Environmental Chemistry – Unit C
Study Guide

1.0 – The environment is made up of chemicals that can support or harm living things

1.1 – Chemicals in the Environment – Chemicals occur naturally in the environment
- Study Figure 1.1

- The Nitrogen Cycle
  - Nitrogen Fixation – the process of changing free nitrogen so that the nitrogen atoms can combine with other elements to found compounds that organisms can use.
  - Know all of the steps on pg. 184-185
  - Memorize Fig. 1.3

Define Pollution – is any change in the environment that produces a condition that is harmful to living things.

Know the following activities that affect the environment
- Agricultural Activities – fertilizer, Pesticides
- Solid Waste – Fig. 1.6 sanitary landfill
- Waste water – sewage, septic tank, sewage treatment plant, effluent, storm sewers
- Fuel Combustion – fossil fuels, Know the formula – hydrocarbon + oxygen -> Carbon Dioxide + water + energy
- Industrial Processes – sour gas

1.2 – Acids and Bases
- Acid is a compound that dissolves in water to form a solution with a pH lower than 7
- pH – number of a solution indicates its acidity. Measure of the concentration of hydrogen ions in a solution
- Base is a compound that dissolves that dissolves in water to form a solution with a pH higher than 7

pH scale
- 0-6 = Acid
- 7 = Neutral
- 8-14 Base Fig. 1.10

Acid-Base Indicators
- Are substances that can change colour when they are placed in solutions.
- Universal indicator is a mixture of indicators that change colour over a wide pH range.

Neutralization

- Acid-base REACTION
- Acid + Base → Salt + Water

1.3 – Common substances essential to living things

- Carbon (C), Oxygen (O), Hydrogen (H)
- Organic Compounds – Contain Carbon
- Inorganic Compounds – Do not contain Carbon
- Nutrients – Elements and compounds that organisms need for living, growing, and reproducing.
- Macronutrients – large amounts
- Micronutrients – small amounts
- Know the Chart on page 197
- Optimum Amounts – the amount that provides an organism with the best health

Types of Organic Molecules

- Carbohydrates – sugar, starch, cellulose, glycogen fig 1.18, 1.19
- Lipids – Fats, oils, waxes Fig. 1.19
- Proteins and Amino Acids – meat, fish, eggs, dairy (fig 1.22)
  Proteins are organic molecule and are made up of units called amino acids
- Nucleic acids – are the largest and most complicated molecules found in living things. DNA and RNA (fig 1.24)

1.4 – How Organisms Take in Substances

- Diffusion – the movement of molecules from an area of higher concentration to one of lower concentration (Fig. 1.26)
- Osmosis – water moves from an area where there are more water molecules to an area where there are fewer water molecules
- Active Transport – Needs energy to move molecules of nutrients

Ingestion and absorption of materials by animals

- Ingestion – taking of food into our bodies
- Hydrolysis – breaking down of a substance by water (green section pg 206)
- Substrate – the material on which an organism moves or lives. Read pg. 209

2.0 The quantity of chemicals in the environment can be monitored

- Ozone $O + O2 \rightarrow O3$
- Ozone layer – a shield that protects Earth from damaging UV (ultraviolet radiation

2.1 Monitoring Water Quality

Know the following: read pg 213

- Human drinking water
- Recreation such as swimming
- Livestock drinking water
- Irrigation
- Protection of aquatic life

Biological Indicators

- Scientists use organisms that live in the water to help determine water quality
- Microbiological Indicators – microscopic organisms such as bacteria can cause serious health problems if they are present in large enough numbers
- Aquatic Invertebrates – Animals without backbones that live in the water.

Aquatic Environments

- Read pg. 215
- If the water environment is below 5.0 – you won't find many fish

Chemical Factors that affect Organisms

- Dissolved oxygen
- Acidity
- Heavy metals
- Pesticides
- Plant nutrients such as nitrogen and phosphorus
- Salts such as sodium chloride and magnesium sulfate

Measuring Chemicals in the Enviroment

- Read pg. 216
- Ppm (parts per million) – know how to find this
- Grams of solute/grams of solution x 1000000

Dissolved Oxygen

- Essential for the health of aquatic life such as fish, insects, and micro-organisms
- Read pg 217

Phosphorus and Nitrogen Content

- Read pg. 219, fig 2.7
- Nutrients in water = increased growth of algae and green plants = as more grow more plants die = more food for bacteria = bacteria numbers goes up again = bacteria uses up oxygen in water = less oxygen kills many fish and aquatic insects

Acidity

- Read pg. 220
- Spring acid shock – dramatic change in pH – Increase of acid with means pH level go down

Pesticides and Measuring Toxicity

- Read pg. 221
- Toxicity – describes how poisonous a substance is
- LD50 – LD stands for lethal dose
  - 50 represents 50%, when 50% of a group dies it is considered a lethal dose

Heavy Metals

- Read page 222
- Heavy metals have a density of 5g/cm(^3) or more. This means they are five or more times heavier than an equal volume of water.
- These metals occur naturally in rocks, soil, and sometimes water
- They can be toxic to a wide range of organisms, including humans
- Usually, large amounts of heavy metals are not readily available in the environment for uptake by plants or ingestion by animals. However, some situations can increase their availability.

2.2 Monitoring Air Quality

Can be determined in two ways:

- By measuring the levels of pollutants in the air
- By estimating the amount of emissions from pollution sources

Sulfur Dioxide (SO2)

- Major air pollutant that forms both smog and acid rain.
- Read pg. 225

Nitrogen Oxides (NO, NO2)

- Major air pollutants that form both smog and acid rain
- Mainly from combustion in vehicles
- Read pg. 226

Carbon Monoxide (CO, CO2)

- Called the silent killer because it is a colorless and odourless gas
- Main source of carbon monoxide from human activities is motor vehicles

Ground Level Ozone

- Odourless, colorless gas composed of three oxygen atoms.

2.3 Monitoring the Atmosphere

Carbon Dioxide as a Greenhouse Gas

- Greenhouse Effect – The atmosphere gases that trap heat are called greenhouse gases – water vapour, carbon dioxide, methane, nitrogen oxides are all greenhouse gases
- Enhanced Greenhouse Effect – increased gases from vehicles heat up the earth.

The Role of Chlorofluorocarbons (CFC's)

- Chlorine, Fluorine, Carbon all bonded together
- Attack Ozone(O3) extremely fast!
- Read pg. 232

3.0 Potentially harmful substances are spread and concentrated in the environment in various ways

3.1 Transport of Materials through Air, Soil, and Water

- Dispersion – molecules scatter
- Deposition – in soil or water

Transport in Groundwater

- Pores – tiny spaces between soil grains
- Permeable soil – one with interconnected pores. Things pass easy.

3.2 Changing the concentration of harmful chemicals in the Environment

- Dispersion – is the scattering of a substance away from its source
- Dilution – reduces the concentration of a pollutant by mixing the polluting substance with large quantities of air or water.

Biodegradation

- Break down of substances by micro-organisms
- Factors affecting: temperature, soil moisture, pH, oxygen supply, nutrient availability

Phytoremediation

- Green plants can be used to remove hazardous materials from the soil or ground water.
- E.g. Sunflowers have been used at Chernobyl to remove radioactive suvstances from groundwater

Photolysis

- The breakdown of compounds by sunlight.
- E.G. pg 247

3.3 Hazardous Chemicals affect living things

- Biomagnification – the increase in concentration of a chemical or element as it moves up the food chain
- Read pg. 248

Exxon Valdez – New oil spill clean-up procedures

- Read pg. 251 - 252

3.4 – Hazardous Household Chemicals

- Read over the chemicals – pg. 253 – 258
- MSDS sheet – Material Safety Data Sheet – gives a detailed description of a substance.