

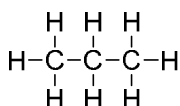
# Functional Groups

**functional group:** an atom, or group of atoms (with specific connectivity), exhibiting identical chemical reactivity regardless of the molecule containing it; the reactivity of individual functional groups dictates the reactivity of the molecule of which they are a part

- divide organic compounds into classes
- sites of characteristic chemical reactions
- serve as basis for naming organic compounds

## A. Alkanes

- contain only carbon-carbon and carbon-hydrogen single bonds



Lewis structure



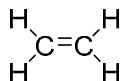
condensed  
structural formula



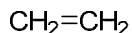
fully condensed  
structural formula

## B. Alkenes

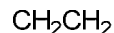
- contain a carbon-carbon double bond



Lewis structure



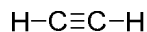
condensed  
structural formula



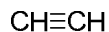
fully condensed  
structural formula

## C. Alkynes

- contain a carbon-carbon triple bond



Lewis structure



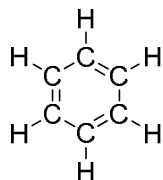
condensed  
structural formula



fully condensed  
structural formula

## D. Arenes

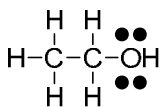
- contain a benzene group



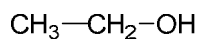
benzene

## E. Alcohols

- contain an -OH (“hydroxyl”) group bonded to a tetrahedral carbon atom



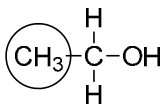
Lewis structure



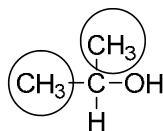
condensed  
structural formula



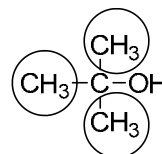
fully condensed  
structural formula



a primary (1°)  
alcohol



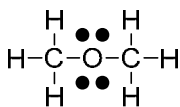
a secondary (2°)  
alcohol



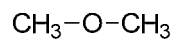
a tertiary (3°)  
alcohol

## F. Ethers

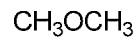
- contain an oxygen atom bonded to two carbon atom groups by single bonds



Lewis structure



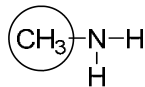
condensed  
structural formula



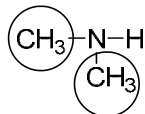
fully condensed  
structural formula

## G. Amines

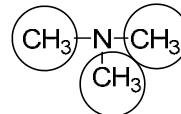
- contain an “amino” group – a N atom bonded to 1, 2, or 3 carbon atom groups by single bonds



a primary ( $1^\circ$ )  
amine



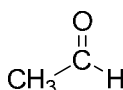
a secondary ( $2^\circ$ )  
amine



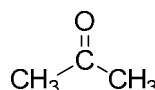
a tertiary ( $3^\circ$ )  
amine

## H. Aldehydes and Ketones

- contain a C=O (“carbonyl”) group



aldehydes contain at least  
one H atom bonded to  
the carbonyl C atom

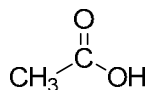


ketones contain 2  
carbon atom groups bonded  
to the carbonyl C atom

- note that in condensed structural formulas, the aldehyde group may be written as  $-\text{CH}=\text{O}$  or as  $-\text{CHO}$

## I. Carboxylic Acids

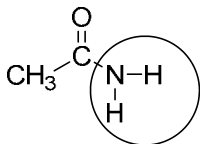
- contain a “carboxylic acid” group – a carbonyl (C=O) group bonded to a hydroxyl group at the carbonyl carbon atom



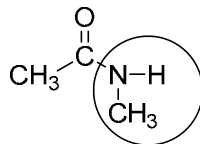
- note that in condensed structural formulas, the carboxylic acid group may be written as  $-\text{COOH}$

## J. Carboxylic Amides (Amides)

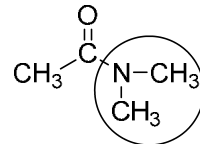
- contain an “amide” group – a carboxylic acid (-COOH) group where the -OH group is replaced with an amine



a primary (1°)  
amide



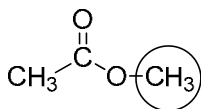
a secondary (2°)  
amide



a tertiary (3°)  
amide

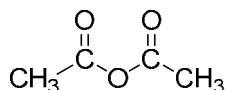
## K. Carboxylic Esters (Esters)

- contain an “ester” group – a carboxylic acid (-COOH) group where the H atom is replaced with a carbon containing group



## L. Carboxylic Anhydrides (Anhydrides)

- contain an “anhydride” group – an oxygen atom bonded to two C=O (“carbonyl”) groups



## M. Nitriles

- contain a “cyano” group (C≡N) bonded to a carbon atom group (i.e., at the carbon atom of the cyano group)

