

## **MODULE 4: BIOGEOCHEMICAL CYCLES**

Life is composed of many chemicals that have to be available in the **right amounts, right concentrations, and right ratios.**

**Biogeochemical Cycles** - the paths chemicals take through Earth's major systems.

**Earth** - only body in the solar system that has the 4 characteristics

- Liquid Water
- Water at its triple point
- Plate Tectonics
- Life

**Biogeochemical Cycles** takes the complete path through the 4 major components of the Earth's system:

- Atmosphere
- Hydrosphere
- Lithosphere
- Biosphere

**Biogeochemical Cycles** that allow materials to be recycled:

- Water Cycle
- Carbon Cycle
- Sulfur Cycle
- Phosphorus Cycle
- Nitrogen Cycle

**Hydrologic Cycle** - transfer of water from the oceans to the atmosphere and back to the oceans. (includes evaporation, precipitation, transpiration, and runoff)

**Carbon Cycle** - Carbon enters the atmosphere through the respiration of living things, fires that burn organic compounds, and diffusion from the sea.

Carbon is removed from the atmosphere by photosynthesis of green plants, algae, and photosynthetic bacteria.

**Carbon Fixation** - the change of carbon from a gaseous carbon dioxide to less mobile organic molecules.

### **Carbon Cycle**

- **Photosynthesis** (plants take in CO<sub>2</sub>)
- Organic compounds in fossil fuels are generated from plants.
- CO<sub>2</sub> is released from fossil fuels by combustion process.

**Global Warming is traced to the release of carbon from these sinks.** (Burning of fossil fuels, clearing of forests.)

### **Nitrogen Cycle**

#### **Nitrogen**

- an important nutrient for living organisms.
- Present in amino acids, peptides, and proteins.
- Takes up 78% of the Earth's Atmosphere.

**Nitrogen-Fixing Bacteria** - only organisms that live within the roots of some plants, that can use nitrogen gas directly from the atmosphere.

Animals get nitrogen by eating plants or other animals.

Bacteria and "Fungi" are **decomposers**. They break down wastes and dead organisms to return the nitrogen back to the soil in the form of Ammonia (NH<sub>3</sub>). (Start of the process) These bacteria then eat the NH<sub>3</sub> to make proteins in a process called **assimilation**.

Some bacteria do not make NH<sub>3</sub>, instead they make Nitrate in the process called **nitrification**.

Some soil bacteria takes the Nitrate then converts it back to N<sub>2</sub>, returning the

nitrogen back to the atmosphere in a process called **denitrification**.

The process of  $\text{NH}_3$  release is called **ammonification**.

### **Sulfur Cycle**

- Plants cannot convert elemental sulfur into something useful.

Plants depend on **chemoautotrophic bacteria** to oxidize elemental sulfur into sulfate for them to incorporate it into their proteins. ( $2\text{H}_2\text{SO}_4$ )

- Proteins are not only made from carbon and nitrogen, but many important proteins also contain sulfur.
- Sulfur is also an important component of coenzyme A, which is used to produce energy in cellular respiration.
- So the availability of sulfur is essential to maintaining life.

Human activities also release large quantities of sulfur in the process of burning fossil fuels.

### **Phosphorus Cycle**

- The keystone of getting phosphorus into trophic systems are the plants.
- Plants absorb phosphorus from water and soil, go into their tissues, then tie them to organic molecules.
- Once taken up by plants, animals are able to eat the plants and absorb phosphorus.

When animals die, they return the phosphorus back into the soil. Due to water forms, phosphorus is able to travel far from its source, from one ecosystem to another.

### **Phosphorus in Unpolluted Water**

- Is imported through dust in precipitation or weathering of rocks.

### **Phosphorus in Polluted Water**

- Comes from human activities

\* In some cases, phosphorus will travel to a lake and settle at the bottom. It will then turn into sedimentary rocks, limestone, to be released millions of years later.

\*\*\*end\*\*\*

## **MODULE 5: ANALYZING ENVIRONMENTAL HEALTH AND POLLUTION**

### **Root Causes of Environmental Problems:**

1. Overpopulation
2. Resource Consumption
3. Man's Activities
4. Industrial Activities

### **SECOND LAW OF THERMODYNAMICS**

- the tendency of all natural systems to go from a state of order toward a state of increasing disorder.

### **Global Warming and Climate Change**

- Records show that the global temp rises as atmospheric  $\text{CO}_2$  increases.
- United Nations Environment Programme (UNEP) created the Intergovernmental Panel of Climate Change (IPCC, issa kind of study ganon).

### **IPCC Conclusions:**

- Average temp of Earth has increased  $0.3^\circ\text{C}$ - $0.6^\circ\text{C}$  and sea levels have risen by 10-25cm (past 100yrs)

- There is a strong correlation between the increase in temp and amount of greenhouse gasses present.
- Human Activity increases greenhouse gasses

### Effects of Global Warming

- 1. Worsening Health**
  - Mortality from heat waves
  - Poor Air Quality
- 2. Rising Sea Level**
  - Erodes beaches and coastal wetlands.
  - 50cm sea level rise will double the global population while 100 will triple.
- 3. Disruption of Water Cycle and Other Cycles**
  - Droughts, floods
  - Damages to life and property
  - Water Scarcity
- 4. Changes in Forests and Natural Areas**
  - Altering of geographic distribution of vegetation types
  - Reduction in biological diversity
  - Reduction of benefits given by ecosystems.
- 5. Challenges agriculture and food supply**
  - Increase/Decrease in crop yields.
- 6. Ozone Depletion**

### Sustainability Issues

- 1. Population** - increase in resource demand
- 2. Global Atmosphere** - emissions of CO<sub>2</sub>
- 3. Air Quality** - pollution from vehicles and industries
- 4. Fresh Water** - increase in demand
- 5. The Sea** - poorer water quality

- 6. Soil** - erosion and lack of organic matter
- 7. Land Use** - lack of planning
- 8. Minerals** - increase in demand

### OTHER ENVIRONMENTAL PROBLEMS

- **Acid Rains** - acidity in rains come from air pollutants and affects vegetation and physical structures
- **Eutrophication** - a syndrome of ecosystem responding to nitrogen and phosphorus fertilization
- **Algae Blooms** - results from excess of nutrients

### INTERNATIONAL LAWS FOR THE ENVIRONMENT

- 1. Basel Convention** - international treaty to reduce the import/export of hazardous waste. (From developed to less developed nations). Intended to minimize the amount of toxic waste generated.
- 2. Montreal Protocol on Substances that Deplete the Ozone Layer** - landmark international agreement designed to protect the ozone layer. Signed in 1987. Compounds that deplete the Ozone layer must be phased out by the year 2000. (Ung mga CFCs chucchu ganon, tas 2005 ung Methyl chloroform ganon)
- 3. Kyoto Protocol** - international agreement that aims to reduce CO<sub>2</sub> Emissions. Nations are divided by 2, Annex 1 (developed) and Non-annex 1 (developing) <Annex 1 buys carbon credits from Non-Annex 1 nations since emission limitations are only for Annex 1 nations, the more credits, the higher the maximum carbon emissions)

**Carbon Trading** - market based mechanism for helping mitigate CO<sub>2</sub> emissions. Buyers and sellers of carbon credits create a rule of trade.

**Who sells carbon credits?** - entities that manage forest or agricultural land might sell credits based on the accumulation of carbon in their forests.

### **Landmark Legislation on Environment (PH)**

1. RA 6969 - Toxic substances and hazardous and nuclear waste control act of 1990.
2. RA 8749 - Clean Air Act 1999
3. RA 9003 - Ecological Solid Waste Management Act of 2000
4. RA 9275 - Clean Water Act of 2004

## **MODULE 6: WATER POLLUTION**

Water is a chemical substance which is the constituent of Earth's hydrosphere and the fluids of mode living organisms.

- It covers 71% of the Earth's surface.
- Small portions of water occur as groundwater, glaciers, and ice caps.
- Vapor, clouds, and precipitation (0.001%)
- Only 3% of water on Earth is freshwater and only  $\frac{1}{3}$  of it is accessible for farming and cities. (The rest is frozen in the glaciers)
- Main source today are the **aquifers** - underground freshwater storage.

Water can be used **directly** and **indirectly**.

**Directly:**

- Bathing
- Drinking
- Cooking

**Indirectly:**

- Processing wood to make paper
- Producing steel for automobiles

The bulk of the world's water use is for agriculture, industry, and electricity.

Worldwide, industry uses about twice as much water as households, mostly for cooling in the production of electricity. Far more water is needed to produce food and fiber (cereals, fruits, meat, cotton) and maintain the natural environment

## **SUSTAINABILITY AND WATER MANAGEMENT**

An increase in global freshwater consumption has led to the depletion of over half of the world's largest aquifers, freshwater reserves are expected to drop by 40%.

Climate Change **can** threaten ecosystems and environments that protect vital water resources.

- 2015 marks the end of a decade of action by the UN on promoting water and sanitation issues.
- Water sustainability is at the core of the GEF Strategy until 2020.
- Protecting the environment for the coming generations begins with more effective water management today.

## **WATER POLLUTION**

- Is the contamination of water bodies. This form of environmental degradation occurs when pollutants are **directly** or **indirectly** discharged into bodies of water.

### Sources of Water Pollution

- Flooding
- Radioisotopes
- Heavy Metal
- Combustion
- Toxic Waste disposal at Sea
- Deforestation
- Mining
- Littering
- Pesticides
- Fertilizers
- Poor septic systems
- Household Chemicals
- Mineral Processing Plants
- Building lavatories over running water.

### Simple Water Solutions

- Keep lakes clean
- Plant trees to prevent soil erosion
- Keep litter, pet waste, leaves, and grass clippings out of gutters and storm drains.

**Water Treatment** is a system to make water acceptable for a desired usage such as drinking water, industrial utilization, etc.

It is to remove or reduce contaminants in the water to meet the required levels.

Drinking Water should be potable and palatable.

**Potable** - healthy for human consumption

**Palatable** - free from contaminants.

### Pollution Management and Control

1. Wash your car away from storm drains.
2. Don't throw trash, chemicals or solvents into sewer drains.
3. Inspect your septic every 3-5 years.
4. Avoid using pesticides and fertilizers that can run off into water systems.

5. Weep your driveway instead of hosing it down.
6. Always pump your waste-holding tanks on boats.
7. Use non-toxic cleaning materials
8. Clean up oil and other liquids with kitty litter.
9. Don't wash paint brushes in the sink.

### Clean Water Act of 2004 (RA9275)

- Aims to protect the country's bodies of water from pollution from land-based sources.

### Module 7: Air Pollution

**Air Pollution** - alteration of the physical, chemical, and biological properties of the atmosphere.

**Air Pollutant** - any matter other than oxygen, nitrogen, water vapor, CO<sub>2</sub>, chuchu alam nyo na toh T-T

### Major Kinds of Pollutants

- **Primary** - released in harmful form
- **Secondary** - becomes hazardous with reactions to Air

Examples:

*Photochemical Oxidants*

*Atmospheric Acids*

- **Stationary Source** - any bldg which emits air pollutants
- **Mobile Source** - vehicles (mga transpo ganon)
- **Fugitive** - do not go through a smoke stack

Examples:

*Dust from Soil Erosion*

*Rock Crushing*

*Bldg Construction*

*Leaking valves (hydrocarbons)*

### Conventional Air Pollutants

- Sulfur Dioxide

- Carbon Monoxide
- Particulates
- Volatile Organic Compounds
- Nitrogen Oxides
- Ozone
- Lead

**Unconventional Pollutants** - produced in less volume compared to conventional.

- Asbestos
- Benzene
- Beryllium
- Mercury
- Polychlorinated Biphenyls
- Vinyl Chloride

### **Halons**

- a compound of one or two carbon atoms combined with bromine and one or two other halogens.
- Used as fire-extinguishing agents
- Affects the Ozone 10x more than CFCs

**Aesthetic Degradation (ateee ← not part of the title T-T)** - simply reduces quality of life.

1. Noise
2. Odors

### **Effects of Air Pollution**

1. Human Health
2. Plant Pathology
3. Visibility Reduction
4. Acid Deposition

### **Factors that influence deterioration**

- Moisture
- Temperature
- Sunlight
- Position of exposed material

### **Ambient Air Quality**

- Refers to the atmosphere average purity

**Emission** - any air contaminant, pollutant, gas stream or unwanted sound from a known source.

**Pollution Control Device** - device or apparatus used to prevent the pollution of air caused by emissions from identified pollution sources

**Pollution Control Technology** - the devices that effectively prevent emissions. (i.e. Pollution Control Device)

### **Air Pollution Control**

1. **Dilution** - early approach done by tall smokestacks to send emissions far from the source.
2. **Reducing Production of Pollutants by reducing electricity consumption.**
3. **Various Control Methods**

### **Air Pollution Control of Stationary Sources**

#### **a. Gaseous Pollutants**

- Absorption - gas dissolved in liquid
- Adsorption - gas dissolved to a solid
- **Flue Gas Desulfurization** - used to remove sulfur oxides from gas stream
- **Removal of Nitrogen Oxide**

#### **b. Particulate Pollutants**

- Cyclones
- Liquid Scrubbing - used when matter to be collected is wet, corrosive, or very hot.
- **Electrostatic Precipitation** - consists of alternating plates and wires where a large current potential is established resulting in the creation of an ion field

- a. Fly Ash - describes particulate matter carried in effluent gasses.

- **Filters:**
  - Deep Bed
  - Baghouse
  - Synthetic Fibers

#### **Air Pollution Control for Mobile Sources**

- Automobiles
- Control of Design and Operating Variables on Emissions

#### **Waste Minimization**

- The first and best step in any pollution control strategy is to minimize the production of pollutants.

#### **Philippine Clean Air Act of 1999**

- **ARALIN NYO NALANG SA PPT INAANTOK NA KO GAIS MB , 20 sections yon T-T yun nalang kulang WHAHAAHHA**

**\*\*pero ttry q pa rin**

#### **Chapter 1:**

**Section 1** - short title lang (Philippine Clean Air Act of 1999)

**Section 2** - Declaration of PRINCIPLES

**Section 3** - Declaration of POLICIES

**Section 5** - DEFINITIONS used in the Act

#### **Chapter 2:**

**Section 6** - Air Quality Monitoring and Information Network

**Section 9** - Airsheds

**Section 10** - Management of Non-Attainment Areas

**Section 11** - Air Quality Control Techniques

**Section 12** - Ambient Air Quality Guideline Values and Standards

**Section 13** - Emission Charge System

**Section 14** - Air Quality Management Fund

**Section 20** - Ban on Incineration

**Section 21** - Pollution from Motor Vehicles

**Section 22** - Regulation of Motor Vehicles and Engines

**Section 23** - Second Hand Motor Vehicles and Engines

**Section 24** - Pollution from Smoking

**Section 25** - Pollution from mobile sources