

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR  
ENVIRONMENTAL STUDIES

PROJECT TITLE:

Nutrient cycle, gaseous and sedimentary nutrient cycle ; Nitrogen, oxygen and carbon cycle.

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DEPARTMENT : CHEMISTRY  
YEAR : 2020  
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① what is nutrient cycle?

Living organisms need food to grow and to reproduce. Any food or element required by an organism to live, grow, or reproduce, is called nutrient.

Depending on the amount it is needed in, a nutrient can be classified as a macronutrient (needed in large quantities e.g., carbon, oxygen, hydrogen, nitrogen, phosphorous etc.) or micronutrient (needed in small quantities e.g., iron, zinc, copper, iodine etc.). In nature, the nutrient element and their compounds co-nutrie continuously move from the non living environment to the living organisms, and back to the non living environment. This cyclic movement of minerals from their reservoirs (air, water, soil), to the living components, and back to the reservoir is called nutrient or biogeochemical cycling.

## (2) Global Nutrient cycle and its classification :-

An adequate and balanced supply of elements necessary for life, provided through the ecological processes of nutrient cycling, underpins all other ecosystem services. — Global Nutrient cycle.

Broadly speaking, nutrients can — occur in gaseous form (such as  $N_2$ ,  $CO_2$ ,  $O_2$  etc), mineral form (such as apatite), inorganic form (such  $\overset{+}{NH}_4^+$ ,  $NO_3^-$ ) and as well as organic from (C based compound).

\*> Nutrient cycle are mainly classified into three cycles :

- (i) oxygen cycle
- (ii) carbon cycle
- (iii) nitrogen cycle

(3) Oxygen cycle :-i) Definition :-

The cyclic movement of oxygen from their reservoir (air, water, soil) to the living being and back to the reservoir is called oxygen cycle.

Oxygen cycle, along with the carbon cycle and nitrogen cycle plays an essential role in the existence of life on the earth. The oxygen cycle is a biological process which helps in maintaining the oxygen level by moving through three main spheres of earth which are

- ① Atmosphere
- ② Lithosphere
- ③ Biosphere

(ii) Main reservoir :

The main reservoirs of oxygen are :

- I) Atmosphere
- II) Biosphere
- III) Hydrosphere
- IV) Lithosphere

(iii) Step of O<sub>2</sub> cycle :-

The steps involved in the oxygen cycle are :-

stage-1 : All green plants during the process of photosynthesis, release oxygen back into the atmosphere as a by-product

stage-2 : All aerobic organisms use free oxygen for respiration.

Stage 3: Animals exhale carbon-dioxide back into the atmosphere which is again used by the plants during photosynthesis. Now oxygen is balanced with in the atmosphere.

iv) Process of O<sub>2</sub> cycle:

The four processes that use atmospheric oxygen are :

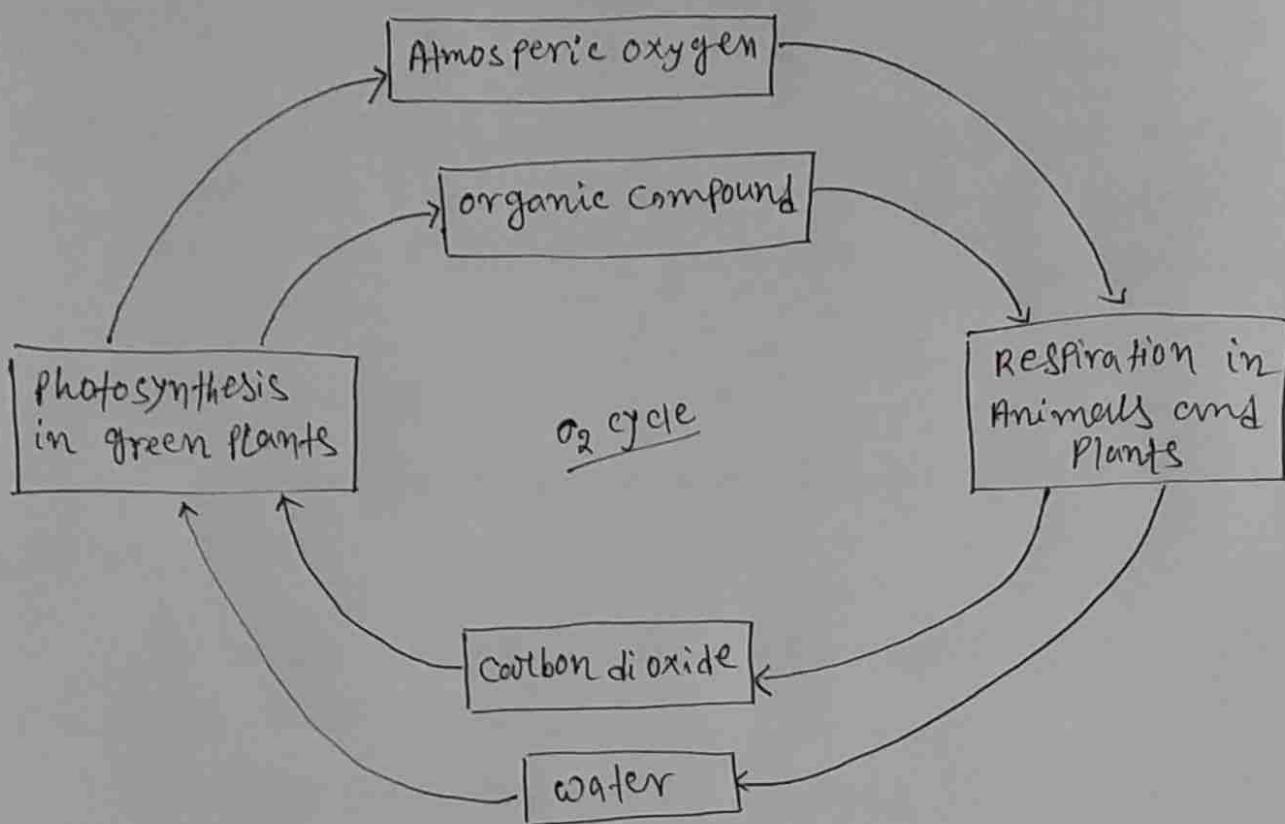
- i) Breathing
- ii) Decomposition
- iii) Combustion
- iv) Rusting

v) Some important fact about O<sub>2</sub> cycle:-

① phytoplankton is one of the most significant producers of oxygen followed by terrestrial plants and trees.

② oxygen is also produced when the sunlight reacts with water vapour present in the atmosphere.

③ A large amount of oxygen is stored in the earth's crust in the form of oxides, which cannot be used for the respiration process as it is available in the combined state.



vi) main importance of O<sub>2</sub> cycle:-

Oxygen is one of the most essential components of the earth's atmosphere. It is mainly required for:

- ① Breathing
- ② Combustion
- ③ Supporting aquatic life
- ④ Decomposition of organic waste

The oxygen cycle is mainly involved in maintaining the level of oxygen in the atmosphere. The entire cycle can be summarised as, the O<sub>2</sub> cycle begins with the process of photosynthesis in the presence of sun light, release oxygen back into the atmosphere, which humans and animals breathe in oxygen and breathe out CO<sub>2</sub> and again taking back to the plants. This also proves that both the oxygen and carbon cycle occur independently and are interconnected to each other.

4) carbon cycle :-

i) definition :- carbon cycle is the process where carbon compounds are interchange among the biosphere, geosphere, pedosphere, hydrosphere and atmosphere of the earth.

ii) carbon cycle steps:

the major steps involved in the process of the carbon cycle:-

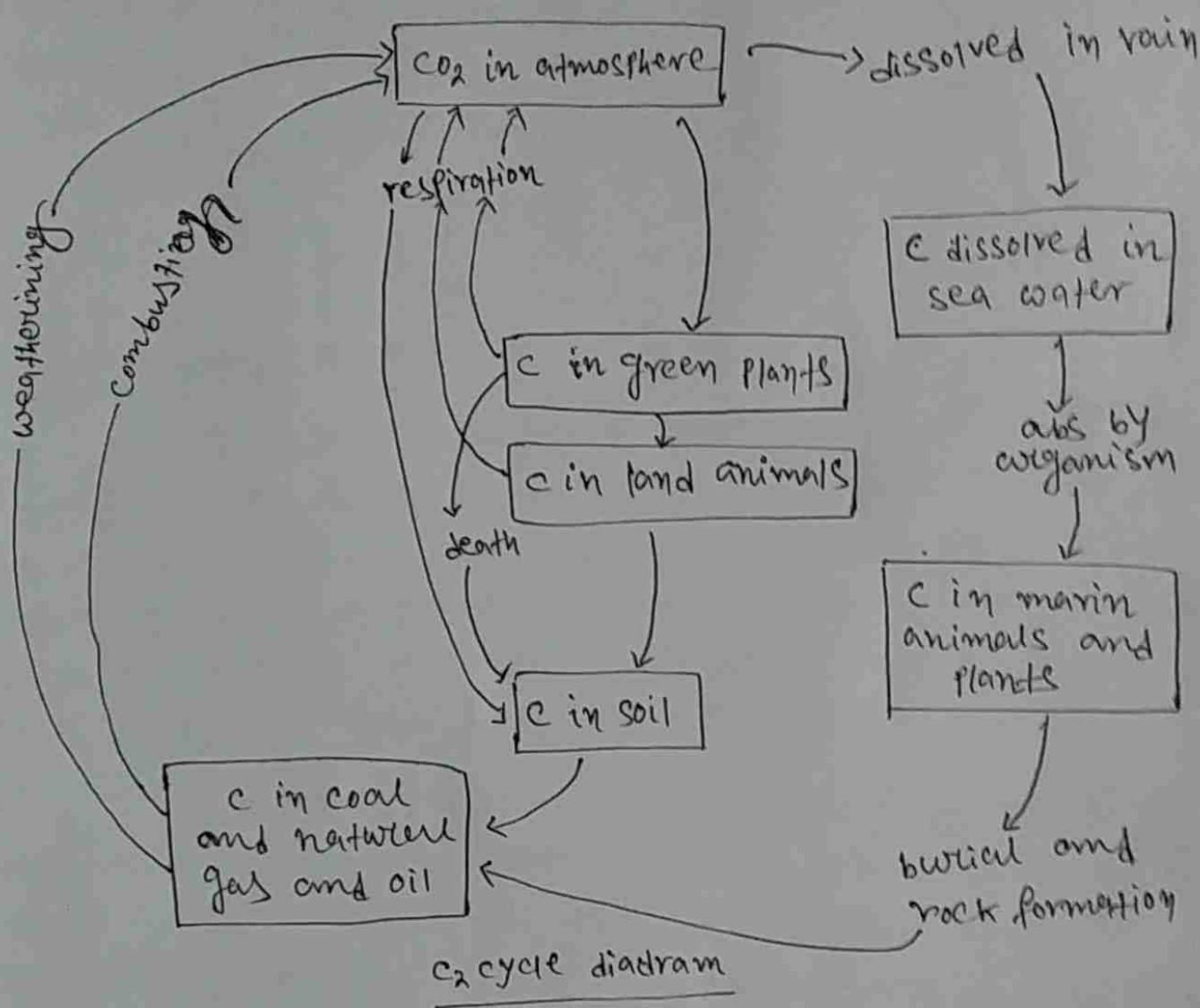
1) carbon present in the atmosphere is absorbed by plants for photosynthesis.

2) these plants are then consumed by animals, and carbon gets bioaccumulated into their bodies.

3) these animals and plants eventually die, and upon decomposing, carbon is released back into the atmosphere.

4) some of the carbon that is not released back into the atmosphere eventually become fossil fuels.

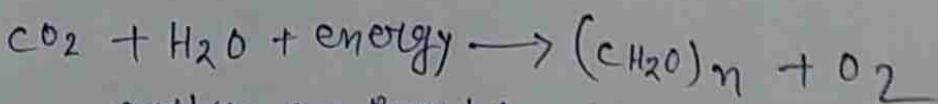
iii)

Schematic diagram :-

iv)

Land carbon cycle:

Carbon in atmosphere is present in the form of CO<sub>2</sub>. Carbon enters the atmosphere through natural process such as respiration and industrial applications such as burning fossil fuels. The process of photosynthesis involves the absorption of CO<sub>2</sub> by plants to produce carbohydrate. The equation is as follows:



Carbon compounds are passed along the food chain from producers to consumers. The rate of

decomposers is to eat the dead organism and return the carbon from their body back into the atmosphere.  
The equation for this process is:



#### v) Oceanic carbon cycle :-

This is essentially a carbon cycle but in the sea. Ecologically, oceans take in more carbon than it gives out. Hence, it is called a "carbon sink". Marine animals convert carbon to calcium carbonate and this forms the raw building materials required to create hard-shells, similar to the ones found in clams and oysters.

When organisms with calcium carbonate shells die, their body decomposes, leaving behind their hard shells. These accumulate on the seafloor and are eventually broken down by the waves and compacted under enormous pressure, forming lime stone.

#### vi) key points on carbon cycle :-

① Carbon cycle explains the movement of carbon between the earth's biosphere, geosphere, hydrosphere and atmosphere.

② Carbon is an important element of life.

③ The formation of fossil fuels and sedimentary rocks contribute to the carbon cycle for very long periods.

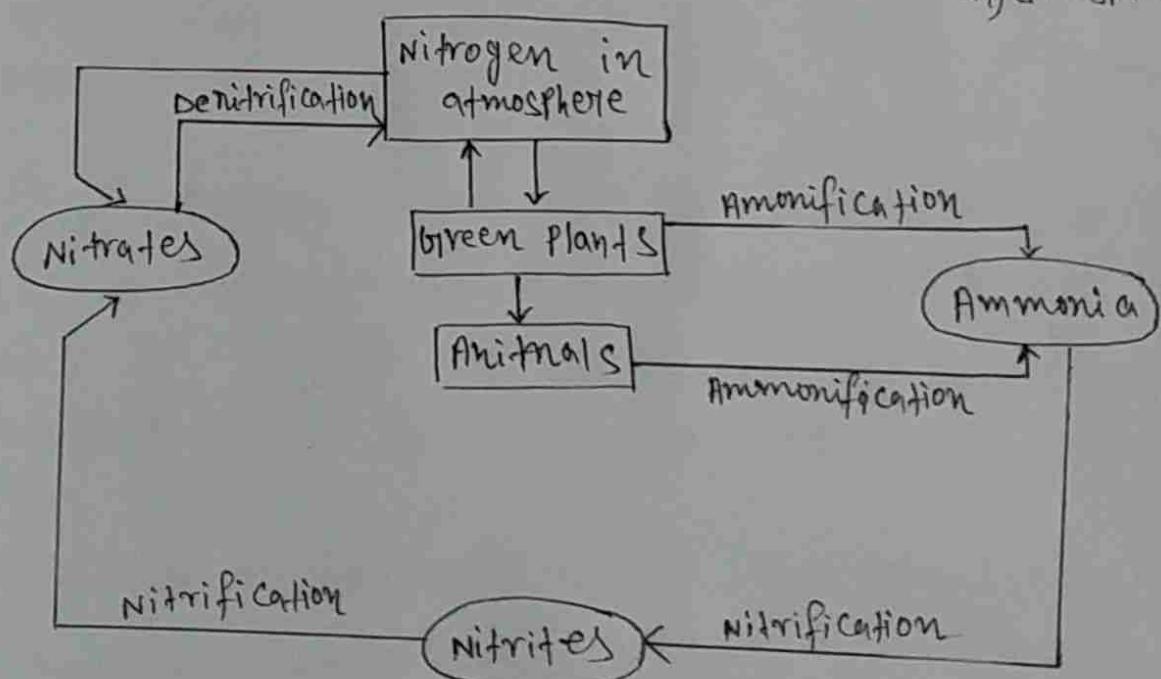
- ① The carbon cycle is associated with the availability of other compounds as well.
- ② Carbon atoms are released as carbon dioxide ( $\text{CO}_2$ ) when organisms respire.

5)

what is nitrogen cycle?

=> The nitrogen cycle is the biogeochemical cycle that describes the transformations of nitrogen and nitrogen-containing compounds in nature.

It is shown that 95% of the  $\text{N}_2$  flow in the global terrestrial system is restricted to the plant-micro-organism-soil system; only 5% of the total flow is concerned with exchanges to and from the atmosphere and the hydrosphere.



(ii)

Introduction:-

Annual N<sub>2</sub> transfers between soil and vegetation by far exceed other global nitrogen transfer. Its main characteristics are -

- most commonly limiting nutrient
- important plant nutrient
- critical for food production
- human manipulation is intense
- Pollutant in water and air.

iii

The Basics:

① Earth's atmosphere is about 78% nitrogen making it the largest pool of N<sub>2</sub>.

② Some fixation occurs in lightning strikes, but most fixation is done by free living or symbiotic bacteria.

③ Nitrogen is essential for many biological processes, it is in all amino acids, is incorporated into proteins, and is present in the bases that make up nucleic acids, such as DNA RNA.

④ In plants, much of the nitrogen is used in chlorophyll molecules which are essential for photo-synthesis and further growth.

iii)

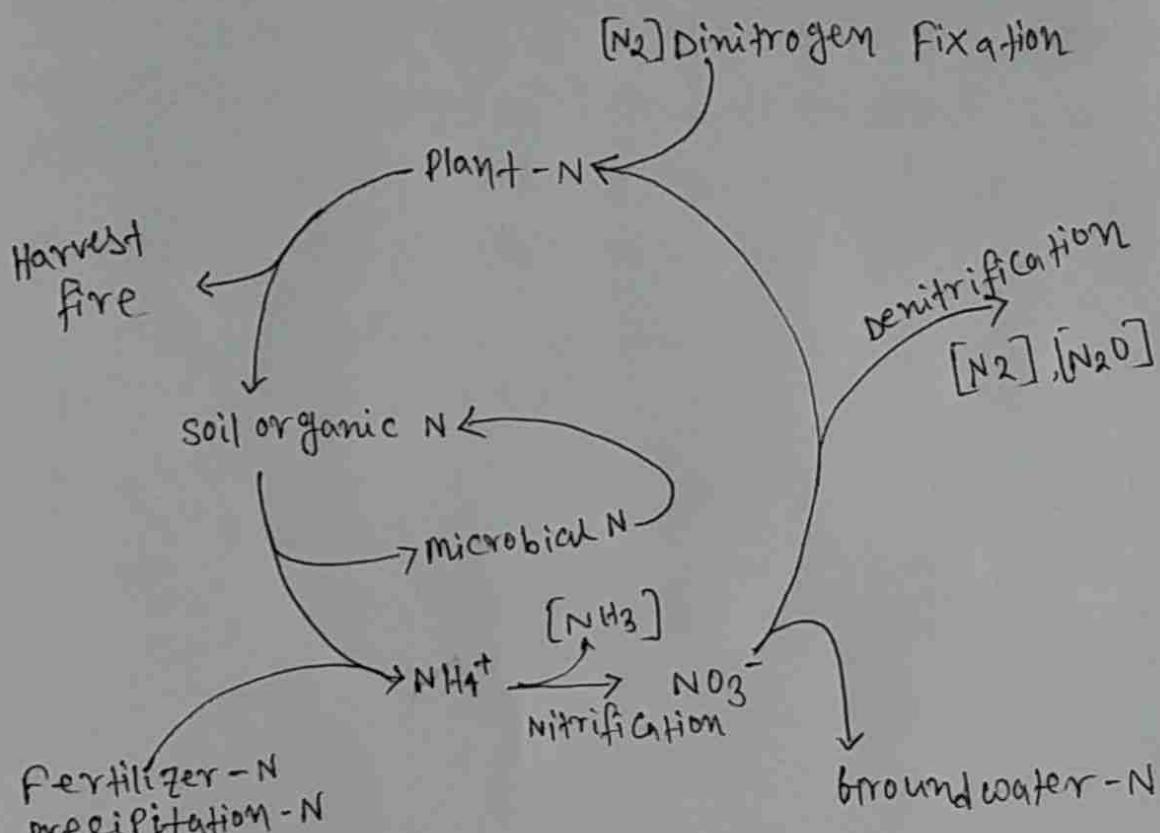
### Nitrogen conversions in soil :-

The vegetational cover of the earth is dependent on inorganic nitrogen for growth, and the amounts of plant-available ammonium- or nitrate-nitrogen at any one time are usually limiting. The ammonium nitrogen in soil water is in equilibrium with exchangeable inorganic nitrogen, which is bound to clay minerals and organic colloids. The amount of exchangeable and soluble inorganic nitrogen rarely exceed 2% of total soil nitrogen (Hewinsen & Holmbrander, 1983). Ammonium can also be fixed to clay minerals in such a way that it becomes unavailable, and amounts of fixed nitrogen have been reported occurring levels above 40% of total soil nitrogen (Young, 1962).

Molecular diNitrogen is fixed by certain bacteria and blue-green algae, becoming bound in the form of protein in biomass. Biological nitrogen fixation is one of the major inputs of nitrogen to the soil system. The ammonium vegetation type is restricted to soils with a low pH, which limits the activity of nitrifying bacteria. The nitrate type is confined to wet tropical forests and certain deciduous forests on soils with high pH.

iv)

### A Global Chart for Soil Nitrogen :-



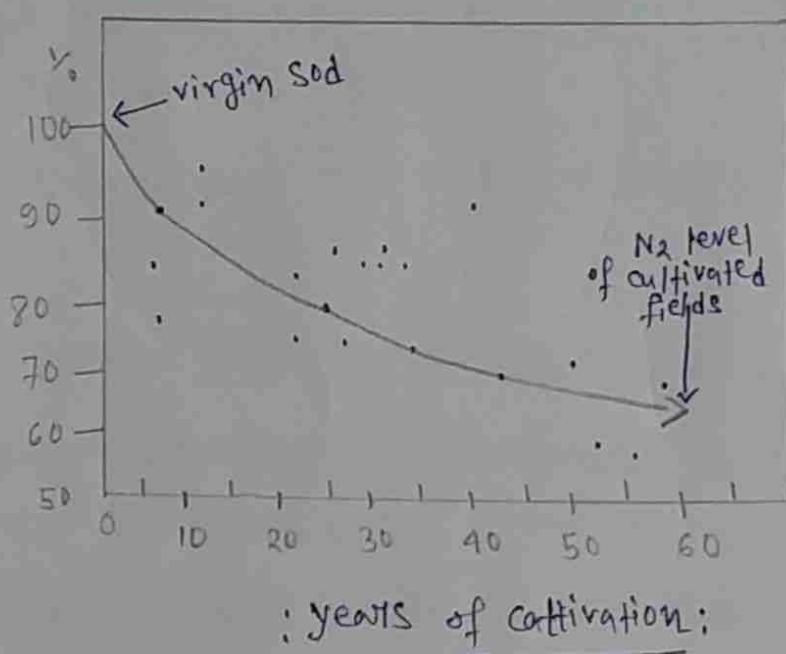
⟨ The Global Nitrogen cycle ⟩

v)

### N<sub>2</sub> cycle of ecosystem :

In the estimation of nitrogen transfers in the 'world' ecosystem, it was assumed that the system is in a steady state, since, at present, there is no conclusion evidence proving that world primary production is either decreasing or increasing. It should be realized, however, that a steady state rarely occurs in isolated system (ecosystem), in which N<sub>2</sub> may be either be increasing or

decreasing. As examples, the changes in N<sub>2</sub> content in the soil with time in a cropped ecosystems. The N<sub>2</sub> content of soil is thus very dependent on management-practices, and increased land cultivation will surely affect the N<sub>2</sub> content of the soil and consequently affect the total N<sub>2</sub> cycle.



- Ecosystem conserve N<sub>2</sub> by a more or less closed cycle of N<sub>2</sub> between the vegetation and the soil, and it is generally agreed that the developmental stages of ecosystem tend to have a more open nutrient cycle as compare with the nature (climax) stages (Odum, 1969). Thus large amounts of N<sub>2</sub> are removed from the system in annual harvests. The system thus has large inputs/outputs, and is only prevented from running low in N<sub>2</sub> by add'n of fertilizers.

6&gt;

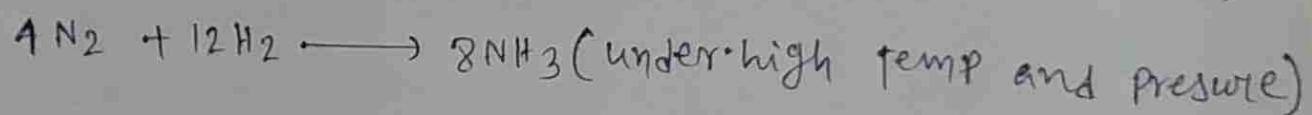
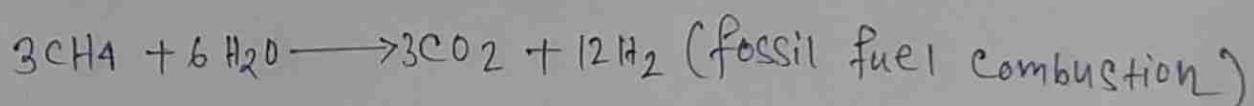
### N<sub>2</sub> cycle reactions and related processes :-

- 7 oxidation states of N
- most transformations are biotic, most carried out by micro-organism.
- N fixation  $\rightarrow$  N<sub>2</sub> + 6e<sup>-</sup>  $\rightarrow$  2NH<sub>3</sub>  $\rightarrow$  Amino Acids  $\rightarrow$  proteins.
- large energy input required to break that N to N triple bond.
- free living and mutualistic approaches to obtaining this energy

- ① cyanobacteria pair photosynthesis and N<sub>2</sub> fixation.
- ② Rhizobium associates with plants, gets photosynthate in return for giving up some NH<sub>3</sub>.
- ③ Frankia associates with older trees.
- ④ heterotrophy (Azotobacter, others)
- ⑤ more N<sub>2</sub> fixation in rhizosphere (Azotobacter).
- typically occurs in environment with low or limiting NH<sub>3</sub> concentrations.
- N fixation done by enzyme complex, Nitrogenase, encoded by nif genes.
- ⑥ dinitrogenase reductase (Fe protein)
- ⑦ dinitrogenase (Mo, Fe protein)
- nitrogenase very sensitive to O<sub>2</sub>
- ⑧ reduced oxygen tension (Azospirillum)
- ⑨ Anaerobic heterotrophs (Clostridium)

- ① Anoxygenic phototrops (*Rhodospirillum*).
- ② protective structure - root nodule for *Rhizobium* sp.  
heterocysts in cyanobacteria sp.

Haber-Bosch process (industrial fertilizer i.e., human N fixation):



### 7) Ammonification:-

organic matter N  $\rightarrow$  NH<sub>3</sub> (NH<sub>4</sub><sup>+</sup> in acid to natural a<sub>4</sub>SO<sub>4</sub><sup>n</sup>)

- organic to inorganic, SO decomposition.

- plant detritus C-C-C-C-NH<sub>2</sub>, microbes eat up C for growth and energy.

e.g., i) Sawdust C:N = 225 : 1

bacteria C:N = 6 : 1

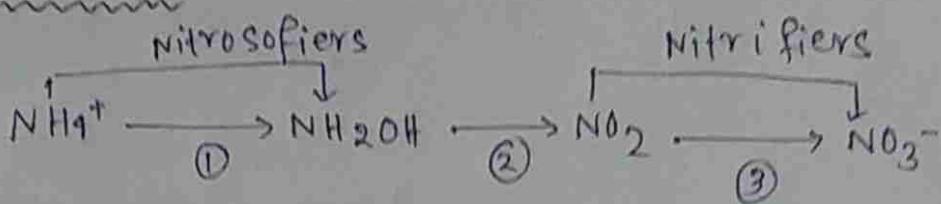
result: to get C, the bacteria scavenges N from soil

$\longrightarrow$  IMMobilization

\* fate of NH<sub>4</sub><sup>+</sup>  $\rightarrow$

- ① Plant up take
- ② microglobal uptake
- ③ volatilization
- ④ bound to clay
- ⑤ nitrification
- ⑥ bound to soil colloids or humus.

8) Nitrification :-



1 = ammonia monooxygenase

2 = hydroxylamine oxidoreductase

3 = nitrite oxidoreductase

two steps process ( $\text{NH}_4^+ \rightarrow \text{NO}_2^-$  and  $\text{NO}_2^- \rightarrow \text{NO}_3^-$ )

① first step by Nitrosifiers (Nitrosomonas)

② second step by Nitrobacters (Nitrobacter)

③ steps are closely coupled.

④ fate of  $\text{NO}_3^-$

① plant uptake

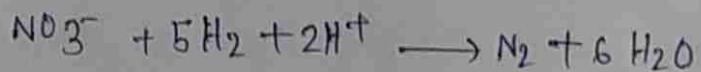
② leaching, run off

③ reduction to  $\text{NH}_4^+$

④ reduction to dinitrogen gas ( $\text{N}_2$ )

9)

Denitrification :-



- multistep process -

①  $\text{NO}_3^- \rightarrow \text{NO}_2^- \rightarrow \text{NO} \rightarrow \text{N}_2\text{O} \rightarrow \text{N}_2$

② 1<sup>st</sup> step by nitrate reductase, 2<sup>nd</sup> step by nitrite reductase

- environmentally-limited process:

- ① carbon-rich-environment
- ② few e<sup>-</sup> acceptors
- ③ sewage sludge
- ④ stagnant water
- ⑤ some sediments (high org. matter)
- ⑥ rumen

\* fate of PHS ( $\text{NO}_x, \text{N}_2\text{O}, \text{N}_2$ ):

- ① gaseous loss to atmosphere
- ② output of N from ecosystem
- ③ reduces soil fertility
- ④ reduces  $\text{NO}_3^-$  leaching.

10&gt;

N<sub>2</sub> cycle for living being:-

Nitrogen is essential for all living things, because it is a major part of amino acids, which are the building blocks of proteins and of nucleic acids such as DNA, which transfers genetic information to subsequent generation of organisms. About 78% of the atmosphere is made by  $\text{N}_2$ , but plants and animals can't take nitrogen directly from the air. A process called the nitrogen cycle makes this happen.

11.

## CONCLUSIONS

The biosphere has developed over millions of years to a mature system with a very close N<sub>2</sub> cycle. On a global scale, 95% of the annual N<sub>2</sub> flows occur within the soil & between soil and vegetation.

The earth, as well as individual ecosystems, seems to have adapted to a fairly constant - turnover rate for N<sub>2</sub> in various components. Although the total magnitudes for the flows vary, the turnover rates for separate components are very similar.

At present, man induced change probably affect the prevailing patterns of N<sub>2</sub> conversions - to a minor extent. It should be noted that small changes have profound effects - for example the catalytic action of oxides of N<sub>2</sub> on the ozone layer.

## ACKNOWLEDGEMENT

I convey my deep sense of gratitude to Sir, for suggesting the way to find suitable for the development, in the preparation of the project manuscript. I owe to him in every sense for providing me with the facilities, volumic guidance and constant help through out the course of investigation.

Date :-

Swaraj Bhagat

signature of the  
student

## CERTIFICATE

certified that the project work submitted by Surajit Rayen is done under the supervision of my honorable sir as a part of curriculum for the partial fulfilment of the class- VI<sup>th</sup> and semester

Date :

Signature of the  
Teacher

# RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

### PROJECT TITLE:

AIR POLLUTION IN CITIES AND MEASURES TO  
CONTROL IT.

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DEPARTMENT : Economics  
YEAR : 2020  
SIGNATURE : Susnato Maji

# Air Pollution in Cities

and

## Measures to control it.

**A**ir pollution is the presence of substances in the atmosphere that are harmful to the health of humans and other living beings, or cause damage to the climate or to materials. There are different types of air pollutants such as gases (such as Ammonia, carbon monoxide, sulfur dioxide, nitrous oxides etc.), particulates (both organic and inorganic), and biological molecules. Air pollution may cause diseases, allergies and even death to humans. It may also cause other animals.

Substances and factors which cause air pollution, are called air pollutants.

According to central pollution control board (CPCB) particle size 2.5  $\mu\text{m}$  or less than in diameter are responsible for causing the greatest harm to human health.

## Air Pollution in Cities

- ◻ Delhi leads the country India in its level of air pollution.  
It has more cars than states of West Bengal and Gujarat put together.
- ◻ In 1990's Delhi ranked 4th among the 41 most polluted cities of the world.

## Causes of Air Pollution in India.

- ① Smokestacks of thermal power plants, smelters and other industries release particulate and gaseous air pollutants together with harmless gases such as  $N_2$  and  $O_2$ .
- ② Pollutants from automobiles, locomotives, aircrafts and exhausts in cities constitute the major part of the total air pollution.
- ③ Incomplete and complete combination of the carbon contents of fossil fuel wood and charcoal produce  $CO$  and  $CO_2$  along with  $SO_2$ .

## Effects of Air Pollutants:

Pollutants	Source	Effects.
1. Aerosols [Evapour chemicals in the form of Fluoro-carbon CFC, SO <sub>2</sub> NO <sub>2</sub> , NO etc]	<ul style="list-style-type: none"> <li>• Emissions of jet and supersonic aeroplanes.</li> <li>• Refrigerators and air conditioners use aerosols (CF<sub>2</sub>Cl<sub>2</sub>) as refrigerant.</li> </ul>	Causes O <sub>3</sub> depletion.
2. Smoke [Visible suspension of carbon]	The power stations throw out large amount of fly ashes.	Causes respiratory problems like asthma and bronchitis in humans.
3. Dust and mist	Both are released from the industries.	Causes Byssinosis Asbestosis silicosis etc.

## Measures to Control Air pollution in Cities.

Air pollution in India's many cities (especially Delhi) became so serious that a public Interest Litigation (PIL) was filed in Supreme Court of India.

After being considered very strongly by the Supreme Court, under its directive the government was asked to take within a specified time period, appropriate measures including switching over the entire fleet of public transport i.e. buses, from diesel to CNG. All the buses of Delhi were converted to run on CNG by the end of 2002.

## Some Actions that are taken by Govt in this regard.

The Govt of India through a new auto fuel policy has laid out a roadmap to cut down vehicular pollution in Indian cities.

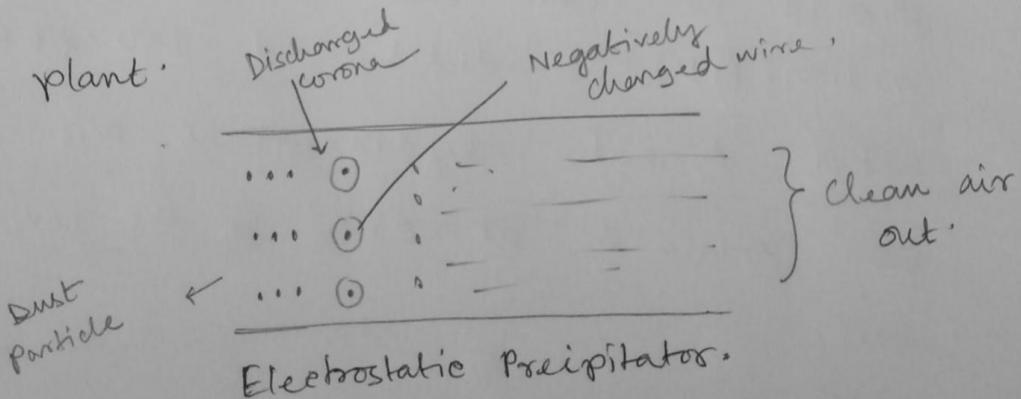
More stringent norms for fuels means steadily reducing the sulphur and aromatic content in petrol and diesel fuels.

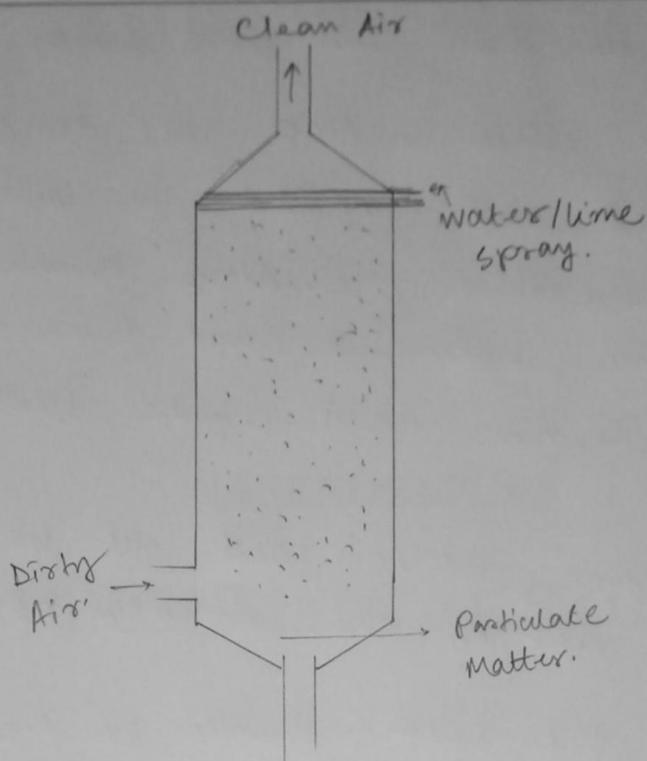
- ⦿ On April 29, 1999 the Supreme Court of India ruled that all vehicles in India have to stay Euro-I India 2000 norms by June 1
- ⦿ Euro II in the NCR by April 2000
- ⦿ Euro III norms, stipulate that sulphur should be controlled at 350 parts per million (ppm) in diesel and 150 ppm in petrol. Aromatic hydrocarbons are to be contained at 42% of the concerned fuel.

## Bharat stage 4

Fuels contain 50 ppm Sulphur. The BSIV norms had been enforced across the country since April 2017.

- # Use of unleaded petrol
- # Use of low sulphur petrol and diesel.
- # Use of catalytic converters in vehicles.
- # Application of stringent pollution level norms for vehicles.
- # Use of scrubber in industries.
- # Use of electrostatic precipitation which is most effective device to remove over 99% of particulate matter present in the exhaust from a thermal power plant.





Scrubber.

# In 2016 the centre had announced that the country would skip the BS V norms altogether and adopt BSVI norms by 2020

# The BSVI fuel is estimated to bring around an 80% reduction of sulphur from 50 ppm to 10 ppm.

# Delhi has become the first city in India to deliver Bharat Stage VI grade fuel (both petrol and diesel). State owned oil firms have started supplying the BSVI

fuel at all their 391 petrol pumps in NCR.

Other cities in NCR like Noida, Gurugram, Ghaziabad and Faridabad as well as other 13 mega cities including Mumbai, Chennai, Bengaluru, Hyderabad and Pune will roll out cleaner BS VI Grade fuel from Jan'19.

However, BS VI fuel will be rolled out in rest of the country by April '20.

At the last thanks to the efforts made, the air quality of cities have significantly improved. According to an estimate, a substantial fall in CO<sub>2</sub> and SO<sub>2</sub> level has been found in various cities between 1997 and 2005.

# RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

PROJECT TITLE:

POND ECOSYSTEM AND FOOD CHAINS

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YEAR : 2020  
SIGNATURE : Subhendu Maji

• [CERTIFICATE] •

certified that the project work submitted by Subhendu Maji is done under the supervision of my honourable sir as a part of curriculum for the partial fulfilment of the class - WG 2nd semester.

Date :

\_\_\_\_\_  
signature of the  
teacher

## ACKNOWLEDGEMENT

I convey my deep sense of gratitude to Sir, for suggesting the way to find suitable for the development in the every sense for providing me with the facilities, valuable guidance and constant help through out the entire course of investigation.

Subhendu Maji

Date → 15/11/2020

\_\_\_\_\_  
Signature of the  
student.

● Introduction: A pond is either a natural or an artificial body of water that is enclosed. Ponds can occur naturally in the world or they can be human made (such as garden pond).

An ecosystem is the technical term for a community of organisms. For such a community to form an ecosystem, it needs to be a distinct system where the organisms live and interact.

Pond Ecosystem differs from other water ecosystems. Unlike the river ecosystem, which is categorised under the lotic ecosystems, pond ecosystem falls under the lentic ecosystem for the reason that the water remains stagnant in ponds for a relatively longer period of time.

● Types of Pond Ecosystem:

Ponds can come in many different forms, and they all have their own differentiating characteristics. Below we will find a discussion of some of the key types of pond ecosystem.

1. Salt pond:

Salt ponds contain brackish (i.e. salty) water and can occur close to the sea side where waterlogged ground creates natural pools. Salt pond can also occur in rocky areas on beach, though here they are called rock pools. It is also possible to find salt ponds inland, thanks to the presence of brackish streams created through streams flowing through salty rocks.

## 2. Garden ponds:

These artificially created ponds can contain ornamental plants and animal species that come from all over the world (i.e. non-native species).

## 3. Freshwater pools:

Freshwater pools can form anywhere inland, either from rainfall or from the presence of water saturating the soil. They can also be created by rivers flowing in to a depression in the ground. They can be home to fish, birds, amphibians, crustaceans, and many other kinds of wildlife.

## 4. Vernal pools:

Vernal pools are seasonal ponds. They form in depressions in the ground, but only during certain types of years when the rainfall is heaviest. As a result, they will attract certain types of animals and birds that are in need of a drink. Whenever they appear and at other times of the year will be relatively deserted — one example for instance is a seasonal oasis in desert. These types of pond ecosystems are sometimes referred as ephemeral pools as well, to reflect the fact that they only exist at certain times of year.

## 5. Underground ponds:

Ponds can also form underground, in the rocky environment of caves. Here, a surprising amount of life can be found, including fish, different bacteria, lichens and so on.

- Characteristics of pond ecosystem:

There are several things that mark pond ecosystems out from other types of ecosystems. Below, we will find some of the main features of these ecosystems.

1. Still waters: pond ecosystems are lentic ecosystems i.e. they involve stagnant or standing water.
2. Surrounded by banks: by definition, pond ecosystem are surrounded by either artificial or natural banks.
3. Wet: these ecosystem are wet and humid ones.
4. Different levels: distinct communities of creatures will live at different levels of a pond. crustaceans and deep water fish may live at the lower level, for example; whilst birds and blooming plants may live towards the surface.
5. Variable in size: some pond ecosystem can be very small (such as rockpool) whilst others can be almost as large as a lake.

- Components of pond Ecosystem and its food chain:

In pond ecosystem like other ecosystem; there are main two components:-

i) Abiotic component

ii) Biotic component.

1. Abiotic component: Abiotic component of pond consists of water, dissolved minerals, oxygen and carbon dioxide.

2. Biotic component: It includes the following:

(i) producers, (ii) consumers, (iii) decomposers and transformers.

### (i) producers:

The main producers in pond ecosystem are algae and other aquatic plants such as Azolla, Hydrilla, Potamogeton etc. These are either floating or suspended or rooted at the bottom. These green plants converts the radiant energy into chemical energy through photosynthesis. The chemical energy stored in the form of food is utilized by all the organisms. Oxygen involved by the producers in photosynthesis is utilized by all the living organisms in respiration.

(ii) consumers: In a pond ecosystem, the primary consumers are tadpole, larvae of frogs, fishes and other aquatic animals which consume green plants and algae as their food. These herbivorous aquatic animals are food of secondary consumers. Frogs, big fishes, water snakes are secondary consumers. On pond ecosystem besides the secondary consumers, there are consumers of highest order, such as water birds, turtle, called tertiary consumers.

### iii) Decomposers and transformers:

When aquatic plants and animals die; a large number of bacteria and fungi attack their dead body and convert the complex organic substances into simpler inorganic component and elements. These micro-organisms are called "decomposers".

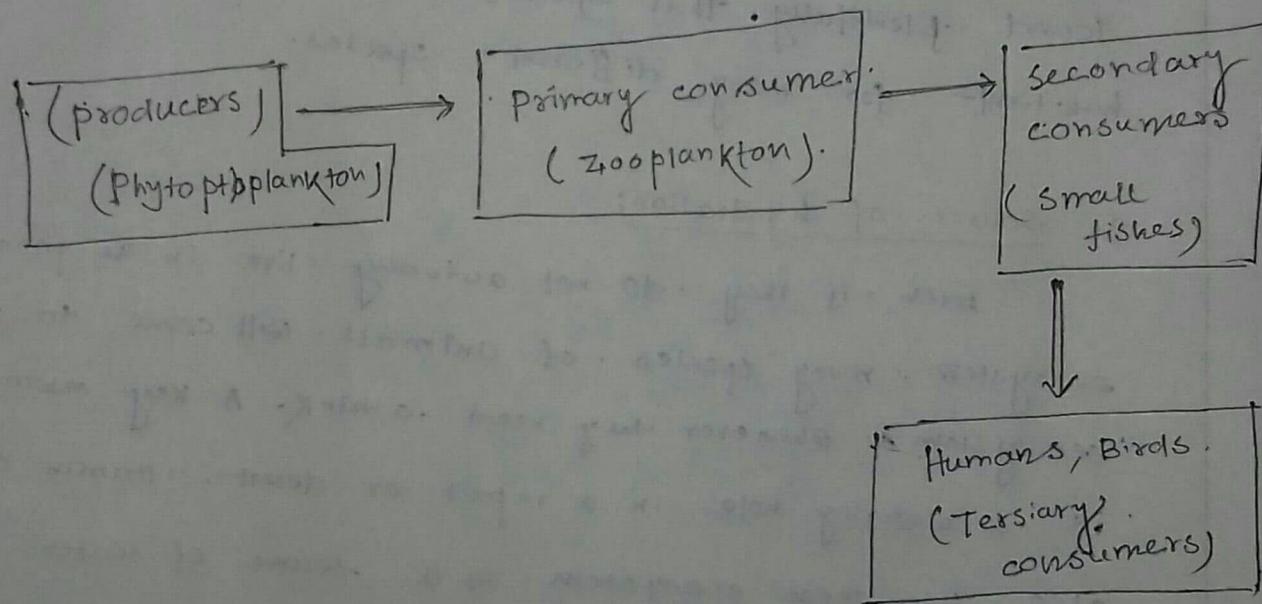


Diagram: Food chain in pond ecosystem.

### • Importance of pond ecosystem:

Pond ecosystem are very important, and for this reason it is vital that we take steps to protect and nurture them. Below, we will find some significant reasons why this is the case.

#### 1. Biodiversity:

Pond ecosystem are very important habitats for so many different types of fish, birds, plants and crustaceans as well as insects such as dragonflies, damselflies and pond skaters.

2. Ubiquity: pond ecosystem can be found on every continent on the planet. That makes them very important for the life of organisms all over the world.

### 3. Abundance:

Pond ecosystem are very ~~important~~ abundant. Not only can they be found almost everywhere, they can be found plentifully. That again, makes them a key habitat for many different species.

### 4. Source of hydration:

Even if they do not actually live in the pond ecosystem, many species of animals will come to pond ecosystem whenever they need a drink. A key example is a watering hole in a savannah or desert. Human can also use these ecosystem as a source of water.

### 5. Beauty:

Pond ecosystem are very beautiful as well. As we watch the sunlight reflecting off the surface of a pond, we can feel inspired, calm and in touch with nature.

### ● Conclusion:

Though they can be found all over the globe, pond ecosystem are often neglected by conservationists. All of our wetland ecosystems ought to be safeguarded because they are vital habitats for an abundance of different species.

# RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

### PROJECT TITLE:

Nutrient cycle of - Nitrogen (Mainly), oxygen  
and carbon

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COLLEGE ROLL NO : CHUGI/152/19  
DEPARTMENT : Chemistry  
YEAR : 2020  
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~~Page~~

# ACKNOWLEDGEMENT

I convey my deep sense of gratitude to Sir, for suggesting the way to find suitable for the development, in the preparation of the project manuscript. I owe to him in every sense for providing me with the facilities, valuable guidance and constant help through out the course of investigation.

Date: 11/11/2020

Swapnil Sen  
\_\_\_\_\_  
Signature of the student

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① What is 'NUTRIENT CYCLE' :

Living organisms need food to grow and survive in nature. Any food or element required by an organism to live or to lead his/her life in a fruitful way, is called nutrient.

Depending on the amount it is needed in, a nutrient can be classified as a macronutrient (needed in large quantities e.g., carbon, oxygen, hydrogen, nitrogen, phosphorous etc.) or micronutrient (needed in small quantities e.g., iron, zinc, copper, iodine etc.).

In nature, the nutrient elements and their compounds continuously move from the non-living environment to the parts of living organisms and back to the non-living environment. This is a cyclic movement of minerals from their sources or ~~reservoirs~~ reservoirs (air, water, soil etc.), to the parts of living creatures and then to the sources again. This cycle is referred as 'NUTRIENT' or 'BIOGEOCHEMICAL CYCLE'.

## ② Global 'Nutrient Cycles' and its Classification

An adequate and balanced supply of elements necessary for life, provided through the ecological processes of nutrient cycling, underpins all other ecosystem services is referred as a whole 'global Nutrient Cycle'.

"If you look at the ecological circuitry of this planet, the ways in which materials like carbon or sulfur or phosphorous or nitrogen get cycled in ways that makes them available for our biology, the organisms that do the heavy lifting are bacteria".

— Andrew H. Knoll

Broadly speaking, nutrients can occur in gaseous form (such as  $N_2$ ,  $CO_2$ ), mineral form (such as apatite), inorganic form (such as  $NH_4^+$ ,  $NO_3^-$ ) and as well as organic form (C based compound).

- ⇒ Nutrient cycles are mainly classified into three cycles - (i) Oxygen cycle  
 (ii) Carbon cycle  
 (iii) Nitrogen cycle

### ③ Oxygen Cycle:

(i) Definition: The cyclic movement of oxygen from their reservoir (air, water, soil) to the living being and back to the reservoir is called 'Oxygen cycle'.

Oxygen cycle, along with the carbon cycle and nitrogen cycle plays an essential role in the existence of life on the earth. The oxygen cycle is a biological process which helps in maintaining the oxygen level by moving through three main spheres of the earth which are —

- Atmosphere
- Lithosphere
- Biosphere

(ii) Main Reservoir: The main reservoirs of oxygen are :  
a) Atmosphere  
b) Biosphere  
c) Hydrosphere  
d) Lithosphere

(iii) Steps of O<sub>2</sub> cycle: The steps involved in the oxygen cycle are —

Stage - 1 → All green plants during the process of photosynthesis, release oxygen back

into the atmosphere as a by-product.

Stage - 2 → All aerobic organisms use free oxygen for respiration.

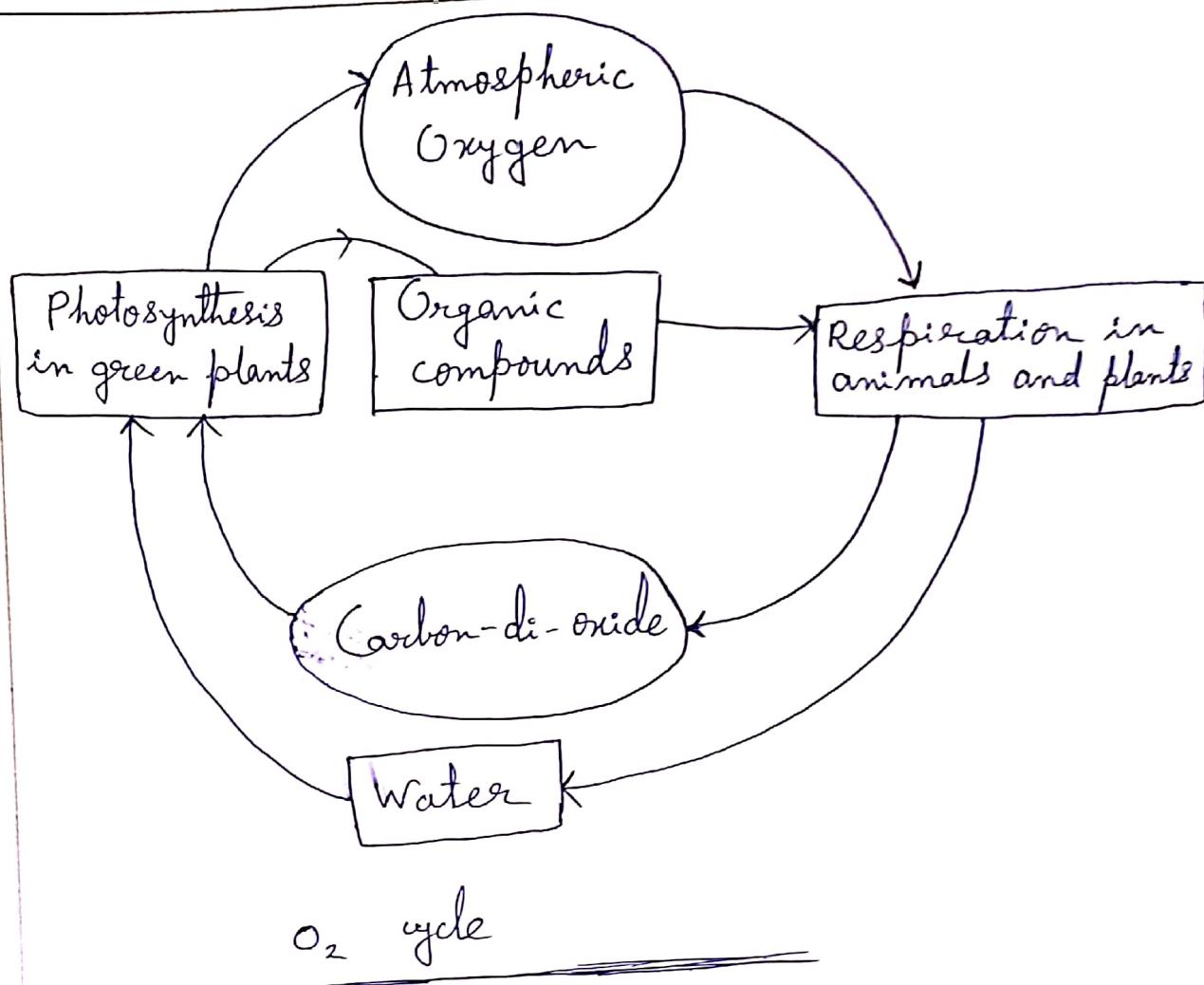
Stage - 3 → Animals exhale carbon-di-oxide back into the atmosphere which is again used by the plants during photosynthesis. Now oxygen is balanced with in the atmosphere.

iv) Process of O<sub>2</sub> cycle: The four processes that use atmospheric oxygen are:

- (a) Breathing
- (b) Decomposition
- (c) Combustion
- (d) Rusting

(v) Some important facts about O<sub>2</sub> cycle:

- Phytoplankton is one of the most significant producers of oxygen followed by terrestrial plants and trees.
- Oxygen is also produced when the sunlight reacts with water vapour present in the atmosphere.
- A large amount of oxygen is stored in the earth's crust in the form of oxides, which can not be used for the respiration process as it is available in the combined state.



(vi) Importance of O<sub>2</sub> cycle: Oxygen is one of the most essential components of the Earth's atmosphere. It is mainly required for:

- ④ Breathing.
- ④ Combustion.
- ④ Supporting aquatic life.
- ④ Decomposition of organic waste.

The oxygen cycle is mainly involved in maintaining the level of oxygen in the atmosphere. The entire cycle can be summarised as, the O<sub>2</sub> cycle begins with the process of photosynthesis in presence of

sunlight, releases oxygen back into the atmosphere, which humans and animals breathe in oxygen and breathe out  $\text{CO}_2$  and again linking back to the plants. This also proves that both the oxygen and carbon cycle occur independently and are interconnected to each other. According to Jacko Willink

"Why do you want to get a good workout early in the morning? Well, because it sends more oxygen to your brain; it releases endorphins. It puts you in a state of mind where you can crush things, which is where you want to be."

#### ④ Carbon Cycle:

(i) Definition: Carbon cycle is the process where carbon compounds are interchanged among the biosphere, geosphere, pedosphere, hydrosphere and atmosphere of the earth.

(ii) Carbon Cycle Steps: The major steps involved in the processes of the carbon cycle:

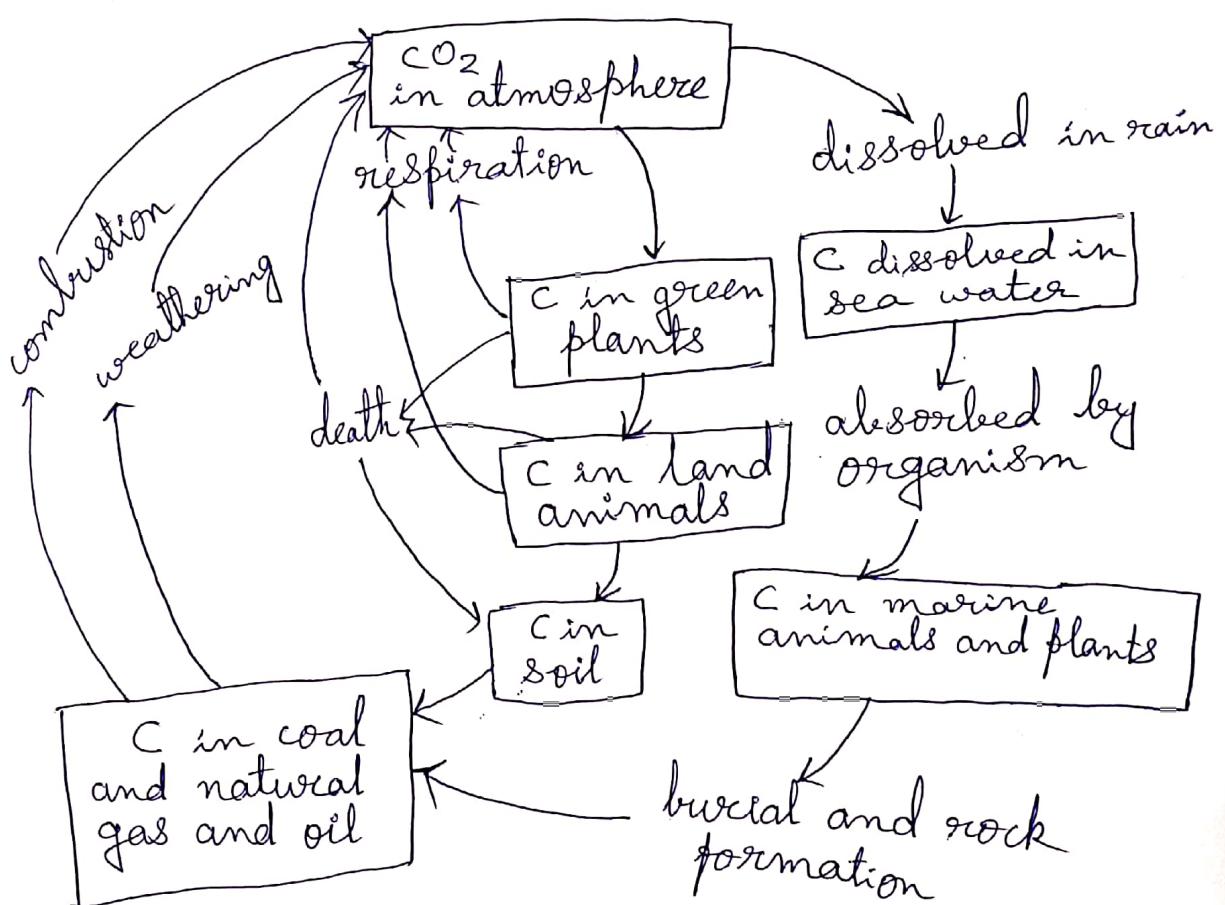
a) Carbon present in the atmosphere is absorbed by plants for photosynthesis.

b] These plants are then consumed by animals and carbon gets bioaccumulated into their bodies.

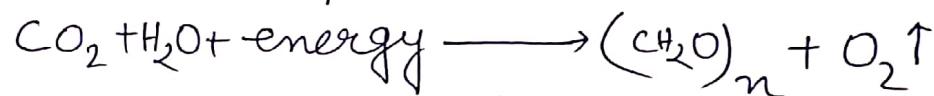
c] These animals and plants eventually die and upon decomposing, carbon is released back into the atmosphere.

d] Some of the carbon, not released, back into the atmosphere eventually become fossil fuels.

### (iii) Schematic diagram : Carbon Cycle



(iv) Land Carbon Cycle: Carbon in atmosphere is present in the form of  $\text{CO}_2$ . Carbon enters the atmosphere through natural process such as respiration and industrial applications such as burning fossil fuels. The process of photosynthesis involves the absorption of  $\text{CO}_2$  by plants to produce carbohydrate. The equation is as follows:



Carbon compounds are passed along the food chain from producers to consumers. The role of decomposers is to eat the dead organism and return the carbon from their body, back into the atmosphere. The equation for this process is:



(v) Oceanic Carbon Cycle: This is essentially a carbon cycle but in the sea. Ecologically, oceans take in more carbon than it gives out. Hence, it is called a "Carbon Sink". Marine animals convert carbon to carbonate

and this form the raw building materials require to create hard shells, similar to the one found in clams and oysters.

When organisms with calcium carbonate shells die, their body decomposes, leaving behind their hard shells. These accumulate ~~one~~ of the seafloor and are eventually broken down by the waves and compacted under enormous pressure, forming lime-stone.

#### (vi) Key points on Carbon Cycle:

- ◆ Carbon cycle explains the movement of carbon between the earth's biosphere, geosphere, hydrosphere and atmosphere.
- ◆ Carbon is an important element on Earth to structure the life.
- ◆ The formation of fossil fuels and sedimentary rocks contribute to the carbon cycle for very long periods.
- ◆ The carbon cycle is associated with the availability of other compounds as well.

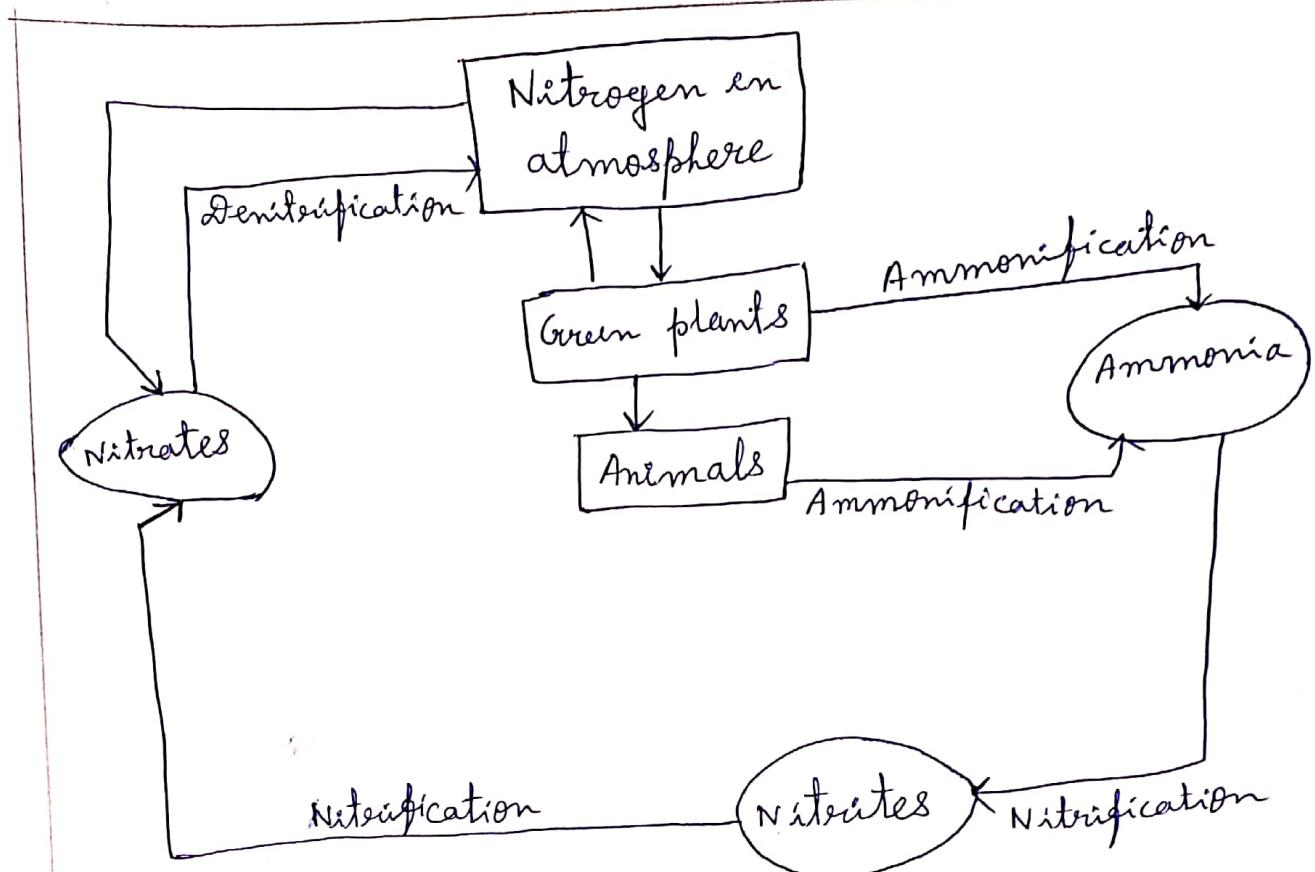
Carbon atoms ~~are~~ ~~not~~ are released as Carbon-di-oxide ( $\text{CO}_2$ ) when organisms respire.  
According to Jacob Bronowski,

"You will die but the carbon will not; its career does not end with you. It will return to the soil, and there a plant may take it up again in time, sending it once more on a cycle of plant and animal life."

## ⑤ NITROGEN CYCLE:

⇒ The nitrogen cycle is the biogeochemical cycle that describes the transformations of nitrogen and nitrogen-containing compounds in nature.

It is shown that 95% of the  $\text{N}_2$  flow in the global terrestrial system is restricted to the plant-microorganism-soil system; only 5% of the total flow is concerned with exchanges to and from the atmosphere and the hydrosphere.



Schematic diagram of 'Nitrogen Cycle'.

(i) Introduction: Annual  $N_2$  transfers between soil and vegetation by far exceed other global nitrogen transfer. Its main characteristics are -

- Most commonly limiting nutrient
- Important plant nutrient
- Critical for food production
- Human manipulation is intense
- Pollutant in water and air

(ii) The Basics:

- Earth's atmosphere is about 78% nitrogen

making it the largest pool of  $N_2$ .

- Some fixation occurs in lightning strikes, but most fixation is done by free living or symbiotic bacteria.
- Nitrogen is essential for many biological processes, it is in all amino acids, is incorporated into proteins, and is present in the bases that make up nucleic acids, such as DNA and RNA.
- In plants much of the nitrogen is used in chlorophyll molecules which are essential for photosynthesis and further growth.

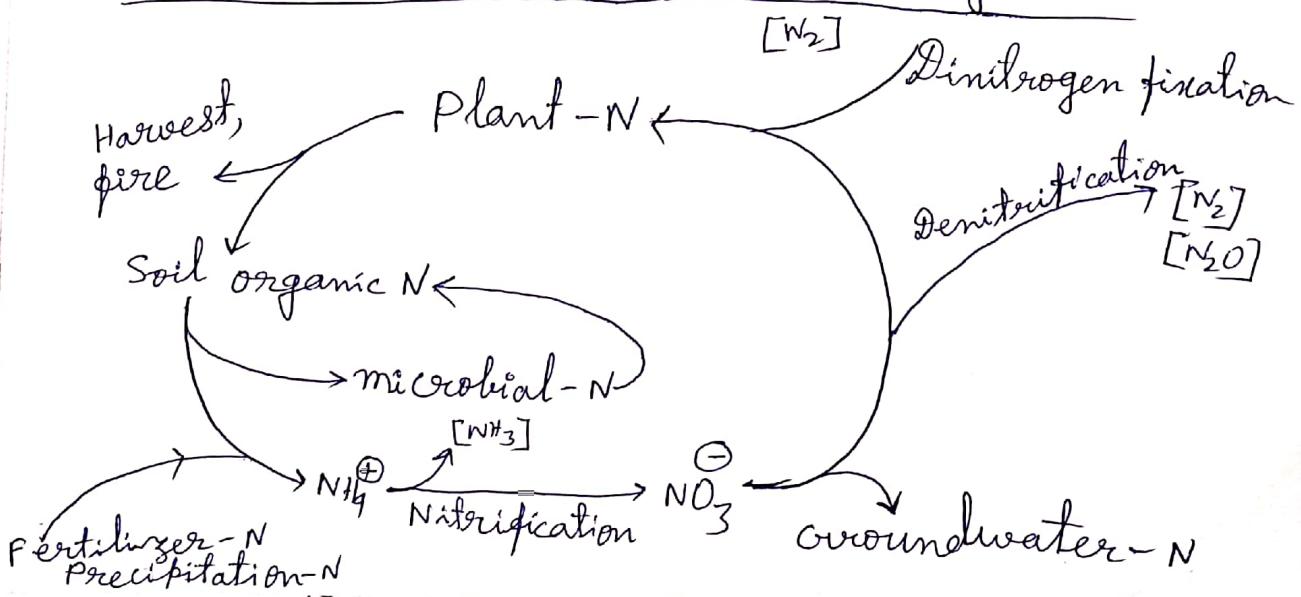
### (iii) Nitrogen Conversions in Soil:

The vegetational cover of the earth is dependent on inorganic nitrogen for growth and the amounts of plant-available ammonium or nitrate nitrogen at any one time are usually limit limiting. The ammonium nitrogen in soil water is in equilibrium with exchange-able inorganic nitrogen, which is bound to clay minerals and organic colloids. The amount of exchangeable 2% of total soil nitrogen rarely exceed 1965). Ammonium can also be fixed to clay minerals.

clay minerals in such a way that it becomes unavailable and amounts of fixed nitrogen have been reported attaining ~~soil~~ levels above 40% of total soil nitrogen (Young, 1962).

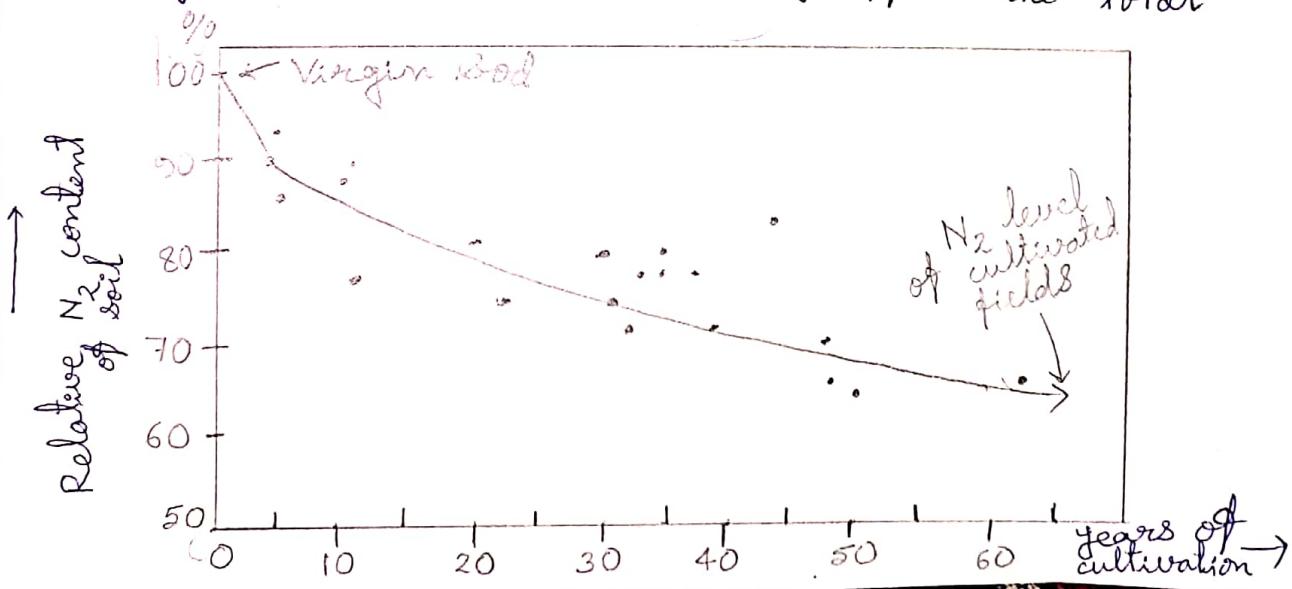
Molecular dinitrogen is fixed by certain bacteria and blue-green algae, becoming bound in the form of protein in biomass. Biological nitrogen fixation is one of the major inputs of nitrogen to the soil system. The ammonium vegetation type is restricted to soils with a low  $P^H$ , which limits the activity of nitrifying bacteria. The nitrate type is ~~confine~~ confined to wet tropical forests and certain deciduous forests on soil with high  $P^H$ .

#### (iv) A Global chart for Soil Nitrogen :



## (V) $N_2$ cycle of ecosystem:

In the estimation of nitrogen transfers in the 'World Ecosystem', it is assumed that the system is in a steady state, since, at present, there is no conclusive evidence proving that ~~world~~ primary production of world is either decreasing or increasing. It should be realized; however, that a steady state rarely occurs in isolated system (ecosystem) in which  $N_2$  may be either ~~be~~ increasing or decreasing. As examples, the changes in  $N_2$  content in the soil with time in a cropped ecosystems. The  $N_2$  content of soil is thus very dependent on management-practices, and increased land cultivation will surely affect the  $N_2$  content of the soil and consequently affect the total  $N_2$  cycle.

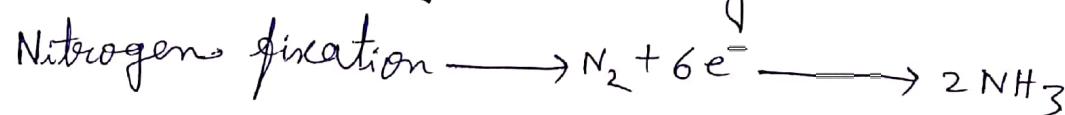


— Ecosystem conserve  $N_2$  by a more or less closed cycle of  $N_2$  between the vegetation and the soil, and it is generally agreed that the developmental stages of ecosystem tend to have a more open nutrient cycle as compare with the ~~most~~ nature (climax) stages (Odum, 1969). Thus large amounts of  $N_2$  are removed from the system in annual harvests. The system thus has large inputs running low in Nitrogen by addition of fertilizers.

## (VI) Nitrogen cycle reactions and related processes

# 7 oxidation states of nitrogen.

# Most transformations are biotic, most carried out by micro-organism.



Proteins ← Amino acids ← ]

# Large energy input required to break that  $N\equiv N$ , triple bond ( $N$  to  $N$ ).

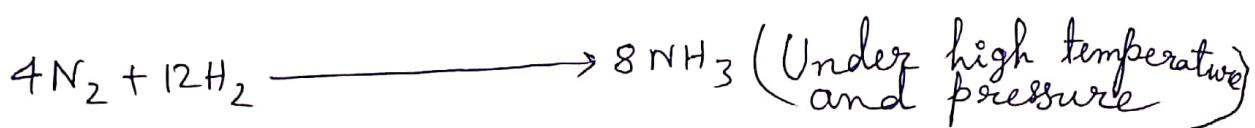
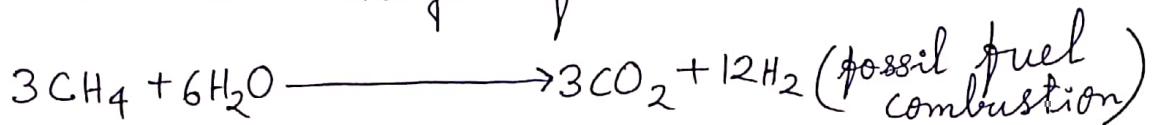
# Free-living and mutualistic approaches to obtaining this energy.

- cyanobacteria fair photosynthesis and N<sub>2</sub> fixation.
- Rhizobium associates with plants, gets photosynthate in return for giving up some NH<sub>3</sub>.
- Frankia associates with alder trees.
- Heterotrophy (Azotobacter, others).
- More N<sub>2</sub> fixation in rhizosphere (Azotobacter)
- # Typically occurs in environment with low or limiting NH<sub>3</sub> concentrations.
- # N fixation done by enzyme complex,
- 'Nitrogenase', encoded by 'Nif genes'.
- Dinitrogenase reductase (Fe protein)
- Dinitrogenase (Mofe Protein)
- # Nitrogenase very sensitive to O<sub>2</sub>
- Reduced oxygen tension (Azospirillum)
- Anaerobic Heterotrophs (Clostridium)
- Anoxygenic Phototrops (Rhodospirillum)

○ Protective Structures - root nodule for Rhizobium heterocysts in cyanobacteria.

### Haber-Bosch Process (Industrial fertilization)

i.e., human Nitrogen fixation



### (VII) Ammonification:

Organic matter containing Nitrogen

$(\text{NH}_4^+ \text{ in acid to neutral aqueous solution})$   $\text{NH}_3 \leftarrow$

# Organic to inorganic, so decomposition.

# Plant detritus  $\text{C}-\text{C}-\text{C}-\dots-\text{C}-\text{NH}_2$ , microbes eat up carbon for growth and energy.

e.g.)

a) Sawdust C:N = 225:1

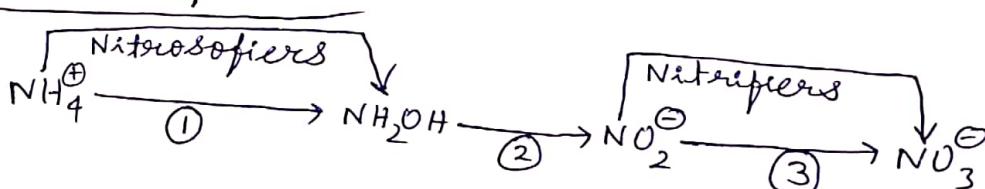
b) bacteria C:N = 6:1

Result: To get carbon, the bacteria scavenges Nitrogen from soil  
 $\longrightarrow$  Immobilization

## \* Fate of $\text{NH}_4^+$ →

- Plant uptake
- Microglobal uptake
- Volatilization
- Bound to clay
- Nitrification
- Bound to soil colloids or humus

## (VIII) Nitrification:



- ① = Ammonia monooxygenase
- ② = Hydroxylamine oxidoreductase
- ③ = Nitrite oxidoreductase

Two steps process ( $\text{NH}_4^+ \rightarrow \text{NO}_2^-$  and  $\text{NO}_2^- \rightarrow \text{NO}_3^-$ )

○ First step by nitrosomicrobes (Nitrosomonas acts here)

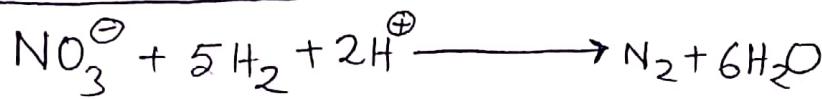
○ Second step by nitrifiers (Nitrobacter acts here)

○ Steps are closely coupled.

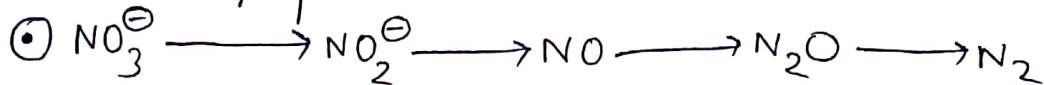
## \* Fate of $\text{NO}_3^- \Rightarrow$

- Plant uptake
- Leaching, run off
- Reduction to  $\text{NH}_4^+$
- Reduction to dinitrogen gas ( $\text{N}_2$ )

## (IX) Denitrification:



► Multistep process



• 1st step by nitrate reductase,  
2nd step by nitrite reductase

► Environmentally-limited process, ~~needed~~

Limits:

- Carbon-rich-environment
- Few electron acceptors
- Sewage sludge
- Stagnant water
- Some sediments (High organic matter)
- Rumen.

\* Fate of products ( $\text{NO}$ ,  $\text{N}_2\text{O}$ ,  $\text{N}_2$ ):

- Gaseous loss to atmosphere.
- Output of N from ecosystem.
- Reduces soil-fertility.
- Reduces  $\text{NO}_3^-$  leaching.

## (X) Nitrogen cycle for living being:

Nitrogen is essential for all living things, because it is a major part of amino acids, which are the building blocks of proteins and of nucleic acids

such as DNA, which transfers genetic information to subsequent generation of organisms. About 78% of the atmosphere is made by N<sub>2</sub>, but plants and animals can't take nitrogen directly from the air. A process called the nitrogen cycle makes this happen. According to John Shinkus,

"Nitrogen fertilizer is used on all crops produced in this country, but it is a key plant nutrient to ~~produce corn~~ produce corn a critical crop to Illinois farmers."

# CONCLUSION

The biosphere has developed over millions of years to a mature system - with a very closed  $N_2$  cycle. On a global scale, 95% of the annual  $N_2$  flows occur within the soil and between soil and vegetation.

The earth, as well as individual ecosystems, seems to have adapted to a fairly constant turnover rate for  $N_2$  in various components. Although the total magnitudes for the flows to vary, the turnover rates for separate components are very ~~some~~ similar.

At present, man induced change probably affect the prevailing patterns of Nitrogen conversions to a ~~no~~ minor extent. It should be noted that small changes have profound effects - for example the catalytic action of oxides of Nitrogen on the ozone layer. According to Fritz Haber,

"Agricultural husbandry essentially maintains the balance of bound nitrogen".

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by J. Jones.
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H.A. Mills and J. Jones.

# RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

PROJECT TITLE:

"Water pollution and measures to control it."

NAME : SWAPRAVA MUKHOPADHYAY.  
COLLEGE ROLL NO : HJUG/011/19  
DEPARTMENT : History.  
YEAR : 2020  
SIGNATURE :

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### ଏହିବେଳେ :-

ଜୀଲ୍ୟ ମର୍ତ୍ତ୍ଵ କେନ ଯାହିଁର ପଦ୍ଧତି ମିଳେ ଯାଏଥା  
ଯାଇ ଯାହିଁ ଜୀଲ୍ୟ ଅର୍ଥର ଏ ବ୍ୟାକାନିକ ବ୍ୟାକ ଏ ଉଦ୍‌ଦେଶ୍ୟ  
ଓ ପ୍ରମାଣେ ଏହା କେନ ପାଇସନ ହୁଏ ଯାଏ ଯାଇ ଗଲିବି  
ତେବେଳେ ଏହା ଏହା ଏହା ଏହା ଏହା ଏହା ଏହା  
ଏହା ଏହା ଏହା ଏହା ଏହା ଏହା

### ଜୀଲ୍ୟରେ ବ୍ୟାକ୍ :-

ମାତ୍ରାଚୟ ଦୈନିକିନ ଜୀବନକାର ଯାଇ ତାର କାହା  
ବ୍ୟାକ୍ କ୍ଷେତ୍ରର ବ୍ୟାକ୍ ଏହାର ବ୍ୟାକ୍ କ୍ଷେତ୍ରର ବ୍ୟାକ୍, ହୃଦୟରେ  
ଦୈନିକିନ ଯାକଣି ବ୍ୟାକ୍ ଯେତେ ଯାଇ ମାତ୍ରିଯ ଭେଦ  
ଭ୍ୟାକ୍ କ୍ଷେତ୍ରର ବ୍ୟାକ୍ ଏହା ଏହା ବ୍ୟାକ୍ ଏହା ଏହା ଏହା  
କ୍ଷେତ୍ରର ବ୍ୟାକ୍ ଏହା ଏହା ଏହା ଏହା ଏହା ଏହା  
କ୍ଷେତ୍ରର ବ୍ୟାକ୍ ଏହା ଏହା ଏହା ଏହା ଏହା ଏହା  
ଏହା ଏହା ଏହା ଏହା ଏହା ଏହା ଏହା ଏହା  
ଏହା ଏହା ଏହା ଏହା ଏହା ଏହା ଏହା ଏହା

③

ପ୍ରିୟ ଯାତ୍ରିନାର ମହି ଶିଖିନ ବିଷ୍ଣୁ ଦେବ ଏମ୍ବେ, ଗମ,  
ଗ୍ରା, କାତମିଯାର ଏ ଶିଖିନ ବିଷ୍ଣୁ ଦେବ ଏମ୍ବେ  
ଏବଂ ପ୍ରତ୍ୟେବ ଏଲମାର, ହ୍ୟାମାର, ଶୁଭବିନ ହୀର୍ଦ୍ଦିତ ଦେବ  
ଏବଂ, ବୁଲି ଜଳର ମୁଦିତ ଏବଂ,

କଥା ଓ ଆମେ ଗାଁଧିତ କୀଟୋକୁଳା ପିତ୍ତର ଏମ୍ବେ

କୁତୁଳ ଏବଂ କୋନ ହୃଦୟ କଳିକାର୍ଯ୍ୟ, ସିଂହ ପୂର୍ବ ମୁଦିତ କଲେଯ  
କେନେ କର୍ମକାଳ ଏକବୀ ଏତ୍ତେ କିମ୍ବା ଏବଂ ଶିଖିନ ଏକ  
ଅକ୍ଷୟାକ୍ଷୟ, ଶିଖିନ, ଶିଖିନ, ଏକାକ୍ଷୟ ଉପରେ ଦେବାବିତ ଏବଂ  
ଏକାକ୍ଷୟକୁଳିତେ ବିଷ୍ଣୁ ପିତ୍ତର ଏ ଦୁଃଖାଶ୍ରୀତି ଏବଂ,

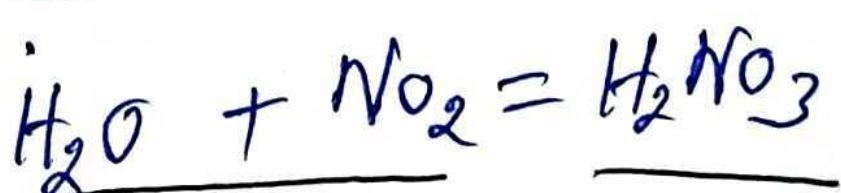
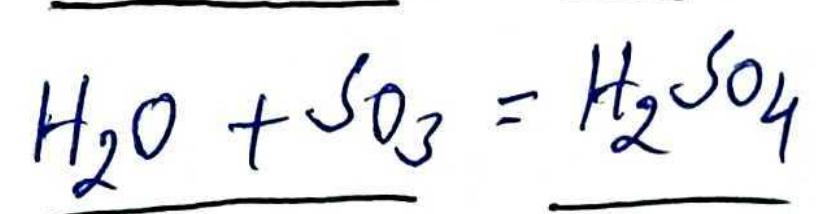
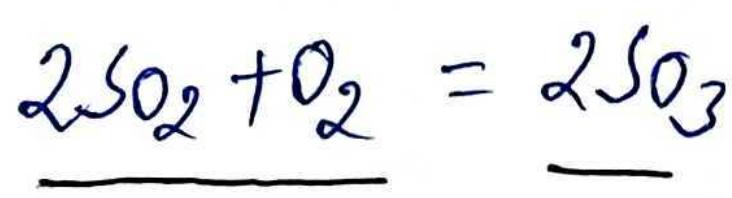
ଦୁଃଖାଶ୍ରୀତି ଏବଂ ମାନୁ ଓ ଶିଖିନଙ୍କୁ ଦେଖି କାଳାବ୍ଦୀ,  
କାଳାବ୍ଦୀ କୋଣ ଏବଂ, ଯାହା ଚଳେ ଏହି ଜଳ ଶୁଣିବେଳେ କିମ୍ବା  
ବୁଦ୍ଧିକବ କାଳାବ୍ଦୀ ପାଇଁବେ ଯୁଦ୍ଧବୈକଳ ଏହି ପରିବାରର  
ବେଳେ ଏହିନ,

କୁତୁଳ ଏ କୁତୁଳରେ ଚଳେ ଶିଖିନ ଏବଂ ଏକଳେ  
କୁତୁଳ ଶିଖିନ ଏକଳେ ଏ ଶିଖିନରେ କୁତୁଳ ଏବଂ,  
କୁତୁଳରେ କୁତୁଳ-କୁତୁଳ-କୁତୁଳ ଏକଳେ କୁତୁଳ ଏକଳେ  
ଏକଳେ ଏକଳେ କାଳାବ୍ଦୀ ଏହି ଏଥାର କୁତୁଳ ଏକଳେ

(4)

ବ୍ୟାକ ହେଉଥିବା ମଧ୍ୟ ଦେଖିବାରେ, ପ୍ରାଚୀନ ଉତ୍ସମାନ  
ଠିକ୍ ଅନୁଷ୍ଠାନ କିମ୍ବା କେବେ, ଯାଇ କାଳେ ଏକିବେଳେ ୩  
ଶୀଘ୍ର ଜୀବିକାର୍ଥ ଓ ଜୀବିକାର୍ଥ କମାର୍ଥ କେବେ  
ବ୍ୟାକ ହେଉଥିବା କାଳେ ଏକିବେଳେ କେବେ  
ପ୍ରାଚୀନବାଣୀ ଯୁଦ୍ଧଲୋକ ଜୀବିକାର୍ଥ କମାର୍ଥ  
କମାର୍ଥ,

ଯାହିଁର ଶୀଘ୍ର କାଳେ ଏକିବେଳେ ଯୁଦ୍ଧ କମାର୍ଥ, କାଳେ  
କେବେ ପରିବାର ବିଭାଗେ ଏବଂ ଆମ କାଳେ ଜୀବିକାର୍ଥ କମାର୍ଥ  
କମାର୍ଥ ଏବଂ କମାର୍ଥ ଏକିବେଳେ କେବେ,  
ଯାହିଁର ଶୀଘ୍ର କମାର୍ଥ  $\text{SO}_2 + \text{NO}_2$  କମାର୍ଥ କେବେ ଯାହିଁର  
ଶୀଘ୍ର କମାର୍ଥ ୨୫,



କମାର୍ଥ ଏକିବେଳେ ଏକିବେଳେ କେବେ କେବେ କେବେ  
ଯାହିଁର ଯୁଦ୍ଧକାଳେ ଏକିବେଳେ ଏକିବେଳେ କେବେ କେବେ

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କିମ୍ବିର ଓ ହାତୀ ଏବଂ ପ୍ରକାଶିତ ହେଉଥିଲା ଏହା ପରେ,  
ହୁଣିରେ ଏବଳେ ଯାତ୍ରିକ ପରିମାତ୍ର ଏବଂ ସିଦ୍ଧାନ୍ତ  
ଗୀତଙ୍କ ପରିମାତ୍ର ଯାତ୍ରାକାରୀଙ୍କ ଜୁବ ଉପରେ ଏବଳେ  
ପରିଷ୍ଠାନୀ, ଯାତ୍ରୀ, ପାଇବୁ ଏବଂ ପାଇବୁ ଏହା, ପରିଷ୍ଠାନୀ  
ଏବଂ ପାଇବୁ ଏବଳେ ମିଳେ ଏହି ଏବଳ ହୁଣିର ପରିମାତ୍ର  
ଗୀତଙ୍କାରୁଳିଟେ ପରିଷ୍ଠାନୀ ଏହା, ଏହାରେ ଏବଳେ ପରିଷ୍ଠାନୀରେ  
ପରିଷ୍ଠାନୀ ଏବଳେ ଏବଳେ ଏବଳେ ଏବଳେ ଏବଳେ ଏବଳେ  
ମିଳେ ଏବଳ ହୁଣିର ପରିମାତ୍ର,

ଅନୁଷ୍ଠାନିକ ରୂପ ମାନବଦେହରେ ହୃଦୀ-ଶୈଖରାଜି:

ଶୈଖରାଜି ହୋଇ ଏବଂ କୌଣସି ହୋଇଥାଏଇବିନିମ୍ୟା - କୁଣ୍ଡଳ  
ମାନୁମାନ - ଏ ପରିମାତ୍ର ପରିମାତ୍ର ଏବଂ ଏ ହୃଦୀ ପରିଷ୍ଠାନୀ  
ଏବଂ ଏବଳେ ଏବଳେ ଏବଳେ ଏବଳେ, ଏହିବୀଟେ ଏହାରେ  
ପରିବହନ ଶୈଖରାଜି ହୋଇ ଏବଳେ ଏବଳେ 2 ମିଳିଲିନ  
ମାନୁମାନ ହୁଣିରେ ଯାହିଲୁଣି ଶୈଖରାଜି, ଉଚ୍ଚାଲାହୀନ  
ଯାହିଲୁଣି ଏ ଉଚ୍ଚାଲାହୀନ ପାଇବୁ ଏବଳେ ଏବଳେ  
ଏବଂ ଶୈଖରାଜି ହୁଣିରେ ମାନୁମାନ ପରିମାତ୍ର ଏବଳେ -

୧୨) ପ୍ରାଚୀକାଳୀ ଏ ଅର୍ଦ୍ଧତାମ ଏ ଜୀବିତୀ(ପ୍ରାଚୀକାଳୀ)  
ଶିଖିତିର ମହିମା,

ଶ୍ରୀକାରୀକୁ ଶୀଘ୍ର ଦେଖୁଣ୍ଡି—

ଶ୍ରୀକିଂକଳ ଏକା ଶ୍ରୀକାରୀକୁ ମହିମା ଗଲାଟ  
ଦିଅବେ କ୍ଷେତ୍ର ୨୮ ମାତ୍ର, ଯେବେ ପରିମା ଓ ଉପରେ ଶିଖିତ  
ପରିମା କାଳୀ ଶ୍ରୀକାରୀ କିମି ଦେଖିବା କବୁ ଦେଖିବା,

ପାଲିକା;— ଅନ୍ତର୍ଦ୍ଵାରା ଯେବେ ଶ୍ରୀକିଂକଳ ଏକା ଶ୍ରୀକାରୀ  
ଦିଅବେ ଏକ ମାତ୍ର ଏ ଶ୍ରୀକାରୀ ମହିମା ଘରମାରୀ ଘରମାରୀ  
ଦେଖିବା, ଏହି କାଳୀ କ୍ଷେତ୍ର ନିମ୍ନ ୩୦-୫୦ ମାତ୍ର କାଳୀ  
ମାତ୍ର ମାତ୍ରମାରୀ ଓ ଏମି କାଳୀ, କାଳୀ କବିତା ସେବା ଯତିରିତ  
ମହିମା କାଳୀ ଯେହିଦେଇ ଆଜେ ଯାଏକି ହୁଲିବ, ମାତ୍ରା ହୋଇ  
ଶିଖିତି ଉପରେ କାଳୀ ଦେଖିବା,

ଶ୍ରୀରାମଙ୍କ;— ଶ୍ରୀକିଂକଳ କାଳୀ ପଞ୍ଚ ଦିନ କିମି କାଳୀ ଦେଖିବା,  
କିମି କାଳୀ ଶ୍ରୀକାରୀକୁ କାରିତା କିମି ଦିଅବେ ଏ କାଳୀ କାଳୀ  
ଦେଖିବା କାଳୀ କାଳୀ, କିମି କାଳୀ କାଳୀ ଶିଖିତିର କାଳୀ  
କାଳୀ, ମାତ୍ରା କାଳୀ ଓ ପରେଯ କାଳୀ କାଳୀ କାଳୀ,

ଉଦ୍‌ଦେଶ୍ୟ ହିତ କଥା:-

ଜନେର ନୃତ୍ୟ ଓ ଶିଳ୍ପିଙ୍କର ମାନବଚରଣରେ ଏହା  
ଉଦ୍‌ଦେଶ୍ୟରେ କୌଣସି ଏହା ହାତେ ଯେତେ ଉପରୋକ୍ତରେ ଏହା  
ପରିଚିତ, ଉଦ୍‌ଦେଶ୍ୟ ହିତ ଏବଂ ସୁଧାରିତ କରି  
୧ ଅଧ୍ୟାତ୍ମିକ କୌଣସି,

ଏହାରେ ଯାତାନାନୀ, ଅନ୍ତିମ ପ୍ରତ୍ୟାମନକାରୀଙ୍କ ହିତ କଥା  
ଏହାରେ ହାତ ଦେଖାଇବା,  
ଧ୍ୟାନିକ ନୃତ୍ୟ କଥା:-

ଜଳ ପରିଷ୍ଠିତ ଶିଳ୍ପିଙ୍କ ମାନୁଷଙ୍କ ଏବଂ ମନୁଷ୍ୟ  
କୌଣସି ଏହା - i) ଯାତାନାନୀ ବୀର୍ଯ୍ୟ କଥା ନୃତ୍ୟ  
ଏବଂ (ii) ଯାତାନାନୀ ବୀର୍ଯ୍ୟ ଏବଂ ପରିଚିତ  
କରିବାର ପାଇଁ, iii) ମନୋକର୍ମନୀ ଏବଂ ଏବତ୍ ସାମାଜିକ  
ଧ୍ୟାନିକ ଶ୍ରବନ ଏବଂ ଯୁଵି ଧ୍ୟାନିକ ଏବଂ  
ଏହାରେ ହାତ କଥା ଏବଂ ନୃତ୍ୟ କଥା,

## ପାର୍ଯ୍ୟନ୍ତିକ ହସ୍ତ:-

ଯେଉଁକୁ ଯାହାରିବେଳେ ଏପରିଚ୍ୟ କରନ୍ତି ଜଣେ ଏହି ଦ୍ୱାରା  
ଯାହାରିବ ହେଲା ଏବେ, ଯାହାରିବ ନାହିଁ ଯେବେ ଯିବ ନ ହେଲା  
ଏବେ ଯିବେଳେ ଏବେ ଯିବେଳେ ଯିବେଳେ ଏବେ ଏବେ ଏବେ ଏବେ  
ଏବେ ଏବେ ଏବେ ଏବେ ଏବେ ଏବେ ଏବେ ଏବେ

ଯାତ୍ରାରେ ହିଂଦୁ କଣ୍ଠାଳି ମିଶ୍ର ଓ ମହିଳା ଏଲେଖା ଏ  
ମିଶ୍ର ପାଦମଣି ପାଇଁ ୧୨୩୦ ୨୮୮୨୭; ଲମା-ଜାହାଚିହ୍ନ  
କୀଟକର ଖାଇୟ, ii) ଅଛି ଲମା, ଉତ୍ତର ମିଶ୍ର / ୨୫, ଉତ୍ତରାଞ୍ଚିଲ  
କିଳୋ, iii) ଗର୍ଭକ ଦ୍ୱାରା ନାହିଁ କିମ୍ବା ଘର୍ଷମାନ ୧୨୩୦  
ଏହାତେ ଏହା ଏକ ଯାତ୍ରାରେ ପ୍ରୟୋଗ ହେବାର,

ଯୋଗିବିଳା ହୁଏଥାଏ ରାଜୀ ମଧ୍ୟ ପାଇଁ କାହାର କାହାର  
କାହାର ମାତ୍ରର ଲାଗୁ ହେବି କିମ୍ବା କିମ୍ବା - ଯୋଗିବିଳା  
ରାଜୀ ହୀବାହେବେ ହେବେ କେବଳ ଯୋଗିବିଳାକୁ ରାଜୀ, ରାଜୀର  
ଅନ୍ତିମରତ୍ନ ଯୋଗିବିଳା ଯାହାର ଉତ୍ତର କାହାର 10 ଲଙ୍ଘା  
ଦିଲି, କିମ୍ବା କିମ୍ବା କିମ୍ବା କିମ୍ବା - କିମ୍ବା, କିମ୍ବା, କିମ୍ବା  
ଯୋଗିବିଳା କିମ୍ବା କିମ୍ବା କିମ୍ବା କିମ୍ବା, କିମ୍ବା, କିମ୍ବା,  
କିମ୍ବା, କିମ୍ବା, କିମ୍ବା, କିମ୍ବା, କିମ୍ବା, କିମ୍ବା, କିମ୍ବା

ରୀତିଶ୍ଵର, କଣ୍ଠରାମ ୨୭, iii) ବୁଲଗଳି ଓ ଫୁଲ ଦେଖିବା  
ପାଇଁ, ଏହି ଘରରେ କୁଟୁମ୍ବ କାଳ ଥାଏ, ଅର୍ଥାତ୍ କାଳରେ  
କୁଟୁମ୍ବ ଥିଲା ୨୮।

## ଏହାର୍ଦ୍ବିକ ଧୂପତ:-

ଦେବତା ପ୍ରଥିମୀ କୌ ପ୍ରମିଳେଖ ଶ୍ରୀ-ପତିଜାନ୍ମ  
ପତିଜାନ୍ମ- ଯା ପ୍ରଥମ ମୁଦ୍ରା ଓ ମରାଗୁଡ଼ିଙ୍କ ହେଉଥାଏଇବା  
ପରିବେଳେ ଦୁଇ ଏକ ଅଧିକ ପ୍ରଥିମୀ ପରିବେଳେ ଦୁଆରୀ ହେଲା  
ଏହାମ୍ ପ୍ରଥମ ଚିତ୍ରାଯି ବିଚାର, ଏଣାକୁବେଳେ ଏବେଳେ ମୁଦ୍ରା  
ବିଭିନ୍ନ ପରିବେଳେ ଏବେ ବିଭିନ୍ନ ଯୋଗେ ମୁଦ୍ରାଙ୍କ ପରିବେଳେ ଓ  
ପ୍ରଥମିତର ବିଭିନ୍ନ ଏବେ ବିଭିନ୍ନ କାହାରେ ଏହା ଏହାକୁ  
ପୁରୁଷ ଓ ଫ୍ରାନ୍ସର ବିଭିନ୍ନ ଧର୍ମ, ବେଳମଧ୍ୟ ମୁଦ୍ରା  
ପ୍ରଥମିତର ବିଭିନ୍ନ କାହାରେ ଏହାକୁ-କୁଳାଚି ପ୍ରଥମ କୁଳ  
ବିଭିନ୍ନ ବେଳେ ଏହା କାହାରେ ଏହା ଏହା ଏହା ଏହା ଏହା  
ମୁଦ୍ରାଙ୍କ କାହାରେ ଏହା ଏହା ଏହା ଏହା ଏହା ଏହା  
ଏହା ଏହା ଏହା ଏହା ଏହା ଏହା ଏହା ଏହା ଏହା

## ଜଳଦୂଚାଳ-ନିଷ୍ଠା ଓ କୁରୀକୁଶାଳେ ପରିମାଣ :-

- ଜଳଦୂଚାଳ ପ୍ରତିକାରୀ ପ୍ରକଟି ଏହା ଜଳ କୁରୀ କୁରୀ  
ପ୍ରକାଶକେ ରଖ ଦିଆ ଓ ଅନ୍ତର୍ଗତ ପରିମାଣ କରିବାରେ ୧  
ନିଷ୍ଠା ଏବା, ଜଳଦୂଚାଳ-ନିଷ୍ଠା ଏବାରେ ପରିମାଣ -
- i) ଜଳର ପ୍ରକଟି ପ୍ରକାଶ କରି, କୁରୀ, ଛାଲ-କିଳ,  
କୁରୀ କୁରୀ ପରିମାଣ କରିବାରେ ପରିମାଣ କରିବାରେ  
କାଳୀ ଏହି ଏବା,
  - ii) କୋଟ କାଣ୍ଡ, କୁରୀ ଏବା କୁରୀ କାଳୀ ଯାତ୍ରା କଲାକ  
ପରିମାଣ କରିବାରେ ଏବା,
  - iii) କୁରୀ ଏବା କାଣ୍ଡ ପରିମାଣ କରିବାରେ କିମ୍ବାକୁ  
କିମ୍ବା କାଳୀ ଏବା କାଣ୍ଡ ପରିମାଣ କରିବାରେ ଏହି ଏବା,
  - iv) କାଣ୍ଡ ଯାତ୍ରା ଏବା ପରିମାଣ କରିବାରେ ଏବା କାଣ୍ଡ  
ପରିମାଣ କରିବାରେ ଏହି ଏବା,
  - v) ମହୁରାଳୀ ଏବା କାଳୀ ଏବା ପରିମାଣ କରିବାରେ,  
କାଣ୍ଡ କାଣ୍ଡ ଏବା କାଣ୍ଡ କାଣ୍ଡ ଏବା ଏହା ଏହା
  - vi) ଆରାଣୀ କାଣ୍ଡ କୁରୀ ଏବା କାଳୀ ଏବା ଏହା ଏହା  
କାଣ୍ଡ କାଣ୍ଡ ଏବା କାଣ୍ଡ କାଣ୍ଡ ଏବା କାଣ୍ଡ କାଣ୍ଡ  
ପରିମାଣ କରିବାରେ ଏହା ଏହା ଏହା,

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Vii) పరిషత్ బీజ, కుచ్చి శుద్ధి చేయడానికి విభాగ  
సమానంగా బీజ దా పరిషత్,

Viii) గల్కోప లిఫ్టర్స్ ఏ ప్రార్థన 1974 మాల ప్రార్థనల్లో  
కుచ్చి నిష్టత ఘరీన ప్రార్థన రూపా 1978 మాల కుచ్చి అంశం  
ఎస్, ప్రార్థనలై 1977, 1988 రూపాలలై కుచ్చి అంశం  
లిఫ్టర్స్ ఒ ప్రార్థన ఘరీన ప్రార్థన రూపా.

స్వరూప ప్రార్థన కుచ్చి రూ - గల్కోప ప్రార్థన  
ఉనిషట, కుచ్చి కుచ్చి మాల ప్రార్థన రూ - గల్కోప  
ఘరీన ప్రార్థన కుచ్చి ప్రార్థన కుచ్చి ప్రార్థన  
ప్రార్థన ఘరీన ఘరీన ఘరీన,  
ప్రార్థన తల ప్రార్థనలని అంశం:-

ప్రార్థన:- స్వరూప కుచ్చి ప్రార్థన ఘరీన ప్రార్థన  
కుచ్చి కుచ్చి ప్రార్థన, ప్రార్థన తలకె ప్రార్థన లో రూ విషయ  
ప్రార్థన ఏ కుచ్చి, రూ తల ప్రార్థన ఘరీన ప్రార్థన  
ఘరీన ప్రార్థన కుచ్చి ప్రార్థన రూ,

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ପରିଷେଷକୀ- ହାଲେ ପରମାଣୁ ଶକ୍ତି ଯାବାକୁ ଗଠିନି

କାନ୍ତରୀଣ ହୁଏ ହେଉଥିଲା ଏହାରେ ପାଇଁ କାନ୍ତରୀଣ  
କାନ୍ତରୀଣ କାନ୍ତରୀଣ ହୁଏ ହେଉଥିଲା ଏହାରେ କାନ୍ତରୀଣ  
କାନ୍ତରୀଣ କାନ୍ତରୀଣ ହୁଏ ହେଉଥିଲା ଏହାରେ

W.F.B. 25

ପରିମା ପରିପରା: - ଏହା ପରିପରା କୁ କଥା ମାତ୍ର

ପରେ- ପରିମା କିମ୍ବା କିମ୍ବା କିମ୍ବା  
ଏହା ସମ୍ବନ୍ଧରେ କିମ୍ବା କିମ୍ବା କିମ୍ବା  
ଏହା ଏହା ଏହା, ଏହା ଏହା  
ଏହା ଏହା ଏହା, ଏହା ଏହା

ବ୍ୟାକ: ଏହା ପରିଚ୍ୟତ ଏବଂ ଲିଖି ଥିଲା କୌଣସି  
ନାରୀଶ୍ଵର ଏ ଧାର୍ଯ୍ୟକାରୀ କିମ୍ବା ଏହା ପରିଚ୍ୟତ  
କୁଳ ପରିଚ୍ୟତ ଏବଂ ଅନେକାଂଶରେ ଉପରେ ପରିଚ୍ୟତ  
କିମ୍ବା ପରିଚ୍ୟତ ଏବଂ ଅନେକାଂଶରେ  
କୁଳ ପରିଚ୍ୟତ ଏବଂ ଅନେକାଂଶରେ  
କୁଳ ପରିଚ୍ୟତ ଏବଂ ଅନେକାଂଶରେ

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ଯେହି କ୍ଷେତ୍ର ପରିମାଣ କିମ୍ବା ଏକ ଶତାବ୍ଦୀ ବେଳେ  
ନିର୍ମାଣ କରି ଥିଲା ତାହାର ପରିମାଣ କିମ୍ବା

ଅଗ୍ରିମ୍ କୁଳାରିତ କେବେ ପରିମାଣ କିମ୍ବା :-

ମାତ୍ରା ଲିଟର୍ କ୍ଷେତ୍ରର କିମ୍ବା ଏକ ଶତାବ୍ଦୀ ବେଳେ  
ଦୂରକାରୀ ଓ ଉଚ୍ଚତା ଅଧିକ କିମ୍ବା ଏକ ଶତାବ୍ଦୀ ବେଳେ  
କାହା ମନ୍ଦିର ଏବଂ ଅକ୍ଷୀର୍ଥ ପରିମାଣ କିମ୍ବା ଏକ ଶତାବ୍ଦୀ  
କାହା ଅକ୍ଷୀର୍ଥ ଏବଂ କୋଣି କାହା ଏକ ଶତାବ୍ଦୀ  
ଏବଂ କିମ୍ବା, ଏକ ଶତାବ୍ଦୀ ଏକ ଶତାବ୍ଦୀ  
ଦୂରକାରୀ ଏବଂ ଉଚ୍ଚତା ଏକ ଶତାବ୍ଦୀ

କିମ୍ବା 10-20

i) ମାତ୍ରା ଏକ - 200-200 ମିନି କୁଳାରି କିମ୍ବା

କିମ୍ବା ଏକ ଶତାବ୍ଦୀ, ଏକ ମାତ୍ରା ଏକ ଶତାବ୍ଦୀ କୁଳାରି  
କିମ୍ବା ଏକ ଶତାବ୍ଦୀ ଏକ ଶତାବ୍ଦୀ ଏକ ଶତାବ୍ଦୀ କିମ୍ବା  
ଏକ ଶତାବ୍ଦୀ ଏବଂ ଏକ ଶତାବ୍ଦୀ ଏକ ଶତାବ୍ଦୀ

ii) ଏକ ଶତାବ୍ଦୀ ଏକ ଶତାବ୍ଦୀ ଏକ ଶତାବ୍ଦୀ ଏକ  
ଶତାବ୍ଦୀ ଏକ ଶତାବ୍ଦୀ 12 ମିନି ଏକ ଶତାବ୍ଦୀ

ଏକ ଶତାବ୍ଦୀ ଏକ ଶତାବ୍ଦୀ ଏକ ଶତାବ୍ଦୀ ଏକ

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ମୁଣ୍ଡ ପାଇଁ କିମ୍ବା କିମ୍ବା କିମ୍ବା କିମ୍ବା

(iii) ଅନ୍ତର୍ଭୂତ ଏ ଯୁଦ୍ଧକାଲୀନ ବୟବ କିମ୍ବା

ମୁଣ୍ଡ କିମ୍ବା ପରିଷର ଯୁଦ୍ଧକାଲୀନ କିମ୍ବା କିମ୍ବା

ମୁଣ୍ଡ 3-4 ମହିନେ କିମ୍ବା କିମ୍ବା କିମ୍ବା

ମୁଣ୍ଡ ମଜା କିମ୍ବା କିମ୍ବା କିମ୍ବା, କିମ୍ବା କିମ୍ବା

12 ମହିନା କିମ୍ବା କିମ୍ବା କିମ୍ବା କିମ୍ବା

କିମ୍ବା କିମ୍ବା କିମ୍ବା କିମ୍ବା କିମ୍ବା କିମ୍ବା

ମୁଣ୍ଡ,

ପ୍ରମାଣିତ କିମ୍ବା କିମ୍ବା କିମ୍ବା କିମ୍ବା

କିମ୍ବା କିମ୍ବା କିମ୍ବା କିମ୍ବା କିମ୍ବା କିମ୍ବା

## ଶ୍ରୀମତୀ ଶ୍ରୀକାର.

ଏହି ପ୍ରକଳ୍ପ ଦୁଃଖରେ ଏବଂ ଯାହାର ହାତିଲାକାର  
ପରିବର୍କ କିମ୍ବା ବିଜୟରେ ଯତ୍ତ କିମ୍ବା କିମ୍ବା ବେଳେ  
ଏବାନ୍ତରେ ଏବଂ କିମ୍ବା ଏବଂ,

ଏହାର ଯାହା କରିବାର ପାଇଁ ଯାହାକାର କରିବାର  
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ଶ୍ରୀରାମ ପରିବର୍କ,

# RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

PROJECT TITLE: AIR POLLUTION IN CITIES  
AND MEASURES TO CONTROL IT

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COLLEGE ROLL NO : PHUB / 007 / 19  
DEPARTMENT : PHYSICS  
YEAR : 2020  
SIGNATURE :

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## Air Pollution in cities and Measures to control it:-

From the beginning of human civilisation man started to exploit the nature. In twenty-first century, massive urbanisation not only making disaster to the nature but creating major issues to the man also. In cities this pollution is intensified, specially air pollution. Air pollution is a major problem in the planet.

### Air pollution:-

Air pollution is the presence of substances in the atmosphere that are harmful to the health of humans and other living beings, or caused damage to the climate or different objects.

### Air pollution in the cities and sources:-

As cities are filled with industries, cars, and people. This is the source almost all kind of pollutants.

### Different pollutant and sources:-

① carbon dioxide ( $\text{CO}_2$ ): —  $\text{CO}_2$  is the main 'green house gas' which causes global

warming'. It reduces the  $O_2$  level in the air.

It is mainly produced by car and industries due to burning of fossil fuel.

- ② sulfur Oxides) —  $SO_x$  in atmosphere converted to  $H_2SO_4$  in moist. It causes acid rain. It is also poisonous.  
It is mainly produced by fossil fuel. cars and petrochemical industries are common source of it.
- ③ Nitrogen oxides! —  $NO_x$  is a common green house gas, and poisonous to,  
It is mainly produced by cars.
- ④ carbon monoxide ( $CO$ )! —  $CO$  is very poisonous gas which may cause death if inhaled in large amount.  
It is produced by the burning of fossil fuel.
- ⑤ volatile organic compounds, — (VOC)  
VOC are well known outdoor

air pollutant. They are the organic compound generally used as solvent e.g. benzene, isoprene, terpenes, methanol etc. They are very poisonous even if taken in small amount. It is proven that they cause cancer.

City is also a VOC which is not poisonous but ~~if~~ it is a green house gas.

Mainly house holds, cars, and chemical industries, paint are primary source of VOC.

#### ⑥ SPM (suspended particulate matter) :-

Now-a-days SPM is major pollutant in urban areas. It is the suspended dust particle, asbestos, ash and other harmful particles suspended in air as aerosol.

#### ⑦ Other:- CFC, phosphine, smoke etc are also air pollutant.

Cause of pollution in Air in cities:-

- ① cities have very high population densities.
- ② large number of cars and industries operates in small area.
- ③ less regulation of pollution sources.
- ④ very poor tree to land ratio.

Effects of Air pollution:-

There are many adverse effects of air pollution which are following -

① smog:-

$\text{Smoke} + \text{fog} = \text{smog}$ , Smog is an intense effect of air pollution. Man made smog is derived from coal combustion, emission, vehicular emissions, industrial emissions and photochemical reactions.

Due to photochemical reaction smog is composed of ground level ozone ( $O_3$ ), PAN (peroxy acetyl nitrate).

Smog is a major problem for cities like 'Los Angeles', 'New Delhi', 'Beijing', 'Lahore', etc.

One of the most dangerous type smog is photochemical smog. It is the chemical reaction of sunlight, NO<sub>x</sub>, VOC in atmosphere, which leaves PAN ground level ozone.

Smog continues to harm human health in cities. It is harmful for senior citizens, children, and people with heart and lung conditions such as emphysema, bronchitis, and asthma. Smog is responsible for an estimated 9500 premature death in the year 2016 alone. Smog also causes cancer.

- ① ~~Heat~~ Due to high concentration of greenhouse gases and low tree to land ratio, city areas are now heated above the normal temperature. This increase storm and destabilize normal rain wind.
- ② Health effects:-
- a) Mortality:- World Health Organization

estimated in 2014 that every year air pollution causes the premature death of some 7 million people worldwide.

b) Cardiovascular disease:- A 2007 review of evidence found that ambient air pollution exposure is a risk factor correlating with increase of total mortality from cardiovascular events (Yang : 12% to 14% per  $10 \text{ } \mu\text{g}/\text{m}^3$  increase)

c) Lung disease:- Research has demonstrated increased risk of developing asthma and COPD from increased exposure to traffic-related air pollution. Additionally air pollution has been associated with increased hospitalization and mortality from asthma and COPD chronic obstructive pulmonary disease (COPD) ~~includes~~ includes diseases such as chronic bronchitis and emphysema.

④) cancer; - A review of the evidence regarding whether ambient air pollution exposure is a risk factor for cancer in 2007 found solid data to conclude that long term exposure to SPM and VOC increase overall risk of cancer by 6%.

c) Affects children and other Animals:-

~~Due to~~ Due to pollution children are highly affected. Many diseases and death happen every year due to air pollution.

Little animals like birds are also very affected, destroying the ecological balance.

⑤ Economic effects:-

Air pollution costs the world economy '\$5 trillion' per year as a result of productivity losses and degraded quality of life, according to a study by world bank.

## Measures to control Air pollution:-

various pollution control technologies and strategies are available to reduce air pollution, which are following:-

### A) Land-use planning:-

using land in proper manner, increase forest areas in cities, removing heavy industries and regulation population density reduce the Air pollution in cities.

### B) reduction of fossil fuel:-

various efforts are taken to reduce fossil fuel. To reduce air pollution in cities we need to increase the number of solar cells.

### C) plantation of trees:-

Trees are very good natural controller of pollutants, several varieties like snake plant, erica pulm, aglowina etc, not only absorb co<sub>2</sub> but also absorb vocs.

Q) control devices:- The following items are commonly used as pollution control devices in industries and transportation. If those devices can be used, we can reduce the level of pollution.

- Particulate control:-

- mechanical collectors (dust cyclones, multicyclone)
  - Electrostatic precipitators (E.S.P.)  
is a particulate control device clean air using induced electrostatic charge.
  - Baghouses are designed to handle heavy dust loads. A dust collector consists of a blower, dust filter, a filter cleaning system which removes dust.
  - particulate scrubbers is a wet scrubber which remove gases like SO<sub>x</sub>, NO<sub>x</sub> and CO and CO<sub>2</sub> as well as SPM
- Scrubber:- scrubber systems are a direct group of air pollution control devices that can be used to remove some particulates and gases from industrial exhaust systems.

there are different types of scrubber  
which are:-

- > Buffer spray scrubber.
- > cyclonic spray scrubber.
- > Gidco venturi scrubber.
- > mechanically aided scrubber.
- > spray scrubber.
- > wet scrubber.

• NO<sub>x</sub> control:- There are different tools to control NO<sub>x</sub> emission which are

- > low NO<sub>x</sub> burners.
- > selective catalytic reduction.
- > Selective non-catalytic reduction.
- > NO<sub>x</sub> scrubbers.
- > catalytic converter.

• VOC abatement:- Many plants absorb VOCs. we also can use: activated carbon filter, flares, Thermal oxidizers etc to reduce it.

• SO<sub>2</sub> control:-  $\text{SO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{SO}_4$   
as SO<sub>2</sub> become H<sub>2</sub>SO<sub>4</sub> in moist wet scrubber is useful.

E) controlling vehicle Emissions →

Vehicle emission can be controlled by using new engines, biofuel, we also need to increase electric cars, odd-even system ~~can~~ employed in Delhi is also a very good technique.

F) Public Awareness:- Public awareness

is the key to stop any kind of environmental pollution.

G) Governmental and nonpolitical steps:-

Government of many countries as well as UN have taken steps to reduce air pollution. If the lawsuits are efficiently implemented then we can easily reduce air pollution in cities.

Conclusion:- Cities are the economic centres of any country. Educational, economic, industrial power houses are mostly located in cities. But air pollution causing lots of damage. So we need to reduce air pollution as much as possible to improve our lives.

## ACKNOWLEDGEMENT!

I convey my deep sense of gratitude to you for giving me the option to write on 'air pollution in cities' project. I am also very thankful to 'Wikipedia' and 'National Geographic community' in the internet for saving me with gigantic databases.

Date :- 14 Nov 2020

Tijan Sapui

signature of the  
student

CERTIFICATE

certified that the project work submitted  
by Tugas Sapui is done under the super-  
vision of my honourable sir as a part  
of curriculum for the partial fulfilment  
of the class - XI 2nd semester.

Date

\_\_\_\_\_  
Signature of the  
Teacher.

# RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

PROJECT TITLE:

Water Pollution and Measures to  
Control It

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YEAR : 2020  
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## Acknowledgement -

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## Introduction -

Water is one of the renewable resources essential for sustaining all forms of life, food production, economic development and for general well-being. Water is also one of the most manageable natural resources as it is capable of diversion, storage, transport and recycling. All these properties impart to water its great utility to of human being. All ground water and surface water resources play a major role in agriculture, hydropower generation, livestock production, industrial activities, forestry, fisheries, navigation, recreational activities. It is impossible to substitute most of its uses, difficult to de-pollute and it is truly a gift for to mankind ~~for~~ for nature.

## Water Pollution -

- waterbody I

Water is considered polluted if some substance or condition to such a degree that the water cannot be used for a specific purpose. Olaniran (1905) defined water pollution to be the presence of excessive amounts of pollutant in water in such a way that water cannot be used for drinking, bathing, cooking or other uses. Water pollution has been a research focus of government and scientists. Therefore, protecting river water quality is urgent because of serious water pollution and global scarcity of water resources. Any change in the properties of water by physical, chemical and biological agents, singly or in combination that would adversely affect the use of water for general or specific purposes may be broadly termed as water pollution.



## Sources of Water Pollution -

Water pollution can occur from two sources. They are - 1) Point Source and 2) Non-point Source

### 1) Point Source :

When a source of pollution can be really and readily identified because it has a definite source and place where it enters the water, it is said to come from a point source. For example, pipe attached to a factory, oil spill from a tanker, effluence coming out from industries.

### 2) Non-point Source :

When a source of pollution cannot be readily identified, such as agricultural run-off, acid rain etc, they are said to be non-point sources of pollution.

Some of the important sources of water pollution are - 1) Urbanisation, 2) Sewage and other oxygen-demanding wastes, 3) Industrial wastes,

- 4) Agro-chemical wastes, 5) Thermal pollution,
- 6) Oil spillage, 7) Acid-rain pollution,
- 8) Radioactive waste, 9) Climate change

Water pollution is generally induced by humans. The growth of human population, industrial and agricultural practices is the major cause of pollution. Overcrowding in urban areas result water pollution. Sewage is the water-borne wastes of the society and discharge of untreated sewage causes water pollution. Besides many of the industries are situated along the banks of the rivers such as steel and paper industries for their requirement of huge amount of water in manufacturing process and finally their wastes containing acids, alkalies and other chemicals, dumped and poured down into rivers as effluents.

In the agricultural sector, agro-chemical wastes which includes fertilizers, pesticides - herbicides and insecticides, widely used in crop-fields to enhance productivity. These make water polluted.

Changes in water temperature adversely affect water quality and aquatic biota. Some sources of thermal pollution are nuclear power, steel melting factories, coal fire power plant etc. Oil discharge into the surface of sea by way of accident or leakage from cargo tankers carrying petrol, diesel pollute sea water to a great extent.

Atmospheric sulphur dioxide and nitrogen dioxide emitted from natural or human-made resources interact with hydrogen and oxygen to form sulfuric and nitric acids in the air. These acids fall down to earth through precipitation in the form of rain or snow. Water pollution that alters a plant's surrounding pH value, due to acid rain can kill or harm the plant.

Radioactive pollution is caused by the presence of radioactive materials in water. Global warming has also an impact on water resources through enhanced evaporation, soil moisture, the frequency and severity of droughts and floods.

## Effects of Water Pollution —

Water pollution has a dual effect on nature. It has negative effects on living and also on the environment. The effects of pollution on human beings are many and varied. Water pollution causes approx 14000 deaths per day, mostly due to contamination of drinking water by untreated sewage in developing countries.

### 1. Effects on Human-health —

There is a greater association between pollution and health problems.

Disease causing micro-organisms are known as pathogens and these are spreading disease among humans directly. Many waterborne diseases are spreading from man to man. Heavy rainfall and floods are creating hazards for developed and developing countries. Some diseases due to water pollution are —

- i) Pesticides can damage the nervous system and cause cancer because of the carbonates that they contain.
- ii) Chlorides can cause reproductive damage.
- iii) Nitrates are especially dangerous to babies who drink formula milk. It restricts the amount of oxygen in the brain and cause the 'blue-baby' syndrome.
- iv) Lead can accumulate in the body and damage the central nervous system.
- v) Arsenic causes liver damage, skin cancer and vascular disease.
- vi) Fluorides in excessive amount can make our teeth yellow and cause damage to the spinal cord.
- vii) Petrochemicals even with very low exposure can cause cancer.
- viii) Untreated drinking water and contamination of water is the major cause of diarrhea, fever

Fever, abdominal pain, headache are the major symptoms of diarrhea. Good hygienic practices and use of antibiotic can prevent the disease.

- ix) The disease Cholera is caused by the contaminated water. Vibrio Cholerae is responsible for this disease. This bacterium produces toxins in digestive tracts. Symptoms are watery diarrhea, nausea, vomiting. Antimicrobial treatment is used to get rid of this disease.
- x) Besides, poliomyelitis, gastroenteritis are viral diseases. Cryptosporidiosis is a parasitic disease due to effects of water pollution.

These are the effects of water pollution on human health.

## 2. Effects of Water Pollution on Plants -

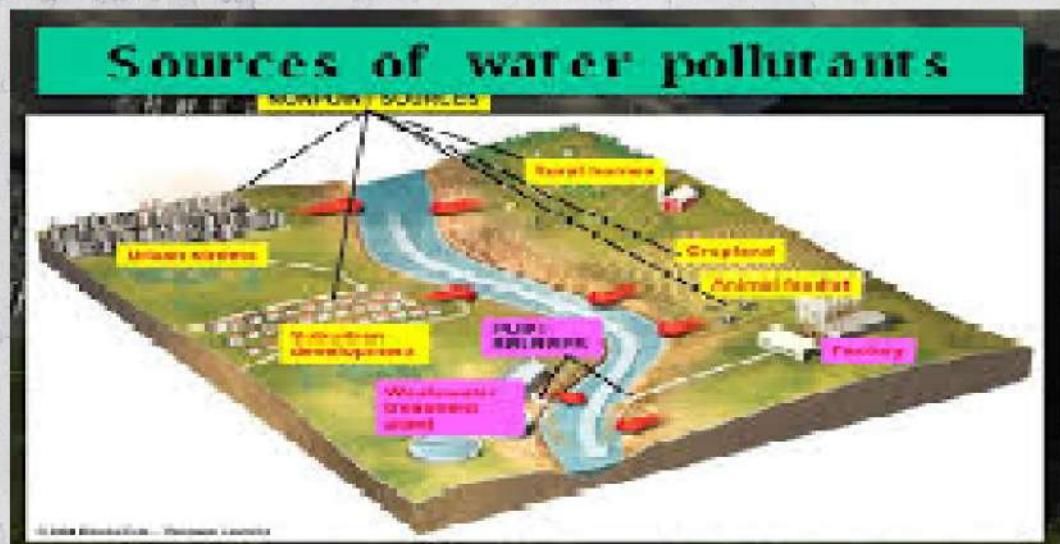
Water can become polluted by a number of sources, ranging from sewage treatment plants and factories to mining activities, paved roads and agricultural run-off. Water pollution has a wide variety of effects on plant-life and on the environment in general. Pollution in water not only harms plant growth but also helps plants to absorb dangerous chemicals from the water and pass them on the animals that rely on them for survival.

i) Foliation and Bark Damage - Acid rain contains sulfuric and nitric acid which can damage tree-leaves and barks and hurt the fine-root hairs of many plants. Acid rain is the result of the mixing of the components like sulfur dioxide and nitrogen oxides and other chemicals in the atmosphere.

Many of the compounds stem from power plants that burn fossil fuel such as coal as well as exhaust from buses, trucks and cars.

## i) Photosynthesis Issues - Water pollution from

substances can disrupt photosynthesis in aquatic plants. When water is polluted, the capacity of water to dissolve gases in it such as  $\text{CO}_2$  is negatively affected. Because plants grow in water and naturally depend on photosynthesis for their survival, any interference in the photosynthetic process can kill them.



## Measures to Reduce Water Pollution -

Everyone understands that clean is vitally important. Yet, many things we do can contribute to water pollution in different ways.

i) Household solvents, pesticides and cleaners might not seem that bad. But, bleach, paint, paint thinner, ammonia and many chemicals are becoming a serious problem. If you combine millions of people every month dumping toxic chemicals down the drain or flushing them down the toilet, the effects add up. This is why proper disposal is important. Many household chemicals can be recycled. Your community may have a recycling center that can take the old paint, used motor oil, and other chemicals and recycle them. Community collection centers and drop-off sites also exist in some areas. Your community may even have a hazardous waste collection day where those toxic old chemicals can be dropped off for safe disposal.

ii) Many companies now sell non-toxic cleaners and biodegradable cleaners and pesticides. Spending a little extra money on those products automatically

ii) cuts down on water pollution.

iii) Grease, fat and used cooking oil should be disposed of in the trash or kept in a 'fat jar' for disposal with other solid waste. ~~Y~~ Pipes might clog and cause sewer pipes to clog and back up into yards and basements. The waste also contaminates local bodies of water.

iv) Phosphates are not the only harmful chemicals in cleaners. ~~S~~ Phosphates lead to algae blooms and kill fish and other aquatic animals by reducing the oxygen in water. So, we ~~can~~ should use phosphate-free detergent and dish-cleaner.

v) We should never flush medicines down the toilet and never dump them in the nearest ponds or creek. The drugs tend to accumulate in the water and in fish and other wildlife. Hormones and other compounds end up causing a variety of health problems in fish and plants and contaminate drinking water that people and livestock use.

vi) Plastic shopping bags and plastic rings from six packs of beverages cause inordinate problems in lakes and seas. Plastic bottles can last for decades in the water. We should buy some reusable cloth or plastic grocery bags instead. They can be had for ~~for~~ as little as \$1 each, so there is a minimal cost involved. We have to use reusable, insulated containers to hold drinks and make our own filtered water at home.



## Bibliography -

I have taken help from the book 'Environment' by Prof. Rathindra Narayan Basu and the following websites for my knowledge about Water Pollution and Measures to Control It and some associated pictures.

- i) [www.wikipedia.org/wiki/water.pollution](http://www.wikipedia.org/wiki/water.pollution)
- ii) [blog.arcadia.com](http://blog.arcadia.com)
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- iv) Google Images

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE

NARENDRAPUR

ENVIRONMENTAL STUDIES

PROJECT TITLE:-

“WATER POLLUTION AND MEASURES  
TO CONTROL IT”

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College Roll No - BNUG/101/19

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YEAR — 2020

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Lishu Maheshwara  
Signature

Another important part of the earth's surface is the water resource or atmosphere. All surface water bodies are collectively called the atmosphere. vast and vast reservoirs are called sea or oceans. The structure of the surface of the sea or oceans is completely different from the characteristics. water bodies can also be seen above ground level. However, their land area is less than that of the sea and ocean. About 71 percent of the total surface area is under water. Excluding the remaining 29 percent of the area is occupied by land. The distribution of water and land in both hemispheres of the world can be thought of as a footfall. This is because the northern hemisphere has an excess of land, while the southern hemisphere has almost all the water share.

Currently water pollution is an important problem. This problem is so big that it is not possible to control it at all. But the theme of our's project is "water pollution and measures to control it :"

### WATER POLLUTION :-

A water molecule is composed of two hydrogen atoms and one oxygen atom. But it goes without saying that 'pure' water is not available in nature water can be contaminated due to physical reason and the combination of various chemical or organic substances and germs. In fact, any measure of water quality that makes water unusable in one or more cases is called - 'Water Pollution'.

According to the definition it can be said:- " If any unwanted substance mixed with the water, it changes the physical, chemical and biological properties and quality of the water and

makes the water unusable and there is a risk of extreme loss to the community, that is called 'water pollution'.

### \* CLASSIFICATION OF WATER POLLUTION:

\* Surface water Pollution:- Ocean, rivers, lakes get polluted in number of ways.

\* Ground water Pollution :-

is often caused by pesticide contaminations from soil.

\* Oxygen depleting :-

When biodegradable material is added to water the number of micro-organisms increases rapidly consuming available oxygen. When this happens harmless aerobic micro-organisms die and anaerobic micro-organisms produce harmful toxins such as ammonia and sulfides.

## \* Nutrients and their effect on water:-

nutrients are essential for plant growth and development. Many nutrients are found in waste water and fertilizers, if these are in excess it can cause weed and algal growth.

- 1) This can contaminate drinking water and clog filters.
- 2) This can damage other aquatic organisms as algae use up the oxygen in the water.

## \* Microbiological water pollution :-

It is natural way of water pollution form by micro-organisms.

## \* Suspended matter :-

Some pollutants do not dissolve in water as their molecules are too big to mix between water molecules called as suspended matter.

- 1) These particles settle down forming thick slit at the bottom, thus

Harmful to marine life that lives on floor.

- 2) Biodegradable substances often suspended in water causing problem as high numbers of anaerobic micro-organisms presents.
- 3) Toxic chemicals suspended in water can be harmful to the development and survival of aquatic life.

#### \* Chemical Water Pollution :-

Industrial and agricultural work involves the use of many different chemicals that can run-off into water and pollute it.

- 1) Metals and solvents from industrial and work pollute water causing loss to aquatic life.
- 2) Pesticides use in farming causes water pollution putting threat to aquatic life, birds, humans and

other animals.

3) Petroleum contaminate the water through oil spill when ship ruptures. This have only localised effect on wild life, It can cause death of many fishes and stick to feathers of seabirds causing them to loose the ability to fly.

## \* CAUSES OF WATER POLLUTION :-

The water gets polluted by various causes and at various sources which are divided as :-

### \* Point Source :-

Source is identifiable (if pollution comes from single source such as oil spill it is called 'point source')

### \* Non-Point Source :-

Source is not identifiable (if pollution comes from many sources is called 'Non-Point Sources')

## \* POINT SOURCE :- (Water pollution through industrial discharges :-)

- \* Industrial effluents have wide variety of organic and inorganic pollutants, e.g. Breweries, tanneries, paper and pulp mills, dying textile industries are main source of industrial water pollution.
- \* The fertilizers and chemical industries have also made problem of water pollution a serious environmental issue.
- \* The heavy metal discharged from the industries such as  $\text{Na}$ ,  $\text{Cu}$ ,  $\text{Cr}$ ,  $\text{Hg}$ ,  $\text{Pb}$  etc. have serious effect on the living organisms.
- \* Their main source is incinerators, coal burning power plants. Also mine drainage and leaching.

## \* NON-POINT SOURCE :- (water Pollution through Agricultural discharge:-)

- \* The modern agricultural uses chemical fertilizers, chemical pesticides, herbicides, and weedicides, which gets dissolved in water making them polluted.
- \* It alters PH Value of water affecting aquatic animals as these animals are sensitive to PH of water thereby threatening the aquatic ecosystem. Phosphates and nitrates in the fertilizers make water rich with nutrients and it becomes more productive - is called as Eutrophication.
- \* This reduces the oxygen level in water thereby increasing  $\text{CO}_2$  level. This change kills the aquatic life which further makes water more polluted.

\* Water pollution through the solid waste of the industries :-

\* Lead and mercury are the main toxic solid substance which comes out of the industrial waste and get mixed with nearby water pool.

\* Consumption of this water makes direct impact on the human health e.g. Damage to liver and kidney, reduction in haemoglobin formation, leads may effect the central nervous system which leads to coma or death \* source of lead to water is effluents from lead processing industrial plants, paper and pulp industries, fluorescent light tubes, high intensity street lamps, batteries, thermometers.

\* Mercury compounds enter in water body get converted into methyl mercury compounds due to anaerobic microbes. Finally it enters in the aqua food chain and disturbs the

the entire aqua ecosystem of pond or lake.

## EFFECT OF WATER POLLUTION:-

- \* oil pollutants spill through oil tankers get spread over the water creating thin layer over the water surface. This affect the water cycle and lead to death of water birds and fishes.
- \* From mining Radio-active pollutants like uranium, thorium enter the human bodies through food and water which get accumulated in blood thyroid glands, liver, bones and muscles causing serious illness and death also.
- \* Excess amount of fluorides causes dental and intestinal problems.
- \* In general consumption of polluted water causes diseases like typhoid, dysentery, cholera.

# MEASURES TO CONTROL WATER POLLUTION :-

## POLLUTION :-

- \* Through the natural water cycle the water itself gets converted into pure water.
- \* Disinfection of water, in this process harmful bacteria are killed making water safe for drinking. This is done by chlorination by using bleaching powder.
- \* Sedimentation, in this process suspended materials are removed from water. For this sedimentation tanks are used these may be circular tanks having either radial or circumferential flow, rectangular tank and hopper bottom tank.
- \* Filtration, in this process water is allowed to pass through a bed of coarser and fine sand. It removes colour, taste,

odour and also bacteria. These filters may be pressure filters and gravity filters.

\* Softening of water, It is used to removed the hardness of water, two methods are used - by boiling water the hardness is removed or by adding lime in the water the hardness can be removed.

\* Data collection and Acknowledment :-

All the data collected from library and  
and Ramakrishna Mission Residential College (Auto-  
nomous) Nanendrapur's campus area.

\* Data collection's Books :-

- 1) Pollution very basic - (EDITOR)
- 2) Chemical Pollution by Vijaya Menon.
- 3) Environment - Prof. Rathindra Narayan Basu  
(EDITOR)

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

PROJECT TITLE:

### **WATER POLLUTION AND MEASURES TO CONTROL IT**

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DEPARTMENT : **MATHEMATICS**  
YEAR : **2020**  
SIGNATURE : *Uttam Kumar Dolai*

## Introduction:

Water is one of the most vital natural resources on earth and has been around for a long time. In fact, the same water which we drink has been around in one form or the other since of the time of the dinosaurs.

The earth as more than two thirds of its surface covered with water. This translates to just over 1 octillion liters ( $1,260,000,000,000,000,000$  liters) of water distributed in the oceans, rivers, lakes and streams.

That is a lots of water, however, less than 0.3% is accessible for human consumption. As commercialization and industrialization have progressed that number continues to dwindle down. Furthermore, inefficient and out dated practices, lack of awarness and a plethora of other circumstances have led to water pollution.

## What is Water Pollution?

Water pollution can be defined as the contamination of water bodies. Water pollution is caused when water bodies such as rivers, lakes, oceans, ground water and aquifers get contaminated with industrial and agricultural effluents.

When water gets polluted it adversely affects all lifeforms that directly or indirectly depend on this source. The effects of water contamination can be felt for years to come.



## Sources of water pollution

The key causatives of water pollution are

- Urbanization
- Deforestation
- Industrial effluents
- Social and Religious practices
- Use of Detergents and Fertilizers
- Agricultural run-offs - Use of insecticides and pesticides
- One of the primary causes of water pollution is the contamination of water bodies by toxic chemicals. As seen in the example mentioned above, the dumped plastic bottles, tins, water cans and other wastes pollute the water bodies. These result in water pollution, which harms not just humans but the whole ecosystem. Toxins drained from these pollutants travel up to the food chain and eventually affect humans. In most cases, the outcome is destructive to only local population and species but it can have an impact on a global scale too.

Nearly 6 billion kilograms garbages is dumped every year in the oceans. Apart from industrial effluents and untreated sewage other forms of unwanted materials are dumped into various water bodies. These can range from nuclear waste to oil spills - the latter of which can render vast areas uninhabitable.



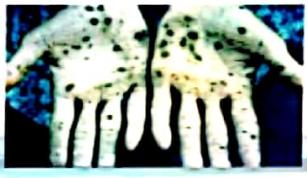
## Effects of Water Pollution

The effects of water pollution depends upon the type of pollutants and its concentration. Also, the location of water bodies is an important factor to determine the levels of pollution.

- Water bodies in the vicinity of urban areas are extremely polluted. This is the result of dumping garbage and toxic chemicals by industrial and chemical establishments.
- Water pollution drastically affects aquatic life. It affects their metabolism, behaviour, causes illness and eventual death. Dioxin is a chemical that causes a lot of problems from reproduction to uncontrolled cell growth or cancer. This chemical is bioaccumulated in fish, chicken and meat. Chemical such as this travel up the food chain before entering the human body.

- The effect of water pollution can have a huge impact on the food chain. It disrupts the food chain. Cadmium and lead are some toxic substances, these pollutants upon entering the food chain through animals (fish when consumed by animals, humans) can continue to disrupt at higher levels.
- Humans are affected by pollution and can contract diseases such as hepatitis — through faecal matter in water sources. Poor drinking water treatment and unfit water can always cause an outbreak of infectious diseases such as cholera etc.
- The ecosystem can be critically affected, modified and destructured because of water pollution.

### Effects of water pollution



## Control Measures of Water Pollution

Water pollution, to a larger extent, can be controlled by a variety of methods. Rather than releasing sewage waste into water into water bodies, it is better to treat them before discharge. Practising this can reduce the initial toxicity and the remaining substances can be degraded and rendered harmless by the water body itself. If the secondary treatment of water has been carried out, then this can be reused in sanitary systems and agricultural fields.

A very special plant, the water Hyacinth can absorb dissolved toxic chemicals such as cadmium and other such elements. Establishing these in regions prone to such kinds of pollutants will reduce the adverse effects to a large extent.

Some chemical methods that helps in the control of water pollution are precipitation, the ion exchange process, reverse osmosis and coagulation.

As an individual, reusing, reducing and - recycling wherever possible will advance a long way in overcoming the effects of water pollution.



# RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

### PROJECT TITLE:

Nitrogen cycle and its importance  
for living beings

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YEAR : 2020  
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- Stages
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## Nitrogen cycle definition :-

" Nitrogen cycle is a biological & biochemical process which transform the inert nitrogen present in the atmosphere to a more usable form of living organisms"

Furthermore, Nitrogen is a key nutrient element for plants, However, the abundant nitrogen in the atmosphere can not be used directly by plants or animals. Read on to explore how the nitrogen cycle makes usable nitrogen available to plants & other living organisms.

## What is Nitrogen cycle :-

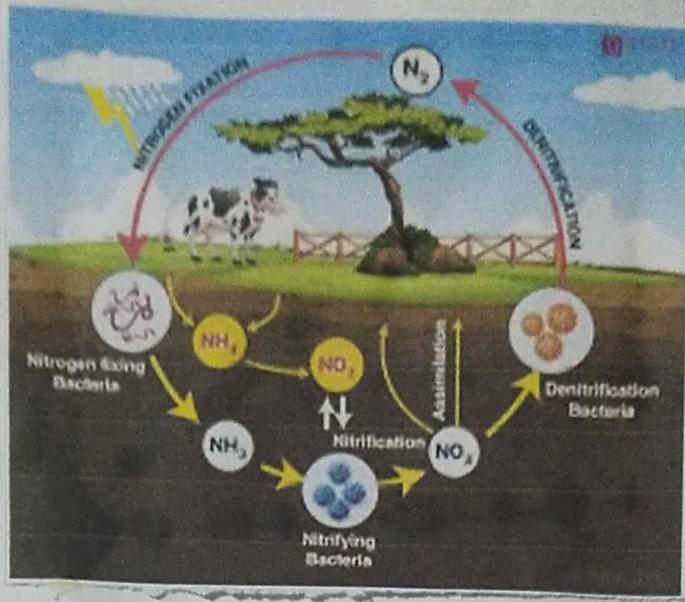
Nitrogen cycle is a biogeochemical process through which nitrogen is converted into many forms from the atmosphere to the soil to organism and back into the atmosphere.

It involves several process such as nitrogen fixation, nitrification, denitrification, decay and putrefaction

The nitrogen gas exists in both organic and inorganic forms. Organic nitrogen exists in living organism, and they get passed through the food chain by consumption of other living organisms.

In organic forms of nitrogen are found in abundance in the atmosphere. The nitrogen is made available to plants by symbiotic bacteria which can convert the inert nitrogen and nitrates.

Nitrogen undergoes various types of transformation to maintain a balance in the ecosystem. Furthermore, this process extends to various biomes, with marine nitrogen cycle being one of the most complicated biogeochemical cycles.



## Stages of Nitrogen cycle :-

Process of Nitrogen cycle consists of the following steps - Nitrogen fixation, Nitrogen Assimilation, Ammonification and Denitrification. The process take place in several stages are explained below.

### Nitrogen fixation :-

It is the initial step of nitrogen cycle.

Here Atmospheric nitrogen ( $N_2$ ) which is primarily available in an inert form, is converted into the usable form - ammonia ( $NH_3$ )

During the process of Nitrogen fixation, the inert form of nitrogen gas is deposited into soils from the atmosphere and surface waters, mainly through Precipitation. Later, the nitrogen undergoes a set of changes in which two nitrogen atoms get separated and combine with hydrogen to form ammonia ( $NH_3$ ).

The entire process of Nitrogen fixation is completed by symbiotic bacteria which are known as Diazotrophs, Azotobacter, and Rhizobium also have a major role in this process. These bacteria consists of a nitrogenase enzyme which has the capability to combine gaseous nitrogen with hydrogen to form ammonia.

Nitrogen fixation can occur either by the atmospheric fixation which involves lightning or industrial fixation by manufacturing ammonia under high temperature and pressure condition. This can also be fixed through man made processes primarily industrial process that create ammonia & nitrogen rich fertilizers.

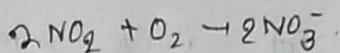
### Types of Nitrogen Fixation :-

- 1) Atmospheric fixation :- A natural phenomenon where the energy of lightning breaks the nitrogen into nitrogen oxide and is then used by plants.
- 2) Industrial nitrogen fixation :- Is a man made alternative that aids for nitrogen fixation by the use of ammonia. Ammonia is produced by direct combination of nitrogen & hydrogen and later, it is converted into various fertilizers such as urea.
- 3) Biological nitrogen fixation :- We already know that nitrogen is not usable directly from the air for plants and animals. Bacteria like Rhizobium & blue-green algae transform the unusable form of nitrogen to other compounds that are more readily useable. The nitrogen compounds get fixed in the soil by these microbes.

## ① Nitrification :-

In this process, the ammonia is converted into nitrate by the presence of bacteria in the soil. Nitrites are formed by the oxidation of ammonia with the help of Nitrosomonas bacteria species. Later, the produced nitrates are converted into nitrates by Nitrobacter. This conversion is very important as ammonia gas is toxic for plants.

This reaction involved in the process of Nitrification is as follows:



## ② Assimilation :-

Primary Producers - Plants take in the nitrogen compounds from the soil with the help of their roots, which are available in the form of ammonium ions and are used in the formation of the plant and animal proteins. This way, it enters the food web when the primary consumers eat the plants.

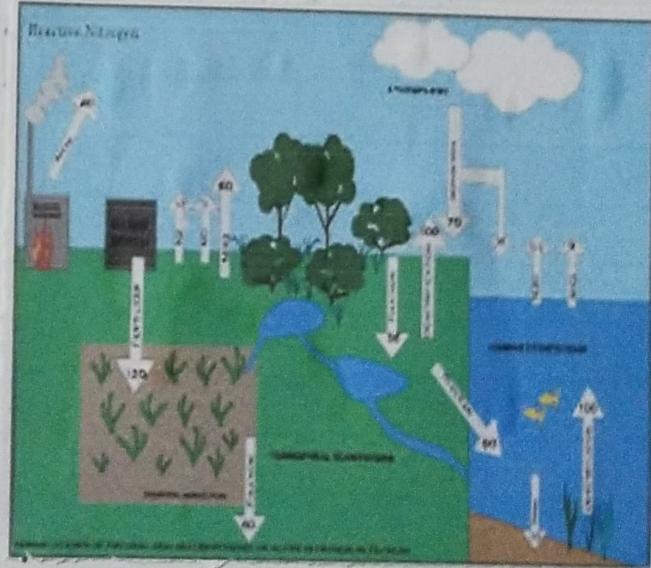
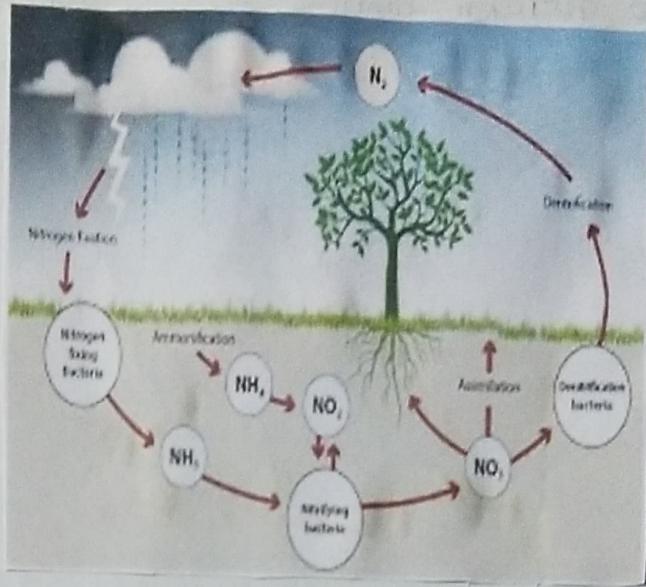
## ③ Ammonification :-

When plants or animals die, the nitrogen present in the organic matter is released back into the soil. The decomposers namely bacteria, fungi present in the soil convert the organic matter back into ammonium. This process of decomposition produces ammonia which is further used for other biological processes.

## ④ Denitrification :-

Denitrification is the process in which the nitrogen compounds make its way back into the atmosphere by converting nitrate ( $\text{NO}_3^-$ ) into gaseous nitrogen ( $\text{N}_2$ ). This process of the nitrogen cycle in the final stages and occurs

in the absence of oxygen. Denitrification is carried by the denitrifying bacteria namely Clostridium & Pseudomonas, which will process nitrate to gain oxygen and gives out free  $N_2$  as a byproduct.

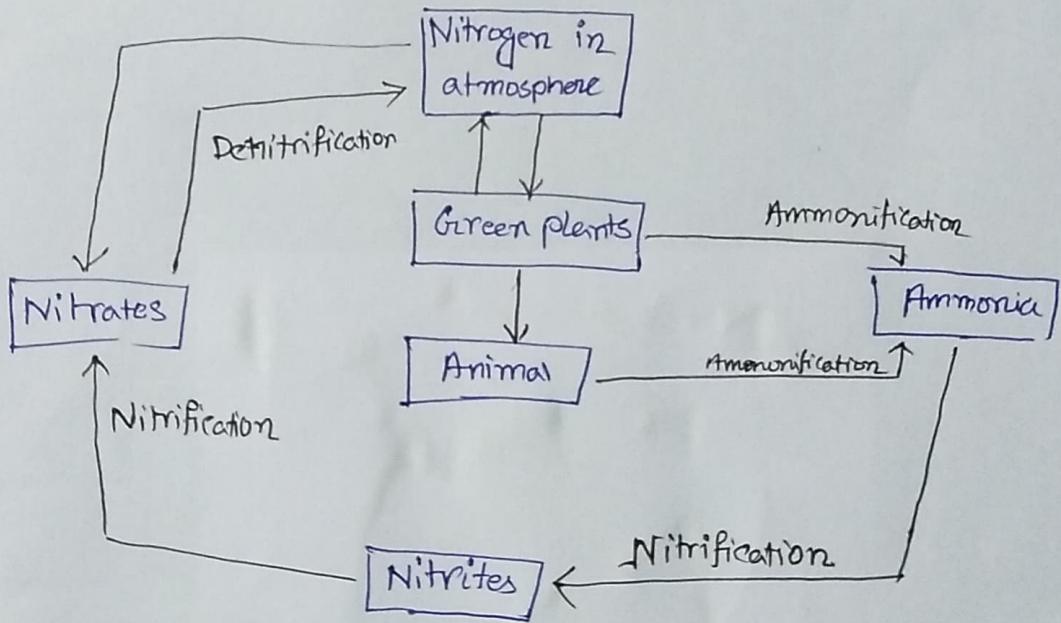


## Nitrogen Cycle in Marine Ecosystem

The process of the nitrogen cycle occurs in the same manner in the marine ecosystem as in the terrestrial ecosystem. The only difference is that it is carried out by marine bacteria.

The nitrogen-containing compounds that fall into the ocean as sediments get compressed over long period and form sedimentary rocks move to land. Initially, it was not known that these nitrogen containing sedimentary rocks are an essential source of nitrogen. But recent researches have proved that the nitrogen from these rocks is released into the plants due to the weathering of rocks.

## Schematic Diagram



## Importance of Nitrogen Cycle

Importance of nitrogen cycle are as follows:

- 1) Helps plants to Synthesize chlorophyll from the nitrogen compounds.
- 2) Helps in converting inert nitrogen gas to a usable form for the plants through biochemical process.
- 3) In the process of ammonification, the bacteria help in decomposing the animal and plant matter which indirectly helps to clean up the environment.
- 4) Nitrates & Nitrites are released into the soil, which helps in enriching the soil with necessary nutrients required for cultivation.
- 5) Nitrogen is an integral component of the cell and it forms many crucial components and important biomolecules.

Nitrogen is also cycled by human activities such as combustion of fuel and the use of nitrogen rich fertilizer. These processes increase the levels of nitrogen containing compounds in the atmosphere. The fertilizers containing nitrogen are washed away in lakes and rivers and results in eutrophication.

## Conclusion:

- Nitrogen is abundant in the atmosphere, but it is unusable to plants or animal unless it is converted into nitrogen compounds.
- Nitrogen - fixing bacteria play a crucial role in fixing the atmospheric nitrogen into nitrogen compounds that can be used by plants.
- The plants absorb the Usable nitrogen Compounds from the Soil through their roots . Then ,these nitrogen compounds are used for the production of proteins and other Compounds in the cell
- Animal assimilated nitrogen by Consuming these plants or other animals that contain nitrogen . Humans Consume proteins from these animal and their nitrogen assimilates into our System
- During the final stages of nitrogen cycle , bacteria and fungi help decomposes organic matter , where the nitrogenous Compounds get dissolved in to the soil is again used by plants.
- Some bacteria then convert these nitrogenous Compounds in the soil and turn it into nitrogen gas . Eventually ,it goes back to the atmosphere.
- These sets of process repeat continuously and thus maintain the percentage of nitrogen in the atmosphere.

## ACKNOWLEDGEMENT

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Date: 14/11/20

Victor Ghosh  
Signature of the  
student

■ CERTIFICATE ■

Certified that the project work submitted by Victor  
Ghosh is done under the supervision of my  
honourable sir as a part of curriculum for the partial  
fulfilment of the class - UG 2nd Semester

Date:

Signature of the  
Teacher