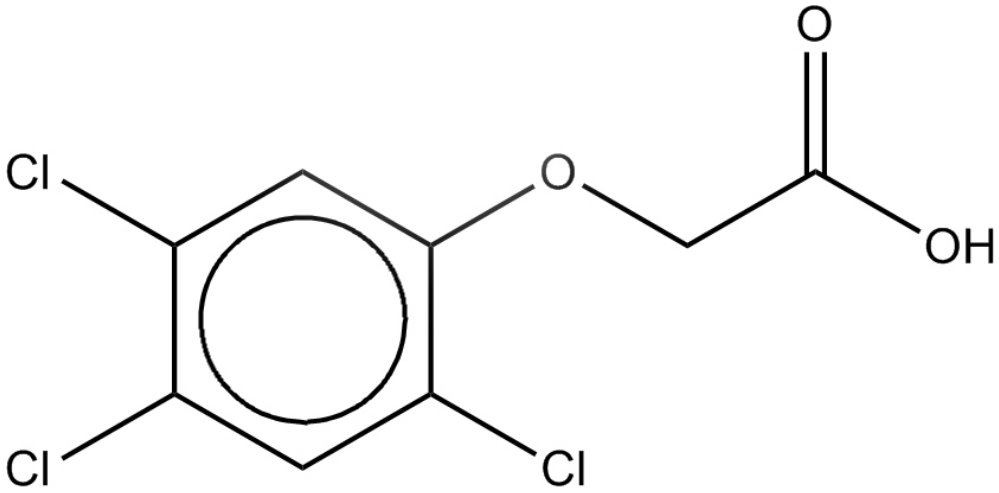
**intermolecular bond is dipole-dipole**

**smaller compounds are soluble in water**

**<u>Carboxylic Acids:</u>**

**most have “disagreeable odors”**

**smaller acids are soluble in water**



**Esters: many have pleasant odors – banana, apple, pineapple, wintergreen**

**Amine – used to make many drugs**

**generally have an unpleasant smell**

**low molecular weight amines are soluble in water, and generally liquids**

**Organic Reactions:**

1. **Substitution – Swap 1 atom for another.**

2. **Oxidation – or combustion**

3. **Addition: Add an element to a carbon compound.**

4. **Condensation (dehydration): H from 1 molecule + OH from another join to make water, and the remaining 2 fragments join.**

5. **Saponification – Ester plus alkali produce soap plus alcohol.**

**Alkane reactions:**

1. **Oxidation**
2. **Substitution**

**Alkene and Alkyne reactions:**

1. **Addition**
2. **Oxidation**

**Alcohol reactions:**

1. **Condensation**
2. **Oxidation**

**Ethers: generally stable and un-reactive except for oxidation.**

**Carboxylic Acids:**

1. **Neutralization**

2. **Condensation**

**Amines: combine with organic acids to make amino acids**

**Amino acids undergo condensation reactions to form proteins**