REVIEWER IN ENVIRONMENTAL SCIENCES
-made by camile ganda

TOPIC 1 :METALS

What are Metals?

- Metals are minerals or substances that form naturally below the surface of the Earth.
-Most metals are lustrous or shiny.
-Metals are inorganic, which means they are made of substances that were never alive.

-Metals are natural compounds of earth's crust, in which they are generally found in the form of metal ores, associated both with each other and with many other elements.
-They are also naturally present in the rocks washed by surface water and groundwater and in atmospheric dust.

Physical Properties

• The physical properties of metals include shininess, malleability, ductility, and conductivity.
• A malleable material is one that can be hammered or rolled into flat sheets and other shapes.
• A ductile material is one that can be pulled out, or drawn, into a long wire.
• For example, copper can be made into thin sheets and wire because it is malleable and ductile.

• Conductivity is the ability of an object to transfer heat or electricity to another object.
• Most metals are good conductors.
• In addition, a few metals are magnetic.
For example, iron (Fe), cobalt (Co), and nickel (Ni) are attracted to magnets and can be made into magnets.
• Most metals are also solids at room temperature.
However, one metal—mercury (Hg)—is a liquid at room temperature.

Chemical Properties

• The ease and speed with which an element combines, or reacts, with other elements and compounds is called its reactivity.
• Metals usually react by losing electrons to other atoms.
• Some metals are very reactive.
• For example, sodium (Na) reacts strongly when exposed to air or water.
• To prevent a reaction, sodium and metals like it must be stored under oil in sealed containers.
• By comparison, gold (Au) and platinum (Pt) are valued for their lack of reactivity and because they are rare.

Metals in the Periodic Table

•The metals in a group, or family, have similar properties, and these family properties change gradually as you move across the table.
•The reactivity of metals tends to decrease as you move from left to right across the periodic table .

Alkali Metals

• The metals in Group 1, from lithium to francium, are called the alkali metals.
• Alkali metals react with other elements by losing one electron.
• These metals are so reactive that they are never found as uncombined elements in nature.
• Instead, they are found only in compounds. In the laboratory, scientists have been able to isolate alkali metals from their compounds.
• As pure, uncombined elements, some of the alkali metals are shiny and so soft that you can cut them with a plastic knife.

• The two most important alkali metals are sodium and potassium.
• Sodium compounds are found in large amounts in seawater and salt beds.
• Your diet includes foods that contain compounds of sodium and potassium, elements important for life.
• Another alkali metal, lithium, is used in batteries and some medicines.

Alkaline Earth Metals

• Group 2 of the periodic table contains the alkaline earth metals.
• Each is fairly hard, gray-white, and a good conductor of electricity.
• Alkaline earth metals react by losing two electrons.
• These elements are not as reactive as the metals in Group 1, but they are more reactive than most other metals.
• Like the Group 1 metals, the Group 2 metals are never found uncombined in nature.

• The two most common alkaline earth metals are magnesium and calcium.
• Mixing magnesium and a small amount of aluminum makes a strong but lightweight material used in ladders, airplane parts, automobile wheels, and other products.
• Calcium compounds are an essential part of teeth and bones.
• Calcium also helps muscles work properly.
• You get calcium compounds from milk and other dairy products, as well as from green, leafy vegetables.

Transition Metals

• The elements in Groups 3 through 12 are called the transition metals.
• The transition metals include most of the familiar metals, such as iron, copper, nickel, silver, and gold.
• Most of the transition metals are hard and shiny.
• All of the transition metals are good conductors of electricity.
• Many of these metals form colorful compounds.

• The transition metals are less reactive than the metals in Groups 1 and 2.
• This lack of reactivity is the reason ancient gold coins and jewelry are as beautiful and detailed today as they were thousands of years ago.
• Even when iron reacts with air and water, forming rust, it sometimes takes many years to react completely.
• Some transition metals are important to your health.
For example, you would not survive without iron.
• It forms the core of a large molecule called hemoglobin, which carries oxygen in your bloodstream.

Transition Metal Compounds made with transition metals can be very colorful. Several transition metals are used to make paints.

Metals in Mixed Groups

• Only some of the elements in Groups 13 through 15 of the periodic table are metals.
• These metals are not nearly as reactive as those on the left side of the table.
• The most familiar of these metals are aluminum, tin, and lead.
• Aluminum is the lightweight metal used in beverage cans and airplane bodies.
• A thin coating of tin protects steel from corrosion in some cans of food.
• Lead was once used in paints and water pipes.
• But lead is poisonous, so it is no longer used for these purposes. Now, its most common uses are in automobile batteries and weights for balancing tires.

TOPIC 2: WATER

- ✓ Water covers about three quarters of Earth's surface. All known life forms are made mostly of water.
- ✓ The human body is comprised of over 70% water, and it is major component of many body fluids including blood, urine, and saliva.
- ✓ Water is the only natural substance that can exist in all three states of matter at the temperatures normally found on Earth.

WATER MOLECULE

- 1 oxygen atom, 2 hydrogen atoms
- The 3 atoms are held together by polar covalent bonds
- Electrons are not shared equally, they are closer to the oxygen
- Molecule has a bent shape (looks like Mickey head)

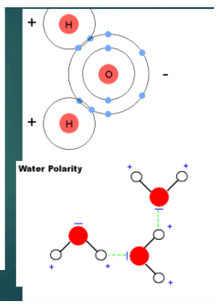
PROPERTIES OF WATER

1. Polarity
2. Capillary Action
   a. Adhesion
   b. Cohesion
3. Surface Tension
4. Heat Capacity
5. Heat of Vaporization
6. Density
7. Universal Solvent

POLARITY

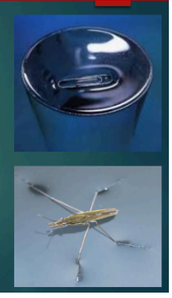
Polar molecule - a molecule with positive and negative charged regions
- In water, electrons shared unequally
  - Oxygen is more electronegative, giving it a partial - charge
  - Hydrogen atoms get a partial + charge

▸ This causes the - end of one water molecule to be attracted to the + end of a different water molecule



Surface Tension

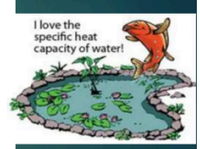
SURFACE TENSION - a measure of the force necessary to stretch or break the surface of a liquid
- Hydrogen bonds between water molecules at surface of water resist breaking creating an invisible film.
- This allows some insects to walk/run on water.



Heat Capacity

HIGH SPECIFIC HEAT - amount of heat that must be absorbed or lost before it actually changes the temperature. It means that water takes longer to heat up and to cool down.
- Water can absorb or release **large** amounts of heat with only a slight change in its own temperature.

Ex: Water takes a long time to boil.
Water in a pond will stay relatively the same from day to night.



Heat of Vaporization

HIGH HEAT OF VAPORIZATION - The cooling of a surface occurs when the liquid evaporates.
- Water's heat of vaporization is around 540 cal/g at 100 °C, water's boiling point.

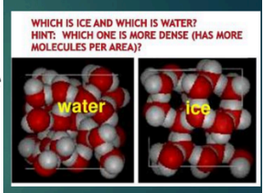
Examples:
When water boils, as the steam leaves the water, it takes the heat with it, and the water cools.

Your body sweats so the water will absorb your heat then evaporate to cool you.

Density

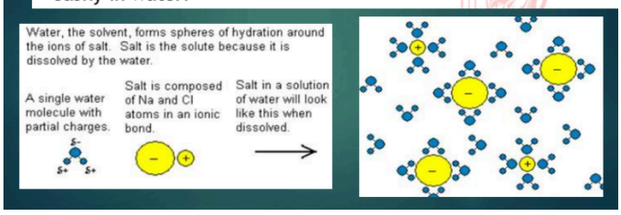
DENSITY - a measure of how compact the atoms or molecules are within a substance or how much mass there is in a given space (volume)

- Water compared to other liquids (like syrup) is not very dense.
- Water is denser as a liquid than as a solid



Universal Solvent

Water is considered universal solvent because it can dissolve many substances. Ions and hydrophilic substances dissolve easily in water.



Classification of Water

- ✓ 97% of the water on the Earth is salt water. 3% is fresh water. Slightly about 2/3 of this is frozen in glaciers and polar ice caps.
- ✓ The remaining unfrozen freshwater is found mainly as groundwater. Only small fraction is present above ground or in air.
- ✓ Fresh water is a renewable source.

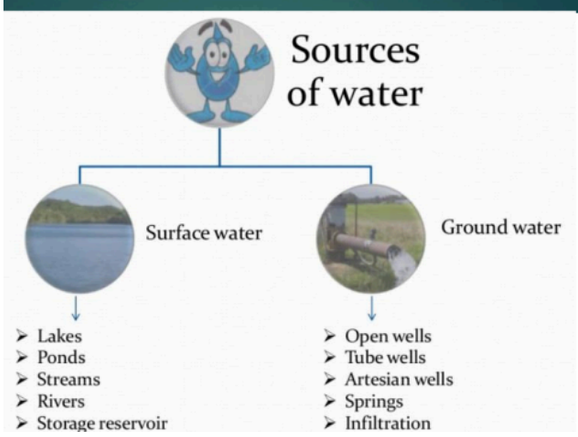
Potable Water

POTABLE WATER - safe for drinking, cooking, bathing and washing dishes.

In contrast, non-potable water is contaminated with pollutants that include particulates from dirt, toxic metals (e.g. arsenic), or bacteria that cause cholera.

Although it is not drinkable, non-potable water has its uses like washing sidewalks, reducing roadway dust or for irrigation.

Sources of Water



Surface water

SURFACE WATER - is the most convenient source for human activities. It can be found in lakes, rivers, and streams.

Ground water

GROUND WATER - It is the fresh water found in underground reservoirs known as aquifers. People worldwide pump groundwater from wells drilled deep into these underground reservoirs. Fresh water is also found in our atmosphere in the form of mists, fogs, and humidity.

Surface and Ground water

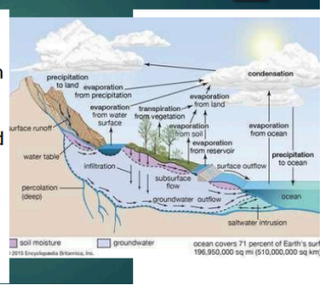
General Characteristics of Groundwater and Surface Water

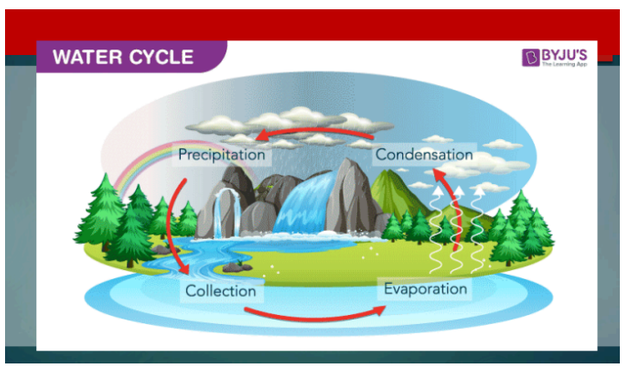
Ground	Surface
Composition is constant	Composition is varying
Mineral content is high	Mineral content is low
Turbidity is Low	Turbidity is high
Has low or no color	Has color
May be bacteriologically safe	Presence of microorganisms
Absence of dissolved oxygen	Presence of dissolved oxygen
Has high hardness	Has low hardness
Presence of H_2S, Fe, Mn	Has taste and odor
Chemical toxicity is possible	Chemical toxicity is possible

Hydrological Cycle

HYDROLOGICAL CYCLE is a cycle that includes all the water present on and in the earth which includes salt and fresh water, surface and groundwater, water present in the clouds and trapped water in rocks far below the earth's surface.

Hydrological cycle mainly describes the movement and conservation of water on Earth.





Two Distinct Processes

Two distinct processes for the transfer of water to the earth's atmosphere:

1. **EVAPORATION** is the conversion of liquid water from lakes, streams, and other bodies of water into water vapor.
2. **TRANSPIRATION** is the process by which water is emitted from plants through the stomata (*small opening on the underside of leaves that are connected to the vascular tissue*). Predominantly, it occurs at the leaves while the stomata are open for the passage of carbon dioxide (CO_2) and oxygen (O_2) during photosynthesis.

Steps in the water cycle

- **Evaporation**: Liquid water changes into water vapor. The sun's energy breaks the bonds between water molecules, causing them to evaporate into the air.
-
- **Condensation**: Water vapor cools and turns back into liquid, forming clouds.
- **Precipitation**: Water falls back to Earth as rain or snow.

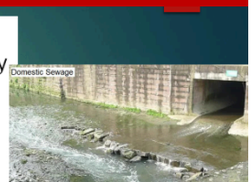
Precipitation

PRECIPITATION is the primary mechanism by which water is released from the atmosphere. Precipitation takes several forms, the most common of which is rain. Additionally, water can fall as hail, snow, sleet, and freezing rain.

As water falls to the earth's surface, the droplets either run over the ground into streams and rivers (referred to as **surface runoff**, **overland flow**, or **direct runoff**), move laterally just below the ground surface (**interflow**), or move vertically through the soils to form groundwater (**infiltration or percolation**).

Sources of Pollutants in Water

POINT SOURCES These are domestic and industrial wastes that are usually collected by a network of pipes or channels and transmitted to a single point of discharge into the receiving water. Domestic sewage along with any industrial wastes that are permitted to be discharged into the sanitary sewers are termed as municipal sewage.

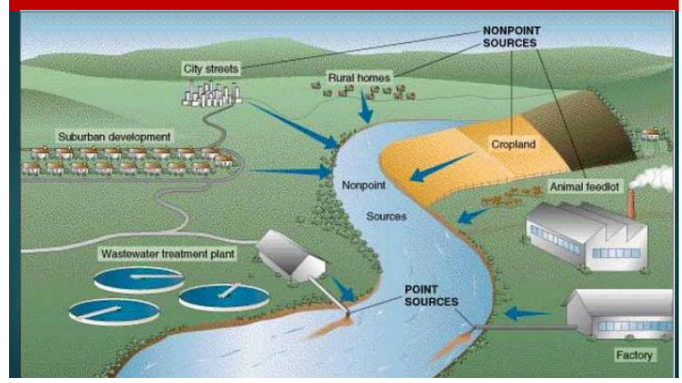


Sources of Pollutants in Water

NONPOINT SOURCES are urban and agricultural runoff which has multiple discharge points. The polluted water usually flows over the surface of the land or along common drainage channel to the nearest body of water.

Storm water run off from different sources can transport pollutants such as nitrogen from fertilizers, herbicides applied to lawns and golf courses, oil, greases, ethylene glycol and other organic debris.

Sources of Pollutants in Water



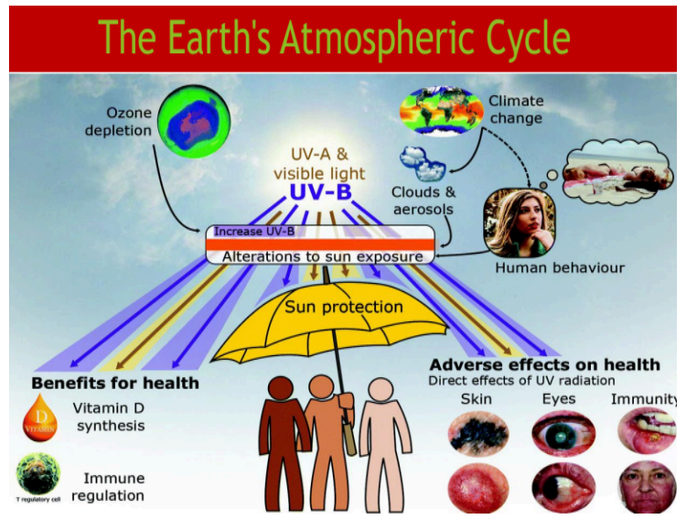
TOPIC 3:ATMOSPHERE

The Earth's Atmospheric Cycle

The atmosphere is a protective blanket which nurtures life on the Earth and protects it from the hostile environment of outer space. It is generally believed that three billion or four billion years ago, Earth's atmosphere consisted mainly of ammonia, methane, and water.

Ultraviolet (UV) radiation from the sun probably penetrated the atmosphere, rendering the surface of Earth sterile. However, the same UV radiation may have triggered the chemical reactions that eventually led to life on Earth.

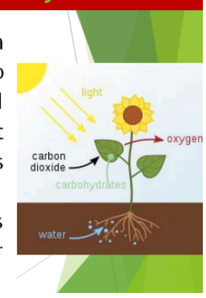
The Earth's Atmospheric Cycle



The Earth's Atmospheric Cycle

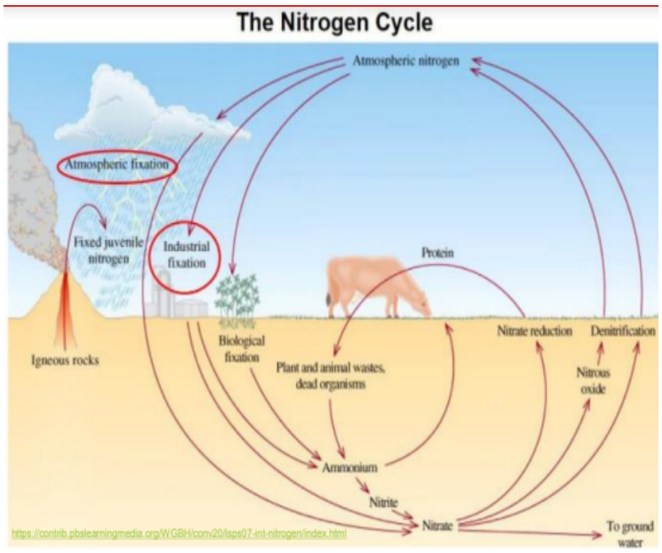
Primitive organisms use energy from the sun to break down carbon dioxide to obtain carbon, which they incorporated in their own cells. The major by-product of this process, called ***photosynthesis***, is oxygen.

Another important source of oxygen is the ***photodecomposition*** of water vapor by UV light.



Nitrogen Cycle

Molecular nitrogen, with its triple bond, is a very stable molecule. In the conversion of molecular nitrogen into nitrogen compounds, atmospheric nitrogen gas is converted into nitrates and other compounds suitable for assimilation by algae and plants. Lightning also produce nitrates from nitrogen gas.



Nitrogen Cycle

Nitric acid is converted to nitrate salts in the soil. These nutrients are taken up by plants, which in turn are ingested by animals. Animals use the nutrients from plants to make proteins and other essential biomolecules. Denitrification reverses nitrogen fixation to complete the cycle.

Layers of the Atmosphere

Scientists divide the atmosphere into several different layers according to temperature variation and composition. As far as visible events are concerned, the most active region is the troposphere, the layer of the atmosphere that contains about 80% of the total mass of air and all of the atmosphere's water vapor. The troposphere is the thinnest layer of the atmosphere (10 km), but it is where rain, lightning, and hurricanes occur.

Layers of the Atmo

Above the troposphere is the stratosphere, which consists of nitrogen, oxygen, and ozone. Here, the air temperature rises with altitude. This warming effect is the result of exothermic reactions triggered by UV radiation. One of the products of this reaction sequence is ozone (O_3), serves to prevent harmful UV rays from reaching Earth's surface.

In the mesosphere, the concentration of ozone and other gases is low, and the temperature decreases with increasing altitude. The Kármán line (or von Karman line) is an attempt to define a boundary between Earth's atmosphere and outer space

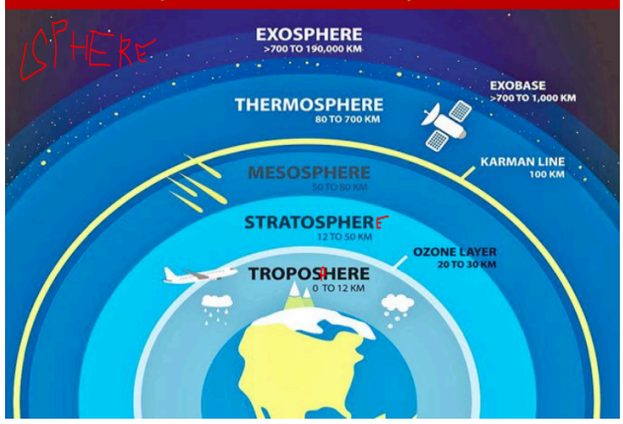
The main components of air in the thermosphere or ionosphere include helium, atomic nitrogen, and atomic oxygen. The thermosphere absorbs a lot of the UV radiation and X-ray given off by the sun. When the sun is more active and the thermosphere heats up more, this layer of earth's atmosphere increases in size.

Layers of the Atmosphere

The exosphere is the uppermost region of Earth's atmosphere as it gradually fades into the vacuum of space. The air in the exosphere is extremely thin - in many ways it is almost the same as the airless void of outer space.

Some scientists consider the thermosphere the uppermost part of Earth's atmosphere, and think that the exosphere is really just part of space. However, other scientists do consider the exosphere part of our planet's atmosphere.

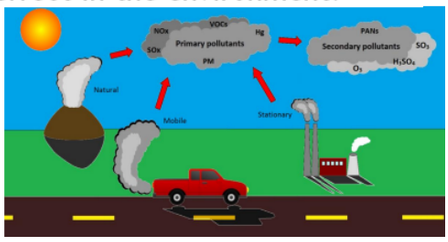
Layers of the Atmosphere



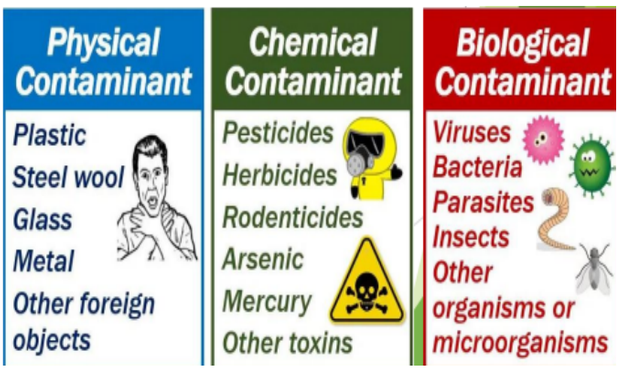
Air Pollution

The demands of increasing population coupled with the desire of most people for a higher material standard of living are resulting in worldwide pollution on a massive scale. Environmental pollution can be divided among the categories of water, air, and land pollution.

A pollutant is a substance present in greater than natural concentration as a result of human activity. This has detrimental effect in the environment.



Contaminants are not classified as pollutants unless they have some detrimental effect and cause deviations from the normal composition of an environment.



The source is particularly important because it is generally the logical place to eliminate pollution. After a pollutant is released from a source, it may act upon a receptor. The receptor is anything that is affected by the pollutant.

TOPIC 4: SOIL

Chemistry of Soil

Soil is a mixture of weathered rocks and minerals, decayed plants and animal material (humus and detritus), and small living organisms which includes plants, animals and bacteria. Soil also consists of water and air.
A typical productive soil is 5% organic matter and 95% inorganic matter.

Importance of Soil

production of food;
maintaining the balance of carbon, nitrogen, and phosphorus;
for the construction of building materials.

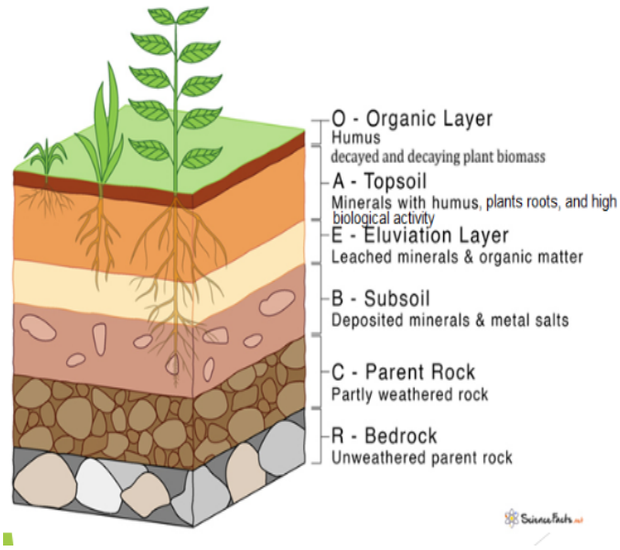
Distinguished Layers of Soil

A layer of a typical soil is called horizon. It is the product of complex interactions between processes that develop during weathering. The rainwater that penetrates through the soil bring dissolved and colloidal solids to lower horizons where they are deposited

Distinguished Layers of Soil

The A horizon or topsoil is the top layer of soil and several inches in thickness. Maximum biological activity in the soil happens in this layer. This layer also contains most of the soil organic matter and is important in the productivity of plant. In defining the composition of soils, the parent rocks where soils are formed play an important role.

DISTINGUISHED LAYERS OF SOIL



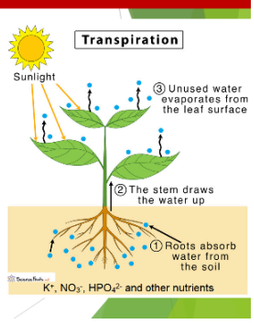
Water and Air in Soil

The other characteristics of soil includes:

- Strength
- Workability
- Soil particle size
- Permeability
- Extent of maturity

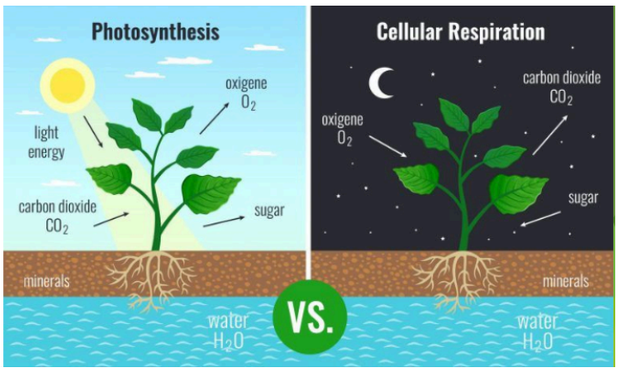
Water and Air in Soil

Water is important because it is the basic transport medium for carrying essential plant nutrients from solid soil particles into plant roots and to the farthest reaches of the plant's leaf structure.
Transpiration happens when the water in a plant evaporates into the atmosphere from the plant's leaves.

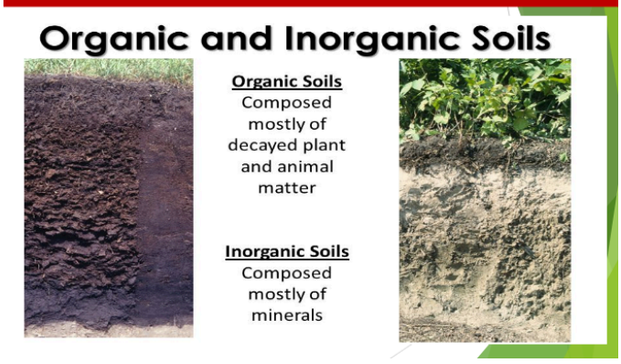


Water and Air in Soil

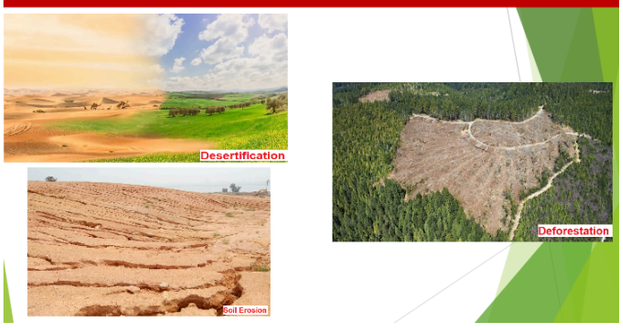
Soil carries the nutrients to the plant extremities by this process wherein plants remove carbon dioxide from the atmosphere and add oxygen by photosynthesis. The reverse of this process occurs during plant respiration.



Components of soil



Soil Pollutants



DESERTIFICATION - the process of land degradation in dry areas that turns fertile land into desert

DEFORESTATION -the deliberate clearing of forests to make room for other uses, such as agriculture, logging, mining, and urbanization

SOIL EROSION - the wearing away of the top layer of soil by water, wind, ice, snow, plants, and animals.

Nature and Pollution

Inorganic and Organic matters

Adjustment of Soil Acidity

Macro- and Micronutrients

Soil Pollutants

Soil Preservation

Food as the most basic need of humans is an important aspect in order to have the sustainability of means to produce food as a top priority. The preservation of soil and its ability to support plant life is the most basic part of food sustainability.

Soil erosion is one of the problem that could affect the soil. The preservation of soil from erosion is commonly termed soil conservation.

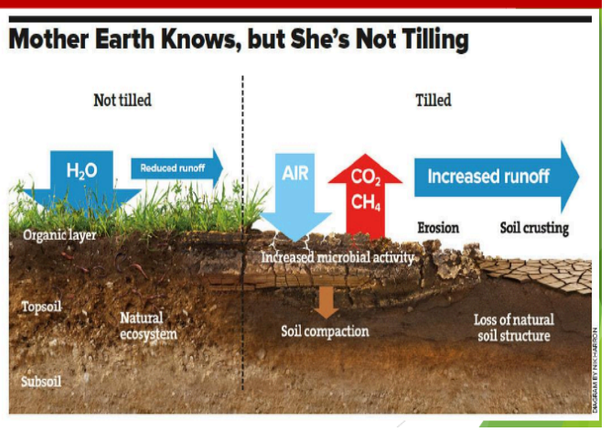
Soil Preservation

There are numerous traditional solutions to the soil problem as agricultural practices which include terracing, contour plowing, and periodically planting fields with cover crops.

Soil Preservation

For some crops, conservation tillage (no-till agriculture) surely decreases erosion. This practice consists of planting a crop among the residue of the previous year's crop without plowing. In the newly planted crop row, weeds are killed by application of a herbicide prior to planting. The surface residue of plant material left on top of the soil prevents soil erosion.

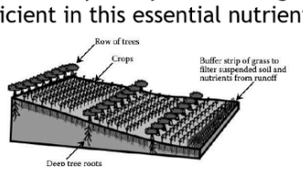
Soil Preservation



Agroforestry

Trees are a known perennial plants which are very effective in stopping soil erosion. In the past, trees were often allowed to grow naturally with native varieties without the benefit of any special agricultural practices such as fertilization. The productivity of biomass from trees can be greatly increased with improved varieties including those that are genetically engineered and with the improved cultivation and fertilization.

Agroforestry is a promising alternative in sustainable agriculture in which crops are grown in strips between rows of trees. The trees help to preserve or balance the soil particularly on sloping terrain. For example, choosing trees with the capability to fix nitrogen then the system can be efficient in this essential nutrient.



Soil Restoration

Soil can be impaired by loss of fertility, erosion, buildup of salinity, and contamination by phytotoxins (such as zinc from sewage sludge). Soil has a degree of resilience and can largely recover whenever the conditions leading to its degradation are removed.

However, in many cases, more active measures called soil restoration are required to restore soil productivity, through the application of restoration ecology. Measures taken in soil restoration may include physical alteration of the soil to provide terraces and relatively flat areas not subject to erosion.

Soil Restoration

Organic matter can be restored by planting crops. Residues of which are cultivated into the soil for partially decayed biomass. Nutrients may be added and contaminants are neutralized.

Green Chemistry and Sustainable Agriculture

Agriculture is a science of living organisms applied to human needs for food and fiber production. So in attempting to find more sustainable and environment-friendly approaches to agriculture, use an approach like biomimetics. It is when humans attempt to mimic natural life systems.

Pesticides that come from natural sources such as plants or bacteria are called biopesticides. These substances are usually more environmentally friendly than synthetic pesticides, although the blanket assumption that anything from a natural source is automatically safer than synthetic materials should not be made.