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Unit 11. Organic Chemistry and Energy

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Organic Chemistry

Based on the element carbon

Hydrogen is always present

Nitrogen and oxygen are the other primary elements

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There are a Huge Number of Organic Molecules

100 new ones described every week

It is estimated that there could be 5×10^{20} different organic molecules

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Energy from Fuels

1. Write the equation showing all bonds
2. Bond Enthalpies: Table 9.1
3. Determine the sum of bond enthalpies for product and reactant: difference is the energy given off during the reaction.

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Hydrocarbons

Hydrocarbon- molecule composed only of carbon and hydrogen.

Alkane- C and H linked only by single bonds

Alkene- contain one or more *double* bonds

Alkyne- contain one or more *triple* bonds

Aromatic- contain one or more *benzene rings*

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Physical Properties of Hydrocarbons

1. Polarity
Nonpolar
2. State
Most gas or liquid, some solid.
3. Soluble in _____ solvents.

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Alkanes

meth-ane	1 carbon
eth-ane	2 carbons
prop-ane	3 carbons
but-ane	4 carbons
pent-ane	5 carbons
hex-ane	6 carbons
hept-ane	7 carbons
oct-ane	8 carbons
non-ane	9 carbons
dec-ane	10 carbons

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Alkenes - Unsaturated Hydrocarbons

Monounsaturated- one double bond

Polyunsaturated- two or more double bonds

C_nH_{2n} is the general formula for monounsaturated

more reactive than alkanes (double bond unstable)

less dense than alkanes (~same volume, fewer atoms)

ethene (ethylene) is the simplest and most common

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Cis-Trans Isomerism

Isomer-previously defined

Geometric isomer-R groups are attached to specific sides of molecules: three possibilities.

Cis Trans Neither

1. Must have 2 R groups
2. R groups must be attached to different carbons
3. Larger R groups get priority

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Fuels

Fuel- a molecule which can be *combusted* to release energy.

Combustion- burning in air to produce energy (heat and light).

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Energy From Fuels

Different fuels have different energy content: depends on the type of bonds as well as the stoichiometry of the combustion rxn.

C-C is 83 kcal/mol; C=C is 146 kcal/mol; C≡C is 200

C-H is 99 kcal/mol

methane 11.5 kcal/g

octane 11.5 kcal/g

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Petroleum and Fuels

- Mixture of many different molecules
- Depending on size, used in different places
 - Methane vs. Propane vs. Octane

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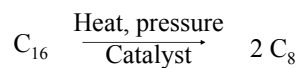
Fractional Distillation

- Used to separate molecules by (size)
 - Fig 9.8- experimental system
 - Fig 9.9- production system
- Essential components
 - heater
 - cooling region
 - way of collecting fractions

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Cracking

- “Cracking” is done to break larger molecules into smaller that are more in demand



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Energy From Fuels Revisited (Alternative Fuels)

Fuel	kcal/g
alkanes	11.5
coal	7.4
Wood	4.3
hydrogen	34.0
methanol	5.4
ethanol	7.1