

# RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

PROJECT TITLE:

Water Pollution and measure to control it

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YEAR : 2020  
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ACKNOWLEDGEMENT

In the completion of this Project successfully, many people supported me. I would like to thank our environmental science teacher Sreevik Bhattacharya for helping me in enrichment of knowledge about Water pollution. I would also like to thank my friends, classmates and family for supporting me while doing this project.

Siddhartha Mondal

Environmental Science Project  
on Water Pollution  
by Siddhartha Mondal  
Siddhartha Mondal is a student of class 9th of  
our school. He is a very good student and  
has a great interest in environmental science.  
He has done a lot of research work on  
water pollution. He has collected a lot of  
information from various sources and  
written a very good report on water  
pollution. His report is well-researched and  
well-written. He has used simple and  
easy language to explain the problem of  
water pollution.

Siddhartha Mondal's project on Water Pollution is a very good one. He has done a lot of research work and written a very good report on water pollution. His report is well-researched and well-written. He has used simple and easy language to explain the problem of water pollution.

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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. It is impossible to substitute for most of most of its uses, difficult to de pollute, expensive to transport, and it is truly a unique gift to mankind from nature. Water is one of the most manageable natural resources as it is capable of diversion, transport, storage and recycling. All these properties impart to water its great utility for human beings.

The surface water and ground water resources of the country play a major role in agriculture, hydropower generation, livestock production, industrial activities, forestry, fisheries, navigation, recreational activities etc.

## Sources of Water Pollution

### Industrial Waste:

Most of the industries are situated along the banks of river such as steel and paper industries for their requirement of huge amounts of water in manufacturing process and finally their wastes containing acids, alkalies, dyes and other chemicals are dumped and poured down into rivers as effluents.



chemical industries

concerning with manufacture of aluminium release large amount of fluoride through their emissions to air and effluents to water bodies. Fertilizer industries generate huge amount of ammonia whereas steel plants generate cyanide. chromium salts also used in industrial process for production of sodium dichromate and other compound containing chromium.

### Agro-Chemical Waste:

Agro-chemical waste

includes fertilizers, pesticides which may be herbicides, and insecticides widely used in crop fields to enhance productivity. Improper

disposal of pesticides from

fields farms and agricultural activities contributes a lot of pollutants to water bodies and soils. Some of the pesticides are: DDT, Aldrin, Dieldrin, Malathion, Hexachloro Benzene etc. Pesticides reach water bodies through surface run off from agricultural fields, drifting from spraying, washing down of precipitation and direct dusting and spraying of pesticides in low lying areas polluting the water quality. Most of them are non-biodegradable and persistent in the environment for long period of time.



## Thermal Pollution:-

Changes in water temperature adversely affect water quality and aquatic biota. Majority of the thermal pollution in water is caused due to human activities.



Some of important sources of thermal pollution are nuclear power and electric power plants, petroleum refineries, steel melting factories, coal fibre power plants, boiler from industries which release large amount of heat to water bodies leading to change in physical, chemical and biological characteristics of receiving water bodies.

High temperature declines the oxygen content of water, disturbs the reproductive cycles, respiratory and digestive rates and other physiological changes causing difficulties for the aquatic life.

## Oil spillage:-

Oil discharge into the surface of sea by way of accident or leakage from cargo tankers carrying Petrol, diesel and their derivatives pollute



the sea water great extent. exploration of oil from off shore also lead to oil pollution in water.

## Acid rain Pollution:

Atmospheric sulfur dioxide and nitrogen dioxide emitted from natural and human-made sources like volcanic activity and burning fossil fuel interact with atmospheric chemicals, including 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. Once acid rain reaches the ground, it flows into waterways that carry its acidic compounds into water bodies. Acid rain that collects in aquatic environments lowers water pH levels and affects the aquatic biota.

## Radioactive Waste:

Radioactive pollution is caused by the presence of radioactive materials in water. They are classified as small doses which temporary stimulate the metabolism and large doses which gradually damage the organism causing genetic mutation. Source may be from radioactive sediment, water used in nuclear atomic plants, radioactive minerals exploitation.



## Effect of Water Pollution on human

### chemical effect:

some of chemicals affecting human health are the presence of heavy metals such as

Fluoride, Arsenic, Lead, Cadmium, Mercury. Usage of ~~lead~~<sup>fluoride</sup> Polluted Water may lead to condition called fluorosis. Arsenic is highly

dangerous for human causing respiratory cancer, arsenic & skin lesion. The best affects of mercury is "Minamata disease". Due to cadmium pollution, the diseases that comes into play are "itai-itai", nephritis, nephrosis.

### water borne disease:

Microorganisms play a major role in Water quality and the microorganism that are concern with water borne diseases are salmonella sp., shigella sp., ~~diarrhoea~~, Escherichia coli and Vibrio cholera. All those causes typhoid fever, diarrhoea, dysentery, cholera etc. The most dangerous form of water pollution occurs

when faeces enter the water supply. And sometime vomiting occurs.



**Water Pollution Diseases**  
**Diseases Caused By Water Pollution**

Diarrhea	Vomiting	Typhoid	Diphtheria
"Drinking Impure Water is one of the main Causes Of Diarrhoea"			
Hepatitis	Kidney Damage	Nerve Disorders	Skin Lesions

## Effect of Water Pollution on Plants:-

i) By acid rain, the pH of the water body decreases. In many countries chemical substances like sulphates, nitrates and chloride have been reported to make water bodies such as lake, river, ponds acidic which harms the aquatic life system.



ii) Fly ash increases the alkalinity of water and cause reduced uptake essential bases leading to death of aquatic plants.

iii) Oil pollution due to spillage from oil tankers and tankers storage containers prevents oxygenation of water and depletes oxygen content of water body by reducing light transmission inhibiting the growth of planktons and photosynthesis in macrophytes.



iv) Thermal pollution reduces the activity of aerobic decomposers due to oxygen depletion because of high temperature. With decreased organic matter decomposition, the availability of nutrients in the water bodies is jeopardised. Aquatic plants show reduced photosynthesis rate due to inhibition of enzyme activity with increase temperature.

v) Due to agro-chemicals and detergent decomposition increases the level of phosphate in water. This results eutrophication. Phosphate enters the plants through roots or surface absorption causing retarded growth of plants, elongation of roots, carbon dioxide fixation, cation uptake.



### Control of Water Pollution

1. The Ganga Action plan and National River Plan are being implemented for addressing the task of trapping, diversion and treatment of municipal waste water.
2. In most parts of the country, Waste Water, containing highly from domestic sources is hardly treated, due to inadequate sanitation facilities. This Waste Water, containing highly organic pollutant load, finds its way into surface and ground water course near the vicinity of human habitation from where further water is drawn for use. Considerable investments should be done to install the treatment system.
3. The central Pollution Control Board (CPCB) has established a network of monitoring and its management

stations on aquatic resources across the country. The water quality monitoring and its management are governed at state/union territory level in India. The network covers 28 states and 6 Union Territories. Water quality monitoring is therefore an imperative pre requisite in order to assess the extent of maintenance and restoration of water bodies.

4. There should be ban on Washing of clothes and Laundry alongside the river bank.
5. Industries should install Effluent Treatment Plant (ETP) to control the pollution at source.
6. All towns and cities must have sewage Treatment plants (STP) that clean up the sewage effluents.
7. Improper use of fertilizers, herbicides and pesticides in farming should be stopped and organic methods of farming should be adopted.
8. Religious practices that pollute river water by dumping colourful paints ~~and~~ or idols containing harmful synthetic chemicals should be stopped.
9. Rain water harvesting should be practised to prevent ~~water~~ the depletion of water table.

10. Making people aware of the problem is the first step to prevent water pollution.
11. Polluter pays principle should be adopted so that the polluter will be the first people to suffer by way paying the cost of the pollution.

### Conclusion

Water pollution is a global issue and world community is facing worst results of polluted water. Major sources of water pollution are discharge of domestic and agricultural wastes, population growth, excessive use of pesticides and fertilizers and urbanization.

Bacterial, viral and parasitic diseases are spreading through polluted water and affecting human health. It is recommended that there should be proper waste disposal system and waste should be treated before entering in to river.

Educational and awareness programme should be organized to control the pollution.

### References

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- ii) Alramman SA, El-kott AF, Kehsk. Water pollution : Source and treatment.

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

ENVIRONMENTAL STUDIES

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

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DEPARTMENT : CHEMISTRY

YEAR : 2020

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## ⑩ What is a Project?

→ A project is a planned undertaking which helps the students to improve their writing skill and enhance their creativity on the whole. According to 'Oxford Advanced Learner's Dictionary' a school project work is "a piece of work involving careful study of a subject over a period of time, done by students".

## ⑪ My Project and Its objective:

I have chosen 'Air Pollution in Cities and Measures to control it' as my ENVS project.

The objective of the project is to know how the cities worldwide are getting polluted and the decreasing of air quality and its harmful effect on environment. It would also provided us to know the ways to get rid of this solution.

## AIR POLLUTION IN CITIES AND MEASURES TO CONTROL IT

### ■ Introduction :-

When due to human activities or some natural processes the amount of solid wastes or concentration of gases other than oxygen, increases in the air more than normal percentage of different gases, the air is said to be polluted and this phenomenon is regarded to as Air Pollution.

Most cities world-wide suffer from serious air-quality problems, which has received increasing attention in the past decade. Air pollution in cities is a serious environmental problem especially in the developing countries. To prevent air pollution in cities, some measures would be taken.

### ■ Definition :-

Air pollution means the presence in the atmosphere, or injection into it of substances that are not present naturally, or present naturally but are in much lesser concentrations, and that may be harm living organisms directly (Allaby 1995)

## Sources of Air Pollution in Cities:-

### → Emissions from Industrial Chimneys:-

There are many industries which act as the major sources of air pollution. Of these air pollution the sources are petroleum refinery, cement factories, stone crushers, food processing, chemical fertilizer factories etc. emit gases through the chimney of the factories. Among those, petroleum refineries are the major sources of  $\text{SO}_2$  and  $\text{NO}_x$ .



Similarly dusts releasing from cement factory cause health hazards. Stone crushers and hot mix plants also create a menace, the SPM (suspended particulate matter) is five times more than the safety limits. Smokes of fertilizer and food factories emit various poisonous gases. Acid vapour is coming continuously from the chemical factories.

Mathura-based petroleum refinery has been accused to aggravate the pollution related decay of the Taj Mahal in Agra as well as monuments of Fatehpur Sikri.

### → Thermal power stations:-

Both normal and superthermal plants are present in or near the cities and coal are used as fuels in most of these plants. The fly-ash,  $\text{SO}_2$  and other gases and hydrocarbons are regularly released in air and these make the air polluted and unhealthy.

→ Automobile Exhaust :-

Toxic exhaust of automobiles is a source of considerable air pollution in cities. It contains  $\text{CO}_2$ ,  $\text{SO}_2$ ,  $\text{NO}_2$ ,  $\text{CO}$  and other toxic substances.

→ Construction and Demolition:-

With rise of population in the city, construction and demolition is a part of the ever going development phase of the cities. Several construction sites and raw materials such as bricks and concrete cause haze and foul air which is hazardous for the people especially children and elderly citizens.

→ Use of chemical and synthetic process:-

Taking about air pollution in cities, we always consider outdoor pollution dangerous for our lives but never talk about indoor air pollution. Household products cause indoor pollution which is 10 times more harmful than outdoor air pollution. Volatile organic compounds found in paints, cleaner and personal care products such as perfume and deodorants are a reason for common health issues.



→ Rapid population growth and cutting trees:-

A major probable reason for the air quality problems is population growth, combined with change in land use due to increasing urban areas. The population growth is caused by drift to the city and excess of births over death in cities.

Also we can see hardly a green area in cities. Most of the trees are cut down for construction and road development.

→ Smoking:-

smoking is the most dangerous and fatal to human health. A lot of air pollutants are exhausted during smoking. It effects the lungs and breathing system of primary consumers as well as non-consumers also.



## Major Air Pollutants And Their Effects :-

The major air pollutants of cities and their effects are given below.

### (i) Carbon Monoxide ( $\text{CO}$ ):-

Source:- Smoke of automobile and burning of fuels in industries, smoking.

Effect:-  $\text{CO}$  is highly toxic gas, it combines with haemoglobin of the blood and blocks the transportation of oxygen. Thus it impairs inspiration respiration and it causes death due to asphyxiation when inhaled in large amount.

### (ii) Unburnt Hydrocarbons (3,4 Benzopyrine, Benzene):

Source: Automobile, burning of fossil fuel (petrol, diesel)

Effect: Hydrocarbon causes lungs cancer

### (iii) Nitrogen Oxide ( $\text{NO}, \text{NO}_2$ ):-

Source: Burning (combustion) of fossil fuel in automobiles, aromatic products etc.

Effect: These nitrogen oxide from photochemical smog in atmosphere and release ozone. These are also responsible for acid rains, and cause health problems like emphysema, bronchitis, swelling of lungs and lung cancer etc.

### (iv) Sulphur Oxide ( $\text{SO}_2, \text{SO}_3$ ):-

Source : Main source of sulphur oxides are coal burning, smelters, oil refineries.

Effect : These causes chlorophyll destruction and also responsible for acid rains. These are also global warming gases.

### (v) Carbon-di-Oxide ( $\text{CO}_2$ ):-

Source : Industrial foul air, thermal plants, automobile, exhaust, smoking

Effect :- It is the main cause of Global Warming. It also disturbs the respiratory actions of animal beings when highly present in amount.

### Some Secondary Pollutants:-

(i) Smog :- (Smog = Smoke + Fog) It is two type -

(a) Photo Chemical Smog :-

It was first observed in Los Angles. In this process smog, fog, nitrogen oxide, hydrocarbons, oxygen UV light and high temperature are essential. These components react with each other and form redded brown smog ( $PAN + O_3 +$  Nitrogen oxides) or brown haze.



(b) London Smog or Sulphur Smog :-

It is first observed in London. In these process cool, smoke, fog, sulphur oxide and low temperature essential. These components react with each other and form vapour of  $H_2SO_4$  which is known as London smog.

Effect :- (i) Photochemical smog causes irritation in eyes and harms the lungs. Due to smog elastic substances (rubber/tyres) also affected

(ii) In sulphur smog, due to inhalation of  $H_2SO_4$  vapour with fog people may die.

(ii) Acid Rain :-

$NO_2, SO_2$  released from different sources in form of smoke dissolved in atmosphere water vapour to form acid ( $H_2SO_4 + HNO_3$ ). These acids come down on earth with rain water, this is called acid rain.

Effect :- (i) Due to acid rain acidity of soil and water increases.  
(ii) Acid rain also causes damages historical monuments e.g. Taj Mahal, Red Fort.

One of the most harmful effect of Air Pollution :-

### → Global Warming:-

The green house effect is a natural phenomena and the basis of substance of life on Earth as it maintains a uniform temperature throughout but due to recent advancement of human civilization like industrialisation, population expansions, modernisation, deforestation, pollution, the level of green house gases has increased alarmingly. The main green houses gases and their contribution percentage given by the picture above.



Effects: Due to global warming, climate changes are more evident. As the temperature increasing, the moisture carrying capacity of air is also increasing. Temperature rising cause thermal expansion of sea waters. The flora and fauna sensitive to temperature will die out. Crop productivity also is affected.



## AIR POLLUTION IN CITIES : Case Study

### ① Case study of Delhi:-

Delhi ranks highest in number of vehicles in India. According to the record in 1990, the number of cars in Delhi were more than the total of WB and Gujarat. Due to this Delhi now become one of most polluted cities in this Delhi now become one of most polluted city in world. Residents of Delhi were suffering from burning eyes and respiratory system problem. Using CNG in transport, replacing old vehicle, making emmission check up are the replacing old vehicle, making emmission check up taken to prevent the air pollution. The Govt use to imply norm to stipulate that sulphur be controlled at 350 ppm in diesel and 150 ppm in petrol. Aromated hydrocarbons should be contained at max 42 percent of fuel and not more than that. Every year in Delhi, low wind speed, low temperature, gear in Delhi, lowing the air quality poor, very poor and severe.

### ② Air Pollution in Kolkata:-

- Kolkata is in the grip of rising air pollution and walk. Pollutant crisis. Official ambient air quality monitoring has shown 61 percent increase in particulate matter in just four years 2010 to 2013. NO<sub>2</sub> levels exceed by close to two times.
- With growing vehicle numbers and resultant congestion and dieselisation air pollution is a growing concern in the city.
- Like delhi, in Kolkata the air quality become very much poor in winter and this enhances public health risk.
- Some effective steps like banning of old vehicles, decreasing the use of diesel, petrol and increasing CNG, using public transportation rather than private transportation like bike, car would be taken to prevent the falling of our quality

## Measures to Control Air Pollution:-

Different kinds of air pollution can be controlled by modern technology. Emissions from factories and power plants can be made free from gaseous pollutants by 3 methods:-

### (i) Combustion Technique:-

Only oxidisable pollutants can be removed by this method. Emissions are burnt at very high temperature. This process is applied in petrochemical and plant industries.

### (ii) Absorption Technique:-

Here scrubbers with packing materials are used to absorb gaseous pollutants. A fine spray of water is applied that dissolves  $\text{NH}_3$ ,  $\text{SO}_2$  etc. Sometimes a bed of lime is also employed to absorb  $\text{SO}_2$ .

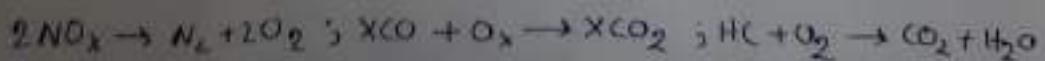
### (iii) Adsorption Technique:-

Activated charcoal, a chief adsorption material is used in this technique. It can adsorb toxic vapours, gases and other harmful matters.

Following steps have to be taken to control pollution of source as well as after the release of pollutants in the atmosphere.

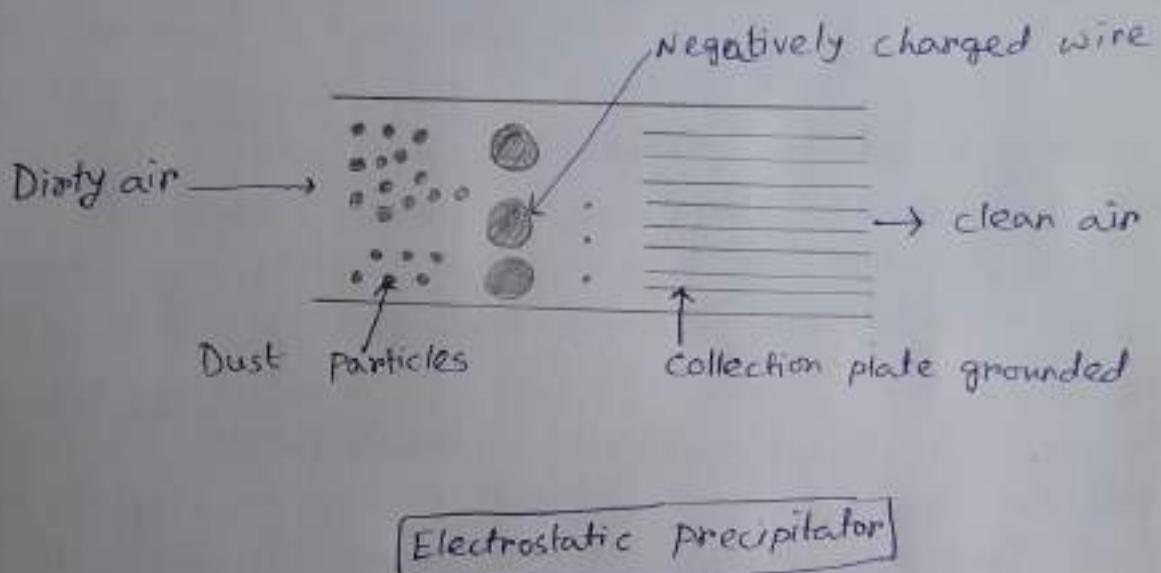
## Prevention and Control of Vehicular Pollution:-

(i) Curbing the pollutant emission from vehicular exhaust by using various devices, such as positive crankcase, ventilation valve and catalytic converter. Catalytic converters consist of metals like palladium, platinum and rhodium as catalyst. The exhaust gases when passed through the the following conversions happen.



(ii) Control of evaporation from fuel tank and carburettor by several mechanical and chemical processes.

- (ii) Control of air pollution can be obtained when filters are used to capture and recycle the hydrocarbons from the engine.
- (iv) Leaded petrol should be avoided, instead, unleaded petrol and low-sulphur diesel should be used.
- (v) Periodic checking of vehicles for pollution control.
- (vi) Increased uses of CNG can lower the amount of pollutants.



## ② Prevention and Control of Industrial Pollution:-

In different industries air pollution can be checked at 5 points of control process.

### (i) Removal of Particulate Matter:

This is used for centrifugation of waste gas containing Particles. It involves the use of following equipment.

#### (a) Cyclone Collector →

This is used for conjugation of waste gas containing particles. Cyclone collectors can remove upto 70% of the particles.

#### (b) Electrostatic Precipitation (ESP) →

To remove the suspended particles from gas stream, the electrical forces are applied within the chamber in precipitator. ESP can remove 99% of the particulate

pollutants from the chimney exhaust. ESPs work very efficiently in power plants, paper mills, carbon black plants, cements mills etc.

#### ② Removal of Gaseous Pollutants :-

This uses the following three methods.

##### (a) Wet systems →

These are used in washing towers in which alkali fluid circulate continuously. This liquid reacts with  $\text{SO}_2$  to produce a precipitate.

##### (b) Dry system →

Here the gas pollutants are allowed to react with an absorbant under a dry phase. Lime( $\text{CaO}$ ), limestone ( $\text{CaCO}_3$ ) are placed in the way of the following gas ( $\text{SO}_2, \text{SO}_3$ ). This process is very less expensive and effective.

##### (c) Wet Dry System →

Here water in absorbent react with acid components. The absorbant  $\text{Ca(OH)}_2$  slurry is spread into hot stream in the form of small droplets.  $\text{Ca(OH)}_2$  reacts with  $\text{SO}_2$  and the hot gases cause the water to evaporate simultaneously. The end dry powder contains fly and ash.

#### ③ Control Air Pollution through law:-

There have been several legislative measures to prevent and control different type of air pollution. Eg → Bengal Smoke Nuisance act (1905), The Motor Vehicle Act (1988), The Environment Act (1981).

#### ④ Recycle and Buy Recycled Products:-

Each stage of manufacture from raw material is accompanied by emissions of polluting particles, chemicals and harmful gases. Since recycled products have already been extracted and processed once, the manufacturing the same products the second time is much less energy intensive and polluting.

## ⑤ Tree Plantation:-

Trees help reduce the air pollutants significantly. Trees remove the particulate matter a large amount. Trees also decrease levels of carbon di-oxide, benzene, dioxin etc. Trees planted alongside road or on the boundaries of houses also slow down polluted air from being carried by wind.

## ⑥ Raise Awareness:-

Awareness raising can be the most effective step to increase the knowledge of people and start the change in their attitudes towards mitigating the problem of poor air quality in affected areas.

## ⑦ Use National Products and Non-Toxic Cleaners:-

The majority of air freshers, detergents, paints and cleaners in the market contain VOC, or Volatile Organic Compound. People should buy the cleanest and greenest products that contain no harmful polluting chemicals.

### Acknowledgement

I would like to express my special thanks of gratitude to my environmental science teachers Mr. Narayan Harty and Mr. Souvik Banerjee for their enormous help and support in completing my project.

- Soubhagya Maji

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

ENVIRONMENTAL STUDIES

PROJECT TITLE: "Pond  
eco-system and food chains".

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YEAR : 2020  
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# \* "ପୁରୁଷେ" ବାନ୍ଧୁତତ୍ତ୍ଵ" \*

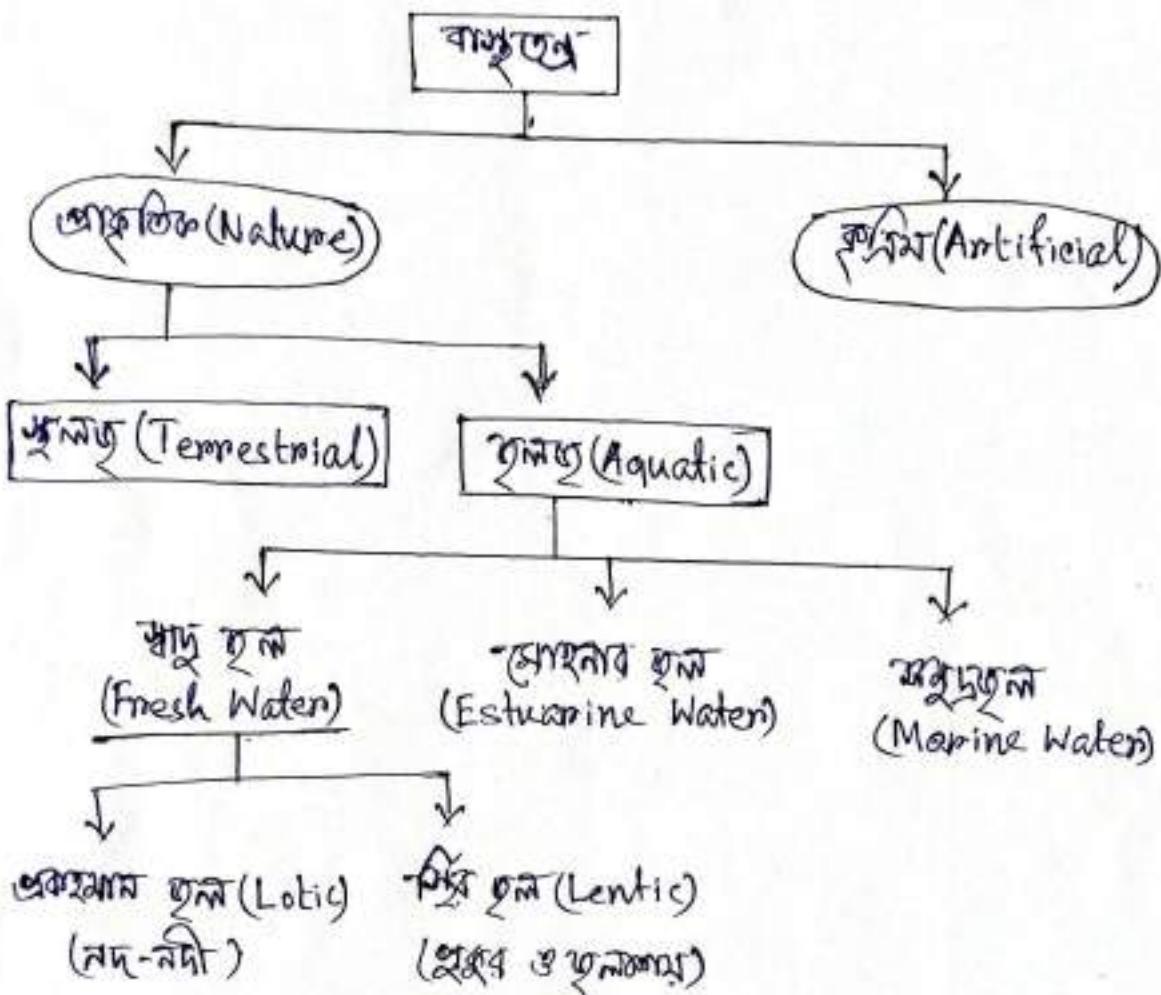
୧ ମୂଳିକୀୟ :> ବାନ୍ଧୁତତ୍ତ୍ଵ ହଲ ବାନ୍ଧୁବିଦ୍ୟା (Ecology) ଆଜିଚି  
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୨ ମୂଳିକୀୟ :> ଜୀବଜ୍ଞାନ ଓ ତାର- ଅବିବତ୍ତେ- ବିଜ୍ଞାନ ପୋଦିନେ  
ମୁକ୍ତି- ଆମ୍ବାକ୍ଷିପ୍ତ- ଅତକଳ୍ପିତ ପ୍ରାଣିଜ୍ଞାନିକ ନିଯମ ବ୍ୟବସ୍ଥାକୁଳରେ  
ଚାଲା । ଏହା ବିଜ୍ଞାନ ନିଯମ ଓ ବିଚିତ୍ର ପକ୍ଷର କାମ କରି । ଏହାମୁକ୍ତ  
ଜ୍ଞାନାଳିତ- ଆମ୍ବାକ୍ଷିପ୍ତ- ହଲ - ବାନ୍ଧୁତତ୍ତ୍ଵ ଓ ବାନ୍ଧୁବିତି- ,

୧) ବୈଜ୍ଞାନିକ୍ୟ : → ବିଜ୍ଞାନୀ ଶିଖ ୨୯୭୪ ଖିମ୍ବାକୁ ଗନ୍ଧାରା-  
ପିଲାଣିପିଲାଣି ବୈଜ୍ଞାନିକ୍ୟରେ କ୍ଷେତ୍ର କହନ -

1. ଗନ୍ଧାରା ଇଲ ଶାନ୍ତିରେଖା- ଥିଲ ଆଧିକାରୀ- ଏକା । ଗନ୍ଧାରା-  
ମହିଦି ଦିଯାଇ ଶିଖର ଏହା ଆଧିକାରୀ ହେଉଥିଲା ।
2. ଗନ୍ଧାରା ପରିବର୍ତ୍ତନ ବିକିନୀ-ରେଟର ଏବୁ ଅଳୋଚନା ଦେଖି-  
ନାଇଲା ।
3. ଗନ୍ଧାରା- ମହିଦି- ଦିଲାହୁ- ଶାନ୍ତି ଅନ୍ତର୍ଭାବରେ ଏହା  
ଏହା ଆଧିକାରୀ- ସାମାଜିକ ପାଦାନମଧ୍ୟରେ ଏହା ଆଧିକାରୀ-  
ମହିଦି- ଶାନ୍ତି ଏହା ।
4. ଗନ୍ଧାରା ମହିଦି- ଦିଲାହୁ- ଶାନ୍ତିର ଅନ୍ତର୍ଭାବରେ ଏହା ଦେଖିଲା ଏହା  
ଶାନ୍ତିର ଦେଖିଲା ।
5. ଶାନ୍ତି ଅନ୍ତର୍ଭାବରେ ଏହା ଆତିଥି କୁଳି- ଶାନ୍ତି ଓ ଆତିଥି-  
ଶାନ୍ତି ଏହା ଏହା ପରିଵାଚିତ ଏହା ଏହା ଆତିଥି ଶାନ୍ତି- ଶାନ୍ତି-  
ପରିଵାଚିତ ଏହା ଏହା ।
6. କୋଣା ଏକାଟି ଗନ୍ଧାରା ନିରିକ୍ଷା ଆତିଥି- ପଥାଳକାନ  
ଏକାଟି ନିରିକ୍ଷା ଶିଖ ଏହା ଏହା- ଶାନ୍ତି ପାଦ- ଏହା; କୋଣା ଶିଖରୁଧ୍ୟ  
ଆମେ ଏହା ନିରିକ୍ଷା- ଆତିଥି- ଶାନ୍ତି କଥାରେ ଏହା ଏହା ।

୦ ବାନ୍ଧୁତତ୍ତ୍ଵ- ଅଳ୍ପରେ : ⇒ ବିଜ୍ଞାନ- ପ୍ରକାଶ- ବାନ୍ଧୁତତ୍ତ୍ଵ ଏକାକି  
ହଜାର ଆଳାରେ ଦେଖାଇଲେ —



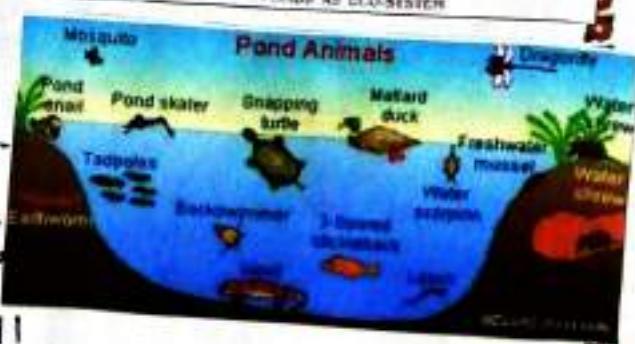
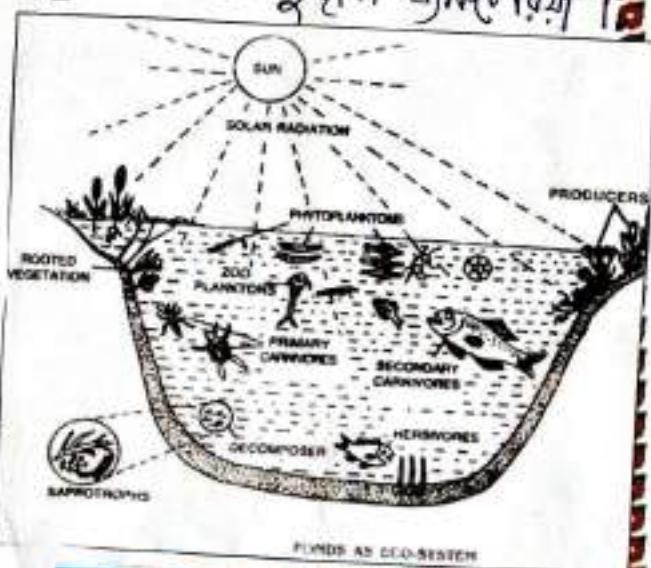
ପ୍ରକାଶ- ବାନ୍ଧୁତତ୍ତ୍ଵ- ମଟ୍ଟି → ଅଳ୍ପରେ ଆଳାରେ ଆଳାକୁ ବିଭିନ୍ନ ହିଲ  
ପିଣ୍ଡ ଜ୍ଵଳ (Lentic) ହାରିବି ପୁରୁଷ ଓ ତୁଳାନୀରେ ବାନ୍ଧୁତତ୍ତ୍ଵ (Pond  
Eco-System) ।

୦ ପୁରୁଷ ରା ତୁଳାନୀରେ ବାନ୍ଧୁତତ୍ତ୍ଵ : ⇒ ପୁରୁଷ ରା ବାନ୍ଧୁତତ୍ତ୍ଵ ଏକାକି  
ଚାଣ୍ଡିଆ ଜାରିକରେ ତୁଳାନୀ ବାନ୍ଧୁତତ୍ତ୍ଵ । ବିଜ୍ଞାନ ପ୍ରକାଶ ଓ ଅଭିଭାବକ ପ୍ରାଦୂର୍ଣ୍ଣରେ  
ଯମ୍ବନ୍ଦୀ- ପାତ୍ର- ବାନ୍ଧୁତତ୍ତ୍ଵ ଗଠିତ । ବିଜ୍ଞାନ ପ୍ରକାଶ ପ୍ରାଦୂର୍ଣ୍ଣ ପ୍ରାଳୀ ହିଲ—  
i) ଅନ୍ତର୍ମାନ ପ୍ରାଦୂର୍ଣ୍ଣ : ତୁଳା ଅନ୍ତର୍ମାନ ଅନ୍ତର୍ମାନ, ଶର୍ଣ୍ଣ ଏହି ଅନ୍ତର୍ମାନ ଓ  
ଲାବନ ।

- i) **ଲୋତ ପ୍ରାଦୂରି :** ହଳ, ଶାଖା, ମୁଣ୍ଡ, ଓ କାନ୍ଦିରିରେ ଅଗ୍ରଭାଗ - ।
- ii) **ଲୈବ ପ୍ରାଦୂରି :** ମୁତ୍ତ ଶିଖର - ନିମ୍ନଲିଖିତ ଲୈବ ପରିମାଣ, ଜାହାଙ୍ଗ, କୁଣ୍ଡି, ବଳ୍ଟ ଉପରି - ।
- iii) **କିଛିବେ ଅବଶୀଳନ ପ୍ରାଦୂରି ରଳ -**
- a) **ପ୍ରଦୂରି :** - ଫଲିଦୁ ଝୁକୁଟିନ, ଶ୍ରୀମଦ୍ଭଗବତ, କାମି, କୁମରପାନୀ, ଶାନ୍ତି, ପିତ୍ର ଆଦି - ।
- b) **ପରିମାଣ :** - ଅନ୍ତି ଝୁକୁଟିନ, ଫୁଲର କିମତିକୁ, ଛୋଟ ଶାନ୍ତି, କାମି, କାନ୍ଦିରି, ବଳ୍ଟିକଣ, ବ୍ୟାଙ୍ଗ, ବଧେ ଶାନ୍ତି (ଯେତା - ଶୋଇ, ଶୋଇ ଉପରି), ପିତ୍ର, କକ୍ଷିନ, ଶିଖ, ବଳ୍ଟ, ପାନକୋଡ଼ି - ଆଦି - ।
- c) **ବିଭିନ୍ନତଃ :** - ଶୋଇକୁଣ୍ଡା, ବ୍ୟାଙ୍ଗ, ବଳ୍ଟିର ଓ ଅନ୍ତର୍ଭାବରେ ଶ୍ରୀମଦ୍ଭଗବତ - ।

### ଲୋବକ୍ଷସ୍ତିର ମାଧ୍ୟମ - ତଳାକ୍ଷେତ୍ର

ତଳାକ୍ଷେତ୍ର ଆମିର ଶ୍ରୀମଦ୍ଭଗବତ ବର ଦେଖି  
ଝୁକୁଟିନ, କାମି, କୁମରପାନୀ ଉପରି - ।  
ଏବୁ ଧାର୍ଯ୍ୟକୁଣ୍ଡରେ କେବଳମୁକ୍ତ  
ଆମିର କବି । ପଥର ପାଇବି ଧାର୍ଯ୍ୟକୁଣ୍ଡ  
ଏବୁରକୁ ଆମ ପକ୍ଷର ବା ଆମି ଝୁକୁଟିନ ।  
କିମ୍ବା ମାନିବ ଧାର୍ଯ୍ୟକୁଣ୍ଡରେ ଢୋଇ ଶାନ୍ତ  
ପରିମାଣ ବା ଆମି ଝୁକୁଟିନ ଧାର୍ଯ୍ୟ, କାମି -  
ମାନିବ ଧାର୍ଯ୍ୟକୁଣ୍ଡରେ ବରେଣ୍ଯ, ବଳ୍ଟ ବାନ୍ଦିରି,  
ପାନକୋଡ଼ି ଧାର୍ଯ୍ୟ ଦିଲୁହିତେ ଢୋଇ ଶାନ୍ତ ଧାର୍ଯ୍ୟ ।



ଶୁଭରାତ୍ର ଖୁଲୁର ଏ ହୃଦୟରେ ବନ୍ଧୁଙ୍କୁ ଇଲି —

ମିଥିଲ ପ୍ଲାଫଟନ ଏ ଶ୍ରୀମଦ୍ଭଗବତ୍ —> ଶ୍ରୀ-ପ୍ଲାଫଟନ / ଜଗନ୍ନାଥ —> ଶ୍ରୀମଦ୍ଭଗବତ୍  
—> ଏହି ଯାତ୍ରା, ସବୁ, ମହାବିଦ୍ୟା, ଆନନ୍ଦାଳୋଚି ।



ଓ পুরুষের বাস্তুতন্ত্র- শৈক্ষণ্য : ) পুরুষের গবেষণামূল্য-  
 বাস্তুতন্ত্র অগ্রিমত করলে ফলস্থ শৈক্ষণ্যচিকিৎসা অভ্যন্তর- দুর্বল নথে  
 ক্ষম মান্য । ফলস্থ পরিবেশে অগ্র শৈক্ষণ্যে কৃতি বিবরণ করে  
 ও তদের ব্যক্তি- পদ্ধতিগতি পরিচয় অভ্যন্তর- দুর্বল ক্ষম মান্য ।  
 এবং পুরুষের বাস্তুতন্ত্র- শৈক্ষণ্যে পরিবেশকে ও অন্যান্য বাস্তুতন্ত্রকে  
 প্রভাবিত করে ও দুর্বল মান্য । এ বর্তমানে আবারও এই-  
 গবেষণায় দুর্বল প্রাণী পরিবেশের পরিপন্থ জনসম্বন্ধ (যেমন-  
 হাইড্রোক্লোরিক অক্সাইডের পরিপন্থ প্রভাব করে করে), গবেষণামূল্য-  
 বাস্তুতন্ত্র- নিয়ে গবেষণা করে আবেচন্না করা হচ্ছে- এবং, অঙ্গীকৃত  
 ক্ষেত্র লাগিয়ে- শৈক্ষণ্যচিকিৎসা ও পরিবেশের ক্ষেত্রমাঝে- ক্ষেত্র প্রক্রিয়া-  
 ক্ষম- হচ্ছে । এই রকম প্রক্রিয়া ক্ষেত্রে আবার পুরুষ শৈক্ষণ্য-  
 বিত্তে উৎপন্ন হিসেব দুর্বল ।

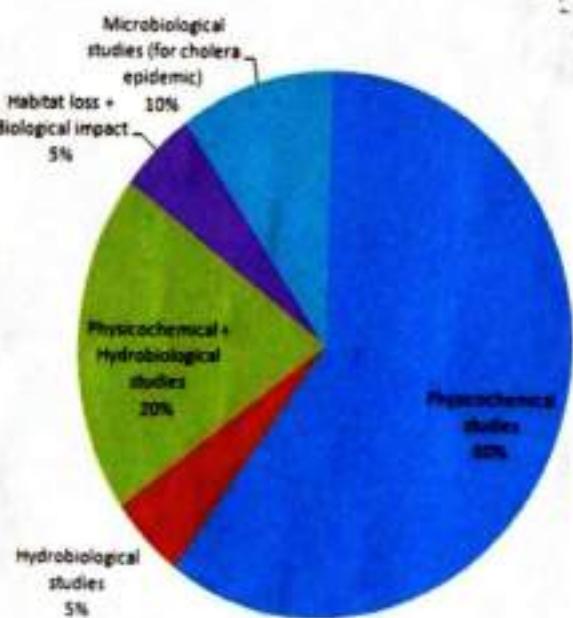


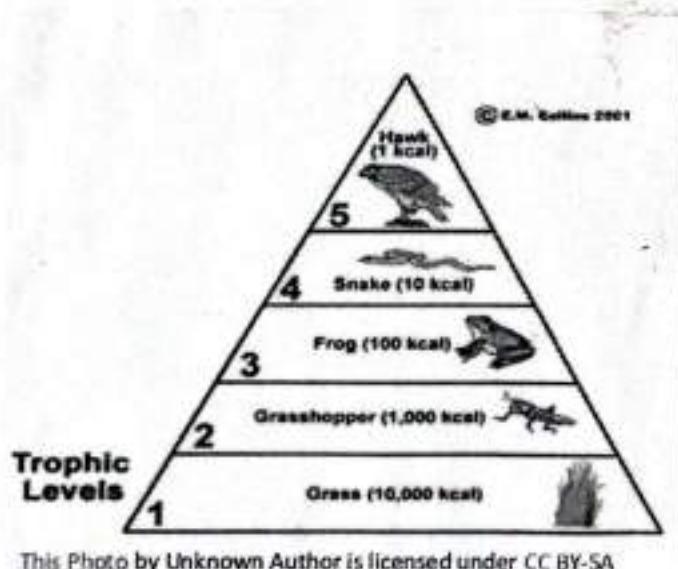
Fig. 5: Different categories of the pond environment investigations taken up by the Indian researchers (in %)

୧୦ ଧାନ୍ୟ-କୁଞ୍ଜଳ (Food Chain) :→ ବାନ୍ଧୁତ୍ତମ ଧାନ୍ୟକୁଞ୍ଜ ବ୍ୟକ୍ତିଗତୀରେ  
ଦେଖାଇଲୁ ହେଲୁ- ଧାନ୍ୟ-ଧାନ୍ୟ ପରିପାଳିତ ବିଭିନ୍ନ ପ୍ରାଣୀ ଦ୍ୱାରା ଉପରେ  
ଅବଶିଷ୍ଟ ହୁଏ । ଧାନ୍ୟ- ଧାନ୍ୟ ମେଚିଦେଇ କେବଳମୁଣ୍ଡଳ ପାଇଲାବ୍ୟକ୍ଷତାକାର  
କାରିଗ୍ରୁ- କ୍ଷେତ୍ରକାରୀଙ୍କ ଜୀବବିଚାରଣା କାହିଁତି ଦୁଃଖକାରୀ କାହା- ନିର୍ଦ୍ଦେଶ-  
ଅଜୀବନୀଯ ଧାନ୍ୟ କ୍ଷେତ୍ର କବଳେ ଥାଇ, କିନ୍ତୁ- ଧାନ୍ୟର ପ୍ରାଣୀର ଜୀବନ  
ପାଇଁ ନାହିଁ । କିନ୍ତୁ, ଜୀବ- ଧାନ୍ୟର ହଳ ମୁଣ୍ଡଳ ମେଚିଦେଇ କାହା ନିର୍ଦ୍ଦେଶ-  
କାରୀ ହୁଏ । ଧାନ୍ୟର ପ୍ରାଣୀ ହାତ ମୁଣ୍ଡଳ ମେଚିଦେଇ- ଧାନ୍ୟ କିମ୍ବା ପରିପାଳିତ  
ପରିପାଳିତ, ତ୍ୟାନ ମେଚିଦେଇ କାହିଁ ଓ ଆମିତି ପାଇସ୍ତର- କିନ୍ତୁ ଏହା  
ଧାନ୍ୟର- ଆମିର ଦେଇ- ମୁଣ୍ଡଳର ହୁଏ, ଆମାର, ଧାନ୍ୟର  
ଆମିର ଦେଇ- କାହିଁତି କାହିଁ ଓ କୁଟି- କୁଟି- ଧାନ୍ୟର ଧାନ୍ୟକୁଞ୍ଜ  
କେବଳିତ ଆମିରର ଦେଇ- କିମ୍ବା- ମୁଣ୍ଡଳର ହୁଏ- ଆମିରର ହୁଏ ।  
ମୁଣ୍ଡଳ ଦେଇ ବାହୁ, ବାନ୍ଧୁତ୍ତମ- ଦେଖାଇଲୁ ହେଲୁ ବିଭିନ୍ନ ଜୀବବିଚାର  
ଧାନ୍ୟକୁଞ୍ଜ କେବଳିତ ଆମିରର କାହିଁ ମୁଣ୍ଡଳ କାହିଁ ଓ ଆମିତି ପାଇସ୍ତର-  
ହୁଏଥାମି କାହାର- ଏହାର ଧାନ୍ୟକୁଞ୍ଜର ହୁଏ  
କାମିଳିତ ।

ଏହା ପ୍ରକାଶ ଧାନ୍ୟକୁଞ୍ଜ- ନିର୍ବିଵେ ମୁଣ୍ଡଳର ହେଲୁ ମୁଣ୍ଡଳ-  
ମୁଣ୍ଡଳର କାହିଁ- କାହିଁ ଦେଖାଇଲୁ ହେଲୁ ଧାନ୍ୟ- ଧାନ୍ୟ ପରିପାଳିତ ବିଭିନ୍ନ  
କୀରଜୋକୀର ମୁଣ୍ଡଳ ଆମିତି କାହିଁ କାହିଁକାରୀ କାହିଁ, ମୁଣ୍ଡଳ- କୁଞ୍ଜକାଳି-  
କାମିଳିତ- କାହିଁ ଆମାର କାହାରକୁ- ଧାନ୍ୟ କୁଞ୍ଜର  
କାମିଳିତ 'Food Chain' ଏବଂ ।

০ ধান্দু-শূঝলোর বৈশিষ্ট্য : ⇒ ধান্দু শূঝলোর বৈশিষ্ট্য পুলি জল-

- ১ ধান্দু শূঝলোর নীচের অধিকার থেকে সর্বোচ্চ পুরু এবং উচ্চ ক্ষমতা অর্জন- পৃষ্ঠাভূমি- হয়।
- ২ ধান্দু-শূঝলোর মুকুটের নীচের কাছে- আগু এবং পুরু লেপিদু।
- ৩ আগুর কাছে কেবল ধান্দু-শূঝলো পুরু লেপিদু দ্বারা পুরু হয়।  
যদিন- পৃষ্ঠাভূমি ও অন্তর্ভূমি ধান্দু-শূঝলো।
- ৪ ধান্দু-শূঝলোর নিম্ন-পুরু থেকে উচ্চতার ক্ষমতা দ্বীপের অভ্যন্তরে ও  
ক্ষমতা- কার্যকারী ক্ষমতার ক্ষমতা পুরু।
- ৫ পুরু-পুরু ধান্দু-শূঝলো অধিকারের অন্তর্ভূমি ৩ থেকে ৫-১৫  
হওয়া- পুরু।



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୧) ଧାନ୍ୟ-ଶୁଷ୍କଲେଖ ଶ୍ରେଣୀ : ⇒ ବନ୍ଦୁତତ୍ତ୍ଵ ଶୈଖିତଳେଖ ଅଣ୍ଟିକୁ ଜ୍ଞାନ

ଧାନ୍ୟ-ଶୁଷ୍କଲେଖ ଶ୍ରେଣୀ ଏକ ଆମ୍ବାନିମିମା । ଧାନ୍ୟ ଶୁଷ୍କଲେଖ ପାଣୀଙ୍କୁ  
ଅଜାଣୀ ଦେଖିଦୁ ଥେବେ କାହିଁ ଓ ସତି କାହାରୁ ଅନ୍ୟାନ୍ୟ ଧାନ୍ୟ ଶୁଷ୍କଲେଖ  
ଅନ୍ତର୍ଭାବିତ ହୁଏ । ତାହା ଧାନ୍ୟ-ଶୁଷ୍କଲେଖ କାନ୍ଦରେ ଏକାଟେ ଶୁଷ୍କଲେଖ  
କିମିଳିମାର ବିଶ୍ଵିତ ଦେଇ ଆମ୍ବା ବନ୍ଦୁତତ୍ତ୍ଵ ବିଶ୍ଵିତ-ଶ୍ରେଣୀ ଆବର ।

୨) ଧାନ୍ୟ-ଶୁଷ୍କଲେଖ ଆମ୍ବାନିବିଶ୍ଵିତ : ⇒ ଧାନ୍ୟ ଶୁଷ୍କଲେଖ ଆମ୍ବାନିବିଶ୍ଵିତ ।

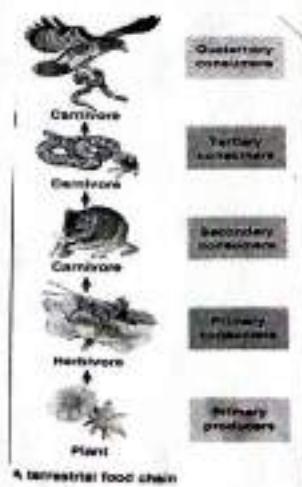
୧) ଧାନ୍ୟ-ଧାନ୍ୟରେ ଅନୁଭବ ଦେଖିବୁ ବନ୍ଦୁତତ୍ତ୍ଵ କିମିଳିମାର ଧାନ୍ୟ-  
ଶୁଷ୍କଲେଖ ଲାଗୁ କରି ଆବର । ଅନ୍ୟ —

i) କିମିଳିମାର- ଧାନ୍ୟ-ଶୁଷ୍କଲେଖ : ଏହିଏ ଧାନ୍ୟ-ଶୁଷ୍କଲେଖ ଆମ୍ବାନିବିଶ୍ଵିତ ଧାନ୍ୟ କା  
ଜାକାଣ୍ଡାରୀ ଆମ୍ବାନି ଥେବେ ଶୁଷ୍କଲେଖ କାହାରୁ ଅନ୍ତର୍ଭାବିତ ହୁଏ ।  
ଅନ୍ୟ — ପାଇଁ → ବୁର୍ଜ୍ → ବାନ୍ଦା → ମୃଦୁର —

ii) ପାଇଁବି ଧାନ୍ୟ-ଶୁଷ୍କଲେଖ : ଏହିଏ ଧାନ୍ୟ-ଶୁଷ୍କଲେଖ  
ଅନ୍ତର୍ଭାବ ବିଶ୍ଵିତ ଆମ୍ବାନିବିଶ୍ଵିତ ଶୁଷ୍କଲେଖ-  
ଅନ୍ତର୍ଭାବ ହୁଏ । ଅନ୍ୟାନ୍ୟ, ଶୁଷ୍କଲେଖ ଶୈଖିତଳେଖ-  
ଆମ୍ବାନି କାହା ପାଇଁବି- ଧାନ୍ୟ-ଶୁଷ୍କଲେଖ ଗଠିତ ହୁଏ ।

ଅନ୍ୟ — ମୃଦୁର → କାନ୍ଦି → ଆମ୍ବାନି-

iii) ମୃତକାରୀ ଧାନ୍ୟ-ଶୁଷ୍କଲେଖ : ଏହିଏ ଧାନ୍ୟ-ଶୁଷ୍କଲେଖ  
ଶୁଷ୍କଲେଖ ଓ ଗାଲିମ ଶୁଷ୍କଲେଖ-ଥେବେ ଅନ୍ତର୍ଭାବ ବିଶ୍ଵିତ  
ଶୁଷ୍କଲେଖ ଆମ୍ବାନିବିଶ୍ଵିତ ହୁଏ । କାନ୍ଦି ମୃତକାରୀ  
ଓ ବିଶ୍ଵିତ ମଧ୍ୟ- ଆମ୍ବାନି ହୁଏ ।



କିମିଳିମାର ଧାନ୍ୟ-ଶୁଷ୍କଲେଖ

୨୦୩୮

୧ - ଶ୍ରୀ କୃତ - ମେନ୍ଦିନୀ → ଟୁଗ୍ଗା → ଶ୍ରୀକୃତିବିଦ୍ୟା

୨) ଧାର୍ଯ୍ୟ ପରିଣାମ ବିନ - ଅଧ୍ୟୁଷିତ - ଧାର୍ଯ୍ୟକୁଞ୍ଚଳ - ତେ ହାତର ରୋଗ କଣ ଶାଖା / ରେଖା -

i) ଧାର୍ଯ୍ୟକୁଞ୍ଚଳ କାନ୍ଦିବିଦ୍ୟା ଧାର୍ଯ୍ୟକୁଞ୍ଚଳ : ଏହା ଧାର୍ଯ୍ୟକୁଞ୍ଚଳ ଉପକାଳ ଶ୍ରୀ ହୀ ଏହା ଆଧ୍ୟାତ୍ମିକ ଧାର୍ଯ୍ୟକୁଞ୍ଚଳ ହାତରିଗ କବି ଚବି - ଧାର୍ଯ୍ୟପ୍ରଥମ - କବି ତାଙ୍କ ଧାର୍ଯ୍ୟକୁଞ୍ଚଳ କାନ୍ଦିବିଦ୍ୟା ଧାର୍ଯ୍ୟକୁଞ୍ଚଳ ବଲେ ।

ଯେମନ - ନାତପୂଜା → ହାତିବି → କାଣ୍ଡ ।

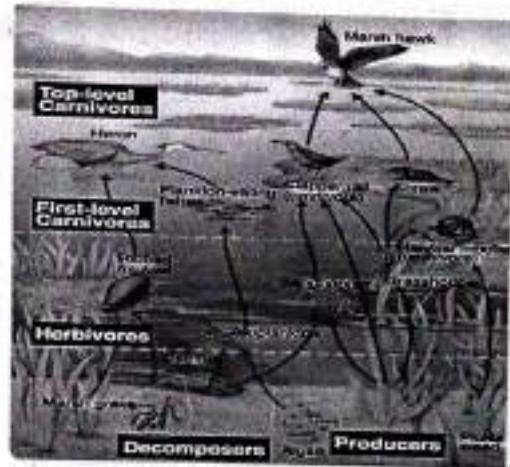
ii) ବିଦ୍ୟାକୁଞ୍ଚଳ - କା ଡ୍ରୋପିଲ୍ - ଧାର୍ଯ୍ୟକୁଞ୍ଚଳ : ଏହା ଧାର୍ଯ୍ୟକୁଞ୍ଚଳ ଅଧ୍ୟାତ୍ମିକ କୁବ ମେଳେ ଶ୍ରୀ ହୀମେ ବିନେ କାନ୍ଦିବିଦ୍ୟା କେବଳ ବିଦ୍ୟାକୁଞ୍ଚଳ - କା ଡ୍ରୋପିଲ୍ ଧାର୍ଯ୍ୟକୁଞ୍ଚଳ ବଲେ । ଲେଖନ

ଯେମନ - ପଦ୍ମ ପାତା → ଲୀପି → ହୈତି ମାଟ୍ → ଗଢ଼ ମାଟ୍ ।

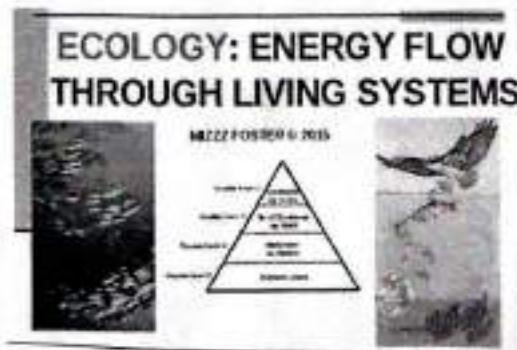
~~ଶ୍ରୀକୃତିବିଦ୍ୟା~~ ଧାର୍ଯ୍ୟକୁଞ୍ଚଳ : ଧାର୍ଯ୍ୟକୁଞ୍ଚଳର ବିଦ୍ୟା ଧାର୍ଯ୍ୟକୁଞ୍ଚଳର - ମହିଦ୍ଵି ପୁରୁଷ କା ପ୍ରିଲାକାମ୍ବର - ଧାର୍ଯ୍ୟକୁଞ୍ଚଳ କ୍ରାନ୍ତି ଧାର୍ଯ୍ୟକୁଞ୍ଚଳର କାନ୍ଦି ଅନ୍ତର୍ଜାତ ।

ଏହା ଧାର୍ଯ୍ୟକୁଞ୍ଚଳ ପୁରୁଷ କା ପଲାକାହୀର - କେବଳାନ କ୍ଷେତ୍ରର କା ପିନ୍ଦ ଲୋକଟାନ, କ୍ଷେତ୍ର - କ୍ଷେତ୍ର ପିନ୍ଦ, କୁର୍ବିପାତା କେବଳ କିମ୍ବାକୁ - କୁଳେ ଅବଶ୍ୟକ ରହେ । ଅର୍ଦ୍ଧକୁ ଧାର୍ଯ୍ୟ କାନ୍ଦି ପ୍ରାଣୀ ଲୋକଟାନ, ଅର୍ଥାତ୍ ଏହା - ଅର୍ଥାତ୍ ପାରିବ ଧାର୍ଯ୍ୟ କୁଳେ ଅବଶ୍ୟକ ରହେ । ଏହା ଧାର୍ଯ୍ୟ ଧାରକରେ ଧାର୍ଯ୍ୟ - କ୍ଷେତ୍ର ମାଟ୍, ଶ୍ରୀ ଅଧିତି କାନ୍ଦି । ଏହାରୁ ଏହା - କ୍ଷେତ୍ରିକ କ୍ଷେତ୍ର ଧାର୍ଯ୍ୟ କୁଳେ ଅବଶ୍ୟକ ରହେ । ଅର୍ଦ୍ଧ - କୁର୍ବିପାତା କୁଳେ ଅବଶ୍ୟକ ପାରିବ ଧାର୍ଯ୍ୟକୁଞ୍ଚଳ କାନ୍ଦି, ରହୁ, ଅନ୍ତରାଳ, ପାନକାନ୍ଦି, ଆପ

ଯାଏ ହିଁଥେ କୁଟୀ ମାତ୍ର, ଆଜି ଗ୍ରାନ୍ଟ ହେଲା । ଏହି ମହିଳା ଯାଏ  
ଅନ୍ଧାଦେ ପିନିଯେ- ଆଗାର- ଫୋର ଆହୁଯ ଯାଏ ଗ୍ରାନ୍ଟ ଗ୍ରାନ୍ଟ' ଏବଂ 'Food  
Web' ଅବଶ୍ୟକ ଏବଂ ଯାଏ ଗ୍ରାନ୍ଟ ଏବଂ ଯାଏ ଗ୍ରାନ୍ଟରେ ଏହାରେ  
ପାଣି ଅବଶ୍ୟକ ଏବଂ ଗ୍ରାନ୍ଟ ଗ୍ରାନ୍ଟରେ ଅନ୍ଧା ହେଲେ ହେବି ଆହୁ ଯାଏ ଗ୍ରାନ୍ଟ ଗ୍ରାନ୍ଟ ।  
ଏହାରେ ଅନ୍ଧାରେ ବାହୁଦୂର ବର୍ଣ୍ଣର ଯାଏ ଗ୍ରାନ୍ଟ ଗ୍ରାନ୍ଟ ଏବଂ ଆହୁ । ନିଚ୍ଛେ  
କିମ୍ବା ମହିଳା- ଏବଂ ଦେଖାଇ ଉଲ୍ଲେ ।



୧ ଅନ୍ଧାରେ ଯାଏ ଗ୍ରାନ୍ଟ କୁଟୀ ମୂଳଧୂର : → ଅନ୍ଧାରେ ଯାଏ ଗ୍ରାନ୍ଟ ଏବଂ  
ଅନ୍ଧାରେ ଯାଏ ଗ୍ରାନ୍ଟ ଏବଂ ଯାଏ ଗ୍ରାନ୍ଟ ଏବଂ ଯାଏ ଗ୍ରାନ୍ଟ ଏବଂ  
ଯାଏ ଗ୍ରାନ୍ଟ ଏବଂ ଯାଏ ଗ୍ରାନ୍ଟ ଏବଂ ଯାଏ ଗ୍ରାନ୍ଟ ଏବଂ ଯାଏ ଗ୍ରାନ୍ଟ ଏବଂ  
ଯାଏ ଗ୍ରାନ୍ଟ ଏବଂ ଯାଏ ଗ୍ରାନ୍ଟ ଏବଂ ଯାଏ ଗ୍ରାନ୍ଟ ଏବଂ ଯାଏ ଗ୍ରାନ୍ଟ ଏବଂ



୧୦ କଣ୍ଠତା ଶୀତାର୍ଥୀ : "ପୁରୁଷେର ବନ୍ଧୁତବ୍ର ଓ ସାମ୍ରାଜ୍ୟରେ" ଏହି  
ବ୍ୟକ୍ତି ଅକଳ୍ପନା ଆଚିନ୍ତା କରୁଥିଲୁଗୁ କଣ୍ଠର ଫଳ୍ପାଦ୍ରର  
ପରିବର୍ତ୍ତ ବିଜ୍ଞାନ ବିଜ୍ଞାନର କୌଣସିଗତ ନାମବିଦ୍ୟା ଆବଶ୍ୟକ  
ମାତ୍ରାରେ ଉଚ୍ଚତାରେ ଆବଶ୍ୟକ କରୁଛନ୍ତି । ତାଙ୍କ ନିର୍ଦ୍ଦେଶ ଦିଲେ ଅକଳ୍ପନା ବ୍ୟକ୍ତିର  
ବଳ ଅଧିକ ହେଉଥିଲା । ତାଙ୍କ ଭାବି ତାଙ୍କର ପରିତଃ କଣ୍ଠତା ହୋଇଥାଏ ।  
ଏହାରେ ଅକଳ୍ପନା କଣ୍ଠର ଫଳ୍ପାଦ୍ର ବିଜ୍ଞାନ ପରିବର୍ତ୍ତ ଯଦୁକର୍ତ୍ତା  
ବର୍ଷ ଏବୁ ଚିତ୍ର ଓ ଅଧ୍ୟ ଅନ୍ତର୍ଗତ ଫଳ୍ପାଦ୍ରର ବିଜ୍ଞାନରେ ପ୍ରମିଳାରେ ଅନୁଷ୍ଠାନିକ



**RAMAKRISHNA MISSION RESIDENTIAL COLLEGE**



**NARENDRAPUR**

**ENVIRONMENTAL STUDIES**

**PROJECT TITLE:**

**Air pollution in cities and  
measures to control it.**

NAME	:	Soumen Pain
COLLEGE ROLL NO	:	BNUG/189/19
DEPARTMENT	:	Bengali
YEAR	:	2020
SIGNATURE	:	

★ Air pollution in cities and measures to control it.

## → INTRODUCTION :-

Human population size has grown enormously over the last hundred years. This means increase in demand for food, water, home, electricity, roads, automobiles and numerous other commodities. These demands are exerting tremendous pressure on our natural resources, and are also contributing to pollution.

Pollution is any undesirable change in physical, chemical or biological characteristics of air, land, water or soil. Agents that bring about such an undesirable change are called pollutants.

In order to control environmental pollution, the Government of India has passed the Environment (Protection) Act, 1986 to protect and improve the quality of our environment (air, water and soil).



## □ Air Pollution:

It is the occurrence or presence of any material or gas in the air in such a concentration which is harmful to man, vegetation, animals and their environment. Substances and factors which causes air pollution are called air pollutants. Air pollution is both natural and anthropogenic.

anthropogenic pollution comes from mobile and fixed sources. Air pollution causes air pollutants coming directly from the pollution sources are called primary air pollutants ( $\text{CO}$ ,  $\text{SO}_2$ ,  $\text{NO}_x$  hydrocarbons). Reaction between two air pollutants (Ozone, PAN)



## Types of air pollution

The most common and harmful pollutants outdoors include:

- (i) Particulate matter
- (ii) nitrogen dioxide
- (iii) ozone
- (iv) sulphur dioxide.

(i) Particulate matter :- Particulate matter

is a mix of solid and liquid, including carbon, complex organic chemicals, sulphates, nitrates, mineral dust and water suspended in the air.

Man-made particulate matter mainly comes from industry, building work, diesel and petrol engines, friction from brakes and tyres, and dust from road surfaces. Diesel engines tend to produce much more than equivalent petrol engines.

Natural sources of particulate matter include volcanoes, sea spray, pollen and soil. It is also formed in the atmosphere when gases such as nitrogen dioxide and ~~sulfur~~ sulphur dioxide are changed in the air by chemical reactions.



### (ii) Nitrogen dioxide (NO<sub>2</sub>)

Nitrogen dioxide is a gas and is a major component of urban air pollution episodes.



Man-made sources of NO<sub>2</sub>, including Nitrogen dioxide, are vehicles are major contributions in urban areas.

### (iii) Ozone (O<sub>3</sub>) :

Ozone is a gas composed of 3 atoms of oxygen. In the upper level of the earth's atmosphere, it absorbs harmful ultraviolet radiation.

### (iv) Sulphur dioxide (SO<sub>2</sub>) :

Sulphur dioxide is a colourless gas, with a pungent, suffocating smell. It's produced by burning sulphur-containing fuels such as coal and oil. This includes vehicles, power generation and heating.

Most sulphur dioxide from electric industries that burn fossil fuels, and also from petrol refineries and cement manufacturing. It can travel over long distances and contributes to the formation of ozone.



□ Health effects: In 2012, air pollution caused premature deaths on average of 1 year in Europe, and was a significant risk factor for a number of pollution-related diseases, including respiratory infections, heart disease, COPD and lung cancer. The most common sources of air pollution include particulates, ozone, nitrogen dioxide, and sulfur dioxide. Children ages less than five years that live in developing countries are the most vulnerable population in terms of total deaths attributable to indoor and outdoor air pollution.

A study by greenpeace estimate there are 4.5 million annual premature deaths worldwide because of pollutants released by high-emission power stations and vehicle exhausts, 65000 deaths occur in the middle east each year due to pollution.

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

- Lung disease : Research has demonstrated increased risk of developing asthma and COPD from increased exposure to traffic-related air pollution. Air pollution exposure also cause lung cancer in non smokers.

It is believed that much like cystic fibrosis, by living in a more urban environment serious health hazards become more ~~obvious~~ apparent. Studies have shown that in urban cities,

Children : In the United States, despite the passage of the Clean Air Act in 1970, in 2002 at least 146 million Americans were living in non-attainment areas. These dangerous pollutants are known as the criteria pollutants and include ozone, particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide and lead. Protective measures to ensure children's health are being taken in cities such as New Delhi, India where buses now use compressed natural gas.

## Causes of air pollution

- (i) Smokestacks of thermal power plants, Smelting and other industries release particulates and gaseous air pollutants together with numerous gases such as  $\text{NO}_x$  and  $\text{SO}_2$ .
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Control of air pollution :

separation of pollutant from harmless gases.

(a) Electrostatic precipitator :

(i) It is most effective device to remove over 90% of particulate matter present in the exhaust from a thermal power plant.

(ii) It has electrode wires that are maintained at several thousand volts which produce a corona that releases electrons.

(iii) These electrons attach to dust particles giving them a net negative charge.

(iv) The collecting plates are grounded and attract the charged dust particles.

(v) The velocity of air between the plates must be low enough to allow the dust to fall.

(b) scrubber :- The industries which produce  $\text{SO}_2$  as a by product must have scrubbing installed in them. In this method, effluents containing sulphur dioxide are passed through a spray of water and crushed limestone ( $\text{CaCO}_3$ )



AI QUAD CAMERA  
Shot by souman

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Proper maintenance of automobiles along with use of lead free petrol or diesel can reduce the pollutants they emit.

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## CONCLUSION :

The air (prevention and control of pollution) Act, 1981: The act deals with the preservation of air quality and the control of air pollution with a concern for the detrimental effects of air pollution on human health and also on the ~~and~~ biological world. In 1987, important amendment to air act 1981 was made and noise was recognised as air pollutants.



AI QUAD CAMERA  
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## Acknowledgement



The success and final outcome of the project required a lot of guidance and assistance from many people and I am privileged to now get this all along the completion of my project.

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**RAMAKRISHNA MISSION RESIDENTIAL COLLEGE**



**NARENDRAPUR**

**ENVIRONMENTAL STUDIES**

**PROJECT TITLE:**

**Air pollution in cities and  
measures to control it.**

NAME	:	Soumen Pain
COLLEGE ROLL NO	:	BNUG/189/19
DEPARTMENT	:	Bengali
YEAR	:	2020
SIGNATURE	:	

★ Air pollution in cities and measures to control it.

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# RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

### PROJECT TITLE:

Corona Pandemic And Role of Common  
People to Control It

NAME : SOUMYA SANKAR JANA

COLLEGE ROLL NO : MTUG / 113 / 19

DEPARTMENT : MATHEMATICS

YEAR : 2020

SIGNATURE :

## Corona Pandemic And Role of Common People to Control It

Covid-19 is a contagious respiratory and vascular disease, caused by severe acute respiratory syndrome Corona virus 2. First identified in Wuhan, China, it is currently an ongoing pandemic.

Common symptoms include fever, cough, fatigue, breathing difficulties and loss of smell and taste. Symptoms begin one to fourteen days after exposure to the virus. While most people have mild symptoms, some people develop acute respiratory distress syndrome, which can be precipitated by cytokine storms, multi-organ failure, septic shock and blood clots. Longer-term damage to organs has been observed, and there is concern about a significant number of patients who have recovered from the acute phase of the disease but continue to experience a range of effects — known as long COVID — for months afterwards, including severe fatigue, memory loss and other cognitive issues, low grade fever, muscle weakness and breathlessness.

Covid-19 mainly spreads through the air when people are near each other long enough, primarily via small droplets or aerosols, as an infected person breathes, ~~coughs~~. Coughs, sneezes, sings or speaks. Transmission via faeces has not been conclusively demonstrated. It can spread as early as two days before infected persons show symptoms, and from asymptomatic individuals. People remain infectious for up to ten days in moderate cases, and two weeks in severe cases. The standard diagnosis method is by real-time reverse transcription polymerase

chain reaction from a nasopharyngeal swab.

Preventive measures include social distancing, quarantining, ventilation of indoor spaces, covering coughs and sneezes, hand washing, and keeping unwashed hands away from the face. The use of face masks or covering has been recommended in public settings to minimize the risk of transmissions.

There are no proven vaccines or specific treatments for COVID-19 yet, though several are in development.

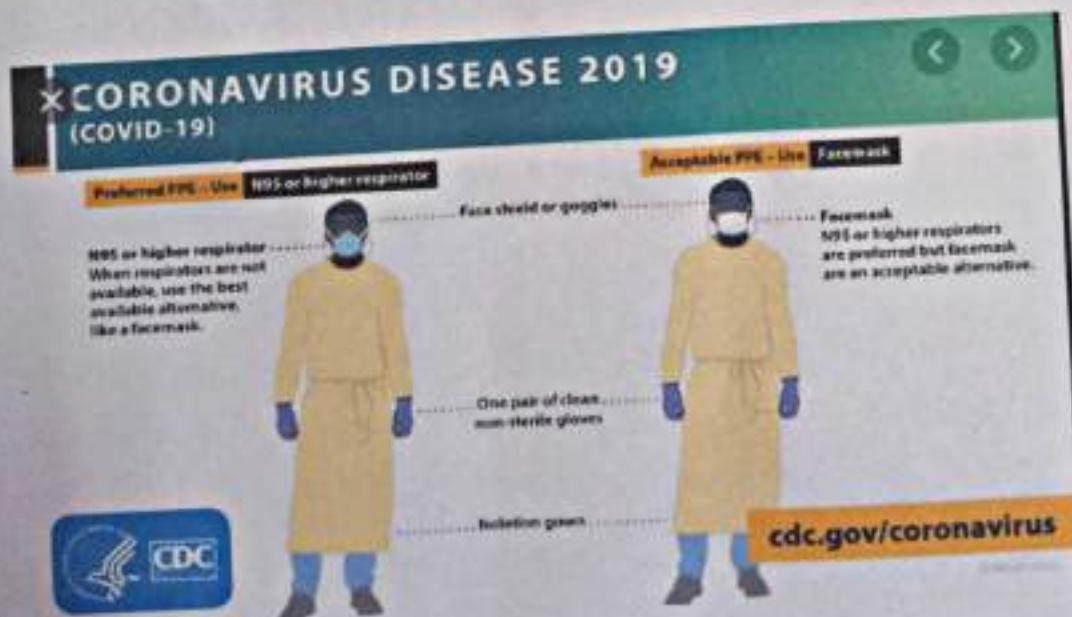
Management involves the treatment of symptoms, supportive care, isolation and experimental measures.

### Prevention And Role of Common People & Control

A COVID-19 vaccine is not expected until 2021 at the earliest. The US National Institutes of Health guidelines do not recommend any medication for prevention of COVID-19, before or after exposure to the SARS-CoV-2 virus outside the setting of a clinical trial. Those diagnosed with COVID-19 or who believe they may be infected are advised by the CDC to stay home except to get medical care, call ahead before visiting a healthcare provider, wear a facemask before entering the healthcare provider's office and when in any room or vehicle with another person, cover coughs and sneezes with a tissue, regularly wash hands with soap and water and avoid sharing personal household items.

## Personal protective equipment:-

For health care professionals who may come into contact with COVID-19 positive bodily fluids, using personal protective coverings on exposed body parts improves protection from the virus. Breathable personal protective equipment improves user-satisfaction and may offer a similar level of protection from the virus. The recommendation is meant to reduce the spread of the disease by asymptomatic and pre-symptomatic individuals and is complementary to established preventive measures such as social distancing. Face covering limits the volume and travel distance of expiratory droplets dispersed when talking, breathing and coughing.



## Social Distance

Social distancing strategies aim to reduce contact of infected persons within large groups by closing schools and workplaces, restricting travel, and cancelling large public gatherings. Distancing guidelines also include that people stay at least apart. After the implementation of social distancing and stay at home orders, many regions have been able to sustain an effective transmission rate of less than one, meaning the disease is in remission in those areas.



## Hand-washing and Hygiene:-

When not wearing a mask, the CDE, WHO, ICMR and NHS recommends covering the mouth and nose with a tissue when coughing or sneezing and recommends using the inside of the elbow if no tissue is available. Proper hand hygiene after any cough or sneeze is encouraged.

Sanitizing of frequently touched surfaces is also recommended or required by regulation for businesses and public facilities; the United States Environmental Protection Agency maintains a list of products expected to be effective.



## Management:-

People are managed with supportive care, which may include fluid therapy, oxygen support, and supporting other affected vital organs. The CDC recommends those who suspect they carry the virus wear a simple face mask. Personal hygiene and a healthy lifestyle, and diet have been recommended to improve immunity.

Supportive treatments may be useful in those with mild symptoms at the early stage of infection.

The WHO, the Chinese National Health Commission and, the United States' National Institutes of Health have published recommendations for taking care of people who are hospitalised with COVID-19. Intensivists and pulmonologists in the US have compiled treatment recommendations from various



agencies into a free resource, the IBCC.

### Prognosis:-

The severity of COVID-19 varies. The disease may take a mild course with few or no symptoms resembling other common upper respiratory diseases such as the common cold. Mild cases typically recover within two weeks, while those with severe or critical disease may take three to six weeks to recover. Among those who have died, the symptom's time onset to death has ranged from two to eight weeks. Air pollution is similarly associated with risk factors and also obesity contributes to an increased health risk of COVID-19.

It is also assumed that those that are immunocompromised are at higher risk of getting severely sick from SARS-CoV-2. One research that looked into the COVID-19 infection in hospitalized kidney transplant recipients found a mortality rate of 11%.

Children make up a small proportion of reported cases, with about 1% of cases being under 10 years and 4% aged 10-19 years.

Mortality rates are highly correlated to age. In those younger than 50 years the risk of death is less than 0.5%, while in those older than 70, is more than 8%. According to a CDC analysis, the risk of death by age groups in the US is 0.003%, 0.02%, 0.5%, and 5.4% for the age group 0-19, 20-49, 50-69, and 70 or over, respectively.

## Comorbidities

Most of those who die of COVID-19 have pre-existing conditions, including hypertension, diabetes mellitus, and cardiovascular disease. According to March data from the US, 89% of those hospitalised had preexisting conditions. The Italian Istituto Superiore di Sanita, reported that out of 8.8% of deaths were medical charts were available, 96.1% people had at least one comorbidity with the average person having 3.4 diseases.

According to this report the most common comorbidities are hypertension, type 2 diabetes, ischemic heart diseases, atrial fibrillation and chronic renal failure.

Most critical respiratory comorbidities according to the CDC, are: moderate or severe asthma, pre-existing COPD, pulmonary fibrosis, cystic fibrosis. Evidence stemming from meta-analyses of several smaller research papers also suggest that smoking can be associated with worse patient outcomes. When someone with existing respiratory problems is infected with COVID-19, they might be at greater risk for severe symptoms. COVID-19 also poses a greater risk to people who misuse opioids and methamphetamine, insofar, as their drug use may have caused lung damage.

## Complications:

Complications may include pneumonia, acute respiratory distress syndrome, multi-organ failure, septic shock and death.

Cardiovascular complications may include heart failure, arrhythmias, heart inflammation, and blood clots.

Approximately 20-30% of people who present with COVID-19 have elevated liver-enzymes reflecting liver injury. Neurologic manifestations include seizure, stroke, encephalitis, and Guillain-Barré syndrome. Following the infection, children may develop paediatric multisystem inflammatory syndrome, which has symptoms similar to Kawasaki disease, which can be fatal.

### Long Term effects:-

Some early studies suggest between 1 in 5 and 1 in 10 people with COVID-19 will experience symptoms lasting longer than a month. A majority of those who were admitted to hospital with severe disease report long-term problems including fatigue and shortness of breath.

ON 30 October, 2020 WHO chief Tedros has warned that "to a significant number of people, the COVID virus poses a range of serious long-term effects. He has described the vast spectrum of COVID-19 symptoms that fluctuate over time as "really concerning." The range from fatigue, a cough and shortness of breath to inflammation, and injury of major organs—including the lungs and heart and also neurological and psychologic effects. Symptoms often overlap and can affect any system in the body.

Infected people have reported cyclical bouts of fatigue, headaches, months of complete exhaustion mood swings and other symptoms.

### Immunity:-

The immunity response by humans to COVID viruses occurs as a combination of the cell-mediated immunity and antibody production, just as with other most infections. However, it remains unknown if the immunity ~~and~~ is long-lasting in people who recover from the disease. Cases in which recovery from COVID-19 are followed by positive tests for coronavirus at a later date have been reported. In some of these cases, the RNA from the first and second infections indicates a different strain of the virus. Some reinfection cases are believed to be lingering infection rather than reinfection. Some other coronaviruses circulating in people are capable of reinfection after roughly a year.

**RAMAKRISHNA MISSION RESIDENTIAL COLLEGE**



NARENDRAPUR

**ENVIRONMENTAL STUDIES**

PROJECT TITLE:

*Nitrogen Cycle  
and its  
Importance for  
Living Beings*

NAME : **Soumyadip Nayak**  
COLLEGE ROLL NO : **MTUG/118/19**  
DEPARTMENT : **Mathematics**  
YEAR : 2020  
SIGNATURE :

## Acknowledgement

I would like to express my special thanks and gratitude to my respected teachers, Mr. Souvik Bhattacharya and Narayan Mitra and our respected Principal and Vice Principal Maharaj who gave me continuous support and encouragement to complete this project work entitled: "Nitrogen Cycle and its Importance for Living Beings". Without their help and tremendous support I might not have been able to complete this project. I am thankful to them for their support.

Soumyadip Nayak

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## Nitrogen Cycle:

The nitrogen cycle is the biological cycle by which nitrogen is converted into multiple chemical forms as it circulates among atmosphere, terrestrial and marine ecosystems. The conversion of nitrogen can be carried out through both biological and physical processes. Important processes in the nitrogen cycle include fixation, ammonification, nitrification and denitrification. The majority of Earth's atmosphere (78%) is atmospheric nitrogen, making it the largest source of nitrogen. However, atmospheric nitrogen has limited availability for biological use, leading to a scarcity of usable nitrogen in many types of ecosystems.

The nitrogen cycle is of particular interest to ecologists because nitrogen availability can affect the rate of key ecosystem processes, including primary production and decomposition. Human activities such as fossil fuel combustion, use of artificial nitrogen fertilizers, and release of nitrogen in wastewater have dramatically altered the global nitrogen cycle. Human modification of the global nitrogen cycle can negatively affect the natural environment system and also human health.

## Processes:

Nitrogen is present in the environment in a wide variety of chemical forms including organic nitrogen, ammonium ( $\text{NH}_4^+$ ), nitrite ( $\text{NO}_2^-$ ), nitrate ( $\text{NO}_3^-$ ), nitrous oxide ( $\text{N}_2\text{O}$ ), nitric oxide ( $\text{NO}$ ) or inorganic nitrogen gas ( $\text{N}_2$ ). Organic nitrogen may be in the form of a living organism, burns on in the intermediate products of organic matter, decomposition. The processes in the nitrogen cycle is to transform nitrogen from one form to another. Many of those processes are carried out by microbes, either in their effort to harvest energy or to accumulate nitrogen in a form needed for their growth for example, the nitrogenous wastes in animal ~~waste~~ urine are broken down by nitrifying bacteria in the soil to be used by plants. ~~The bacteria diagram describes how these processes fit together to form the nitrogen cycle.~~

**Nitrogen fixation:** The conversion of nitrogen gas ( $\text{N}_2$ ) into nitrates and nitrites through atmospheric, industrial and biological processes is called nitrogen fixation.

Atmospheric nitrogen must be 'processed', or 'fixed', into a usable form to be taken up by plants. Between 9 and 10 billion kg per year are fixed by lightning strikes, but most fixation is done by free-living or symbiotic bacteria known as diazotrophs. These bacteria have the nitrogenase enzyme that combines gaseous nitrogen with hydrogen to produce ammonia, which is converted by the bacteria into other organic compounds.

Most biological nitrogen fixation occurs by the activity of Mo-nitrogenase, found in a wide variety of bacteria and some Archaea. Mo-nitrogenase is a ~~more~~ complex heme component enzyme that has multiple metal-containing prosthetic groups. An example of free living bacteria is Azotobacter. Symbiotic nitrogen fixing bacteria such as Rhizobium usually live in the root nodules of legumes (such as peas, alfalfa, and locust trees). Here they form a mutualistic relationship with the plant, producing ammonia in exchange for carbohydrates. Because of this relationship, legumes will often increase the nitrogen content of nitrogen-poor soils. A few non-legumes can also form such symbiosis. Today, about 40% of the total fixed nitrogen is produced industrially using the Haber-Bosch process, which uses high temperature and pressures to convert nitrogen gas and a hydrogen source (natural gas or ammonia) into ammonia.

**Assimilation:** Plants can absorb nitrate or ammonium from the soil by their root hairs. If nitrate is absorbed, it is first reduced to nitrite ions and then ammonium ions for incorporation into amino acids, nucleic acids, and chlorophyll. In plants that have a symbiotic relationship with rhizobia, some nitrogen is assimilated in the form of ammonium ions directly from nodules. It is now known that there is a more complex cycling of amino acids between Rhizobia bacteroids and plants. The plant provides amino acids to the bacteroids so amino

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Assimilation is not required and the heterotrophs pass amino acids (with the newly fixed nitrogen) back to the plant, thus forming an interdependent relationship. While many animals, fungi, and other heterotrophic organisms obtain nitrogen by ingestion of amino acids, nucleotides, and other small organic molecules, other heterotrophs (including many bacteria) are able to utilize inorganic compounds, such as ammonium as sole N sources. Utilization of various N sources is carefully regulated in all organisms.

**Ammonification:** When a plant or animal dies or in animal excreta waste, the initial form of nitrogen is organic. Bacteria or fungi convert the organic nitrogen within the remains back into ammonium ( $\text{NH}_4^+$ ), a process called ammonification or mineralization. Enzymes involved are:

- GS: Glu Synthetase (Cytosolic & Plasto)
- GOGAT: Glu 2-oxoglutarate aminotransferase (Ferredoxin & NADH-dependent)
- GDH: Glu dehydrogenase
  - Minor role in ammonium assimilation
  - Important in amino acid catabolism

**Nitrification:** The conversion of ammonium to nitrate is performed primarily by soil-living bacteria and other nitrifying bacteria. In the primary stage of nitrification, the oxidation of ammonium ( $\text{NH}_4^+$ ) is performed by bacteria such as the Nitrosomas species, which converts ammonia to nitrites ( $\text{NO}_2^-$ ). Other bacterial species such as nitrifiers, are responsible for the oxidation of the nitrites to nitrates.

⑦

into nitrate ( $\text{NO}_3^-$ ). It is important for the ammonia ( $\text{NH}_3$ ) to be converted to nitrate or nitrates because ammonia gas is toxic to plants.

Due to their high stability and because rats are highly mobile to retain nitrates, nitrates can enter groundwater. Elevated nitrate in groundwater is a concern for drinking water use because nitrate can interfere with blood-oxygen levels in infants and cause methemoglobinemia or blue baby syndrome. Where groundwater reaches stream flow, nitrate-enriched groundwater can contribute to eutrophication, a process that leads to high algal population and growth, especially blue-green algal populations. While not directly toxic to fish life, like ammonia, nitrate can have indirect effects on fish if it contributes to this eutrophication. Nitrogen has contributed to severe eutrophication problems in some water bodies. Since 2006, the application of nitrogen fertilizer has been increasingly controlled in Britain and the USA. This is occurring along the same lines as control of phosphorus fertilizer, restriction of which is normally considered essential to the recovery of eutrophied waterbodies.

Denitrification || Denitrification is the reduction of nitrates back into nitrogen gas ( $\text{N}_2$ ), completing the nitrogen cycle. This process is performed by bacterial species such as *Pseudomonas* and *Paracoccus*, under anaerobic conditions. They use the nitrate as an electron acceptor in the place of oxygen during respiration. These facultatively (meaning optionally) anaerobic

bacteria can also live in aerobic conditions. Denitrification happens in anaerobic conditions e.g. waterlogged soils. The denitrifying bacteria use nitrates in the soil to carry out respiration and consequently produce nitrogen gas, which is inert and unavailable to plants.

### Dissimilatory nitrate reduction to ammonium

Dissimilatory nitrate reduction to ammonium (DNRA), or nitrate/nitrite ammonification, is an anaerobic respiration process. Microbes which undertake DNRA oxidise organic matter and use nitrate as an electron acceptor, reducing it to nitrite, then ammonium ( $\text{NO}_3^- \rightarrow \text{NO}_2^- \rightarrow \text{NH}_4^+$ ). Both denitrifying and nitrate → ammonification bacteria will be competing for nitrate in the environment, although DNRA acts to conserve biavailable nitrogen as soluble ammonium rather than producing dinitrogen gas.

### Anaerobic ammonia oxidation

In this biological process, nitrite and ammonia are converted directly into molecular nitrogen ( $\text{N}_2$ ) gas. This process makes up a major proportion of nitrogen conversion in the oceans. The balanced formula for this "anammox" chemical reaction is:  $\text{NH}_4^+ + \text{NO}_2^- \rightarrow \text{N}_2 + 2\text{H}_2\text{O}$  ( $\Delta H^\circ = -357 \text{ kJ/mol}$ )

### Other processes

Though nitrogen fixation is the primary source of plant-available nitrogen in most ecosystems, in areas with nitrogen-rich bedrocks the breakdown of this rock also serves as a nitrogen source. Nitrate reduction is also part of the iron cycle, under anoxic conditions  $\text{Fe}(\text{II})$  can reduce

7

an electron to  $\text{NO}_3^-$  and is oxidized to  $\text{Fe}(\text{III})$  while  $\text{N}_2$  is reduced to  $\text{NO}_2$ ,  $\text{N}_2\text{O}$ ,  $\text{N}_2$ , and  $\text{NH}_4^+$  depending on the conditions and microbial species involved.

### Importance of nitrogen cycle:

The nitrogen cycle is the vital element for the synthesis of plant and animal protein. Indeed, the nitrogen from the atmosphere cannot be directly taken by plants unlike bacteria. Nitrogen fixing bacteria e.g. *Nostoc* sp. which is found abundantly in the soil and *Rhizobium* sp. living on the nodules of leguminous plants. They convert atmospheric nitrogen into ammonium compounds and nitrates, are absorbed by the roots of plants.

Consequently, when animals eat the plants, the organic nitrogen is transferred to the animal. When the plant and animal die, the decomposition takes place where the Nitrifying bacteria e.g. *Nitrobacter* sp. will then convert the ammonia into the atmosphere. Hence, repeating the whole process is known as Nitrogen cycle.

Nitrogen cycle is important for the:

- Stable Optimum growth of plants
- Majority of nitrogen is obtained from the atmosphere and is used in the production of  $\text{NH}_3$  (Haber process) which is a new source of Nitric acid.
- Synthesis of natural and artificial fertilizer e.g., Ammonium sulphate.

• Nitrogen is essential to life because it's building block for RNA, DNA, chlorophyll, acids, proteins, etc.

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- Solomon Aime's post in Quora
- Image Sources: Wikipedia

# RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

### PROJECT TITLE:

Nitrogen Cycle and It's Importance on  
Living Beings

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DEPARTMENT : Chemistry Hon. (1st year)  
YEAR : 2020  
SIGNATURE : Sourav Halder

# NITROGEN CYCLE AND ITS IMPORTANCE FOR LIVING BEINGS

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■■■ Introduction : Nitrogen is the most abundantly present gaseous element (78.09%) in the atmosphere. Nitrogen is extremely essential for every living creature because it is the most important constituent of proteins, nucleic acids and a variety of compounds essential for life. But green plant cannot utilize atmospheric N<sub>2</sub> directly. Only some kind of legumease bacteria and ~~at~~ some blue-green algae can fix atmospheric N<sub>2</sub>. Most plants absorb N<sub>2</sub> from soil as nitrate and ammonium salts and produce their food which is consumed by the animals in the rule of food chains. On the death of the living beings, the fixed N<sub>2</sub> in the bodies go back to the atmosphere through decomposition of another kind of microorganisms. Thus the cycle of Nitrogen involves a series of events around N<sub>2</sub> of the soil and N<sub>2</sub> of atmosphere.

■■■ Steps of Nitrogen cycle :

The steps of nitrogen cycle in the atmosphere and the soil includes the following events —

- ① Nitrogen fixation
- ② Nitrification
- ③ Assimilation
- ④ Ammonification
- ⑤ Denitrification

- Nitrogen fixation :

During this process, the atmospheric nitrogen gets fixed in the soil in form of several nitrogenous compounds like nitrates, nitrites and ammonia. This process can also be categorized in two processes —

- Natural Nitrogen fixation :

During thunder, the atmospheric  $\text{N}_2$  reacts with atmospheric  $\text{O}_2$  and forms nitric oxide ( $\text{NO}$ ) and nitrogen dioxide ( $\text{NO}_2$ ). These oxides react with rain water and form nitrous acid ( $\text{HNO}_2$ ) and nitric acid ( $\text{HNO}_3$ ). They come to the earth, mixed up with rain water and reaches the soil. There those acids react with the metallic salts of soil and results in some nitrate compounds (organic) and remain there. Thus nature helps to get  $\text{N}_2$  fixed.

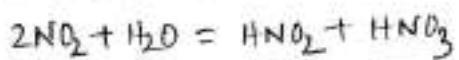
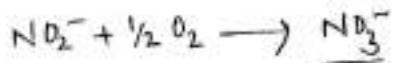
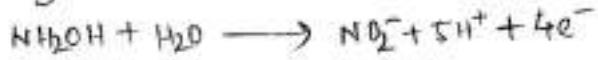
- Biological Nitrogen fixation :

In this process some species of microorganisms fix atmospheric Nitrogen into nitrate compounds. They are called nitrifying bacteria. Such as —

- ① Some autotrophic bacteria (Azotobacter, Clostridium etc.) fixes atmospheric Nitrogen in their body. After their death, the nitrate compounds mix with the soil.
- ② Some blue green algae (Anabaena, Nostoc etc.) directly fixes atmospheric nitrogen into nitrate compounds and increase soil's nitrogen content.
- ③ Some symbiotic bacteria reside in the root nodules of many legumease plants (pulses, beans etc.). The most familiar bacteria of this kind is Rhizobium. These bacteria also fix atmospheric Nitrogen into nitrate compounds and use a portion of those compounds for their nutrition and gives the remaining part to the plants. After the death of the bacteria, the fixed  $\text{N}_2$  in their body also mixes up with the soil, increasing the nitrogen content of that soil.

Reactions of Nitrogen fixation :

Natural fixing :  $N_2 + O_2 = 2NO ; 2NO + O_2 = 2NO_2$

Biological fixing :① Nitrification :

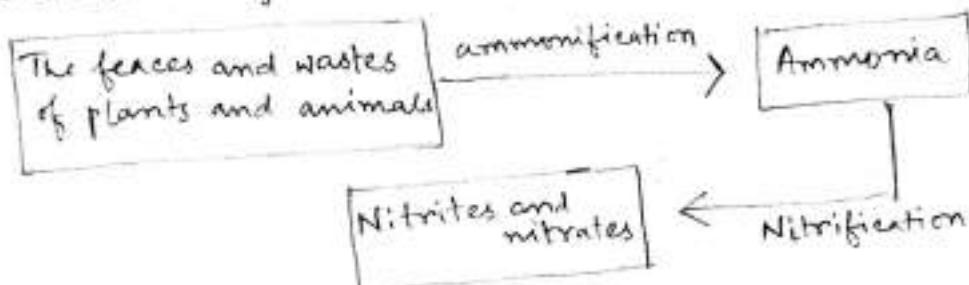
While ammonia can be used for some plants, it is highly toxic, so the most of the nitrogen that is absorbed by the plants are in the form of nitrogen dioxide ( $NO_2^-$ ) and nitric oxides ( $NO_3^-$ ). The nitrogen dioxides and nitric oxides form many nitrogen compounds and they were absorbed by the plant roots. Thus atmospheric nitrogen enters into biological system through the plants.

② Assimilation :

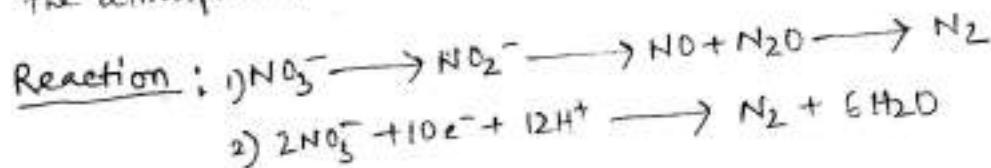
The feeds are made made by plants those nitrogenous compounds. As the plants are the producer of any ecosystem, the nitrogenous compounds flow from one layer to another layer of ecosystem through the food chain.

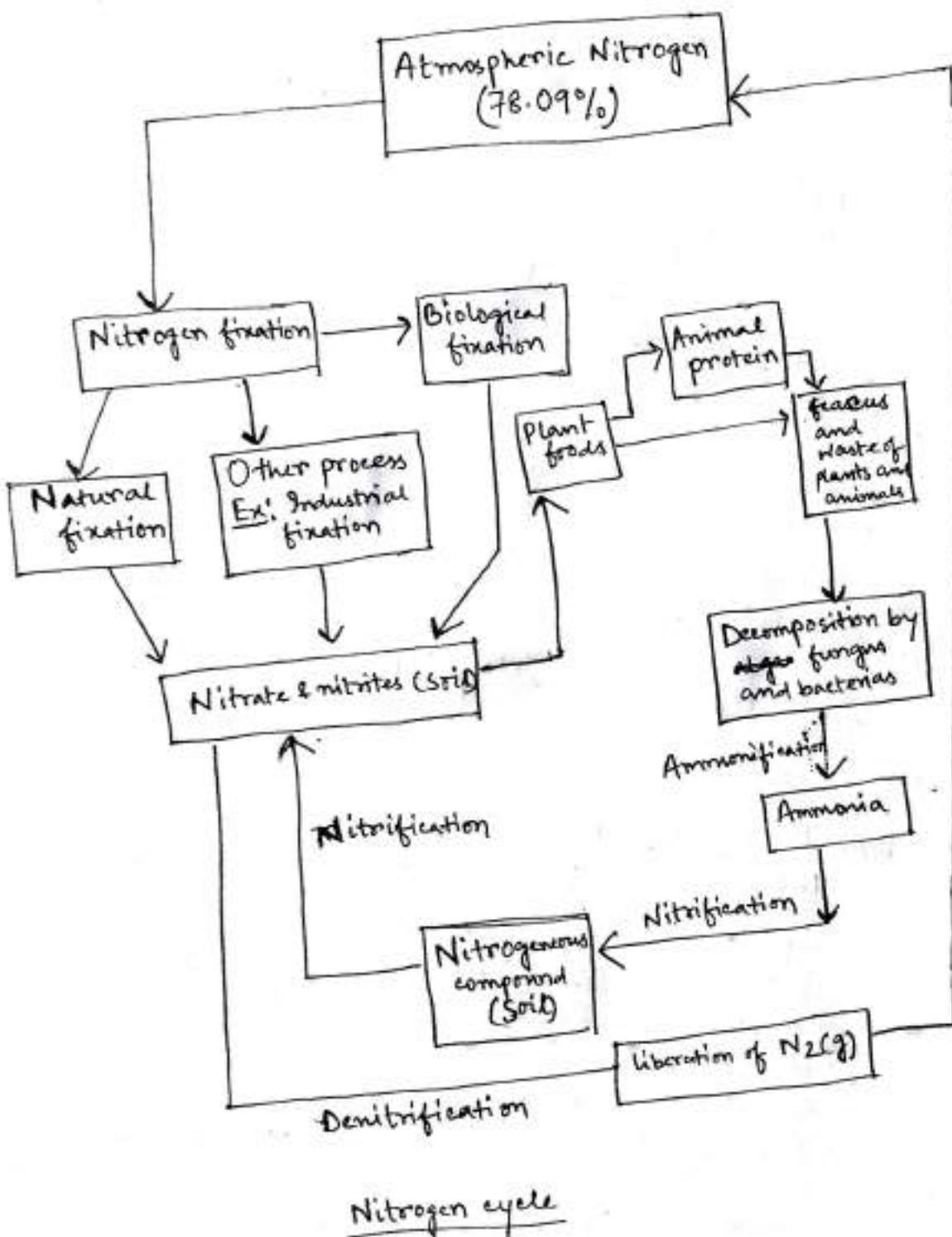
④ Ammonification :

When plants and animals die or when they emit wastes, the nitrogen in the organic matter re-enters the soil where it is broken down by other microorganisms, known as decomposers. There are many decomposing bacteria who decompose the nitrogenous wastes of plants and animals into ammonia; they are called ammonifying bacteria (Bacillus mycoides, Micromoccus etc.). This process is called ammonification. The produced ammonia in the soil is used in many biological processes and recycles into nitrification.



④ Denitrification : Nitrogen makes its way back to the atmosphere through a process called denitrification. In this process  $\text{NO}_3^-$  (nitrate) is converted into gaseous nitrogen ( $\text{N}_2$ ). Denitrification occurs primarily in wet soils where the water makes it difficult for microorganisms. Under this condition, certain bacteria called denitrifying bacteria (Pseudomonas, Thiobacillus etc.) process nitrates and nitrites to gain oxygen, leaving free  $\text{N}_2$  as by-products which gradually enter the atmosphere. This ~~also~~ Thus denitrification keeps the balance of the amount of nitrogen in atmosphere by releasing fixed nitrogen as free nitrogen molecule in the atmosphere.

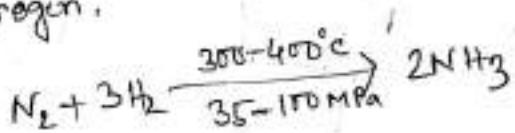


VIIA Diagram of Nitrogen cycle :

### ■ Importance of Nitrogen cycle in living beings:

Nitrogen cycle has tremendous impact on living beings. The cyclical process of Nitrogen makes the balance of nitrogen in environment. Nitrogen is the key element of protein which is one of the most essential elements for every life on earth. The protoplasm and other matter molecules for life can't be made without protein, specifically to be said without nitrogen. The DNA and RNA is also made up of protein chains, so we can say even the simplest living creature such as virus can't live on the earth without nitrogen. Thus nitrogen or we can say the nitrogen cycle is directly influencing the life cycles on earth.

Apart from these many or we can say almost every fertilizer factory <sup>use</sup> ~~produces~~ Nitrogen for the fertilizers. In Haber Bosch method they produce ammonia from Nitrogen.



### ■ Ecological implications of Human alterations to the Nitrogen cycle :

Many human activities have a significant impact on the nitrogen cycle. Burning fossil fuels, application of nitrogen based fertilizers and other activities can dramatically increase the amount of biologically available nitrogen in an ecosystem. And because nitrogen availability often limits the primary productivity of many ecosystems, large changes in the availability of nitrogen can lead to severe alteration of the nitrogen cycle in both aquatic and terrestrial ecosystems.

In terrestrial ecosystems, the addition of nitrogen lead to nutrient imbalance in trees, changes in forest health, and declines in biodiversity. With increased nitrogen availability there is often a change in carbon storage, thus impacting more processes than nitrogen cycle. In agricultural systems, fertilizers are used extensively to increase plant production, but unused nitrogen, usually in the form of nitrate, can leach out of soil, enter streams and rivers, and ultimately makes the way to drinking water, which is dangerous to our health.

Much of the nitrogen applied to agricultural and urban areas ultimately enter rivers and nearshore coastal systems. In nearshore marine systems, increases in nitrogen can often lead to anoxia (no oxygen) or hypoxia (low oxygen), altered biodiversity, changes to food web structure and general habitat degradation. One common consequence of increased nitrogen is an increase in harmful algal blooms (Howarth 2008). (Howarth 2008). Some have even suggested that alterations to the nitrogen cycle may lead to an increased risk of parasite attacks and infectious diseases among human and wildlife. Additionally, increases in nitrogen in aquatic systems can lead to increased acidification in freshwater ecosystems.

■ Conclusion :

Nitrogen is undoubtedly one of the most important nutrient in regulating primary productivity and species diversity in both aquatic and terrestrial ecosystems. Microbially-driven processes such as nitrogen fixation, nitrification and denitrification, constitute the bulk of nitrogen transformations and play a critical role in the fate of nitrogen in the Earth's ecosystem.

However, as human populations continue to increase, the consequences of human activity continue to threaten our resources and have already significantly altered the global nitrogen cycle.

Acknowledgement :

I am very much thankful to the subject teacher of my college, who inspired me many insights about the nitrogen cycle project and guided me to ensure that everything I am manage to describe about the topic. I am also thankful to my parents whose constant support and help made the project much possible. I am also acknowledging my classmates who have guided me with many informations and draged my attention to the right kind of references.

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# 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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## Introduction :

The nitrogen cycle is the biogeochemical cycle by which nitrogen is converted into multiple chemical forms as it circulates among atmosphere, terrestrial, and marine ecosystems. The conversion of nitrogen can be carried out through both biological and physical processes. Important processes in nitrogen cycle include fixation, ammonification, nitrification, and denitrification. The majority of Earth's atmosphere (78%) is atmospheric nitrogen, making it the largest source of nitrogen.

### 5 Stages of Nitrogen cycle

#### Stage 1 : Nitrogen Fixation

In this stage, nitrogen moves from the atmosphere into the soil. Earth's atmosphere contains a huge pool of nitrogen gas ( $N_2$ ). To be used by plants, the  $N_2$  must be transformed through a process call nitrogen fixation. Fixation converts nitrogen in the atmosphere into forms that plants can absorb through their root systems. A small amount of nitrogen can be fixed when lightning provides the energy needed for  $N_2$  to react with oxygen,

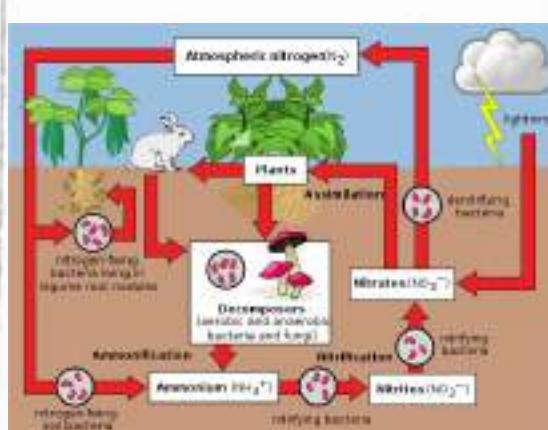
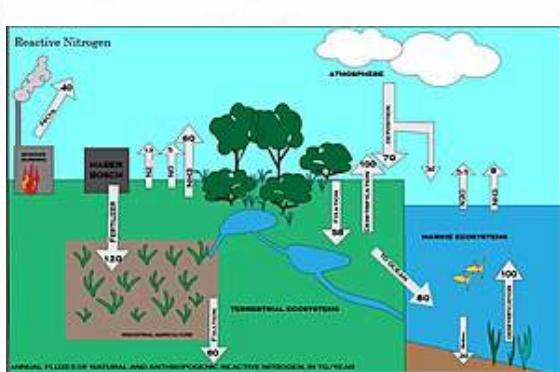
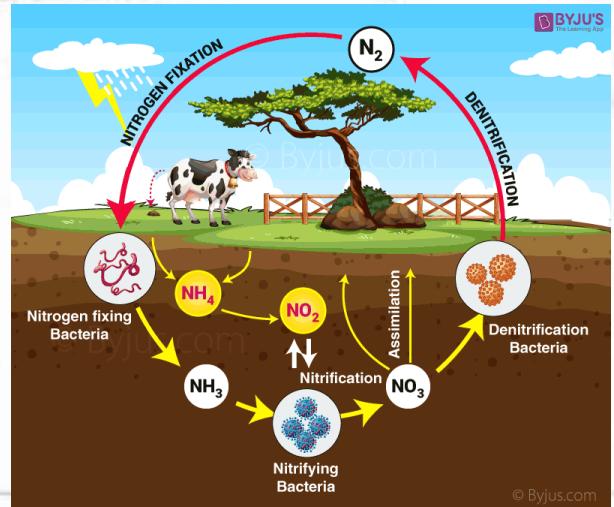
producing nitrogen oxide,  $\text{NO}$  and nitrogen dioxide,  $\text{NO}_2$ . These forms of nitrogen then enter soil through rain or snow.

Nitrogen can

also be fixed through the industrial process that creates fertilizers.

The bacteria gets energy through photosynthesis and, in return, they fix nitrogen into a form that the plant needs. The fixed nitrogen is then carried to other parts of the plant and tissues, so the plant can grow.

Other bacteria live freely in soils & water and can fix nitrogen without their symbiotic relationship. These bacteria can also create forms of nitrogen that can be used by organisms.



## Stage 2 : Mineralization

This stage takes place in the soil. Nitrogen moves from organic materials, such as mature or plant materials to an inorganic form of nitrogen that plants can use. Eventually, the plant dies and decomposes. Mineralization happens when microbes act on organic material, such as animal manure or decomposing plant or animal material and begin to convert it to a form of nitrogen that can be used by plants. All plants under cultivation.

## Stage 3 : Nitrification

The third stage, nitrification, also occurs in soil. During nitrification the ammonia in the soil, produced during mineralization, is converted to compounds called nitrate,  $\text{NO}_3^-$  and nitrite  $\text{NO}_2^-$ .

Nitrate can be used by plants and animals that consume the plants. Some bacteria in the soil can turn ammonia into nitric. Although nitric is not usable by plants and animals directly. Other bacteria can change nitrosen into nitrate - a form that is usable by plants and animals. This reaction provides energy for the bacteria engaged in this process.



### Stage 4 : Immobilization :

The fourth stage of nitrogen cycle is immobilization. Sometimes described as the reverse of the mineralization. These two processes together control the amount of nitrogen in soil. Just like plants, microorganisms pull nitrogen from the soil when the residues of decomposing plants do not contain enough nitrogen. When the micro-organisms take in ammonia ( $\text{NH}_4^+$ ) and nitrate ( $\text{NO}_3^-$ ), these forms of nitrogen are no longer available to the plants and may cause nitrogen deficiency, or a lack of nitrogen. Immobilization, therefore, ties up the nitrogen in micro-organisms. However immobilization is important because it helps control and balance the amount of nitrogen in the soil by immobilizing the nitrogen, tying it up, in micro-organisms.

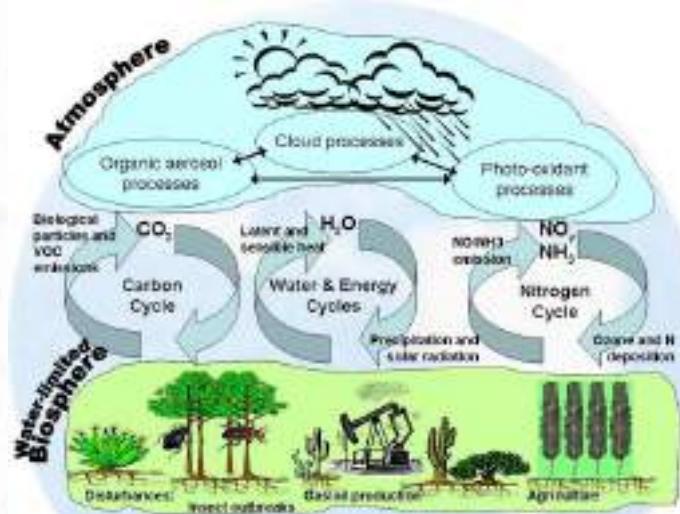
### Stage 5 : Denitrification

In the final stage of nitrogen cycle, nitrogen returns to the air as nitrates are converted to atmospheric nitrogen ( $\text{N}_2$ ) by bacteria through the process we call denitrification. This results in an overall loss of nitrogen from soil, as gaseous form of nitrogen moves into

the atmosphere, back where we began our story.

Nitrogen is as precious as Diamond!!!

Nitrogen is a key element in the nucleic acids DNA and RNA, which are the most important of all biological molecules and crucial for all living beings. DNA carries the genetic information, which means the instructions, for how to make up a life form. When plants do not get enough nitrogen, they are unable to produce amino acids. Without amino acids, plants cannot make the special protein that the plant cells need to grow. Without enough nitrogen, plant growth is affected negatively.



With too much nitrogen, plants produce excess biomass, or organic matter, such as stalks and leaves, but not enough root structure. In extreme cases, plants with very high levels of nitrogen absorbed from soils can poison farm animals that eat them.

## Nitrogen is crucial for life...

The cycling of nitrogen through the ecosystem is crucial for maintaining productive and healthy ecosystems with neither too much nor too little nitrogen. Plant production and biomass (living material) are limited by the availability of nitrogen. Understanding how the plant-soil nitrogen cycle works can help us make better decisions about what crops to grow and where to grow them. So we have an adequate supply of food. Knowledge of nitrogen cycle can also give us awareness so that we can reduce pollution caused by adding too much fertilizers to the soil. Certain plants can uptake more nitrogen or other nutrients such as phosphorous.

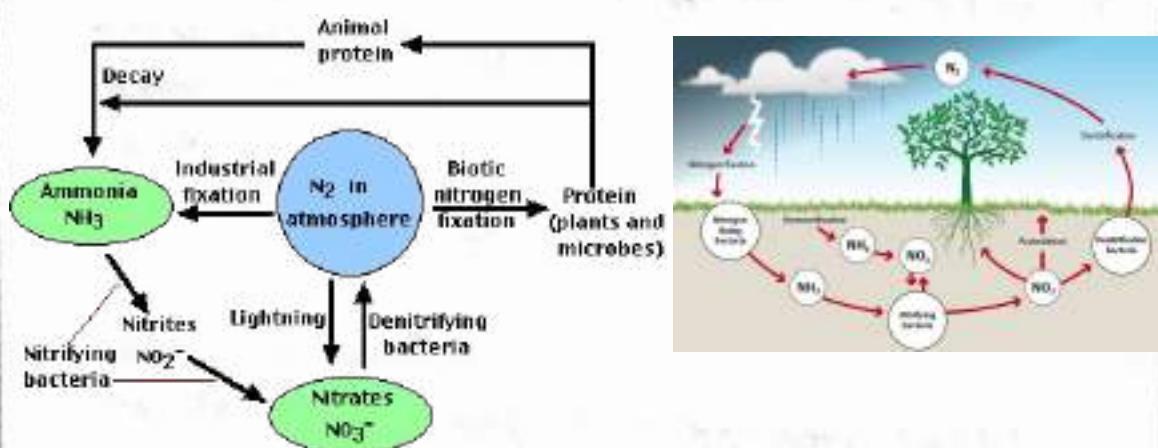
## Importance of Nitrogen Cycle :

Importance of nitrogen cycle can be as follows:

1. Helps plants to synthesize chlorophyll from the nitrogen compounds.
2. Helps in converting inert nitrogen gas into a usable form for the plants through the biochemical process.
3. In the process of ammonification, the bacteria help in decomposing the animal and plant matter, which indirectly helps to cleanup the environment.
4. Nitrates and nitrates are released into the soil, which helps in enriching the soil.

With necessary nutrients are required for cultivation.

5. Nitrogen is an integral component of the cell and it forms many crucial compounds and important biomolecules.



### Conclusion:

From this concise study, we have come to the following conclusions:

- Nitrogen is abundant in the atmosphere, but it is unusable to plants or animals unless it is converted into nitrogen compounds.
- Nitrogen-fixing bacteria play a crucial role in fixing the atmospheric nitrogen into nitrogen compounds.
- The plants absorb the usable nitrogen compounds from the soil through their roots.
- Animals assimilate nitrogen by consuming these plants or other animals that contain nitrogen.
- During the final stages of the nitrogen cycle, bacteria and fungi help decompose organic matter.
- Some bacteria then convert these nitrogenous compounds in the soil and turn it into nitrogen gas.

These sets of processes repeat continuously.

and thus maintain the percentage of nitrogen in the atmosphere.

### Acknowledgement :

I am greatly thankful to our revered principal Mahanaj Swami Shastrajnananda ji for his support and to Souvik Bhattacharya and Prof. Narayan Huitly for their help to complete this project.

### Reference :

The following websites became helpful in this project work -

- 1) <https://www.nature.com/scitable/knowledge/library/the-nitrogen-cycle-processes-players-and-human-15644632>
- 2) <https://www.frontiersin.org/articles/10.3389/fnrm.2019.00041>
- 3) [https://en.wikipedia.org/wiki/Nitrogen\\_cycle](https://en.wikipedia.org/wiki/Nitrogen_cycle)

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

ENVIRONMENTAL STUDIES

PROJECT TITLE:

NITROGEN CYCLE AND ITS  
IMPORTANCE FOR LIVING BEINGS

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DEPARTMENT : ENGLISH

YEAR : 2020

SIGNATURE : Souvik Roy

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I would like to express my special thanks of gratitude to my teachers, Souvik Bhattacharya and Narayan Maity as well as our principal, Swami Shastrajnanda ji Maharaj who gave me the golden opportunity to do this wonderful project on the topic, "Nitrogen cycle and its importance for living beings," which also helped me in doing a lot of research and I came to know about so many new things. I am really thankful to them.

Secondly, I would also like to thank my parents and friends who helped me a lot in finishing this project within this limited time.

I am making this project not only for marks but also to increase my knowledge.

## NITROGEN CYCLE

The nitrogen cycle is a repeating cycle of process during which nitrogen moves through both living and non-living things: the atmosphere, soil, water, plants, animals and bacteria. In order to move through the different parts of the cycle, nitrogen must change forms. In the atmosphere, nitrogen exists as a gas ( $N_2$ ), but in the soils it exists as nitrogen oxide,  $NO$ , and nitrogen dioxide,  $NO_2$ , and when used as a fertilizer, can be found in other forms, such as ammonia,  $NH_3$ , which can be processed even further into a different fertilizer, ammonium nitrate, or  $NH_4NO_3$ .

There are five stages in the nitrogen cycle, and I shall now discuss each of them in turn: fixation or volatilization, assimilation, ammonification, nitrification, and denitrification.

③

## STAGE 1: NITROGEN FIXATION

In this stage, nitrogen moves from the atmosphere into the soil. Earth's atmosphere contains a huge pool of nitrogen gas ( $N_2$ ). But this nitrogen is "unavailable" to plants, because the gaseous form cannot be used directly by plants without undergoing a transformation. To be used by plants, the  $N_2$  must be transformed through a process called nitrogen fixation. Fixation converts nitrogen in the atmosphere into forms that plants can absorb through their root systems.

A small amount of nitrogen can be fixed when lightning provides the energy needed for  $N_2$  to react with oxygen, producing nitrogen oxide,  $NO$  and nitrogen dioxide,  $NO_2$ . These forms of nitrogen then enter soils through rain or snow. Nitrogen can also be fixed through the industrial process that creates fertilizer.

This form of fixing occurs under high heat and pressure, during which

④

atmospheric nitrogen and hydrogen are combined to form  $\text{NH}_3$ , which may then be processed further to produce ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ), a form of nitrogen that can be added to soils and used by plants.

Most nitrogen fixation occurs naturally, in the soil, by bacteria. Some bacteria attach to plant roots and have a symbiotic relationship with the plant. The bacteria get energy through photosynthesis, and, in return, they fix nitrogen into a form the plant seeds. The fixed nitrogen is then carried to other parts of the plant and is used to form plant tissues, so the plant can grow. Other bacteria live freely in soils or water and can fix nitrogen without this symbiotic relationship. These bacteria can also create forms of nitrogen that can be used by organisms.

## STAGE 2: ASSIMILATION

Plants can absorb nitrate or ammonium from the soil by their root hairs. If nitrate is absorbed, it is first reduced to nitrite ions and then ammonium ions for incorporation into amino acids, nucleic acids, and chlorophyll. In plants that have a symbiotic relationship with rhizobia, some nitrogen is assimilated in the form of ammonium ions directly from the nodules. It is now known that there is a more complex cycling of amino acids between Rhizobia bacteroids and plants. The plant provides amino acids to the bacteroids so ammonia assimilation is not required and the bacteroids pass amino acids back to the plant, thus forming an independent relationship. While many animals, fungi, and other heterotrophic organisms obtain nitrogen by ingestion of amino acids, nucleotides, and other small organic molecules, other heterotrophs are able to utilize inorganic compounds, such as ammonium as sole N sources. Utilization of various N sources is carefully regulated in all organisms.

### STAGE 3:- AMMONIFICATION

This stage takes place in the soil. Nitrogen moves from organic materials, such as manure or plant materials to an inorganic form of nitrogen that plants can use. Eventually, the plant's nutrients are used up and the plant dies and decomposes. This becomes important in the third stage of the nitrogen cycle. Mineralization happens when microbes act on organic material, such as animal manure or decomposing plant or animal material and begin to convert it to a form of nitrogen that can be used by plants. All plants under cultivation, except legumes get the nitrogen they require through the soil. Legumes get nitrogen through fixation that occurs in their root nodules, as described above.

The first form of nitrogen produced by the process of mineralization is ammonia ( $\text{NH}_3$ ). The  $\text{NH}_3$  in the soil then reacts with water

to form ammonium,  $\text{NH}_4^+$ . This ammonium is held in the soils and is available for use by plants that do not get nitrogen through the symbiotic nitrogen fixing relationship described above.

#### STAGE 4: NITRIFICATION

The third stage, nitrification, also occurs in soils. During nitrification the ammonia in the soils, produced during mineralization, is converted into compounds called nitrites,  $\text{NO}_2^-$ , and nitrates,  $\text{NO}_3^-$ . Nitrates can be used by plants and animals that consume the plants. Some bacteria in the soil can turn ammonia into nitrites. Although nitrite is not usable by plants and animals directly, other bacteria can change nitrites into nitrates — a form that is usable by plants and animals. This reaction provides energy for the bacteria engaged in this process. The bacteria that we are talking about are called

nitrosomonas and nitrobaeter.

Nitrobaeter turns into nitrates; nitrosomonas transform ammonia to nitrites. Both kinds of bacteria can act only in the presence of oxygen,  $O_2$ . The process of nitrification is important to plants, as it produces an extra stash of available nitrogen that can be absorbed by the plants through their root systems.

## STAGE 5 : DENITRIFICATION

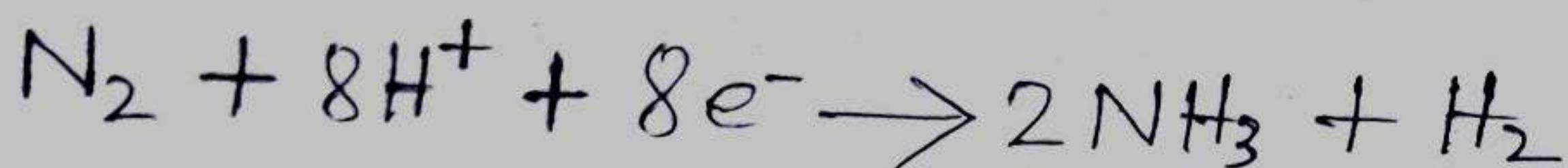
Denitrification is the reduction of nitrates back into nitrogen gas ( $N_2$ ), completing the nitrogen cycle. This process is performed by bacterial species such as Pseudomonas and Paracoccus, under anaerobic conditions. They use the nitrate as an electron acceptor in the place of oxygen during respiration. These facultatively anaerobic bacteria can also live in aerobic conditions. Denitrification happens in anaerobic conditions e.g. waterlogged soils. The denitrifying bacteria use nitrates in the soil to carry out respiration.

⑨

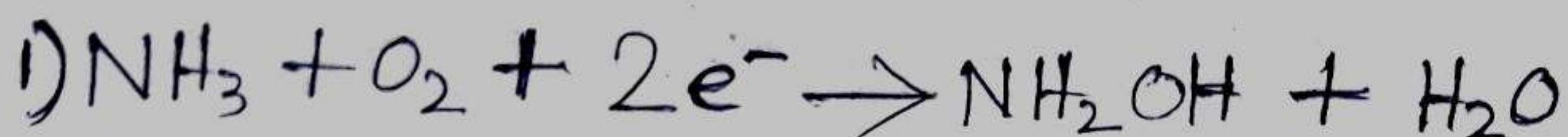
and consequently produce nitrogen gas, which is inert and unavailable to plants.

## REACTIONS RELATED TO NITROGEN CYCLE

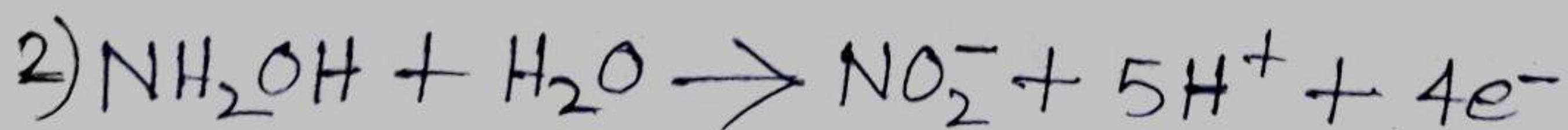
i) Chemical reaction of nitrogen fixation —



ii) Chemical reactions of ammonia oxidation carried out by bacteria —



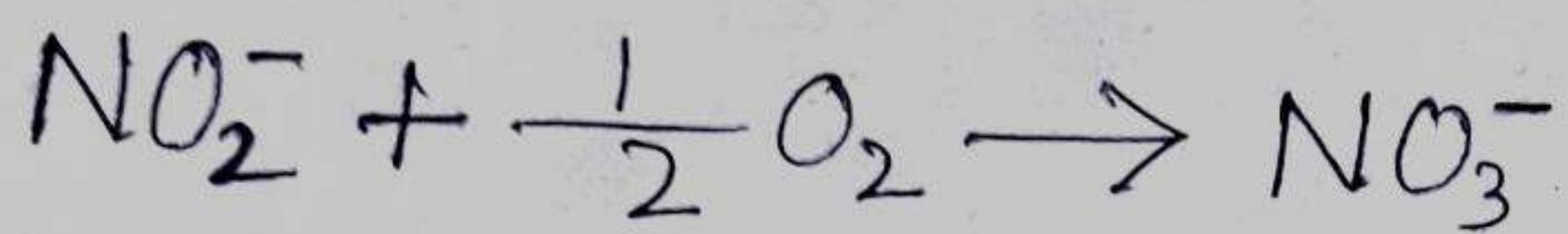
This reaction converts ammonia to the intermediate, hydroxylamine, and is catalyzed by the enzyme ammonia monooxygenase.



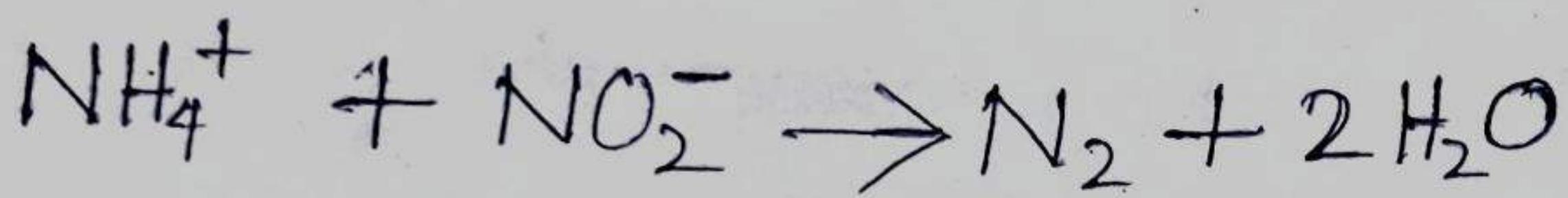
This reaction converts hydroxylamine to nitrite and is catalyzed by the enzyme hydroxylamine oxidoreductase.

(10)

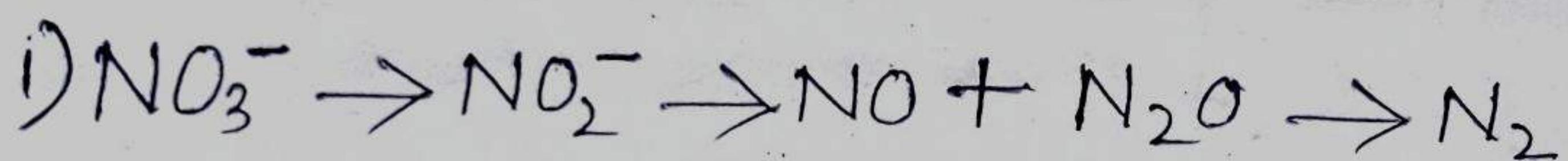
iii) Chemical reaction of nitrite oxidation -



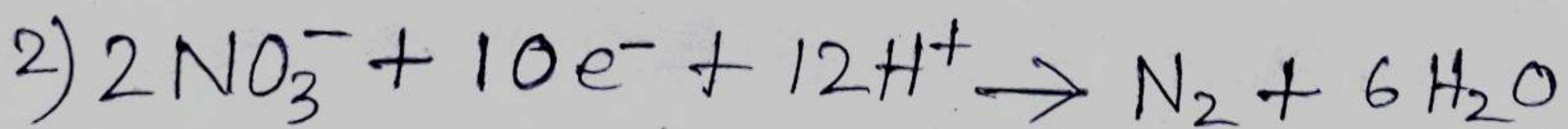
iv) Chemical reaction of anaerobic ammonia oxidation (anammox)



v) Reactions involved in denitrification -



This reaction represents the steps of reducing nitrate to nitrogen gas.



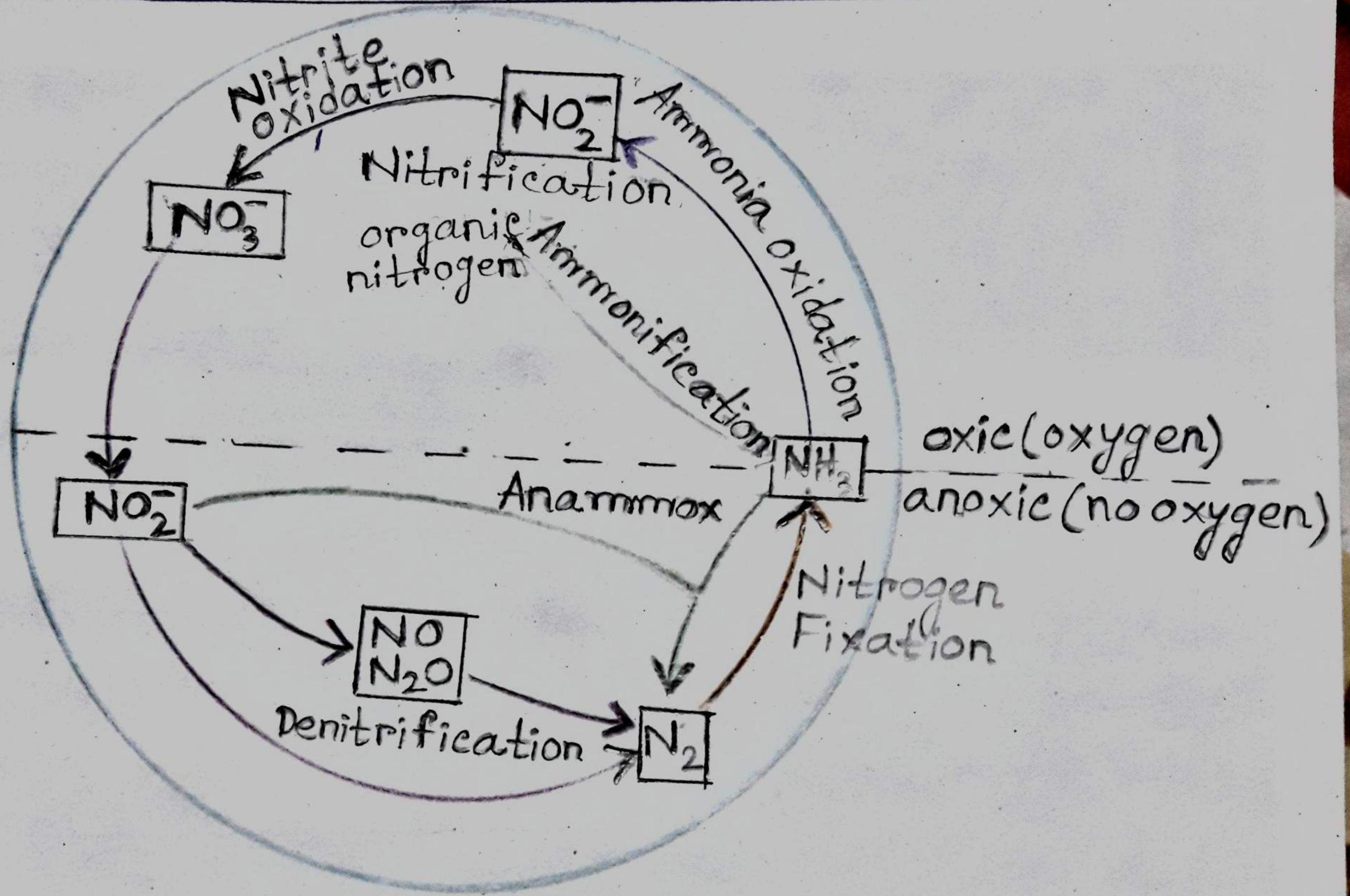
This reaction represents the complete redox reaction of denitrification.

11

# REPRESENTATIVE PROKARYOTES KNOWN TO CARRY OUT NITROGEN FIXATION

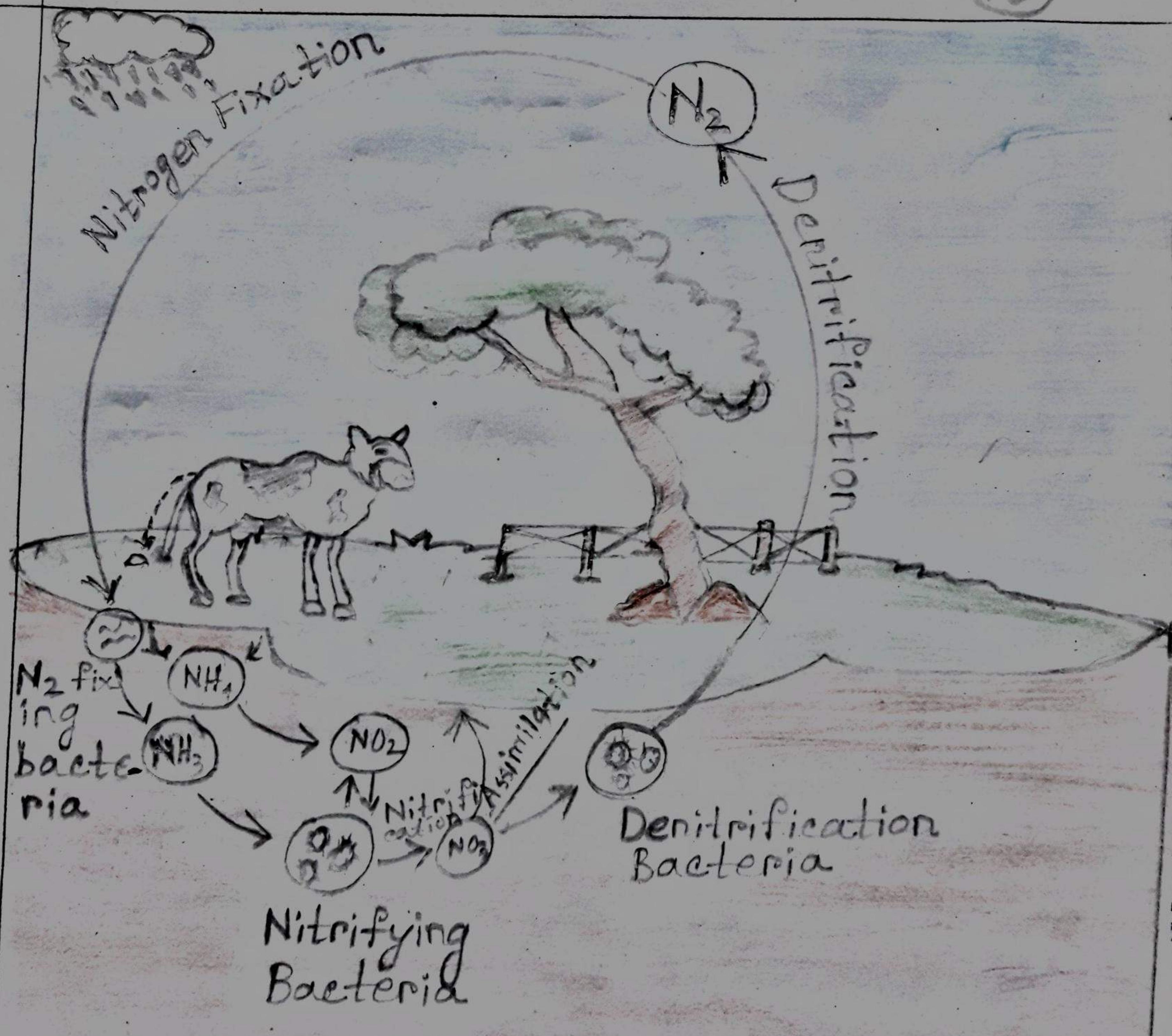
<u>Genus</u>	<u>Phylogenetic Affiliation</u>	<u>Lifestyle</u>
i) Nostoc, Anabaena	Bacteria (cyano bacteria)	free-living, aerobic, phototrophic
ii) Pseudomonas, Azotobacter	Bacteria	free-living, aerobic
iii) Chromatium, Chlorobium	Bacteria	free-living, anaerobic, phototrophic
iv) Rhizobium, Frankia	Bacteria	symbiotic, aerobic, chemоорganotrophic

(12)



Major transformations in the nitrogen cycle

(13)



Nitrogen cycle diagram

## IMPORTANCE OF NITROGEN CYCLE FOR LIVING BEINGS

Importance of the nitrogen cycle are as follows:-

### i) Synthesis of chlorophyll

Nitrogen cycle helps plants to synthesise chlorophyll from the nitrogen compounds. So, it is absolutely essential for them.

### ii) Formation of usable nitrogen

Nitrogen cycle helps in converting inert nitrogen gas into a usable form for the plants through the biochemical process.

### iii) Cleaning up nature

In the process of ammonification, the bacteria help in decomposing the animal and plant matter, which indirectly helps to clean up the environment.

#### iv) Enrichment of soil

Due to the nitrogen cycle, nitrates and nitrites are released into the soil which helps in enriching the soil with nutrients needed for cultivation.

#### v) Making the use of nitrogen

As plants use nitrogen for their biochemical processes, animals obtain the nitrogen and nitrogen compounds from plants. Nitrogen is needed as is an integral part of the cell composition? It is due to the nitrogen cycle that animals are able to utilize the nitrogen in the air.

# RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

PROJECT TITLE:

NITROGEN CYCLE  
AND  
ITS IMPORTANCE IN  
HUMAN BEINGS

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YEAR : 2020  
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Nitrogen is one of the important elements in biological compounds, mainly of nucleic acid and protein and, therefore, it is essential for life. Atmosphere contains about 78% nitrogen, but free nitrogen cannot be utilised by most of the organisms, except a few blue green alga and some bacteria.

Nitrogen atoms are constantly moving in a giant circle from the air, through the soil, into the bodies of plants and animals, and eventually back to the air. This known process is called the nitrogen cycle. All living things need nitrogen to develop and grow.

### 5 Stages of Nitrogen Cycle

#### Stage 1: Nitrogen Fixation

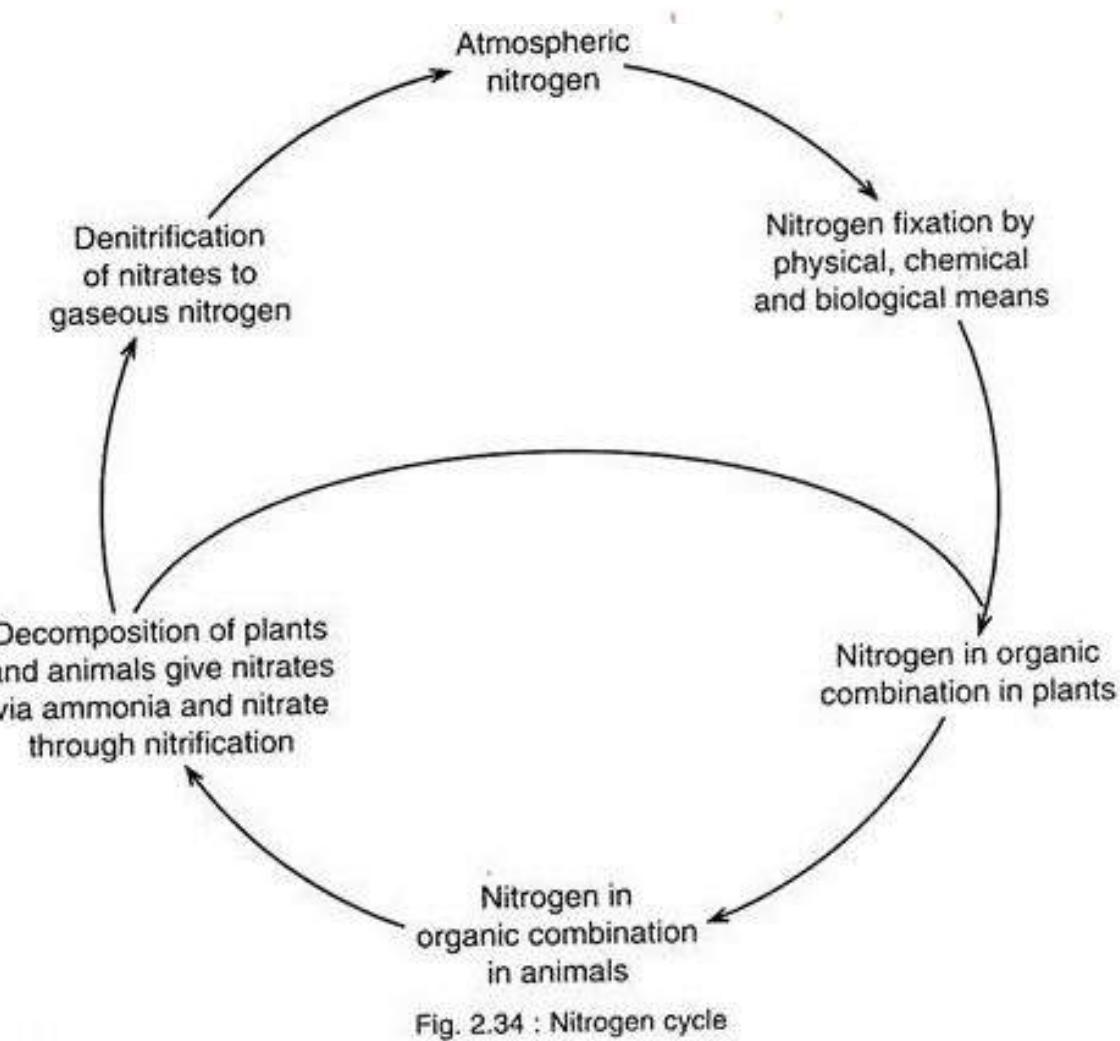
In this stage, nitrogen moves from the atmosphere into the soil. Earth's atmosphere contains a huge pool of nitrogen gas ( $N_2$ ). To be used by plants, the  $N_2$  must be transformed through a process called nitrogen fixation. Fixation converts nitrogen in the atmosphere into forms that plants

can absorb through their root systems.

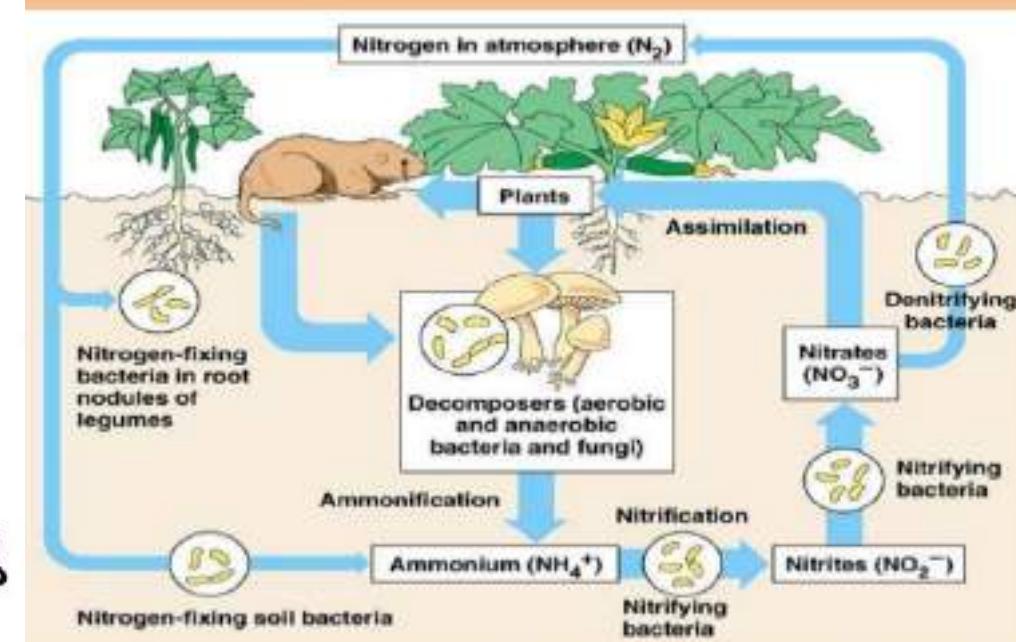
A small amount of nitrogen can be fixed when lightning provides the energy needed for  $N_2$  to react with oxygen, producing nitrogen oxide,  $NO$  and nitrogen dioxide,  $NO_2$ . These

forms of nitrogen then enter soils through rain or snow. Nitrogen can also be fixed through the industrial process that creates fertilizer.

The bacteria gets energy through photosynthesis and, in return, they fix nitrogen into a form the plant needs. The fixed nitrogen is then carried to other parts of the plant and is used to form plant tissues, so the plant can grow. Other bacteria live freely in soils or water and can fix nitrogen without their symbiotic relationship. These bacteria can also create forms of nitrogen that can be used by organisms.



#### Biological nitrogen Fixation



## Stage 2: Mineralization

This stage takes place in the soil. Nitrogen moves from organic materials, such as manure or plant materials to an inorganic form of nitrogen that plants can use. Eventually, the plant's nutrients are used up and the plant dies and decomposes. This becomes important in the second stage of nitrogen cycle. Mineralization happens when microbes act on organic material, such as animal manure or decomposing plant or animal material and begin to convert it to a form of nitrogen that can be used by plants. All plants under cultivation.

## Stage 3: Nitrification

The third stage, nitrification, also occurs in soils. During nitrification the ammonia in the soils, produced during mineralization, is converted to compounds called nitrites,  $\text{NO}_2^-$  and nitrate,  $\text{NO}_3^-$ . Nitrate, can be used by plants and animals that consume the plants. Some bacteria in the soil can turn ammonia into nitrite. Although nitrite is not usable by plants.



and animals directly, other bacteria can change nitrites into nitrates - a form that is usable by plants and animals. This reaction provides energy for the bacteria engaged in this process.

#### Stage 4: Immobilization

The fourth stage of the nitrogen cycle is immobilization, sometimes described as the reverse of mineralization. These two processes together control the amount of soil nitrogen in soils. Just like plants, micro-organisms living in the soil require nitrogen as an energy source. These soil micro-organisms pull nitrogen from the soil when the residues of decomposing plants do not contain enough nitrogen. When the micro-organisms take in ammonia ( $\text{NH}_4^+$ ) and nitrate ( $\text{NO}_3^-$ ), these forms of nitrogen are no longer available to the plants and may cause nitrogen deficiency, or a lack of nitrogen. Immobilization, therefore, ties up the nitrogen in micro-organisms. However, immobilization is important because it helps control and balance the amount of nitrogen in the soil by tying it up, or immobilizing the nitrogen, in micro-organisms.

## Stage 5: Denitrification

In the fifth stage of the nitrogen cycle, nitrogen returns to the air as nitrates are converted to atmospheric nitrogen ( $N_2$ ) by bacteria through the process we call denitrification. This results in an overall loss of nitrogen from soils, as the gaseous form of nitrogen moves into the atmosphere, back where we began our story.

Nitrogen is key to LIFE!

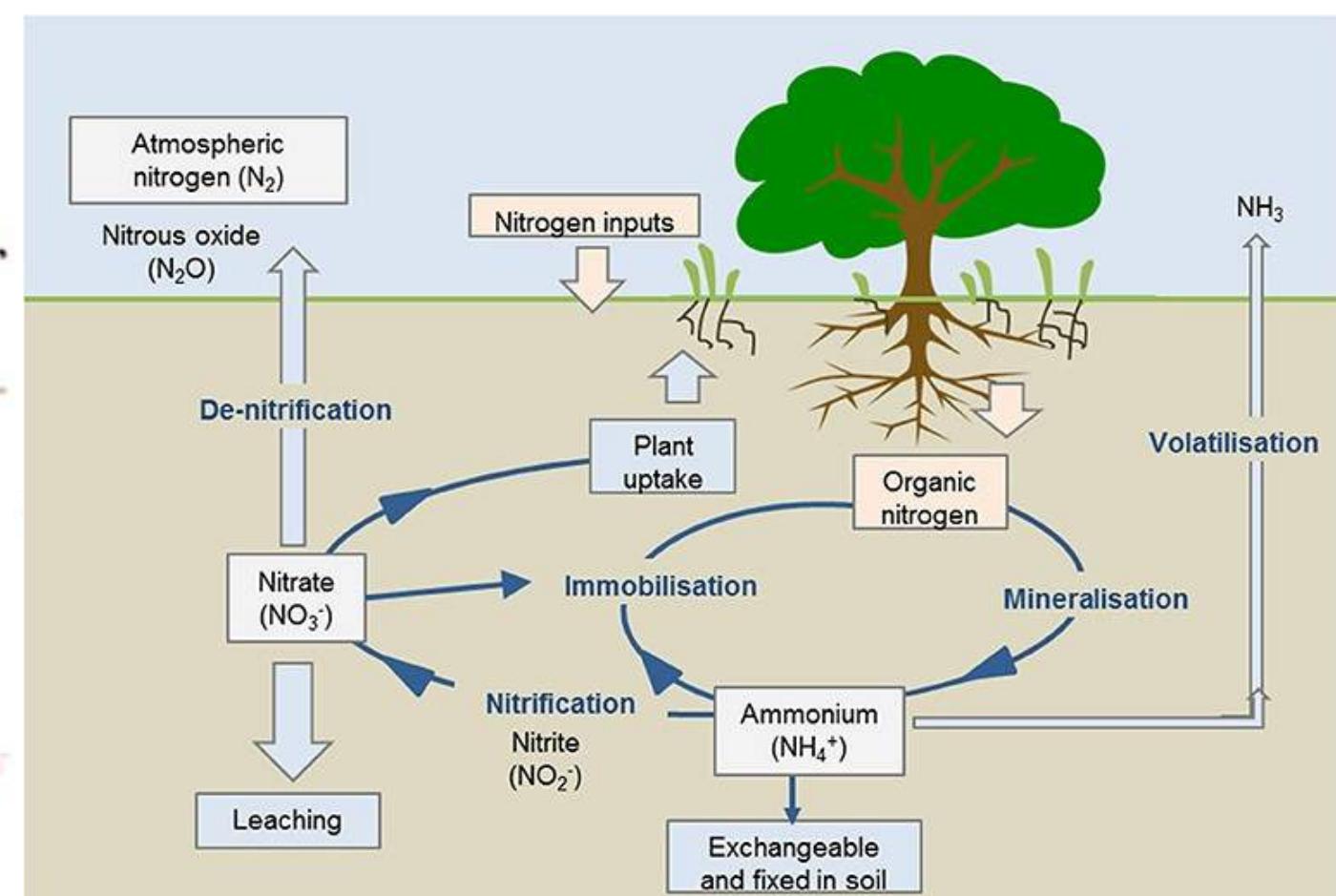
Nitrogen is a key element in the nucleic acids DNA, and RNA, which are the most

important of all biological molecules and crucial for all living things.

DNA carries

the genetic information, which

means the instructions for how to make up a life form. When plants do not get enough nitrogen, they are unable to produce amino acids. Without amino acids, plants cannot make the special protein that the plant cells need to grow. Without enough nitrogen, plant growth is affected negatively.

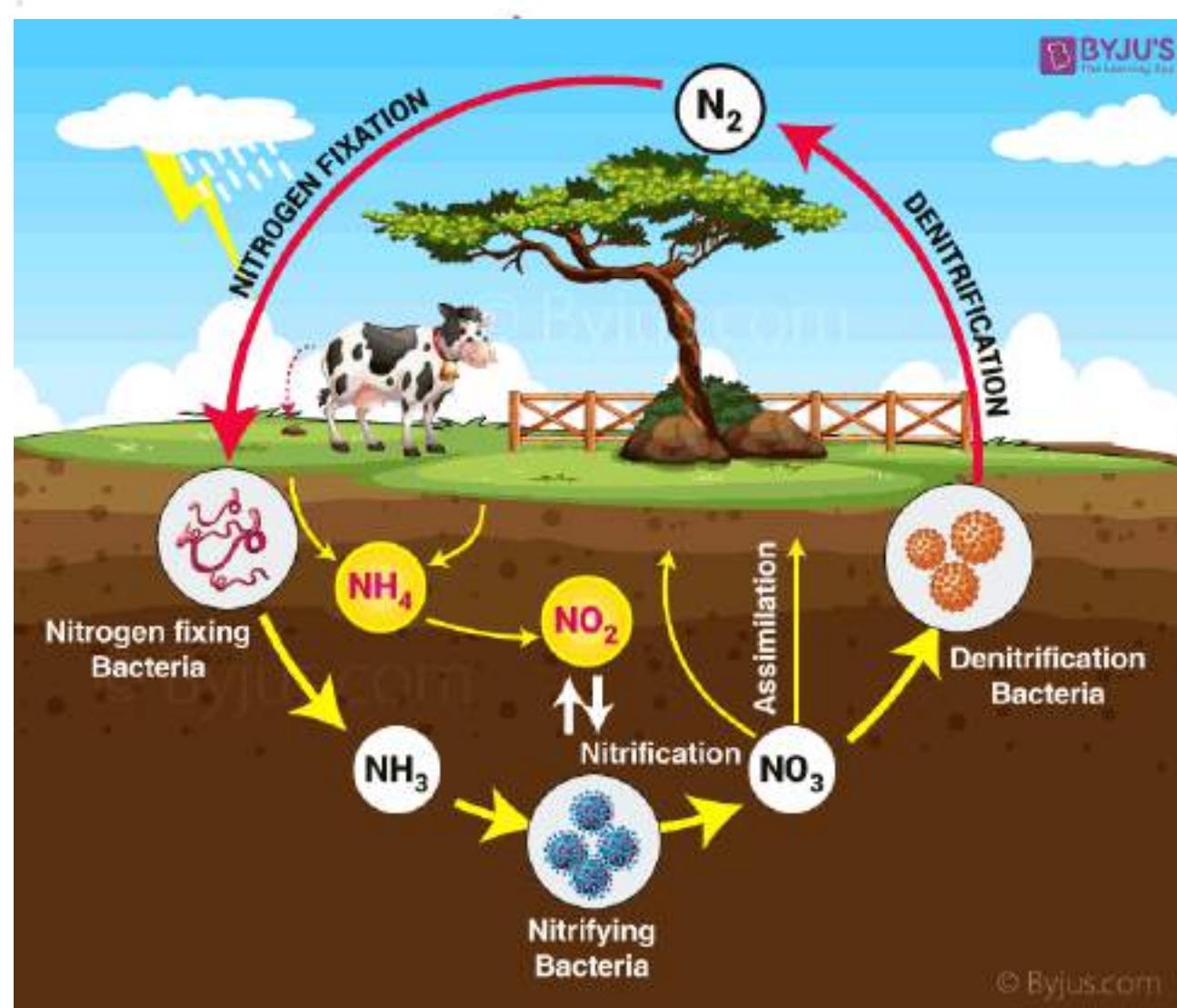


With too much nitrogen, plants produce excess biomass, or organic matter, such as stalks and leaves, but not enough root structure. In extreme cases, plants with very high levels of nitrogen absorbed from soils can poison farm animals that eat them.

### Nitrogen is crucial for life

The cycling of nitrogen through the ecosystem is crucial for maintaining productive and healthy ecosystems with neither too much nor too little nitrogen. Plant production and biomass (living material) are limited by the availability of nitrogen. Understanding how the plant-soil nitrogen cycle works can help us make better decisions about what crops to grow and where to grow them, so we have an adequate supply of food. Knowledge of nitrogen cycle can also help us reduce pollution caused by adding too much fertilizers to the soil. Certain plants can uptake more nitrogen or other nutrients such as phosphorus, another fertilizer, and can even be used as

a "buffer", or filter, to prevent excessive fertilizer from entering waterways. For example, a study done by Haycock and Pinay showed that popular trees used as a buffer held on to 99% of the nitrate entering the underground waterflow during winter, while a riverbank zone covered with a specific grass (*Lolium perenne L.*) held upto 84% of the nitrate, preventing it from entering the river.



As we have seen, not enough nitrogen in the soil leaves plants hungry, while too much of a good thing can be bad: excess nitrogen can poison plants and even livestock! Pollution of our water

Sources by surplus nitrogen and other nutrients is a huge problem, as marine life is being suffocated from decomposition of dead algal blooms. Farmers and communities need to work to improve the uptake of added nutrients by crops and treat animal manure waste properly. We also need to protect the natural plant buffer zones that can take up nitrogen run off before it reaches water bodies. But, our current pattern of clearing trees to build roads and other construction worsen this problem, because there are fewer plants left to uptake excess nutrients. By working toward a more complete understanding of the nitrogen cycle and other cycles at play in Earth's interconnected natural systems, we can better understand how to better protect Earth's precious natural resources.

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Word Count: 1138 words

## BIBLIOGRAPHY

I have taken help from the following websites for my knowledge about nitrogen cycle and some associated pictures.

- (i) Google
- (ii) wikipedia
- (iii) Nature.com