

## Carbon Chemistry

Chemical compounds containing carbon are called "organic" compounds.

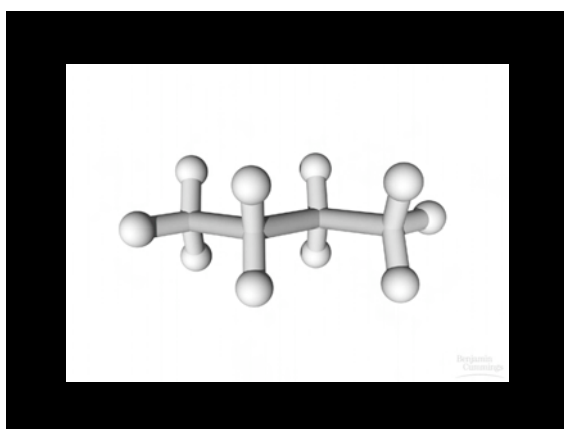
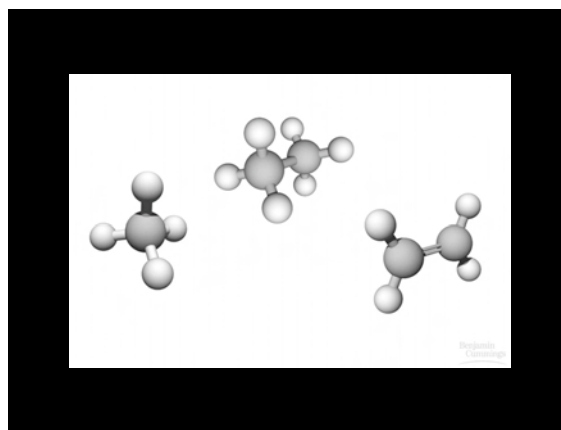
All life on earth is based on molecules built around carbon

## Important Properties of Carbon

- Readily forms covalent bonds
- Single, double or triple bonds
- Tetravalent - it forms four covalent bonds, so it can build complex shapes.

|                   | MOLECULAR FORMULA             | STRUCTURAL FORMULA   | BALL-AND-STICK MODEL | SPACE-FILLING MODEL |
|-------------------|-------------------------------|--|----------------------|---------------------|
| Methane           | CH <sub>4</sub>               | $\begin{array}{c} \text{H} \\   \\ \text{H}-\text{C}-\text{H} \\   \\ \text{H} \end{array}$  |                      |                     |
| Ethane            | C <sub>2</sub> H <sub>6</sub> | $\begin{array}{c} \text{H} & \text{H} \\   &   \\ \text{H}-\text{C}-\text{C}-\text{H} \\   &   \\ \text{H} & \text{H} \end{array}$           |                      |                     |
| Ethene (Ethylene) | C <sub>2</sub> H <sub>4</sub> | $\begin{array}{c} \text{H} & & \text{H} \\ & \backslash & / \\ & \text{C}=\text{C} \\ & / & \backslash \\ \text{H} & & \text{H} \end{array}$ |                      |                     |

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## Functional Groups...

- Attach to carbon backbone
- Each group has distinctive properties

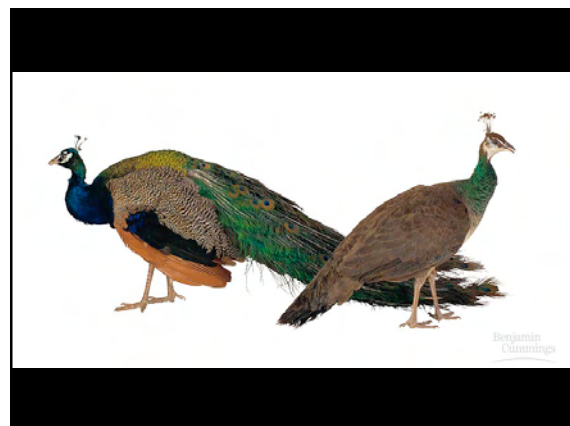
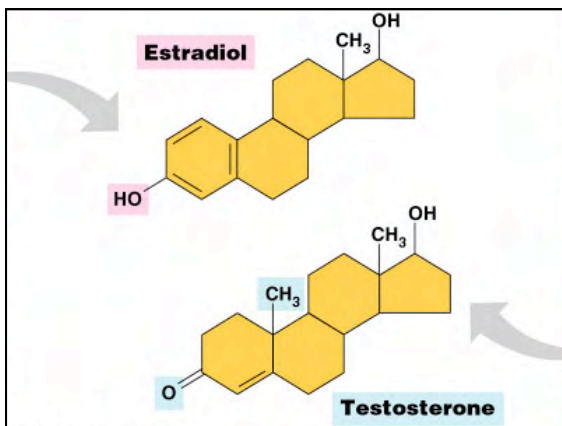
## Functional Groups

- Know these groups from table 4.10: Hydroxyl, Carboxyl, Amino, Phosphate. Know their structure and their properties.
- Properties means: do they make a molecule acidic? Basic? Polar? Ionic?

| Hydroxyl  |  |   |
|-----------|--|---|
| STRUCTURE | <p>(may be written HO—)</p>                                | NAME OF COMPOUND  |
| EXAMPLE   | <p>Ethanol, the alcohol present in alcoholic beverages</p> | FUNCTIONAL PROPERTIES   |
|           |  | <p>Alcohols (their specific names usually end in-ol)</p> <ul style="list-style-type: none"> <li>• Is polar as a result of the electrons spending more time near the electronegative oxygen atom.</li> <li>• Can form hydrogen bonds with water molecules, helping dissolve organic compounds such as sugars.</li> </ul> |

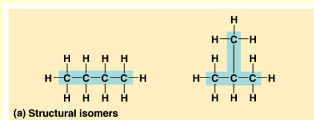
| Carboxyl  |  |  |
|-----------|--|--|
| STRUCTURE |  | NAME OF COMPOUND   |
| EXAMPLE   | <p>Acetic acid, which gives vinegar its sour taste</p> | FUNCTIONAL PROPERTIES  |
|           |  | <p>Carboxylic acids, or organic acids</p> <ul style="list-style-type: none"> <li>• Has acidic properties because the covalent bond between oxygen and hydrogen is so polar; for example,</li> </ul> $\text{H}-\text{C}(\text{OH})-\text{C}(=\text{O})-\text{H} \rightleftharpoons \text{H}-\text{C}(\text{OH})-\text{C}(=\text{O})-\text{O}^- + \text{H}^+$ <p>Acetic acid      Acetate ion</p> <ul style="list-style-type: none"> <li>• Found in cells in the ionized form with a charge of 1- and called a carboxylate ion (here, specifically, the acetate ion).</li> </ul> |

| Amino     |  |  |
|-----------|--|--|
| STRUCTURE |  | NAME OF COMPOUND   |
| EXAMPLE   | <p>Glycine</p> <p>Because it also has a carboxyl group, glycine is both an amine and a carboxylic acid; compounds with both groups are called amino acids.</p> | FUNCTIONAL PROPERTIES  |
|           |  | <p>Amines</p> <ul style="list-style-type: none"> <li>• Acts as a base; can pick up an H<sup>+</sup> from the surrounding solution (water, in living organisms).</li> </ul> $\begin{array}{c} \text{H} \\   \\ \text{H}-\text{N}-\text{H} \\   \\ \text{H} \end{array} + \text{H}^+ \rightleftharpoons \begin{array}{c} \text{H} \\   \\ \text{H}-\text{N}^+-\text{H} \\   \\ \text{H} \end{array}$ <p>(nonionized)      (ionized)</p> <ul style="list-style-type: none"> <li>• Ionized, with a charge of 1+, under cellular conditions.</li> </ul> |

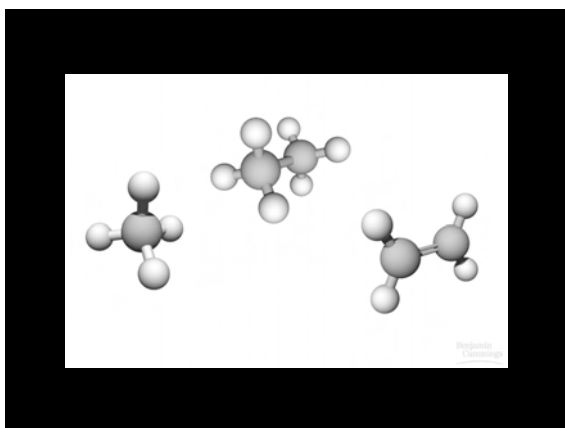
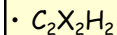


- Isomers have the same formula, but different shapes.

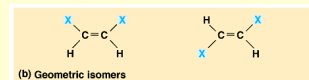
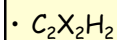
Structural isomers have atoms bonded in different orders:  
 $C_4H_{10}$



- Geometric isomers have different arrangements around a double bond



- Geometric isomers have different arrangements around a double bond



cis

trans

- Enantiomers are mirror images of each other

- Note central carbon bonded to four different things.

- Alanine

