Cycles and Pollution
Water Properties

- **Universal Solvent**: dissolves many substances.
- **Polar Molecule**: the shared electrons of each water molecule aren’t evenly spread throughout the molecule.
- **Substances** that dissolve in water have partial charges that interact with water molecules.
Acids

- Donates hydrogen ions to form hydronium (H₃O⁺) ions.
- Turns blue litmus paper red.
- Conduct electricity.
Bases

- Contains hydroxide ions (OH⁻) or reacts with water to form hydroxide ions.
- Bitter taste
- Slippery
- Conduct electricity
- Turns red litmus paper blue.
pH Scale

- The measure of the hydronium ion concentration in a solution.
- Range is from 0-14
- $< 7$ is acidic $\text{H}_3\text{O}^+$
- $\text{OH}^-$
- $> 7$ is basic $\text{OH}^- > \text{H}_3\text{O}$
- 7 is neutral $\text{OH}^- = \text{H}_3\text{O}$
Neutralization Reactions

- A reaction between hydronium ions and hydroxide ions to form water molecules.
- The resulting solution is more neutral than either of the reactants.
- Strong acids and bases react to form water and salt.
- Example: $\text{KOH} + \text{HNO}_3 \rightarrow \text{KNO}_3 + \text{H}_2\text{O}$
Water Cycle

- Evaporation: Solar energy hits surface water and causes water molecules to move to gas state.
- Transpiration: Plants lose moisture to atmosphere.
- Condensation: Water vapor rises, cools and condenses into tiny water droplets (clouds)
- Precipitation: clouds cool, condense and release moisture.
- Groundwater: Water filters into ground.
- Surface Water: any standing water on the surface of Earth. Oceans, lakes, rivers, etc..
Water Pollution

- Pollution: the contamination of the air, water or soil.
- Most water pollution can be traced to industrial waste, agricultural fertilizers and everyday human activities: Soap, Sewage, Sediment.
Fertilizers

- Applied to farms and lawns and washed away by rain and end up in stream, rivers, lakes or ponds.
- Contain nitrate ions which encourage the growth of bacteria and algae.
Artificial Eutrophication

- An increase in the amount of nutrients.
  1. Excess nitrates released in water.
  2. Algal bloom
  3. Algae die and fall to bottom.
  4. Bacteria feed on dead algae
  5. Bacteria use up available oxygen in water.
  6. Fish and aquatic wildlife die.
Pesticides

- Applied by agriculture and homeowners
- Washed by rain into streams, lakes or ponds.
- Ingested by fish and aquatic wildlife
- Passed along the food chain
- Accumulate up the food chain – Biomagnification or bioaccumulation
DDT

- Was used to control mosquitoes.
- Caused the eggs of fish eating birds like pelicans and osprey to become thin and fragile.
- Bird population numbers dropped because young did not survive.
Earth’s Atmosphere

- **Troposphere**: Layer closest to Earth. Where weather occurs. Densest because of weight of all other layers.
- **Stratosphere**: Layer above troposphere. Contains the ozone layer.
- **Mesosphere**: Coldest layer.
- **Thermosphere**: Warmest layer.
- **Exosphere**: Outermost portion of thermosphere.
Air Pollution

- Comes in many forms from individual molecules to clumps of dust called particulates.
- Combustion of fossil fuels produces the most air pollution.
- Burning of fossil fuels releases:
  1. Energy
  2. Carbon dioxide
  3. Water Vapor
  4. Sulfur Oxides
  5. Nitrogen oxides
Photochemical Smog

- Thick, brownish haze formed when certain gases in the air react with sunlight.
- Major sources = automobiles
- Releases hydrocarbons and nitrogen oxides
- React in sunlight to produce ozone – the major chemical in smog.
- Health effects: lung problems, asthma, breathing conditions.
Temperature Inversion

- Layer of warm air moves over the more dense cold air.
- The warm air gets trapped between 2 layers of cold air.
- Polluted air gets trapped at Earth’s surface and gets more concentrated.
Indoor Air Pollutants

- Dust
- Pet Hair
- Cigarette Smoke
- Perfumes/Air Fresheners
- Asbestos
- Radon
- Carbon Monoxide: forms when wood, coal, oil or gas are incompletely burned.
Ozone Depletion

- Good ozone: in stratosphere, protects from UV rays.
- Chlorofluorocarbons (CFC’s) contain chlorine and fluorine.
- React with ozone and block the cycle that absorbs ultraviolet rays.
- Stable and remain in atmosphere for a long time.
- Banned in 2000.
- Ozone recovery???
Carbon Cycle

- Present in atmosphere as carbon dioxide
- Producers take in CO$_2$ from atmosphere during photosynthesis. Use C from CO$_2$ to produce other carbon molecules (sugars, starches, cellulose and proteins)
- Consumers break down those molecules into simpler forms.
- Consumers release water and CO$_2$ as waste products.
- Plants produce the O$_2$ consumers take in.
- Fossil fuels contain carbon BUT not part of cycle unless brought to the surface – through combustion.
Nitrogen Cycle

- In atmosphere as $\text{N}_2$ called “free nitrogen”
- Cannot be utilized by organisms.
- **Nitrogen Fixation**: process of changing $\text{N}_2$ gas into a usable form. Done by bacteria – called nitrogen fixing bacteria.
- Bacteria live in soil and in the root nodules of certain plants called legumes.
  
  Examples: clover, alfalfa, beans, peas, peanuts.
Nitrogen Cycle

- Decomposers break down compounds in animal waste and in bodies of dead organisms.
- Return the nitrogen back to the soil.
- **Denitrification**: bacteria can eventually break down the nitrogen compounds completely.
- Return Nitrogen back into atmosphere.
- Denitrifying bacteria
Greenhouse Effect

- Atmosphere allows sunlight to reach Earth’s surface but prevent the heat from escaping back into space.
- Without it Earth would be much colder
- Water Vapor
- Carbon Dioxide
- Methane
- Other Gases
Global Warming

- Since the 1800’s CO$_2$ has increased, by 2020 it will be 2x its present level.
- An increase in Earth’s temperature due to an increase in greenhouse gases.
- Due to the combustion of fossil fuels.
Effects of Global Warming

- Ice caps/glaciers melting
- Sea levels rise
- More severe storms
- Change in climate patterns
Land Pollution

- Trash
- Lead
- Hazardous chemicals
- Landfills
- Open dumps
Land Use

- Agriculture
- Business
- Development
- Mining
The 3 R’s

- **Reduce** – create less waste. Example: Composting
- **Reuse** – find another use
- **Recycle** – reclaim raw materials to create new products
- **Biodegradable** – substance that can be broken down and recycled by bacteria and other decomposers.
How can you help??

- Government Regulations
- Alternative Energy Sources
- Conserve Energy
- Carpool
- Conserve Water
What is a Brownfield Site?

Many plots of land in this country have had a previous use, and are occasionally referred to as a brownfield sites. Some of these brownfield sites have been contaminated in the past by industries such as:

- gasworks
- tanneries
- chemical works
- landfills
- former mining sites

What is a Brownfield Site?

Beneath the tarp in the photo is soil contaminated by dioxin and PCBs.

Superfund sites are those Brownfield sites identified by EPA to be cleaned up by law:

Comprehensive Environmental Response, Compensation, and Liability Act
What is a Brownfield Site?

- Many Brownfield sites are located in cities that were once large industrial areas. Now these cities are running out of land and need to reclaim these sites and make them safe for people to live.
What Can Be Done?

- Locate contaminated land
- Inspect potentially contaminated land
- Determine who is responsible for the contamination & cleanup
What Can Be Done?

- Declare land contaminated
- Make sure cleanup takes place
- Consider wildlife that has occupied brownfield sites
- Keeps a registry of contaminated sites

http://www.eco-consult.co.uk/impact_assessment.html
_locate & inspect
contaminated site

Brownfield sites are identified by several methods:

- Review historical use of the site
- Collection of subsurface soil samples
- Check contamination of buildings or other structures on the site
Identification of Responsible Party

Environmental Forensics has the potential to prove who is to pay for the cleanup

Steps in Remediation

- Reduce an immediate hazard.
- Analyze the contamination
- Determine how the hazard has affected the population around the site
- Identify how the site will be “fixed” keeping in mind resources available and how it will be used
- Remediation and/or confinement then takes place.
- Monitor and/or restrict use of the site if necessary
Analyze the Contamination

Complicated Task because it involves:

- A variety of soil types
- Ground and surface water
- A variety of contaminants and how they change over time
- Compilation of a 3-D map of the site
- History of site use
What Can Be Done?

- www.total.com/en/corporate-social-responsibilit...
What Can Be Done?

- Hazardous wastes from Brownfield sites can be incinerated
- The problem----
  - Production of heavy metal emissions such as Hg, As, and Pb
  - Organic pollutants such as dioxin
Cleanup

- Depending on how and where hazardous substances are dispersed, you may need to use an intrusive collection method (pumping, stripping, removing, or excavating) to consolidate environmentally contaminated material for treatment or disposal. These types of operations will usually result in the highest chemical exposure to employees, and require the most physical activity, equipment, and planning.