

Ch. 2b Warm-Up

1. What property of water allows a water strider to “walk” on water?
2. Contrast adhesion and cohesion. Give an example of each.
3. Contrast hydrophobic and hydrophilic substances. Give an example of each.

Warm-Up (Ch. 2b Review)

1. Which of the following is a hydrophobic material: paper, table salt, wax, sugar, or pasta?
2. What kind of bonds are broken when water vaporizes?
3. If the pH of a lake is 4.0, what is the hydrogen ion $[H^+]$ concentration of the lake? What is the hydroxide $[OH^-]$ concentration?



Chapter 3a

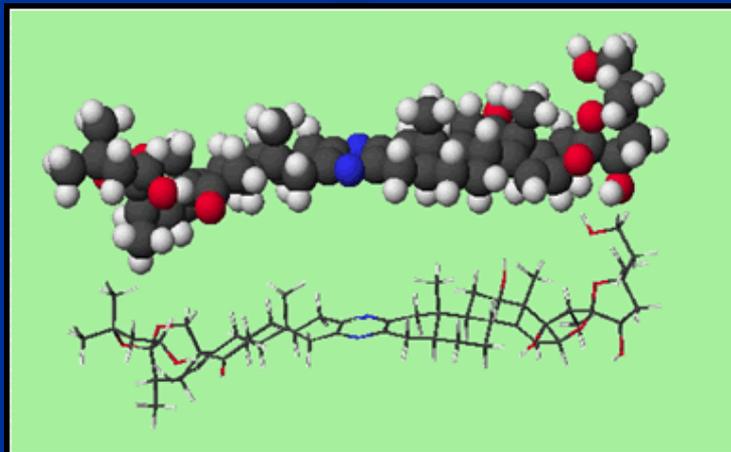
Carbon and the Molecular Diversity of Life

You Must Know

- The properties of carbon that make it so important.

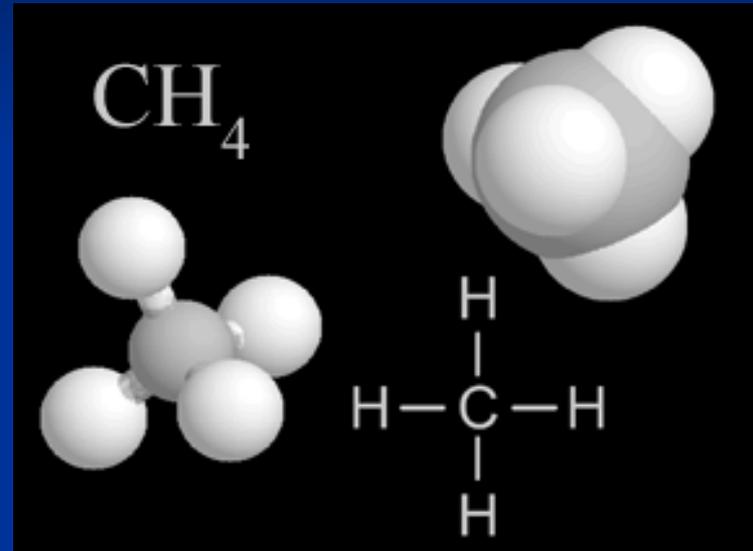
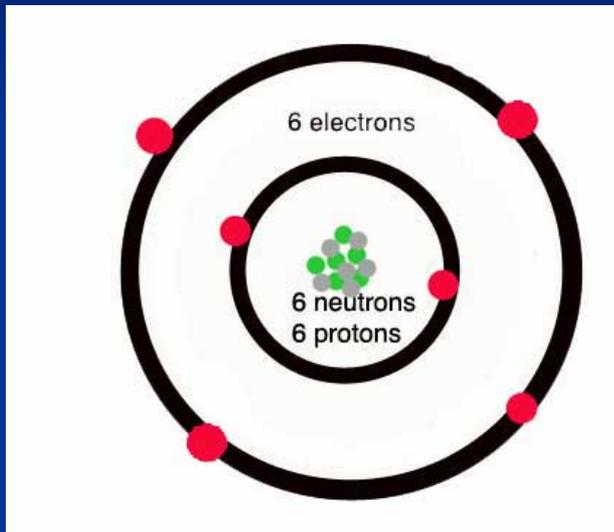
I. Importance of Carbon

- **Organic chemistry**: branch of chemistry that specializes in study of carbon compounds
- **Organic compounds**: contain Carbon (& H)
- **Major elements of life**: CHNOPS
- Carbon can form large, complex, and diverse molecules



II. Diversity of Carbon

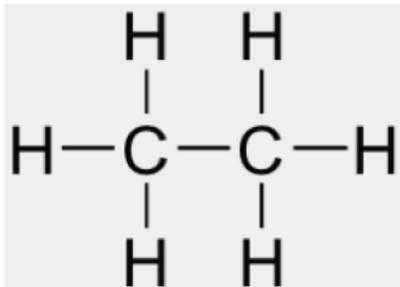
1. It has 4 valence electrons (**tetravalence**)



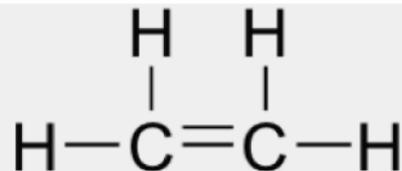
2. It can form up to 4 covalent bonds
 - Most frequent bonding partners: **H, O, N**

II. Diversity of Carbon

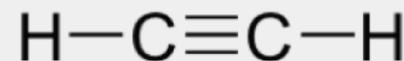
3. Bonds can be single, double, or triple covalent bonds.



ethane
(an **alkane**)



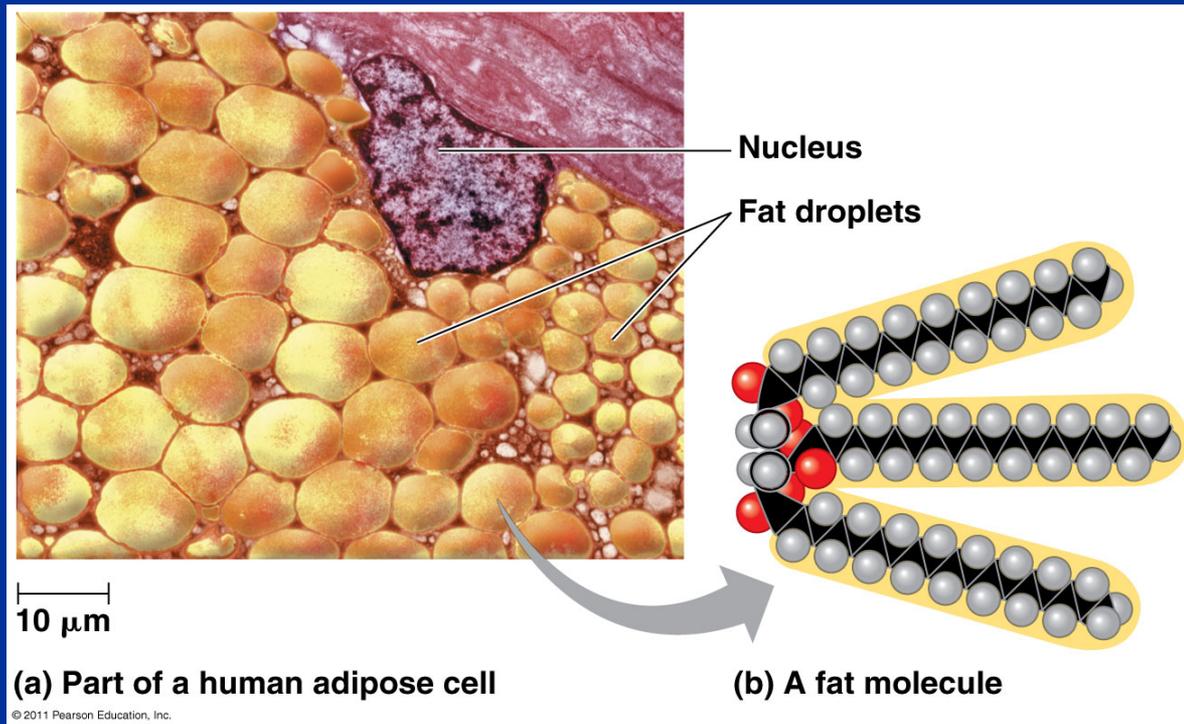
ethene
(an **alkene**)



ethyne
(an **alkyne**)

II. Diversity of Carbon

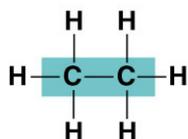
4. Carbon can form large molecules
- 4 classes of **macromolecules**: carbohydrates, proteins, lipids, nucleic acids



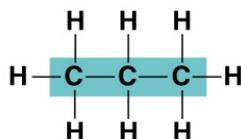
II. Diversity of Carbon

5. Molecules can be chains, ring-shaped, or branched

(a) Length

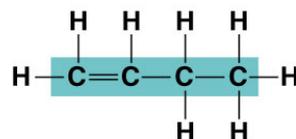


Ethane

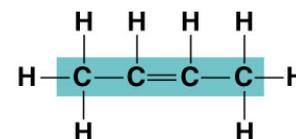


Propane

(c) Double bond position

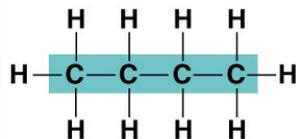


1-Butene

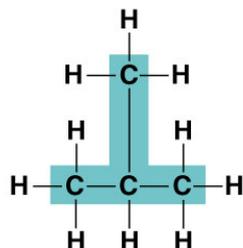


2-Butene

(b) Branching

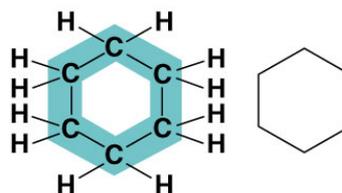


Butane

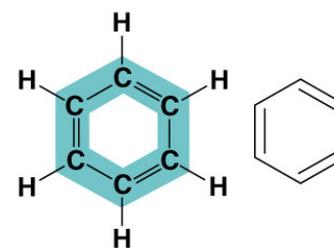


2-Methylpropane
(isobutane)

(d) Presence of rings



Cyclohexane



Benzene

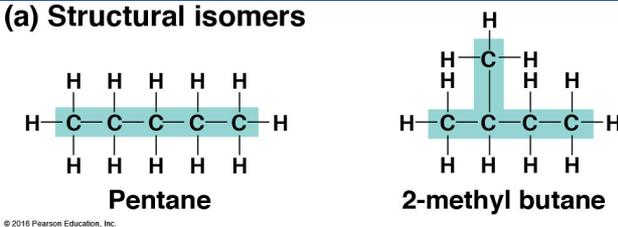
II. Diversity of Carbon

6. Forms isomers

- Molecules have same molecular formula, but differ in atom arrangement
- different structures → different properties/functions

Structural Isomer	Cis-Trans Isomer	Enantiomers
Varies in covalent arrangement	Differ in spatial arrangement	Mirror images of molecules

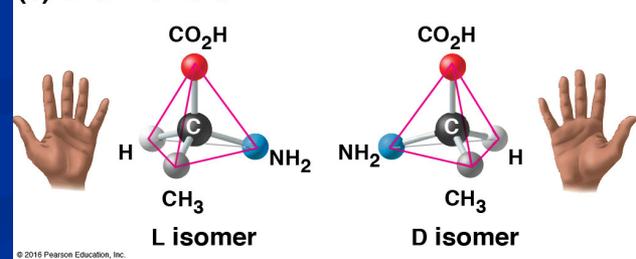
(a) Structural isomers



(b) *Cis-trans* isomers



(c) Enantiomers



Drug manufacturing:

Thalidomide =

- “good” enantiomer → reduce morning sickness
- “bad” enantiomer → cause birth defects
- “good” converts to “bad” in patient’s body
- Now used to treat cancers, leprosy, HIV

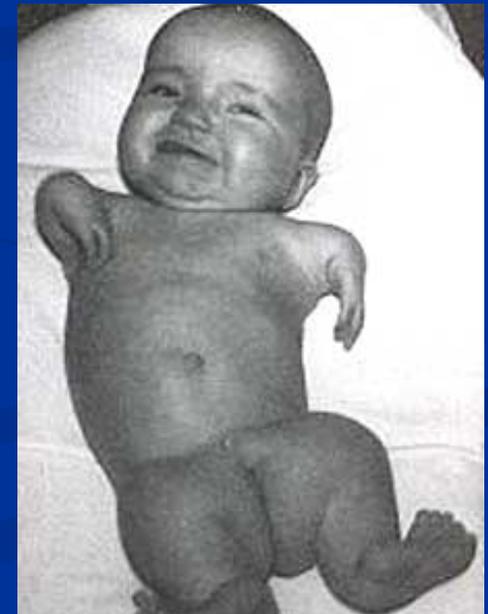
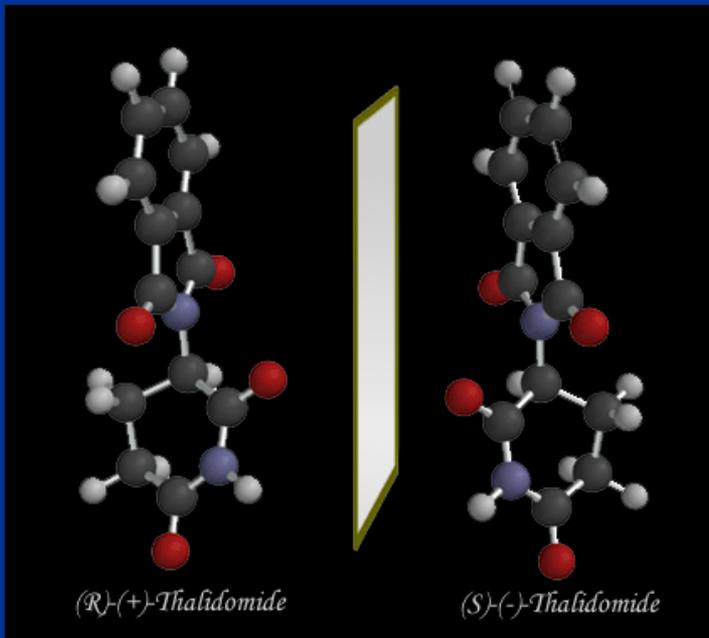
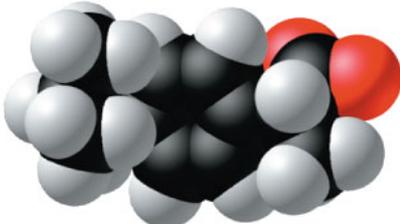
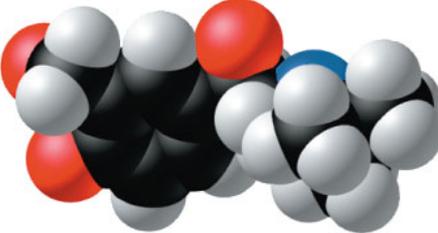
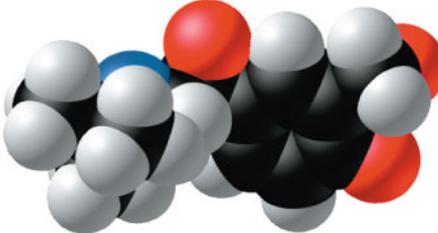
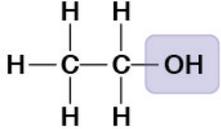
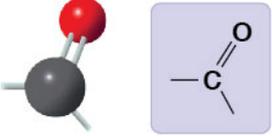
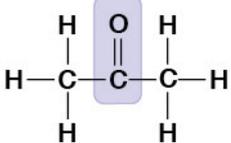
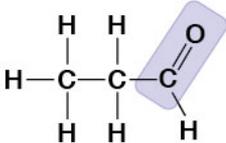
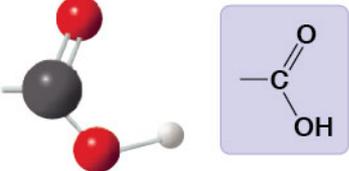
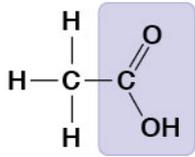
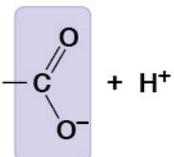
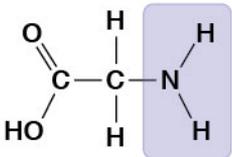
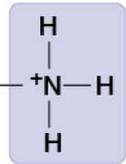


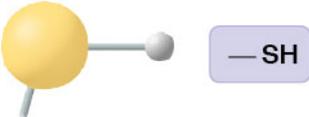
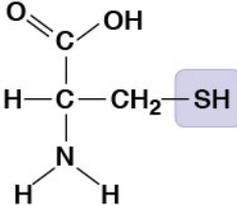
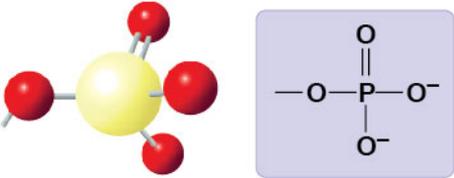
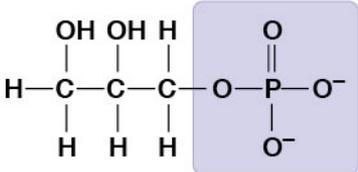
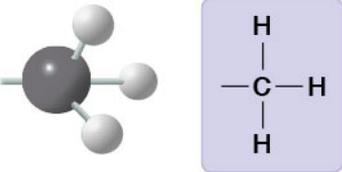
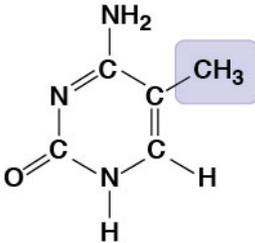
Fig. 4.8 The pharmacological importance of enantiomers

Drug	Condition	Effective Enantiomer	Ineffective Enantiomer
Ibuprofen	Pain; inflammation	 S-Ibuprofen	 R-Ibuprofen
Albuterol	Asthma	 R-Albuterol	 S-Albuterol

III. Functional Groups

- Behavior of organic molecules depends on functional groups
- Most common functional groups:
 1. Hydroxyl
 2. Carbonyl
 3. Carboxyl
 4. Amino
 5. Sulfhydryl
 6. Phosphate
 7. Methyl

Chemical Group	Compound Name	Examples
<p>Hydroxyl group (—OH)</p>  <p>(may be written HO—)</p>	<p>Alcohol</p>	 <p>Ethanol</p>
<p>Carbonyl group (>C=O)</p> 	<p>Ketone</p> <p>Aldehyde</p>	 <p>Acetone</p>  <p>Propanal</p>
<p>Carboxyl group (—COOH)</p> 	<p>Carboxylic acid, or organic acid</p>	 <p>Acetic acid</p> \rightleftharpoons  <p>Ionized form of —COOH</p>
<p>Amino group (—NH₂)</p> 	<p>Amine</p>	 <p>Glycine</p> $+ H^+ \rightleftharpoons$  <p>Ionized form of —NH₂</p>

Chemical Group	Compound Name	Examples
<p data-bbox="86 329 504 368">Sulfhydryl group (—SH)</p> 	<p data-bbox="691 419 780 454">Thiol</p>	 <p data-bbox="1470 422 1624 458">Cysteine</p>
<p data-bbox="86 578 595 629">Phosphate group (—OPO₃²⁻)</p> 	<p data-bbox="691 694 877 772">Organic phosphate</p>	 <p data-bbox="1470 665 1657 743">Glycerol phosphate</p>
<p data-bbox="86 863 459 901">Methyl group (—CH₃)</p> 	<p data-bbox="691 979 884 1058">Methylated compound</p>	 <p data-bbox="1470 936 1779 972">5-Methyl cytosine</p>