RGPVNOTES.IN

Program : **B.Tech**

Subject Name: **Energy and Enviornmental Engineering**

Subject Code: **ES-401**

Semester: **4th**

Introduction:

The living and non-living things, known as ecosystem with their component who support or run the ecosystem like (things like air, water and mineral soil), interacting as a system. The biotic as well as biotic factors consider for this. It is also known as self-supporting. These biotic and abiotic components are regarded as linked together through nutrient cycles and energy flows.

From this etymology, environment means the things or events that surround something else. We can say, the environment is said to the area in which something exists or lives.

Social, cultural and physical conditions that surround, affect and influence the survival, growth and development of people, animals or plants all these comes in environment. Environment includes everything around us. It encompasses both the living (biotic) and non-living (abiotic) components of the Earth.

Segment of Environment

Atmosphere, Ecosphere, Hydrosphere as well as Lithosphere is the part of environment. Also we have known that Surrounding in which we are living, which includes all living (biotic) and
Nonliving (abiotic) factors upon which we depend is known as environment.

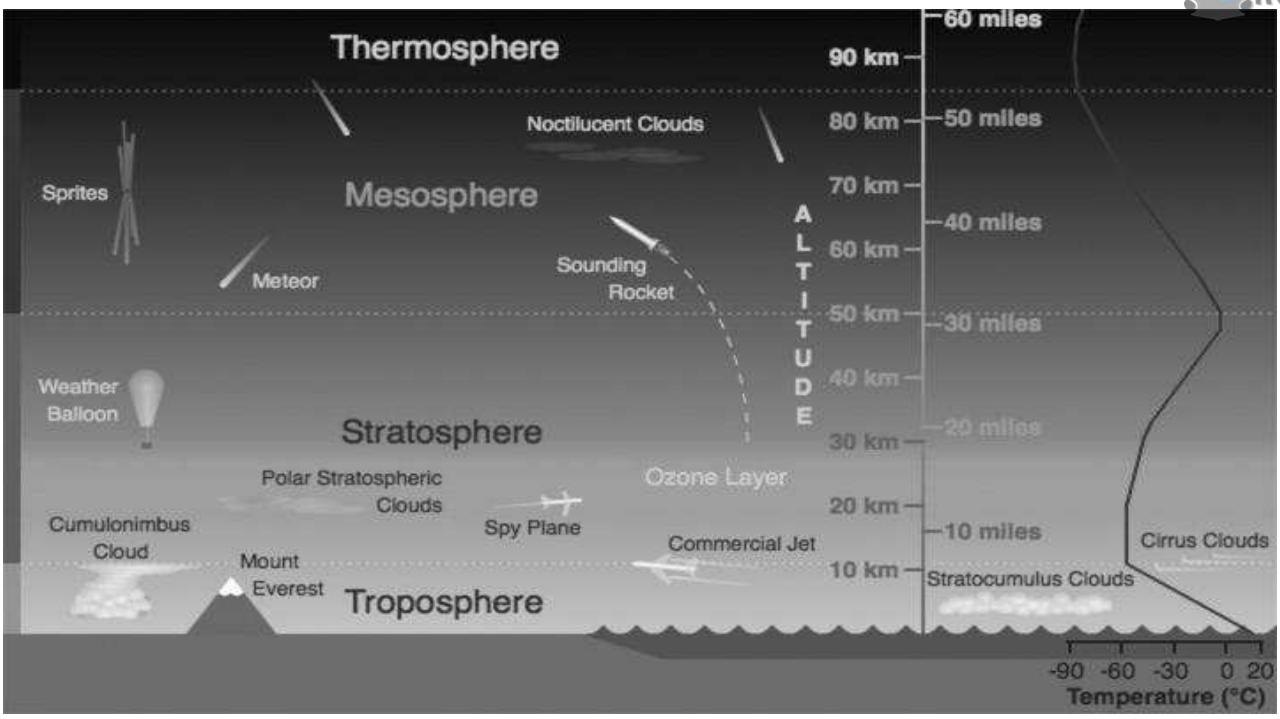


Fig: Layers of Atmosphere

Environment having four different segments as fallows

1. Atmosphere:

Atmosphere is nothing, but the air envelope surrounded the earth. This protective envelops surrounding earth sustain life on earth and protect us from unfriendly environment of outer space. It height of about 1600 km from the earth surface. It has lifesaving gases like oxygen for human and animals and carbon dioxide for plants.

Constitute of Atmosphere moisture and Weather

The moisture constitute proportion in Atmosphere is about 0.002% and other is: clouds, mist and fog, as well as rain, sleet, snow, and hail. While it may seem astounding that atmospheric moisture is such a small portion of the total, this fact says more about the vast amounts of water on Earth than it does about the small amount in the atmosphere. That "small" amount, after all, weighs 1.433 × 1013 tons (1.3 × 1013 masses) or 28,659,540,000,000,000 pounds (12,999,967,344,000,002 kg).

The biosphere is the global sum of all ecosystems. It also known as the zone of life on Earth, a closed (apart from solar and cosmic radiation) and self-regulating system. From the bio physiological point of view, the biosphere is the global ecological system integrating all living beings and their relationships, including their interaction with the elements of the lithosphere, hydrosphere and atmosphere.

Sources and sinks of most gaseous components are situated at the land or sea surface, often by mediation of the biosphere and biological activity. This is true for the case of carbon dioxide, oxygen and water, as well as for most anthropogenic gases and greenhouse gases such as methane (CH_4). However, water stands out as the only one whose phase transition occurs in the temperature range of the (lower) atmosphere itself, resulting in a sink by condensation within the air column and a residence time which is short relative to the mixing and transport rates within the atmosphere.

The lower atmosphere, troposphere is a noticeable convection which is driven by the heating of the Earth's surface by absorption of solar radiation results in mixing of the air column. The thermally driven

convection is dampened at a height of about 8 to 15 km, where the temperature lapse rate is reduced. At a height of about 15 to 25 km, the atmosphere is further heated by absorption of UV radiation. The resulting rise in temperature with height imparts stability to this part of the atmosphere, the stratosphere, against vertical motions.

Lithosphere

The lithosphere is the solid outer section of Earth, which includes Earth's crust (the "skin" of rock on the outer layer of planet Earth), as well as the underlying cool, dense, and rigid upper part of the upper mantle. The lithosphere extends from the surface of Earth to a depth of about 44–62 mi (70–100 km). This relatively cool and rigid section of Earth is believed to "float" on top of the warmer, non-rigid, and partially melted material directly below.

Earth is made up of several layers. The outermost layer is called Earth's crust. The thickness of the crust varies. Under the oceans, the crust is only about 3–5 mi (5–10 km) thick. Under the continents, however, the crust thickens to about 22 mi (35 km) and reaches depths of up to 37 mi (60 km) under some mountain ranges. Beneath the crust is a layer of rock material that is also solid, rigid and relatively cool, but is assumed to be made up of denser material. This layer is called the upper part of the upper mantle, and varies in depth from about 31–62 mi (50–100 km) below Earth's surface. The Combination of the crust and this upper part of the upper mantle, which are both comprised of relatively cool and rigid rock material, is called the lithosphere.

Hydrosphere:

A hydrosphere in physical geography describes the combined mass of water found on, under, and over the surface of a planet. The total mass of the Earth's hydrosphere is about 1.4×10^{18} tone, which is about 0.023% of the Earth's total mass. About 20×10^{12} tone of this is in the Earth's atmosphere (the volume of one tone of water is approximately 1 cubic meter). Approximately 75% of the Earth's surface, an area of some 361 million square kilometers (139.5 million square miles), is covered by ocean. The average salinity of the Earth's oceans is about 35 grams of salt per kilogram of sea water (3.5%)

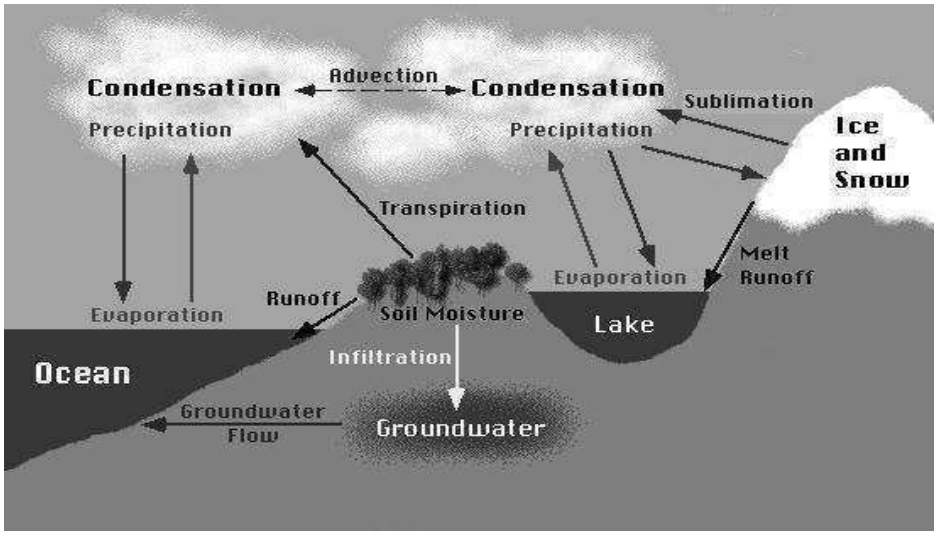


Fig. Hydrosphere

A thick hydrosphere is thought to exist around the Jovian moon Europa. The outer layer of this hydrosphere is almost entirely ice, but current models predict that there is an ocean up to 100 km in

depth underneath the ice. This ocean remains in a liquid form because of tidal flexing of the moon in its orbit around Jupiter. The volume of Europa's hydrosphere is 3×10^{18} m^3, 2.3 times that of Earth.

Hydrological cycle

Insulation, or energy (in the form of heat and light) from the sun, provides the energy necessary to cause evaporation from all wet surfaces including oceans, rivers, lakes, soil and the leaves of plants. Water vapor is further released as transpiration from vegetation and from humans and other animals. Aquifer draw-down or over-drafting and the pumping of fossil water increases the total amount of water in the hydrosphere that is subject to transpiration and evaporation thereby causing accretion in water vapor and cloud cover which are the primary absorbers of infrared radiation in the Earth's atmosphere. Adding water to the system has a forcing effect on the whole earth system, an accurate estimate of which hydro-geological fact is yet to be quantified.

Biosphere:

This segment of environment consists of atmosphere (air- 02, N2, C02), Lithosphere (land- minerals, salts, food, nutrients) and hydrosphere (water- dissolved oxygen, Salts) which influences and support the entire biotic and abiotic life systems.

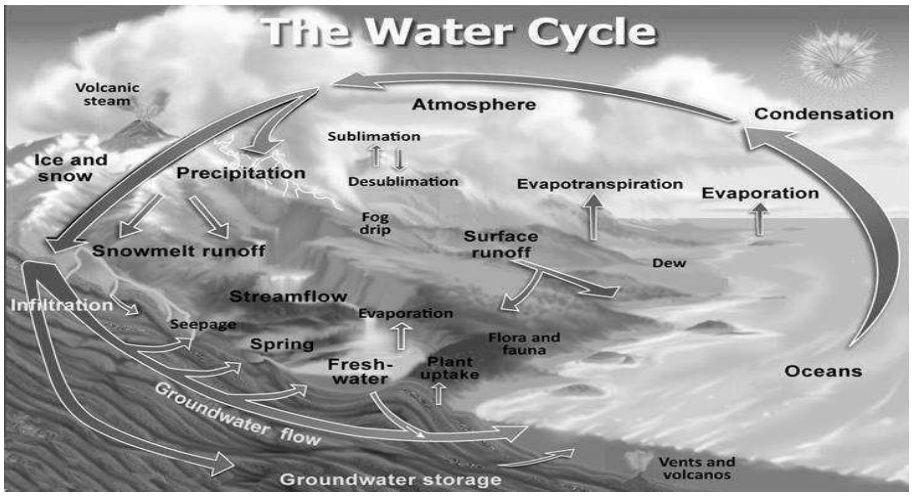
Cycles in Ecosystem

Water Cycle

Carbon Cycle

Nitrogen Cycle

1. The water cycle, also known as the hydrological cycle or the hydrologic cycle, describes the continuous movement of water on, above and below the surface of the Earth. The mass of water on Earth remains fairly constant over time but the partitioning of the water into the major reservoirs of ice, fresh water, saline water and atmospheric water is variable depending on a wide range of climatic variables. The water moves from one reservoir to another, such as from river to ocean, or from the ocean to the atmosphere, by the physical processes of evaporation, condensation, precipitation, infiltration, surface runoff, and subsurface flow. In doing so, the water goes through different forms: liquid, solid (ice) and vapor.



Evaporation is a type of vaporization of a liquid that occurs from the surface of a liquid into a gaseous phase that is not saturated with the evaporating substance. The other type of vaporization is boiling, which is characterized by bubbles of saturated vapor forming in the liquid phase. Steam produced in a boiler is another example of evaporation occurring in a saturated vapor phase. Evaporation that occurs directly from the solid phase below the melting point, as commonly observed with ice at or below freezing or moth crystals (naphthalene or Para dichlorobenzene), is called sublimation.

Condensation is the change of the physical state of matter from gas phase into liquid phase, and is the reverse of evaporation. The word most often refers to the water cycle. It can also be defined as the change in the state of water vapor to liquid water when in contact with a liquid or solid surface or cloud condensation nuclei within the atmosphere.

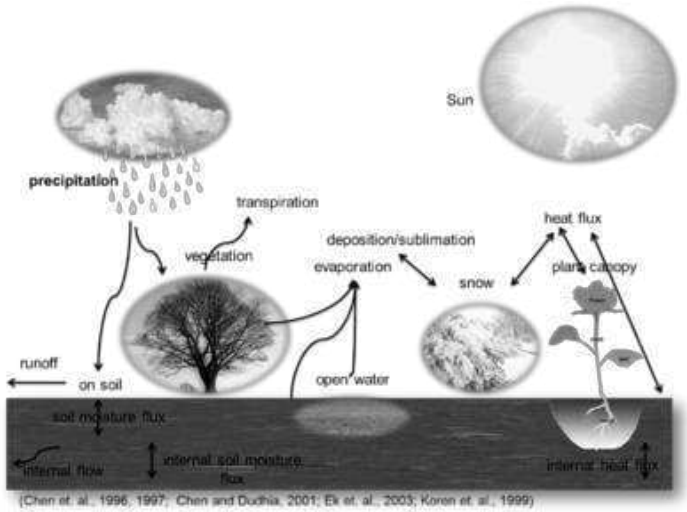


Fig: Condensation Process

Infiltration is the process by which water on the ground surface enters the soil. Infiltration rate in soil science is a measure of the rate at which soil is able to absorb rainfall or irrigation. It is measured in inches per hour or millimeters per hour. The rate decreases as the soil becomes saturated. If the precipitation rate exceeds the infiltration rate, runoff will usually occur unless there is some physical barrier. It is related to the saturated hydraulic conductivity of the near-surface soil. The rate of infiltration can be measured using an infiltrate meter.

Surface runoff (also known as overland flow) is the flow of water that occurs when excess storm water, melt water, or other sources flows over the Earth's surface. This might occur because soil is saturated to full capacity, because rain arrives more quickly than soil can absorb it, or because impervious areas (roofs and pavement) send their runoff to surrounding soil that cannot absorb all of it. Surface runoff is a major component of the water cycle. It is the primary agent in soil erosion by water. Runoff that occurs on the ground surface before reaching a channel is also called a nonpoint source. If a nonpoint source contains man-made contaminants, or natural forms of pollution (such as rotting leaves) the runoff is called nonpoint source pollution. A land area which produces runoff that drains to a common point is called a drainage basin. When runoff flows along the ground, it can pick up soil contaminants including petroleum, pesticides, or fertilizers that become discharge or nonpoint source pollution.

2. The carbon cycle is the biogeochemical cycle by which carbon is exchanged among the biosphere, exosphere, geosphere, hydrosphere, and atmosphere of the Earth. Carbon is the main component of biological compounds as well as a major component of many minerals such as limestone. Along with

the nitrogen cycle and the water cycle, the carbon cycle comprises a sequence of events that are key to make Earth capable of sustaining life. It describes the movement of carbon as it is recycled and reused throughout the biosphere, as well as long-term processes of carbon sequestration to and release from carbon sinks.

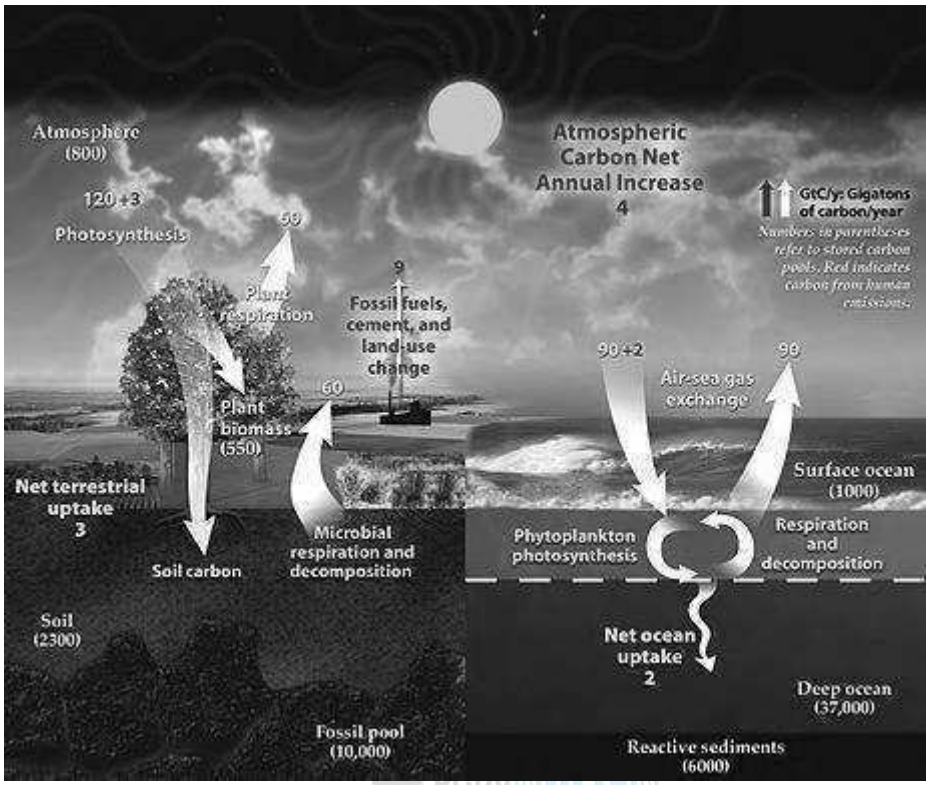


Fig: Carbon Cycle

3. The nitrogen cycle is the biogeochemical cycle by which nitrogen is converted into various chemical forms as it circulates among the atmosphere, terrestrial, and marine ecosystems. The conversion of nitrogen can be carried out through both biological and physical processes.

The processes of the nitrogen cycle

Nitrogen is present in the environment in a wide variety of chemical forms including organic nitrogen, Ammonium (NH+4), nitrite (NO−2), nitrate (NO−3), nitrous oxide (N_2O), Nitric oxide (NO) or inorganic nitrogen gas (N_2). Organic nitrogen may be in the form of a living organism, humus or in the intermediate products of organic matter decomposition. The processes of the nitrogen cycle transform nitrogen from one form to another. Many of those processes are carried out by microbes, either in their effort to harvest energy or to accumulate nitrogen in a form needed for their growth. For example, the nitrogenous wastes in animal urine are broken down by nitrifying bacteria in the soil to be used as new. The diagram besides shows how these processes fit together to form the nitrogen cycle.

Nitrogen fixation

Atmospheric nitrogen must be processed, or "fixed", in a usable form to be taken up by plants. Between $5x10^{12}$ and $10x10^{12}$ g per year are fixed by lightning strikes, but most fixation is done by free-living or symbiotic bacteria known as diazotrophs. These bacteria have the nitrogenize enzyme that combines gaseous nitrogen with hydrogen to produce ammonia, which is converted by the bacteria into other organic compounds. Most biological nitrogen fixation occurs by the activity of Mo-

nitrogenize, found in a wide variety of bacteria and some. Mo-nitrogenaseis a complex two-component enzyme that has multiple metal-containing prosthetic groups. Symbiotic nitrogen-fixing bacteria such as Rhizobium usually live in the root nodules of legumes (such as peas, alfalfa, and locust trees). Here they form a mutualistic relationship with the plant, producing ammonia in exchange for carbohydrates. Because of this relationship, legumes will often increase the nitrogen content of nitrogen-poor soils. A few non-legumes can also form such symbioses. Today, about 30% of the total fixed nitrogen is produced industrially using the Haber-Bosch process, which uses high temperatures and pressures to convert nitrogen gas and a hydrogen source (natural gas or petroleum) into ammonia.

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