GEMS 160  4/12/06

• Thursday lab
  – Video, discovery of radioactivity (30 min), discussion
  – Exam Ch. 13 and 21 (no math !!)
  – Morning lab start at 8:30, afternoon at 12:00
• Questions for poster session due Friday, 4/14
• Chem news notebooks: two weeks left - this week and next, due Friday, 4/21
• Final comments Ch. 21, moving on to nuclear - Ch. 4
• Chem news:
  • Today: - David Grinnell, Tiffany Thaler
  • Next Monday - Mia Rizzo

• Study on the effects of "dog-appeasing pheromone" (DAP) on dogs in an animal shelter.
  • Plug-in diffusers continuously released the airborne molecules to 37 dogs, while a control group of 17 dogs received none. A graduate student, unaware of which dogs were exposed, then studied the dogs' behaviour for a week.
  • The DAP dogs barked less frequently and more quietly and showed more interest in strangers who approached their cages. Sound meters registered an overall peak barking level of 80 decibels for the dogs inhaling pheromones compared to highs of 100 decibels in the control dogs.
  • [http://www.newscientist.com/article.ns?id=dn4923](http://www.newscientist.com/article.ns?id=dn4923)

Jefferson Researchers Discover that Nanoparticle shows promise in reducing Radiation Side Effects

• Fullerene nanoparticles have been found useful in preventing damage that radiation causes to normal tissue.
• Fullerenes are soccer ball-shaped, hollow, carbon-based.
• Fullerenes act as an “oxygen-sink” binding to dangerous oxygen radicals produced by radiation.
• Before, Amifostine was the only drug to help protect against the sides effects of chemotherapy and radiation.
• Scientists are using zebrafish embryos which are transparent the first month of life. This allows them to be able to closely observe the organ damage produced by cancer treatment.
• Fullerene showed to provide organ-specific protection (kidney & certain parts of the nervous system)
• Future studies: determine if Fullerene protects the entire animal from radiation, how it works to protect specific organs, and ability to prevent long-term side effects of radiation
  • [http://www.sciencedaily.com/releases/2006/04/060405235329.htm](http://www.sciencedaily.com/releases/2006/04/060405235329.htm)

A condensation type polymer

1. Needs water in order to make the polymer
2. Has water as part of the polymer
3. Generates water when it is formed
4. Adsorbs water from the atmosphere

Condensation polymers and biology

• An amino acid is a di-functional molecule (21.18)
  – Each amino acid is a monomer
  – They join end-to-end by the elimination of water to form the protein polymers that make most body organs - see also 17.7
• Starch and cellulose are “sugar polymers” (21.6)
  – A sugar molecule is a monomer
  – The elimination of water from two -OH groups on the molecule leaves a -O- as the link between two units in the chain.
  – See also 16.10, 16.11
The main source of the monomer for most commercial polymers is

- 1. Corn and soybeans
- 2. Crude oil
- 3. "rubber" trees
- 4. Recycled plastic products

- Polyethylene terephthalate, PET
- Clear tough plastic, may be used as a fibre.
- NEW: Soft drink and mineral water bottles, filling for sleeping bags and pillows, textile fibres.

- Polypropylene, PP
- Hard, but flexible plastic - many uses.
- NEW: Ice cream containers, potato crisp bags, drinking straws, hinged lunch boxes.
- Recycle: Compost bins, kerbside recycling crates, worm factories.

- High density polyethylene, HDPE
- Very common plastic, usually white or coloured.
- NEW: Crinkly shopping bags, potato crisp bags, milk and cream bottles, bottles for shampoo and cleansers, milk crates.
- RECYCLE: Compost bins, detergent bottles, crates, mobile rubbish bins, agricultural pipes, pallets, kerbside recycling crates.

- Low density polyethylene, LDPE
- Soft, flexible plastic.
- NEW: Lids of ice cream containers, garbage bags, garbage bins, black plastic sheet.
- RECYCLE: Film for builders, industry, packaging and plant nurseries, bags.

- Unplasticised polyvinyl chloride, UPVC
- Hard rigid plastic, may be clear.
- NEW: Clear cordial and juice bottles, blister packs, plumbing pipes and fittings.
- RECYCLE: Detergent bottles, tiles, plumbing pipe fittings.

- Plasticised polyvinyl chloride, PPVC
- Flexible, clear, elastic plastic.
- NEW: Garden hose, shoe soles, blood bags and tubing.
- RECYCLE: Hose inner core, industrial flooring.

- Polystyrene, PS
- Rigid, brittle plastic. May be clear, glassy.
- NEW: Yoghurt containers, plastic cutlery, imitation crystal "glassware".
- RECYCLE: Clothes pegs, coat hangers, office accessories, spools, rulers, video/CD boxes.

- Styrofoam, EPS
- Foamed, lightweight, energy absorbing, thermal insulation
- NEW: Hot drink cups, takeaway food containers, meat trays, packaging.

Serendipity and radioactivity

- Antoine Becquerel - 1896
- Phosphorescence, X-rays and uranium
- Uranium + sunlight ==>
  Phosphorescence + X-rays
- Put uranium on top of covered film while the sun is shining
  Covered film is exposed
- Suggested a connection between phosphorescence and X-rays
One cloudy day ……

- No sunlight, no phosphorescence
- By accident, put uranium on top of covered film
- Covered film still exposed
- Suggested no connection between phosphorescence and X-rays

Marie Curie - 1898

- The mysterious radiation was not connected with sunlight, X-rays or phosphorescence
- **Radioactivity** - the spontaneous emission of radiant energy and/or high energy particles from a nucleus
- 1903 - Nobel prize in physics
- 1911 - 2nd Nobel prize for discovery of radium (88) and polonium (84)

Types of radioactivity

- 1899 - Rutherford
  - \( \alpha \) (alpha), easily stopped by thin material
  - \( \beta \) (beta), more penetrating
- Villard
  - \( \gamma \) (gamma), highly penetrating
- The emission of radiation resulted in a change in atomic number and mass number
- Existence of stable (non-radioactive) isotopes and radioactive isotopes
- Isotope symbol:
  - \( Z \) \( \Rightarrow \) atomic number
  - \( A \) \( \Rightarrow \) mass number

\[ ^{A}X \]

\( \alpha, \beta \) and \( \gamma \) in detail

- Alpha: 2 protons and 2 neutrons
  - \( ^{4}_{2} \alpha \) \( ^{4}_{2} \text{He}^{2+} \)
  - Because of its size, mass and charge it does not travel very far. Velocity of 5% - 7% the speed of light.
  - Nucleus that loses an \( \alpha \) drops by two units in atomic number and by 4 amu in mass. A new element is formed.

\( \alpha, \beta \) and \( \gamma \) in detail

- Beta: a single electron, virtually no mass
  - \( ^{0}_{-1} \beta \) \( ^{0}_{-1} \text{e} \)
  - Because of its small size and charge it travels quite far. Velocity of 90% the speed of light.
  - Nucleus that loses a \( \beta \) increases by one unit in atomic number. A new element is formed.

\( \alpha, \beta \) and \( \gamma \) in detail

- Gamma: electromagnetic radiation, no mass, no charge
  - \( ^{0}_{0} \gamma \) \( \gamma \)
  - Because it has no mass and no charge it penetrates very well. Speed of light.
  - Causes no change in mass or atomic number. Associated with \( \alpha \) and \( \beta \) emission.
  - Collectively referred to as ionizing radiation.