

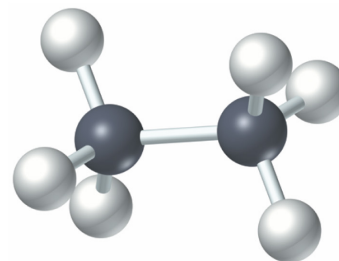
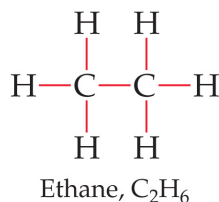
Ch 12. Intro to Organic Chemistry:  
Alkanes

# What is Organic Chemistry?

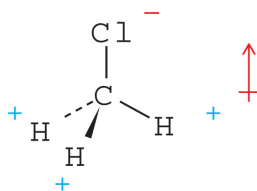
- **Organic Compounds:** Contain carbon as primary component. (Contain C-H bond.)
  - Biological molecules (proteins, nucleic acids, carbohydrates, lipids)
  - Many modern materials (plastics, synthetic fibers), medicine
- **Inorganic Compounds:** Majority do not contain carbon (Those that contain C lack C-H bond, eg.  $\text{CaCO}_3$ ,  $\text{CO}_2$ .)

# Organic Compounds: What is Special about Carbon?

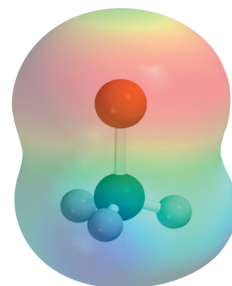
1. Is tetravalent  
(forms 4 bonds)



2. Bonds strongly to itself through covalent bonding— thus can form long chains or rings
3. Bonds strongly to electronegative elements (like N, O, and halogens), to form polar covalent bonds

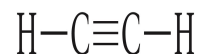
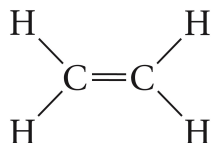
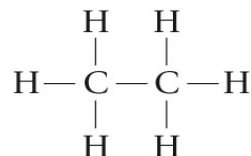


Chloromethane,  
CH<sub>3</sub>Cl

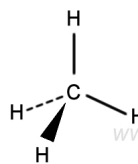
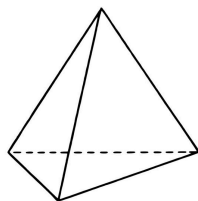


# Organic Compounds: What is Special about Carbon?

4. Can form multiple covalent bonds by sharing more than 2 electrons (double bonds, triple bonds)



5. Forms compounds with specific 3D shape (C single bonds are oriented toward 4 corners of tetrahedron)



Sketched 3-D Structural Formula of Methane



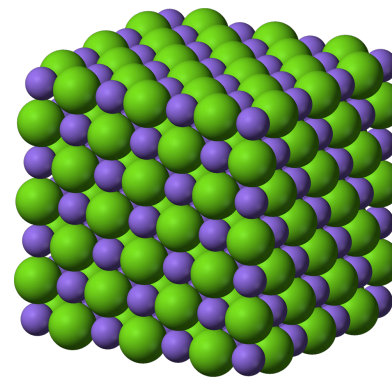
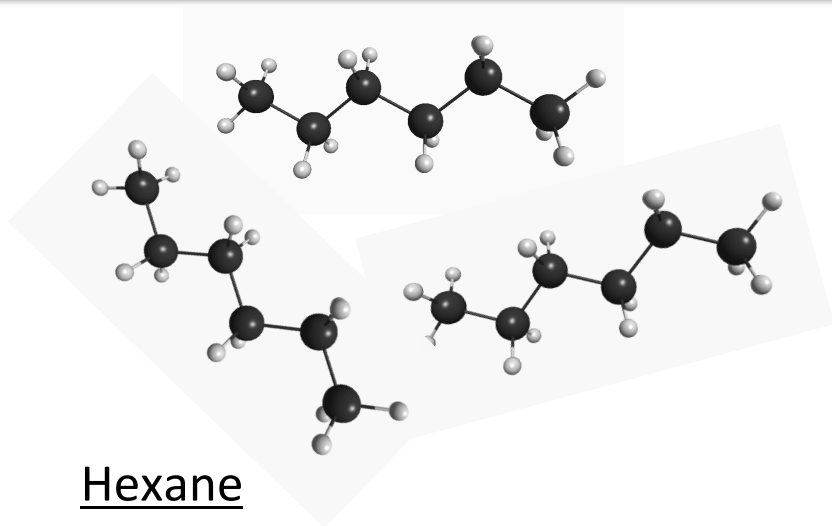
"Ball and Stick" Model of 3-D Structure of Methane

**\*Because of these bonding properties, an extraordinary number of carbon compounds exist!**

# Comparison of General Properties: Organic vs. Inorganic Ionic Compounds

	Organic	Inorganic (Ionic)
Solubility	Most are nonpolar → insoluble in water.	Most are soluble in water.
Electrical Conductivity	When soluble in water, are poor conductors of electricity.	When soluble in water, are good conductors of electricity.
Physical states	Can be gas, liquid, or solid at room temp	All are solids at room temp
Melting and Boiling Points	Relatively low	Very high

# Organic vs. Inorganic Compounds



## Organic Compound

- Covalent (nonpolar) bonding within molecule, but
- Weak London dispersion forces between molecules
- Melting point:  $-95\text{ }^{\circ}\text{C}$
- Boiling point:  $69\text{ }^{\circ}\text{C}$
- Solubility in water: No

## Inorganic Ionic Compound

- Strong ionic bonding between + and – ions
- Melting point:  $801\text{ }^{\circ}\text{C}$
- Boiling point:  $1413\text{ }^{\circ}\text{C}$
- Solubility in water: Yes

# Organic Compound Families: Functional Groups

**Functional group:** an atom or group of atoms responsible for the characteristic properties and behavior of an organic compound. Allows classification of organic compounds into distinct chemical families.

# Some Organic Compound Families

**TABLE 12.1** Some Important Families of Organic Molecules

FAMILY NAME	FUNCTIONAL GROUP STRUCTURE*	SIMPLE EXAMPLE	LINE STRUCTURE	NAME ENDING
Alkane	Contains only C—H and C—C single bonds	CH <sub>3</sub> CH <sub>2</sub> CH <sub>3</sub> Propane		-ane
Alkene		H <sub>2</sub> C=CH <sub>2</sub> Ethylene		-ene
Alkyne		H—C≡C—H Acetylene (Ethyne)		-yne
Aromatic		Benzene		None
Alkyl halide	(X=F, Cl, Br, I)	CH <sub>3</sub> CH <sub>2</sub> Cl Ethyl chloride		None
Alcohol		CH <sub>3</sub> CH <sub>2</sub> OH Ethyl alcohol (Ethanol)		-ol
Ether		CH <sub>3</sub> CH <sub>2</sub> —O—CH <sub>2</sub> CH <sub>3</sub> Diethyl ether		None
Amine		CH <sub>3</sub> CH <sub>2</sub> NH <sub>2</sub> Ethylamine		-amine
Aldehyde		CH <sub>3</sub> —C(=O)—H Acetaldehyde (Ethanal)		-al
Ketone		CH <sub>3</sub> —C(=O)—CH <sub>3</sub> Acetone		-one

# Some Organic Compound Families

**TABLE 12.1** Some Important Families of Organic Molecules

FAMILY NAME	FUNCTIONAL GROUP STRUCTURE*	SIMPLE EXAMPLE	LINE STRUCTURE	NAME ENDING
Carboxylic acid		$\text{CH}_3\text{—}\overset{\text{O}}{\parallel}\text{C}\text{—}\text{OH}$ Acetic acid		-ic acid
Anhydride		$\text{CH}_3\text{—}\overset{\text{O}}{\parallel}\text{C}\text{—}\text{O—}\overset{\text{O}}{\parallel}\text{C}\text{—}\text{CH}_3$ Acetic anhydride		None
Ester		$\text{CH}_3\text{—}\overset{\text{O}}{\parallel}\text{C}\text{—}\text{O—}\text{CH}_3$ Methyl acetate		-ate
Amide		$\text{CH}_3\text{—}\overset{\text{O}}{\parallel}\text{C}\text{—}\text{NH}_2$ Acetamide		-amide
Thiol		$\text{CH}_3\text{CH}_2\text{SH}$ Ethyl thiol		None
Disulfide	$\text{C—S—S—C}$	$\text{CH}_3\text{SSCH}_3$ Dimethyl disulfide		None
Sulfide	$\text{C—S—C}$	$\text{CH}_3\text{CH}_2\text{SCH}_3$ Ethyl methyl sulfide		None

\*The bonds whose connections are not specified are assumed to be attached to carbon or hydrogen atoms in the rest of the molecule.

# Categories of Organic Compound Families

(Refer to *Handout: Families of Organic Compounds*.)

1. Hydrocarbons (contain only carbon and hydrogen): Alkane, alkene, alkyne, aromatic
2. Single bonds only, carbon bonded to electronegative atom: Alkyl halide, alcohol, ether, amine
3. Carbonyl compounds: Aldehyde, ketone, carboxylic acid, anhydride, ester, amide
4. (Sulfur-containing compounds: thiol, sulfide, disulfide)

## For each family, we will learn its...

1. Structure
2. Nomenclature
3. Reactions
4. Physical/chemical properties

Ex probs