GEMS 160 February 24, 2006

- Finish Ch. 6, organic molecules
- Ch. 6 homework due Monday
- Begin Ch. 7
- Chem in the news
  - Today: Julie Robinson
  - Monday: Kathleen Burkhardt

“Oceans May Soon Be More Corrosive Than When The Dinosaurs Died” Julie Robinson

- Ken Caldeira of the Carnegie Institution's Department of Global Ecology has predicted that the oceans will become more acidic within the next century.
- Burning coal, oil, and gases produces carbon dioxide which then dissolves into the ocean, becoming carbonic acid and making the ocean water more acidic.
- Usually the sediment on the ocean floor acts as a buffer against increases in acidity, but the rate of increasing acidity is so high that it is being overwhelmed.

- The rising levels of carbonic acid will be especially damaging to marine animals that use calcium carbonate to make their shells, such as coral.
- The last time the oceans saw such a change in acidity was 65 million years ago when the dinosaurs went extinct. Scientists have studied fossils and discovered the extinction of species with calcium carbonate shells, especially plankton or coral.
- Caldeira warns us that our energy systems could cause the wide-scale destruction of coral reefs and marine organisms, a fact which should "help motivate the search for new energy sources, such as wind and solar, that can fuel economic growth without releasing dangerous CO2 into the environment."

  * [link](http://www.sciencedaily.com/releases/2006/02/060220232335.htm)

How many hydrogens?!

- The maximum number of hydrogens in a hydrocarbon \( \Rightarrow \) SATURATED
  - This is an ALKANE
- If hydrogen can be added the compound is UNSATURATED
  - Hydrocarbons with double and/or triple bonds, often many “multiple bonds” in one molecule
- Saturated fats (w/o double bonds) tend toward cholesterol production by the liver
- Polyunsaturated oils (many double bonds) are better dietary choices

The AROMATIC family

- The common characteristic is at least one 6 carbon ring that has 3 double bonds
  - Typically referred to as a benzene ring
- Common in
  - Plastics
  - Synthetic fibers
  - Pharmaceuticals
  - Gasoline
  - Dyes and inks
  - Food flavorings

Cycloalkane vs Aromatic

- What is characteristic of alkane?
  - Single bonds or saturated
- What is characteristic of aromatic?
  - Unsaturated ring
- There are hydrocarbons that have combinations of double bonds, rings, triple bonds and aromatic in a single compound
Beyond hydrocarbons
- Elements in periodic table are grouped by families with similar chemical properties
- Molecules can be looked at in terms of small sets of atoms that have similar chemical properties.
- These small sets of covalently bonded atoms are called “functional groups”
- Some examples -

The daily consumption of gasoline in the US is approximately

0% 1. 25% of the daily global consumption
8% 2. 43% …
2% 3. 45% …
3% 4. 55% …

The weight of 1L of gasoline is approximately

0% 1. 1200 grams
87% 2. 1000 grams
73% 3. 740 grams
### Hydrocarbons and energy - Ch. 7
- **Useful fuel for the gasoline engine**
  - Large amount of energy/gram
  - Have a reasonable cost
  - Be easily vaporized (boiling point)
  - Burn smoothly and evenly
- **Achieved through a mixture of hydrocarbons**
  - Chain length and boiling point (volatility)
  - Branching and boiling point
  - Concept of structure, property and function

### Octane - a measure of gasoline function
- **What is needed to obtain the maximum amount of energy from gasoline?**
  - A high compression ratio
  - 4.4 for 1925 autos
  - 10 or more in modern cars
- **High compression ratio requires proper combustion of gasoline in the chamber**
  - A well-timed, “smooth” burn
  - No “knocking” - a pre-ignition or uneven burning
  - Octane is a measure of resistance to knocking, higher octane means less knocking

### What contributes to high octane?
- **Highly branched alkanes have good octane ratings**
  - Octane is 20
  - 2,2,4-trimethyl pentane is 100
- **Why not have mostly branched alkanes if high octane is good?**
  - Relation between branching and volatility?
  - If too volatile, there can be too little oxygen for combustion
  - Vapor lock (a gas bubble that blocks fuel flow)
  - Expense
- **The answer to affordable octane**
  - 1920’s - 70’s, tetraethyl lead
  - 1970’s, catalytic converters, get the lead out

### Function of catalytic converter
- **Speeds up reactions, they can take place under milder conditions**
- **Reactions occur to form a greater amount of products**
- **Normal combustion of hydrocarbons is typically not complete**
  - Some of the carbon ends up as CO instead of CO₂
  - Small amounts of various unburned hydrocarbons are produced
- **Catalytic converter helps with complete conversion of the hydrocarbon fuel to CO₂ and water.**
- **Catalytic converter actually increases greenhouse gas emissions while reducing other pollution problems.**