**Learning Goals:** I will be able to...

- explain the general properties of hydrocarbon derivatives (i.e. contain oxygen or nitrogen)- ex. polarity, solubility, melting/boiling point

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**Polar Bonds and the Properties of Hydrocarbon Derivatives**

**Hydrocarbons are non-polar molecules**

*They consist of non-polar carbon-carbon (C-C) and carbon-hydrogen (C-H) bonds.

\[
\Delta \text{EN}_{(C-C)} = 2.6 - 2.6 = 0 \\
\Delta \text{EN}_{(C-H)} = 2.6 - 2.2 = 0.4
\]

Replacing part of a hydrocarbon with a functional group (particularly with C-O bonds) will change the compound's SOLUBILITY.

\[
\Delta \text{EN}_{(C-O)} = 3.4 - 2.6 = 0.8
\]

*Adding the hydroxyl group (-OH) results in a polar molecule

Remember... **solubility rule:** LIKE DISSOLVES LIKE! Polar substances dissolve in polar solvents; nonpolar substances dissolve in nonpolar solvents.

Ex) Methanol (CH₃-OH) a **polar** substance, is **soluble** in water, a **polar** solvent. Methane (CH₄) a **nonpolar** substance, is **NOT soluble** in water.
Hydrogen Bonding

Adding an -OH group INCREASES the attractive forces ("Intermolecular forces") between its molecules.

N.B. When hydrogen of one molecule is attracted to oxygen from another, the strong attractive force that results is called hydrogen bonding.

When attractive forces are higher, a larger amount of energy is needed to separate the molecules, so BOILING POINT increases.

Ex) Boiling point of methanol (CH₃-OH) > methane (CH₄)

Check Your Understanding

A) Match the name of the functional group with the correct structural diagram. Then name the type of hydrocarbon derivative that contains this functional group.

1) H-C        a) carbonyl : ________________
2) H-O-H      b) hydroxyl : ________________
3) H-N         c) amino : ________________
4) H-C        d) carboxyl : ________________
5) H-C        e) halogen : ________________
6) H-C        f) ester : ________________
7) H-C        g) amide : ________________

B) List the compounds in order from least polar to most polar. Explain your reasoning.

<table>
<thead>
<tr>
<th>Type of Organic Compound</th>
<th>Boiling Point (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>propene</td>
<td>-41</td>
</tr>
<tr>
<td>propional</td>
<td>97</td>
</tr>
<tr>
<td>propionic acid</td>
<td>141</td>
</tr>
</tbody>
</table>

C) Will octane dissolve in water? Explain why it will or will not.
Check Your Understanding - ANSWERS

Name: ____________________

A) Match the name of the functional group with the correct structural diagram. Then name the type of hydrocarbon derivative that contains this functional group.

1) ________ a) carbonyl : aldehyde or ketone
2) ________ b) hydroxyl : alcohol
3) ________ c) amino : amine
4) ________ d) carboxyl : carboxylic acid
5) ________ e) halogen : halocarbon
6) ________ f) ester : ester
7) ________ g) amide : amide

B) List the compounds in order from least polar to most polar. Explain your reasoning.

<table>
<thead>
<tr>
<th>Boiling Points</th>
<th>Boiling Point (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>propane</td>
<td>least 1</td>
</tr>
<tr>
<td>propanal</td>
<td>97 2</td>
</tr>
<tr>
<td>propanoic acid</td>
<td>most 141 3</td>
</tr>
</tbody>
</table>

Propane has non-polar C-C & C-H bonds (EN <0.5), so the molecule is non-polar. Propanol has hydroxyl functional group (O-H bond = polar) so molecule is polar. Propanoic acid has carboxyl functional group (O-H and C-O bonds = polar) so molecule is even more polar. The more polar the molecule, the more energy is needed to break the attractive forces between molecules (lots of H-bonding) and the higher the boiling point.

C) Will octane dissolve in water? Explain why it will or will not.

No! Octane is a non-polar molecule and water is a polar molecule. (*Like dissolves like*).

Homework - Study for QUIZ #2 tomorrow!

- Properties and Uses of Hydrocarbons (*Fractional Distillation and Cracking*)

- Hydrocarbon Derivatives: Identification (Functional Groups), Properties and Uses