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THE OXYGEN CYCLE IN THE COURSE OF STUDY RELATED TO THE BIOLOGICAL SCIENCE AT VARIOUS LEVELS

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ABSTRACT:

Oxygen has its own significance in the gaseous cycle in environment. It is produced by green plants and used by all living things in respiration. The oxygen cycle is the biogeochemical transition of oxygen atoms between different oxidation states in ions, oxides, and molecules through redox reactions within and between the spheres/reservoirs of the planet Earth. The oxygen cycle shows the interdependency among organisms, and natural environment. This is also essential knowledge for everybody studying the biology at various levels.

KEYWORDS:

OXYGEN CYCLE, RESERVOIRS, SOURCES & SINKS, CAPACITIES AND FLUXES.

INTRODUCTION

According to the earth's history oxygen gas was first introduced by cynobacteria through the process of photo synthesis. Earlier, around 4.6 billion years ago, there was no life on earth because the atmosphere was devoid of oxygen. Later, there was a gradual increase in the oxygen levels and by the carboniferous period -299 million years ago, oxygen reaches the levels that were similar to today's estimates. Oxygen is freely available in the air and also dissolved in water. It is the second most abundant gas present in the atmosphere and also the most common element of the human body. It plays an essential role in most life forms on earth amd also serves as an essential element in bio molecules like proteins and nucleic acids, oxygen cycle plays an essential role in the existence of life on the earth. It is a biological process which helps in maintaining the oxygen level by moving through three main spheres on the earth which are:

- Atmosphere.
- Lithosphere.
- Biosphere.
- Hydrosphere

The oxygen constitutes about 43% of earth's crust by weight and its cycle is a complicated one because of the innumerable chemical combinations in which it occurs on our planet, Atmospheric oxygen is a major reserve of this gas, in combination of hydrogen it occurs in water, with carbon it occurs in carbon dioxide, carbonates and bicarbonates etc. It forms an important constituent of organic matter. During photosynthesis water molecules dissociate to form oxygen which is fed into the atmosphere from where it is drawn in aerobic respiratory activity of living organisms to yield water molecules again.

Oxygen cycle is the circulation of oxygen in various forms through nature. Free in the air and dissolved in water, oxygen is second only to nitrogen in abundance among uncombined elements in the atmosphere. Plants and animals use oxygen to respire and return it to the

air and water as carbon dioxide (CO_2) as then taken a algae and terrestrial green plants and converted into carbohydrates during the process of photosynthesis, ox*yg*en being a by product. The water resources of the a world are the main oxygen generators of to biosphere, their algae care estimated to replace about 90% of all oxygen used. Oxygen is involved to some degree in call the other biogeochemical cycles.

RESERVOIRS OF OXYGEN

The vast expance of air which envelopes the earth is called atmosphere Among the your change elements of environment the atmosphere is most dynamic as changes take place in it not only from one session to another but also over shorter periods of a few hours. The atmosphere extends to thousands of kilometers above the earth's surface. The atmosphere contains life-giving gases like oxygen for all animals and carbon-dioxide for plants to be used in manufacture of food. The atmosphere is 20.9% oxygen by volume, which equates to tootle of roughly $34x10^{18}$ mol of oxygen.

Biosphere is the life zone of the earth, and an important and unique realm of our natural environment, Biosphere refers to that part of the earth in which all life forms exist. The organisms comprising the biosphere are mostly found in the relatively narrow zones of contact between the three realms of the earth i.e. the atmosphere, lithosphere and hydrosphere. This shallow but extremely complex zone lying at or close to the interfaces between the three realms of the earth i.e. the atmosphere hydrosphere and lithosphere is known as the biosphere. The biosphere is 22% oxygen by volume present mainly as a component of organic molecules and water molecules.

The hydrosphere refers to the layer of water on the surface of the earth in the form of oceans, lakes, rivers and other water bodies. Water covers 71% of the total surface of the earth continents may be considered as large islands rising island from the vast oceans. Presence of large quantities of water in the form of oceans is responsible for maintaining the temperature conditions. The hydrosphere is 33% oxygen by volume present mainly as a component of water volumes with dissolved molecules including free oxygen and carbonic acids.

*L*ithosphere is a sphere of rock including besides mineral rocks also the study of landforms and the soil, actual medium *growth of* plants, animals and microor*ga*nisms.

The lithosphere is a source of various minerals resources and fuels as coal and oil. The soil cover on the land surface in indispensable for the growth of plants and other forms of life. The lithosphere is 46.6% oxygen by volume present mainly as silica minerals (SiO_2) and other oxide minerals.

SOURCES AND SINKS

The presence of profuse concentration of free oxygen in modern earth's atmosphere and ocean is attributed to oxygen production from the biological process of oxygenic photosynthesis in conjunction with a biological sink known as the biological pump and a geologic process of carbon buried involving plate tectonics Biology is the main driver of oxygen flux, on modern earth and the evolution of oxygenic photo synthesis by bacteria.

Biological production. (Photo synthesis)

$6CO_2 + 6H_2O \longrightarrow C6H_{12}O_6 + 60_2$

(Carbon-dioxide) (Water) (Glucose) (Free Ox*ygen*)

ABIOTIC PRODUCTION:

An additional source of atmospheric free oxygen comes from photolysis, whereby high-energy ultraviolet radiation breaks down atmospheric water and nitrous oxide into component atoms (the free H & N) escape into space behaving oxygen in the atmosphere

$6H_2O$ + Energy $\longrightarrow$ $4H+O_2$ oxygen

(water) Hydrogen

$2N_2O$ + Energy $\longrightarrow$ $4N + O_2$

(Nitrogen oxide) (Nitrogen oxygen)

BIOLOGICAL CONSUMPTION

The main way free oxygen is lost from the atmosphere is via respiration and decay mechanisms in which animal life and bacteria consume oxygen and release carbon dioxide.

CAPACITIES AND FLUXES (WALKAR, J.C.G.)

Reservoir	Capacity (kg/02)	Flux in/out (kg O_2 per year	Residence time (years)
Atmosphere	$1.4x10^{18}$	$3x10^{14}$	4500
Biosphere	$1.6x10^{16}$	$3x10^{14}$	50
Lithosphere	$2.9x10^{20}$	$6x10^{11}$	500,000,000

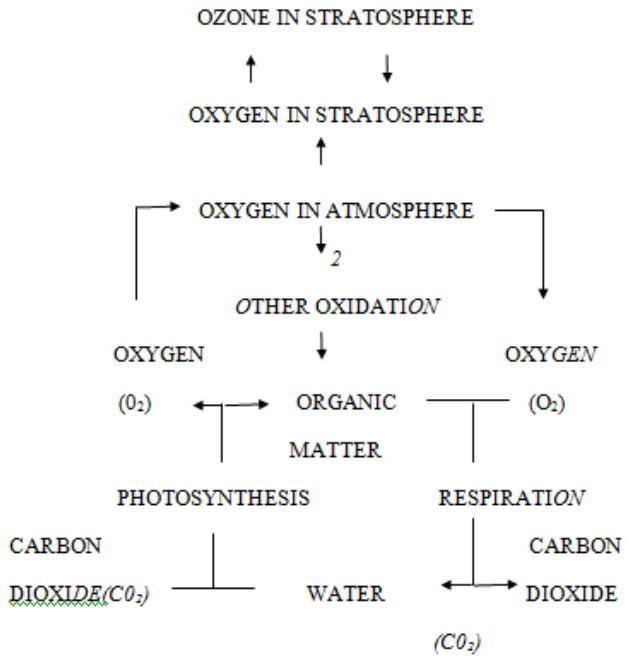
ANNUAL GAIN AND LOSS OF ATMOSPHERIC OXYGEN

(units of 10^{10} kg O_2 per year)

Photosynthesis (land)	= 16,500
Photosynthesis (ocean)	= 13,500
Photolysis of N_20	= 1.3
Photolysis of H_2O	= 0.03
Total gain = 30,*000*	
Losses - Respiration and decay	
Aerobie Respiration	= 23,000
Microbial Respiration	= 5,100
Combustion of fossil fuel (anthropogenic)	= 1,200
Photochemical oxidation	= 600
Fixation of N_2 by lightning	= 12
Fixation of N_2 by Industry (anthropogenic)	= 10
Oxid*a*tion of volcanic gases	= 5
Losses - weatheric chemical weathering	= 50
Surface reaction of ozone	= 12
Total losses	= 30,000

REGULATION OF OXYGEN CYCLE

Oxygen is so important in metabolic activities that all living organisms must have access to it cell times either directly as a gas or indirectly in chemical compounds. It is so common in the air that there is ordinarily of scarcity for most air breathing animals. It is less available in soil or water and may become exceedingly scarce in stagnant water or mud, where anaerobic bacteria, worms, or either animals live with a scarcity of oxygen and may perish if it becomes directly available. It is ordinarily consumed by animals and released by green plants in the daytime, but it also consumed by green plants at all times. Atmospheric oxygen is a major reserve of this gas, in combination of hydrogen it occurs in water, with carbon it occurs in carbon dioxide, carbonates and bicarbonates etc. It forms an important constituent of organic matter. During photo synthesis water molecules dissociate to form oxygen which is fed into the atmosphere from where it is drawn in aerobic respiratory activity of living organisms to yield water molecules again. A number of other oxidation reactions require oxygen.



THE OXYGEN CYCLE

The oxygen cycle is one of the most important biogeochemical cycles present in nature and comprises production and consumption or utilization of oxygen in the environment. It is a biological process in which the oxygen travels through the lithosphere, biosphere, and atmosphere. The earth's crust comprises land and water, which is the lithosphere. It is the outer part of the earth's crust and is the largest oxygen reservoir. The biosphere is the living ecosystem present on the planet where an organism lives. The atmosphere is the blanket of air present around the earth consisting of a mixture of gases like oxygen, nitrogen and other gases. The oxygen cycle is the flow of oxygen through these through these spheres.

The following three steps involved in the oxygen cycle are –

i. All green plants during the process of photo synthesis, release oxygen back into the atmosphere as a by product.

ii. All aerobic organisms use free oxygen for respiration.

iii. Animals exhale carbon dioxide back into the atmosphere which is good again used by the plants during photosynthesis. Now oxygen is balanced w*ith*in the atmosphere.

Early life occurred in water only as there was no effective zone concentration in the atmosphere which could prevent biocidal ultraviolet radiations from reaching earth's surface. Since the level of oxygen in atmosphere determines the extent of ozone concentration, it was only when enough oxygen could accumulates in the atmosphere so as to form an effective ozone shield that life could emerge from water and colonize the land.

In lower atmosphere ozone as harmful to both plants and animals and causes photochemical or oxidizing type of air pollution. But high up in the stratosphere its presence is essential as it absorbs harmful ultra-violet radiations and provides a protecting umbrella to biosphere below Ultra-violet rays a split up oxygen molecules to produce oxygen atoms which combine with molecular oxygen to form ozone. The ozone molecules formed by the reaction above absorb radiation having on appropriate wavelength between UV-C and UV-B. The triatomic a ozone molecule becomes diatonic molecular oxygen plus a free oxygen atom. The atomic oxygen produced quickly reacts with another o*xyge*n molecu*le* to reform ozone.

1. CONCLUSION AND RECOMMENDATIONS

The chemical elements, including all the essential elements of life, tend to circulate in the biosphere in characteristic pathways from environment to organisms and back to the environment. These more or less circular pathways are known as bio-geochemical cycles The movement of these elements and inorganic compounds that are essential to life can be conveniently designated as nutrient cycling.

Oxygen is a resource for both animals and plants. When organic matter decomposes in an aquatic environment, microbial respiration makes a demand for oxygen and this may constrain the types of higher animal that can persist. High biological oxygen demands are particularly *characteristic of* still waters onto which leaf littler or organic animals must either maintain a continual flow of water over their respiratory surfaces or have very large surface areas relative to body volume or have specialized respiratory pigments or a slow - respiratory rate or continually return to the surface to breath The roots of many higher plants fail to grow into waterlogged soil, or die if the water table rises after they have penetrated deeply. These reactions may be direct responses to oxygen deficiency of responses to the accumulation of gases such as hydrogen sulphide, methane and ethylene that are produced by microorganisms engaged in anaerobic decomposition. Even if roots do not die when starved of oxygen they may cease to absorb minerals nutrients so that the plants suffer from mineral deficiency.

Since the life Sciences along with the physical sciences have received much more attention to revise and refresh Course there is an urgent need now to lay emphasis on the protection of environment all over the world and thence to provide a better life to the living beings of this planet. In order to maintain a proper balance between the environment and human survival it becomes imperative to incorporate concepts of immediate concern that have direct implications not only to theory but Practical work and their subsequent application for environmental protection and human survival. This is also significant with the view point to bring out social awareness towards the protection of environment, human survival and then to maintain the ecological balance.

Awareness for maintaining a proper balance between man, plants animals, water, oxygen, carbon dioxide, nitrogen

and ozone layer so that the proper balance between the same may not be disturber

The study of such concept as oxygen cycle should be specifically introduced in the courses of study related to the biological sciences at various levels.

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