

Organic Chemistry

Chapter 1. Introduction to organic chemistry

Chapter 2. Hydrocarbon

Chapter 3. Stereochemistry

Chapter 4. Compounds bearing Oxygen

Chapter 5. Compounds bearing Nitrogen

Chapter 1: Introduction to organic chemistry

What is Organic Chemistry?

Organic Chemistry

- Chemistry of the compounds present in **living organisms**.
- They all contain carbon.
- Organic Chemistry is the **Chemistry of Carbon**.

Natural Sources of Organic Compounds

Living things



Carbohydrates /
Proteins / Fats /
Vitamins / Antibiotics



Crude oil or
coal

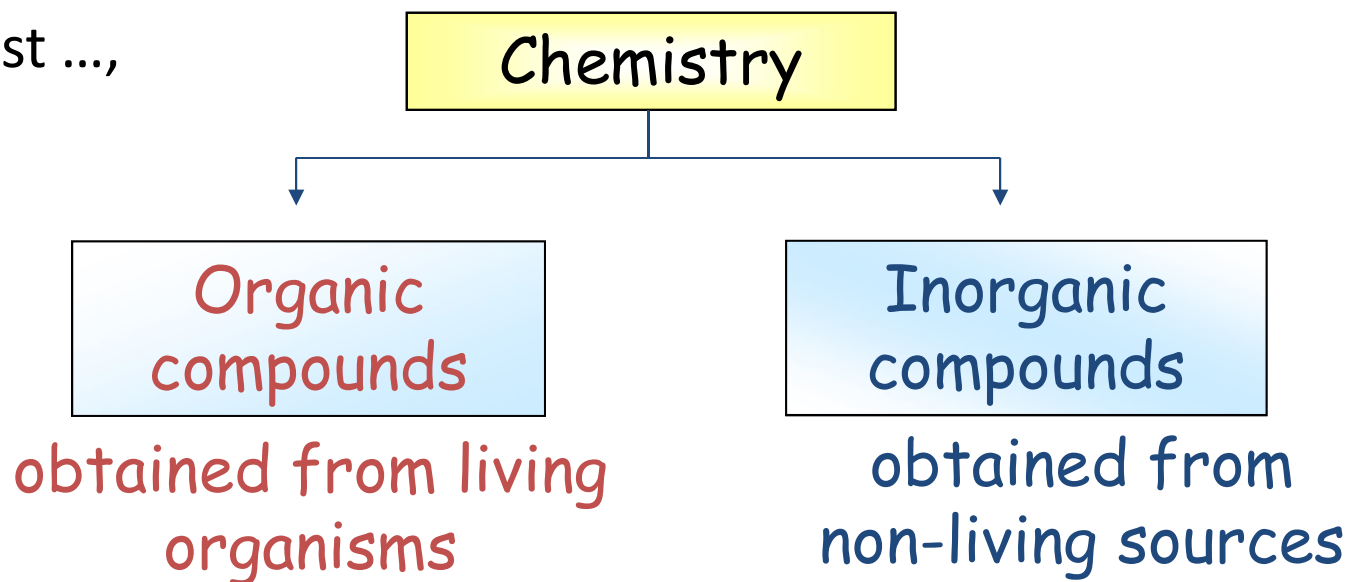
Fractional distillation /
destructive distillation



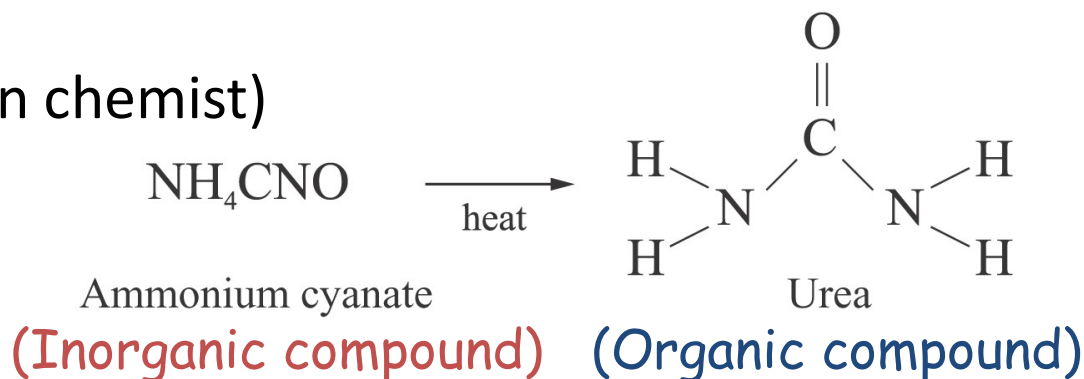
Alkanes / Alkenes
/ Alkynes /
Aromatic
hydrocarbons

History of organic chemistry

In the past ...,



In 1828, Wohler (a German chemist)

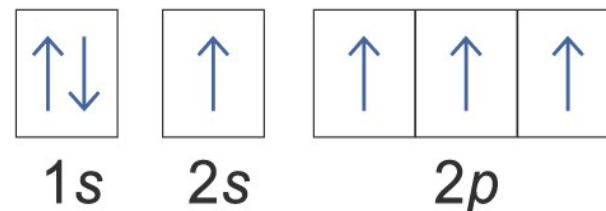


Nowadays,

Organic chemistry is the study of carbon compounds (except CO, CO₂, carbonates, hydrogencarbonates, carbides and cyanides) obtained from natural sources or synthesized in the laboratories.

Ability to Catenate (tạo chuỗi)

- Each carbon atom has four unpaired electrons when excited and tend to form four strong covalent bonds

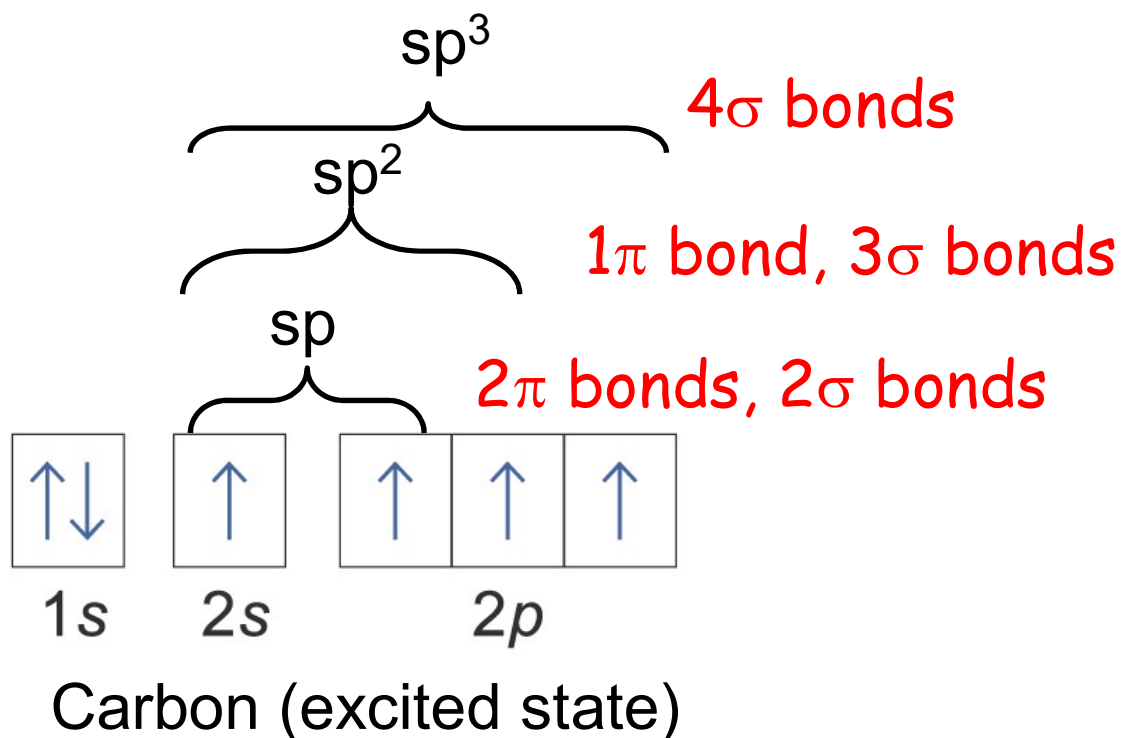


Carbon (excited state)

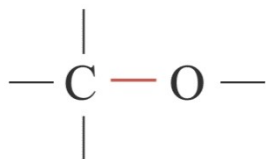
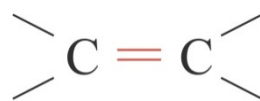
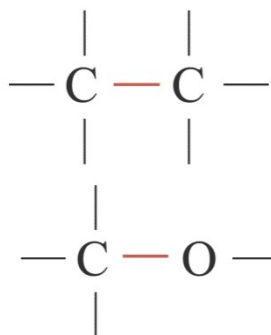
- Carbon atoms link together to form chains of varying length, branched chains and rings of different sizes
- Catenation: Ability of atoms in forming stable bonds with itself, hence joining up into chains or rings
- For group IV,**

$C_n H_{2n+2}$	$n = 1, 2, 3, \dots$ (no limit for n)
$Si_n H_{2n+2}$	$n = 1$ to 6 only \rightarrow silanes
$Ge_n H_{2n+2}$	$n = 1$ to 3 only \rightarrow germanes
$Sn_n H_{2n+2}$	Only SnH_4 (stannane) exists

Ability to form multiple bonds

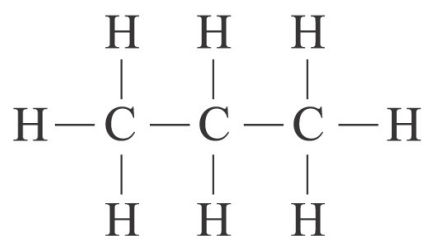


Single bond, double bond and triple bond

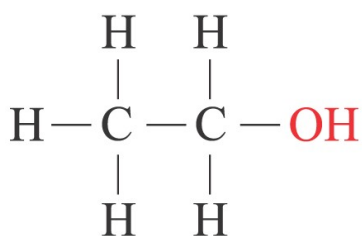


Functional Groups

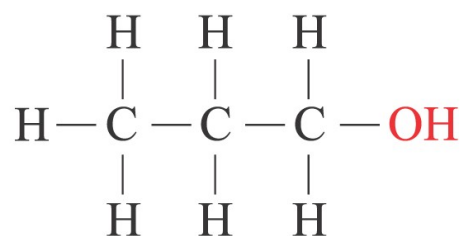
- ❑ Organic compounds are **classified** by the presence of characteristic functional groups.
- ❑ A **functional group** is defined as an atom or a group of atoms that effectively determines the **chemical properties** of an organic compound.



Propane



Ethanol

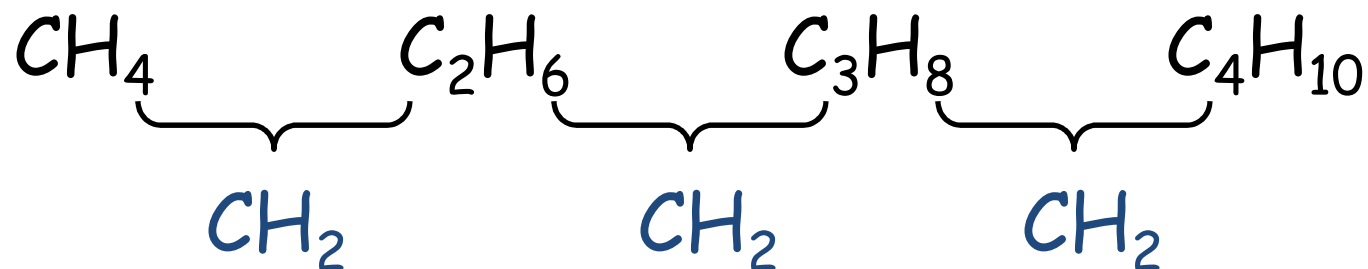


Propan-1-ol

- ❑ Ethanol and propan-1-ol have **similar chemical properties**
 - ➔ they contain the **same functional group –OH**
 - ➔ they are classified into the **same homologous series — alcohols**

Homologous Series (đồng đẳng)

- A **homologous series** is a series of compounds that have the **same** functional group, and each member differs from the next member by a **$-\text{CH}_2-$** unit in their formulae.



- Members in the same series can be represented by a **general formula**.

e.g. alkanes: $\text{C}_n\text{H}_{2n+2}$

alkenes: C_nH_{2n}

alkynes: $\text{C}_n\text{H}_{2n-2}$

Homologous Series (đồng đẳng)

Functional group
of an organic
compound



Chemical
properties

Members of a homologous series have
similar chemical properties

❑ However, the physical properties change **gradually** along the homologous series

e.g. the **longer** the carbon chain in the molecule (or the **greater** the molecular mass)

- ➔ the **greater** the attractive force between molecules
- ➔ the **higher** the melting point, boiling point and density

Double bond equivalent (DBE)

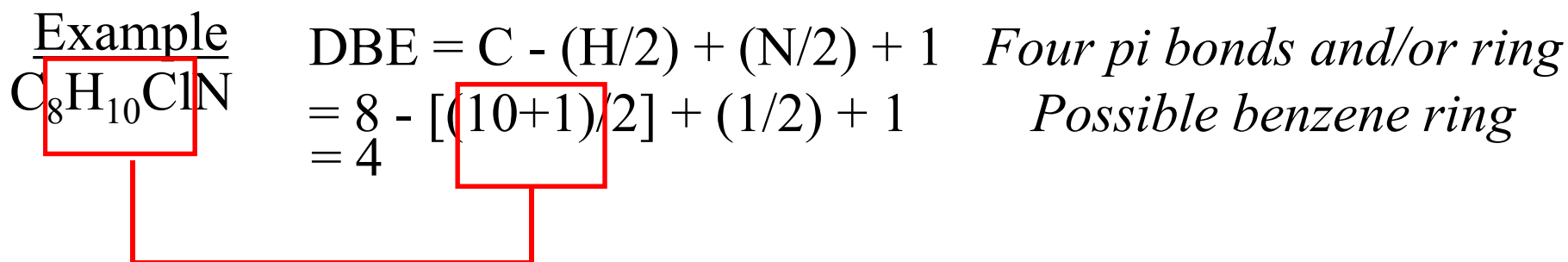
□ DBE may be calculated from molecular formula:

$$\text{DBE} = \underset{\substack{\text{hydrogens and halogens} \\ \swarrow}}{\text{C}} - \frac{\text{H}}{2} + \frac{\text{N}}{2} + 1$$

carbons \swarrow

- One DBE = one ring or one pi bond
- Two DBE = two pi bonds, two rings, or one of each
- Four DBE = *possible* benzene ring

Example

$$\begin{aligned} \text{C}_8\text{H}_{10}\text{ClN} & \quad \text{DBE} = \text{C} - (\text{H}/2) + (\text{N}/2) + 1 & \text{Four pi bonds and/or ring} \\ & = 8 - [(10+1)/2] + (1/2) + 1 & \text{Possible benzene ring} \\ & = 4 \end{aligned}$$


Examples

Calculate DBE of following compounds with molecular formula:

Diethylamine, $C_4H_{11}N$

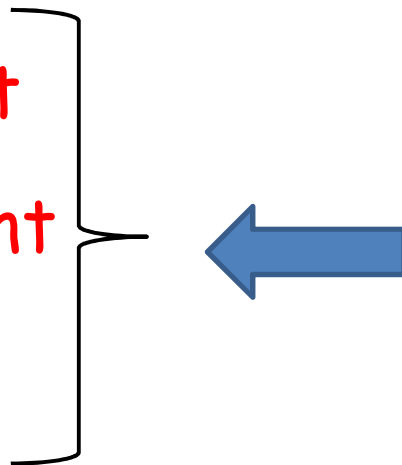
Pyridine, C_5H_5N

Acid acetic, $C_2H_4O_2$

Glucosamine, $C_6H_{13}NO_5$

Factors Affecting the Physical Properties

- Boiling point
- Melting point
- Solubility



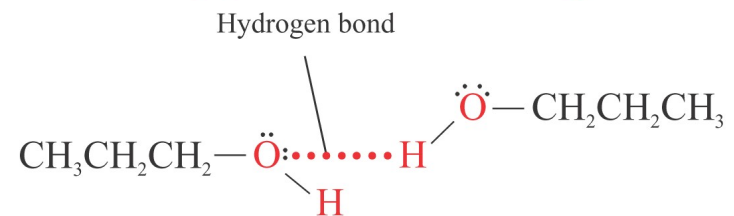
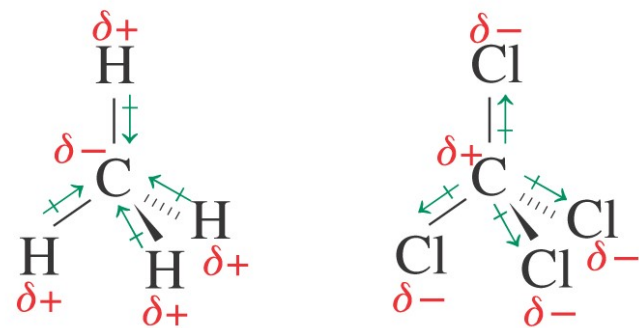
- Carbon length
- Functional group
- Dipole Moment
- Polarity
- Hydrogen Bonding



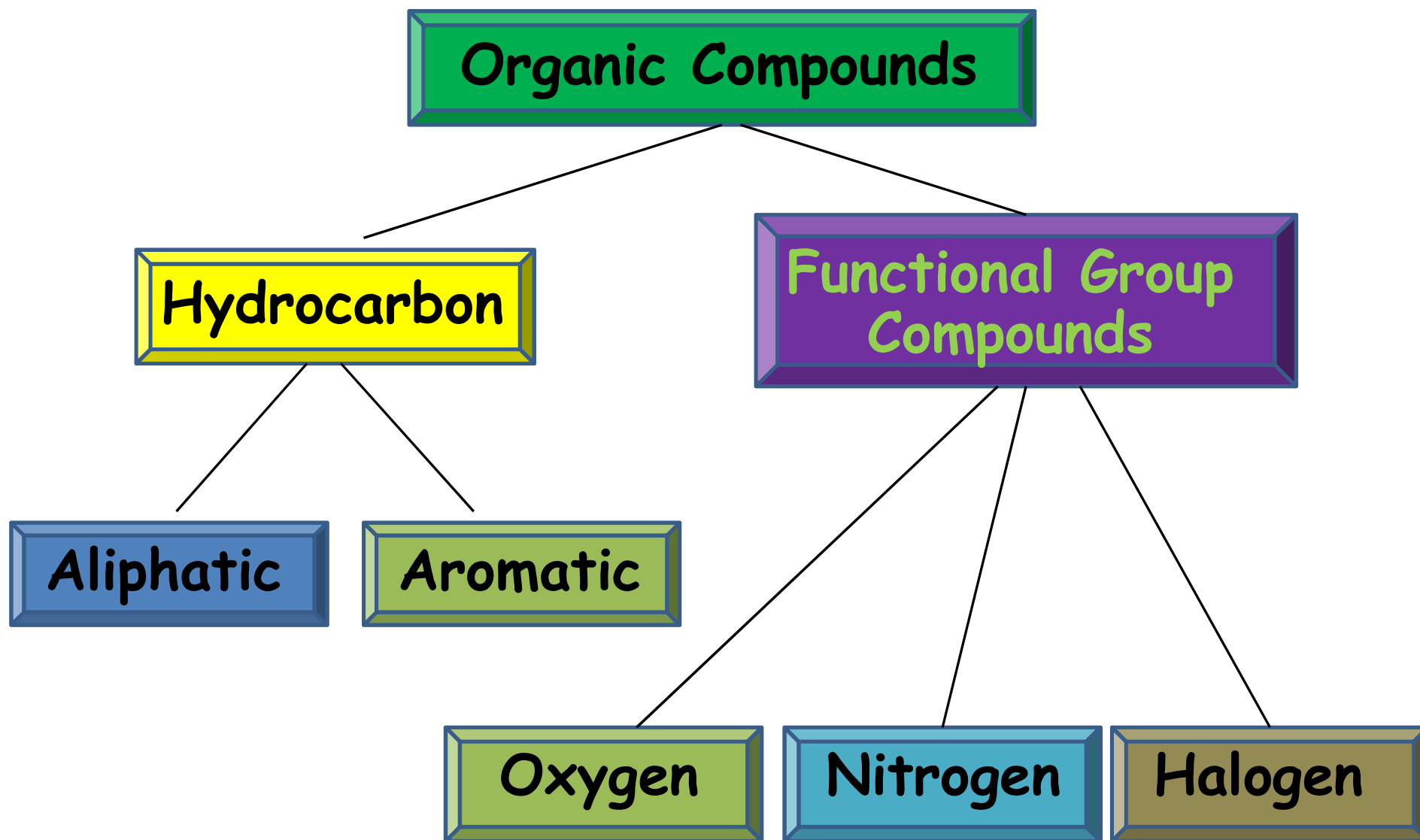
Hexane in CCl_4



Hexane in water



Organic Compounds



Nomenclature of Organic Compounds

The **name** of every organic molecule has **3 parts**:

- The **parent name** indicates the number of carbons in the longest continuous chain.
- The **suffix** indicates what functional group is present.
- The **prefix** tells us the identity, location, and number of substituents attached to the carbon chain.

