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## Biogeochemical Cycles

Biogeochemical Cycles : the cycling of chemical elements required by life between the living and nonliving parts of the environment . Some examples of these chemical elements are P, S, N<sub>2</sub> , O<sub>2</sub> and C etc.

These elements cycle in either a gaseous cycle or a sedimentary cycle .

### In a gaseous cycles

- 1-Elements move through the atmosphere.
- 2-Main reservoirs are the atmosphere and the ocean.
- 3- Includes (carbon , nitrogen , oxygen ) cycles
- 4- Perfect

### In a sedimentary cycle

- 1- Elements move from land to water to sediment.
- 2- Main reservoirs are the soil and sedimentary rocks.
- 3- Includes (Sulfur , Phosphorus ) .
- 4- Imperfect

The affected elements sedimentary cycles with the following activities:

- a- erosion, sedimentation, formation of mountains and volcanic activities.
- b- the biological activities

Organisms need about 40 elements to maintain their life and activity, the most important of these elements are carbon, oxygen, nitrogen, hydrogen, phosphorus, potassium, calcium, iron and magnesium .

The elements (H, N, O, C) represent approximately 97% of the amount of living matter Protoplasm.

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Each cycle can be divided into two parts :

**1- Reservoir pool:** represents the largest part of the cycle and is slow to move and includes non-living components usually.

**2- Cycling pool :** is the smallest active part of the cycle that flows between organisms.

The study of biogeochemical cycles may help us :

- 1- To understand the equilibrium of the ecosystem .
- 2- The phenomenon of pollution and its effects on living and non-living components.
- 3- The possibility of returning the missing part of the cycle and thus accelerate its circulation.

**Odum, 1983 says** that the protection of natural resources generally means converting non-cyclic processes into cyclic processes.

The biochemical cycle consists of three components:

- 1 - Living components: - Includes all living organisms on the surface of the earth.
- 2- Geological components: - Includes soil, rocks, water and air.
- 3 - Chemical elements: - which move between the geological components and between organic molecules in living organisms periodically.

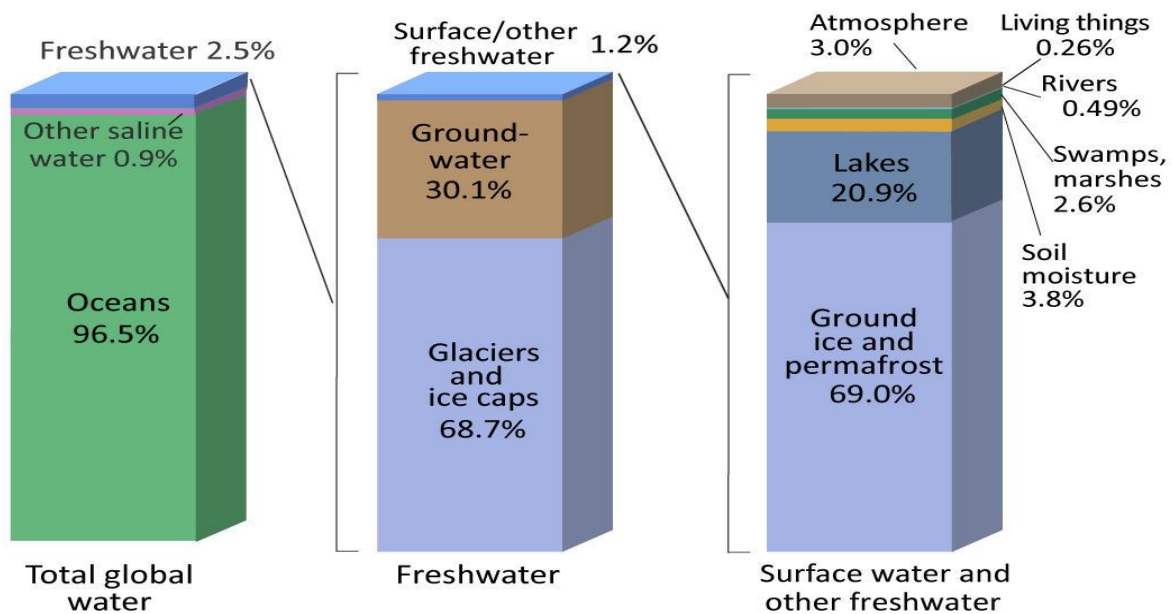
These cycles move by solar energy and this energy is transformed from one form to another by different ecosystems and exposed to loss through this process.

## The hydrologic cycle:

Earth's water is always in movement, and the natural water cycle, also known as the hydrologic cycle, describes the continuous movement of water on, above, and below the surface of the Earth. Water is always changing states between liquid, vapor, and ice.

Water on the Earth is part of a closed system. Water evaporates, forms clouds, falls as rain or snow, collects in oceans, lakes and rivers and freezes as ice. No new water is created and it does not leave the system.

### Where is Earth's Water?



Source: Igor Shiklomanov's chapter "World fresh water resources" in Peter H. Gleick (editor), 1993, *Water in Crisis: A Guide to the World's Fresh Water Resources*. (Numbers are rounded).

Notice how of the world's total water supply of about 333 million cubic miles of water, over 96 percent is saline. And, of the total freshwater, over 68 percent is locked up in ice and glaciers. Another 30 percent of freshwater is in the ground. Thus, rivers and lakes that supply surface water for human uses only constitute about 22,300 cubic miles, which is about 0.007 percent of total water, yet rivers are the source of most of the water people use.

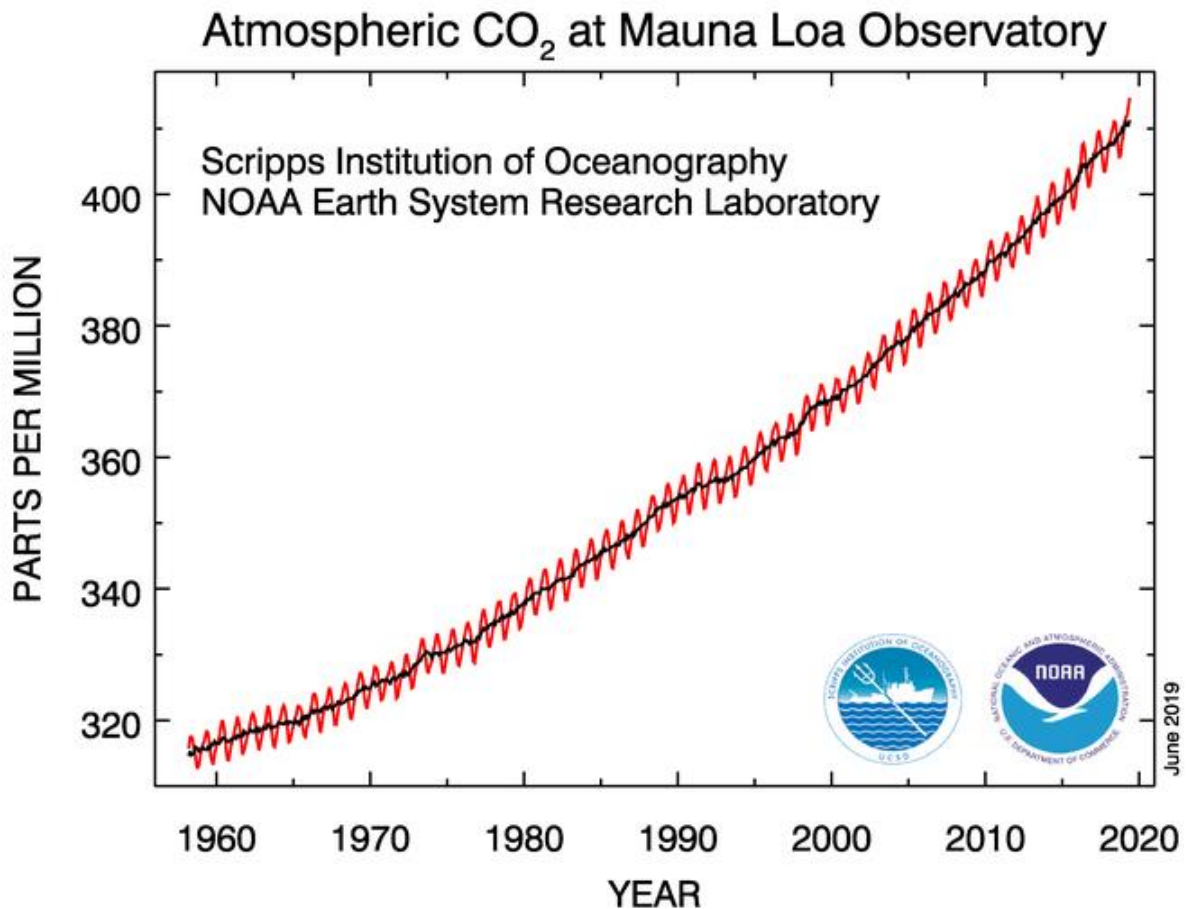
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## Carbon cycle:

Carbon is the basic element in the formation of any organic compound. Green plants and algae stabilize carbon dioxide gas in the form of carbohydrates through photosynthesis, while animals get carbon by feeding on green plants or other animals, where carbohydrates move to their bodies to be used in the construction of other organic compounds to oxidize them to get the necessary energy. The carbon element returns to nature in one of the following ways :

- 1- Breathing processes in different organisms
- 2- Volcanoes and mineral springs
3. Combustion processes for different fuels
4. Decomposition of living organisms by decomposers, leading to the release of most of the carbon in these organic residues in the form of CO<sub>2</sub>.
5. In aquatic environments, carbon is either dissolved in water or in a solid state (in the form of CaCO<sub>3</sub>) in the shells of living organisms. Carbon may be returned to the soil due to erosion due to dry water, but this process is very slow and takes a long time.
- 6 - In the form of organic materials not analyzed in the bottoms of swamps and water environments, and therefore these carbon materials remain reserved for a long time until extracted in the form of oil or gas.

Carbon dioxide (CO<sub>2</sub>) is an important heat-trapping (greenhouse) gas, which is released through human activities such as deforestation and burning fossil fuels, as well as natural processes such as respiration and volcanic eruptions. The graph shows atmospheric CO<sub>2</sub> levels measured at Mauna Loa Observatory, Hawaii, in recent years .



Atmospheric carbon dioxide continued its rapid rise in 2019, with the average for May peaking at 414.7 parts per million (ppm) at NOAA's Mauna Loa Atmospheric Baseline Observatory. The 2019 peak value was 3.5 ppm higher than the 411.2 ppm peak in May 2018

The amount of carbon dioxide, often produced by burning fuel, is about 14 billion tons a year, about half of which is released into the atmosphere.

The small changes in the concentration of carbon dioxide in the atmosphere play a major role in the main impacts of climate. Because the increase in the concentration of this gas leads to an increase in the temperature of the environment, known as the green house effect, which leads to global warming,

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This leads to the melting of the ice, causing a rise in the level of water in the oceans, which leads to the flooding of nearby cities with water, and lead to a defect in the spread of plants and desertification.

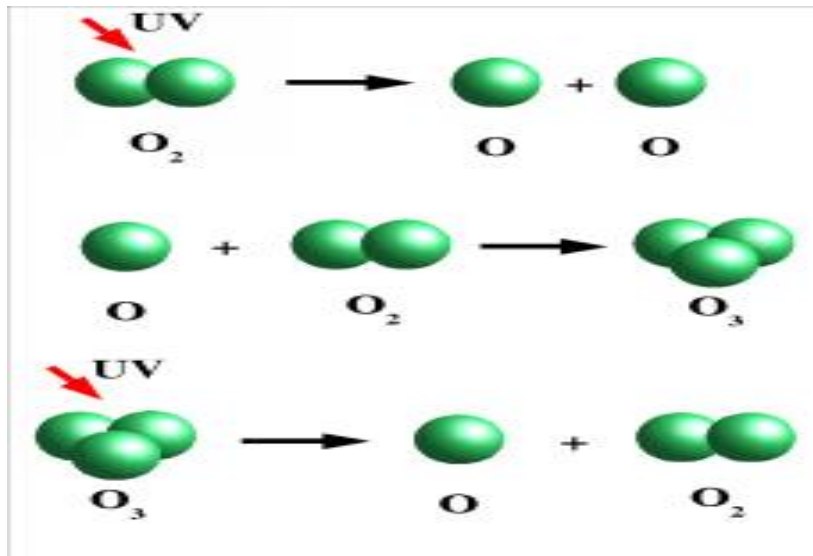
## Oxygen cycle

The percentage of oxygen is about 21% of the total volume of air , In addition to oxygen dissolved in water to breathe aquatic organisms . The oxygen cycle is linked to the carbon cycle through the two important processes of photosynthesis and respiration . Oxygen plays an important role in the construction of the ozone belt in the stratosphere, which protects living organisms living on Earth from ultraviolet radiation, which causes human genetic damage by changing information in the genetic material DNA.

It is estimated that out of 10 million air molecules about 2 millions are of O<sub>2</sub> and only 3 are of ozone The process of ozone formation is called as *photolysis* Stratospheric ozone is measured from the ground in units called "*Dobson Unit*" (D.U)

*How is ozone formed in the atmosphere?*

Stratospheric ozone is formed naturally by chemical reactions involving solar ultraviolet radiation (sunlight) and oxygen molecules, which make up 21% of the atmosphere. In the first step, solar ultraviolet radiation breaks apart one oxygen molecule (O<sub>2</sub>) to produce two oxygen atoms (2 O) (see Figure). In the second step, each of these highly reactive atoms combines with an oxygen molecule to produce an ozone molecule (O<sub>3</sub>). These reactions occur continually whenever solar ultraviolet radiation is present in the stratosphere.



## Causes of Ozone Layer Depletion and Its

### Effects on Human:

#### A- Causes of Ozone Depletion:

Ozone depletion occurs when the natural balance between the production and destruction of stratospheric ozone is disturbed. Although natural phenomena can cause ozone depletion but human activities such as :-

- 1- Chlorofluorocarbons (CFCs) are now accepted as major cause of depletion , All ozone depleting chemicals contain chlorine and bromine .
- 2- Nuclear explosions
- 3- Global Warming
- 4- Nitrogenous Compounds emitted by human activities like NO, N<sub>2</sub>O and NO<sub>2</sub>

#### B- Effects of Ozone Depletion:

- 1- Effects on Eyes : The major cause of blindness in this world
- 2- Effects on Skin : Exposure to UV radiations can cause skin cancer

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- 3- Effects on Human Immunity : Exposure to UV radiations can also result in suppression of immune response to skin cancer, infectious diseases and other antigens
  - 4- DNA Damage and Lung Diseases
  - 5- Lack of food due to stopping the physiological processes of the plant

Note:

Human eye and skin are the most exposed part of the body to these radiations. So there is high degree of incidence of blindness and skin cancer disease increasing day by day with the depletion of ozone layer so we should use sunglasses and full body clothes especially in summer when there is high intensity of sunlight so that we can protect our body from harmful UV radiations. We should also use sun block creams to our most exposed parts of body like face