

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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CERTIFICATE . -

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work titled 'Nitrogen cycle and its
importance for living beings' under the
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Sem examination- 2020.

Date - 15/11/2020

Signature of Examiner

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Finally I also thank all the authors of the sources I referred to for this.

Date: 15/11/2020

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ENVIRONMENTAL SCIENCE (AECC 2)

Sem - II - 2020

PROJECT

**Title: Nitrogen Cycle And Its Importance
for Living Beings.**

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NITROGEN CYCLE

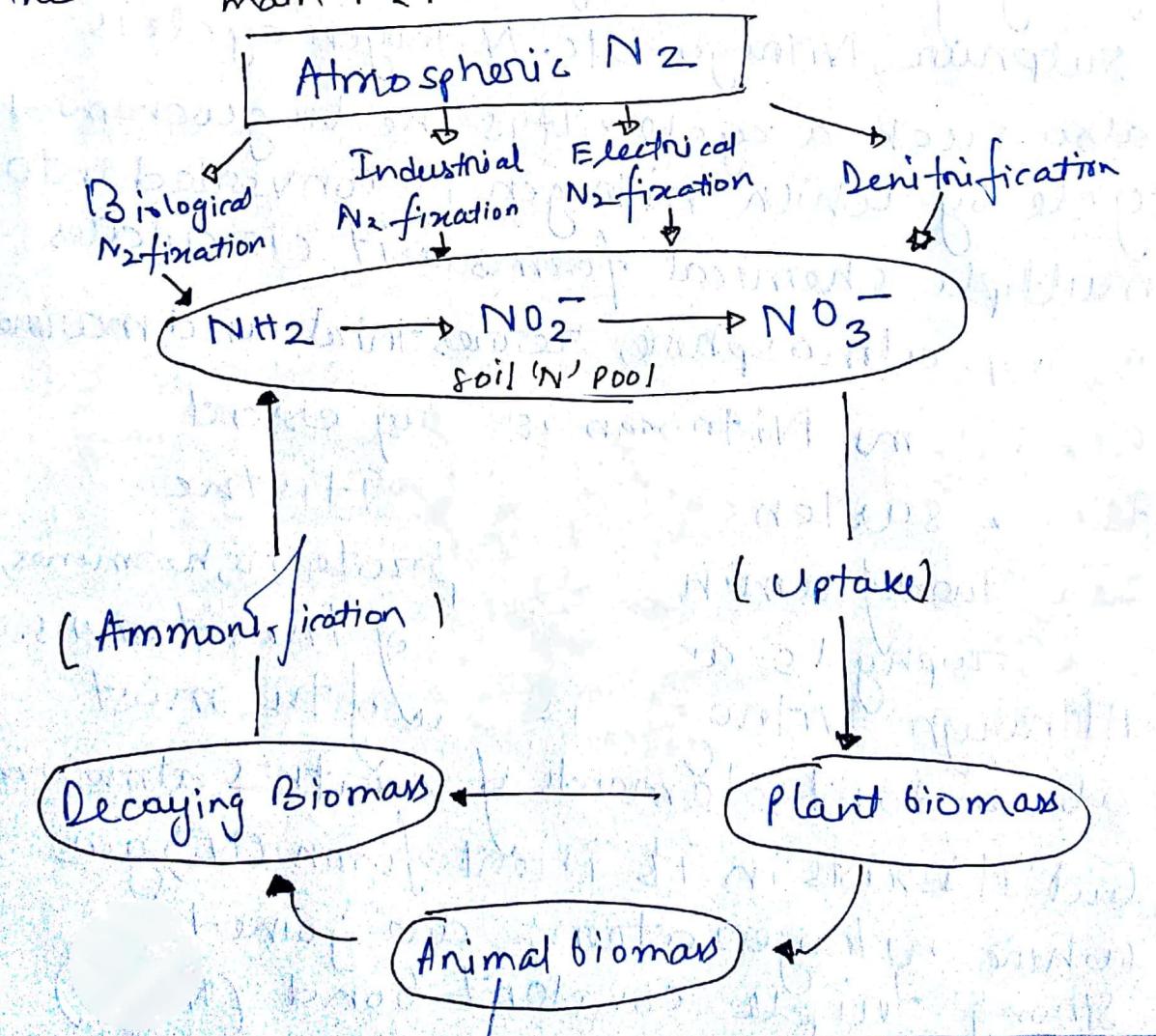
INTRODUCTION:

In nature many substances moves in a pathway among biotic and abiotic components of the ecosystem and maintains a cycling of substances to maintain the availability and distribution of those substances among them. These are mainly called biogeochemical cycles because it involves cycling of various chemical substances through the biological world and also through the earth. These include cycling of carbon, oxygen, phosphorous, sulphur, Nitrogen etc. Nitrogen cycle is also such a cycle. It is the biogeochemical cycle by which nitrogen is converted into multiple chemical forms as it circulates among atmosphere, terrestrial and marine ecosystems. Nitrogen is very essential for the sustenance of life. It is the constituent of amino acids, proteins, hormones, chlorophyll and many of the vitamins. Although Nitrogen is one of the most abundant elements of earth's atmosphere but it exists in its inert form (N_2) gas where nitrogen atoms are joined by strong triple covalent bond ($N \equiv N$)

Hence to make the living world use this nitrogen, it goes through the nitrogen cycle where it is changed into different forms which can be used by plants and the living world.

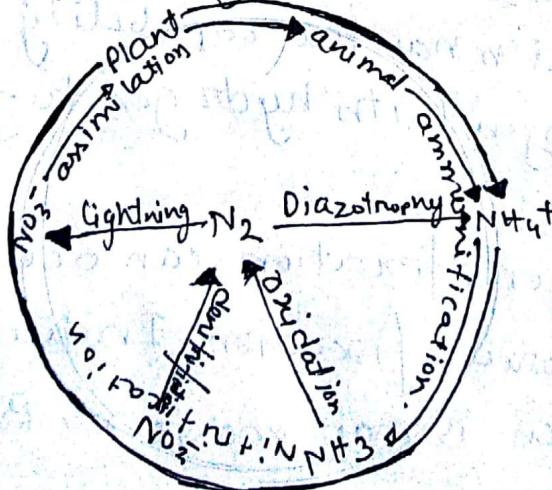
The conversion of nitrogen can be carried out through both biological and physical processes. Important processes in the nitrogen cycle include fixation, ammonification, nitrification and denitrification.

The Nitrogen cycle showing relationship between the three main N₂ pools - atmosphere, soil & biomass.



The Processes Involved:

Nitrogen is present in the environment in a wide variety of chemical forms including organic nitrogen, ammonium (NH_4^+), nitrite (NO_2^-), nitrate (NO_3^-), nitrous oxide (N_2O), nitric oxide (NO) or in organic forms of a ~~lit.~~ of nitrogen gas (N_2). Organic nitrogen may be in the form of a living organism, humus or in the intermediate products of organic matter decomposition. The processes 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 onto accumulate nitrogen in a form needed for their growth. The processes can be ~~be~~ represented in a cyclic manner classically as follows.



Nitrogen fixation

Nitrogen is present in air as (N_2) gas. The conversion of nitrogen (N_2) into usable form ammonia and eventually to various nitrogen oxides is termed as nitrogen fixation. It is the initial step of the nitrogen cycle. During the process of nitrogen fixation, the inert form of nitrogen gas is deposited into soils from the atmosphere and surface waters mainly through precipitation. Later, the nitrogen undergoes a set of changes in which two nitrogen atoms gets separated and combine with hydrogen to form ammonia (NH_4^+).

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

Nitrogen fixation can occur either by atmospheric fixation, Industrial fixation which is man made or Biologically.

Types of Nitrogen Fixation:

1. Astroospheric fixation: A natural phenomenon where the energy of lightning breaks the nitrogen into nitrogen oxides and then used by plants.
2. Industrial Nitrogen fixation: It is a man-made alternative that aids in nitrogen fixation by the use of ammonia. Ammonia is produced by the direct combination of nitrogen and hydrogen and later, it is converted into various fertilisers such as Urea.
3. Biological nitrogen fixation: ~~as~~ Nitrogen is not usable directly from the air for plants and animals. Only certain prokaryotic species are capable of fixing Nitrogen. Reduction of nitrogen to ammonia by living organism is called biological nitrogen fixation. The enzyme, nitrogenase which is capable of nitrogen reduction is present exclusively in prokaryotes. Such microbes are called N_2 -fixers.



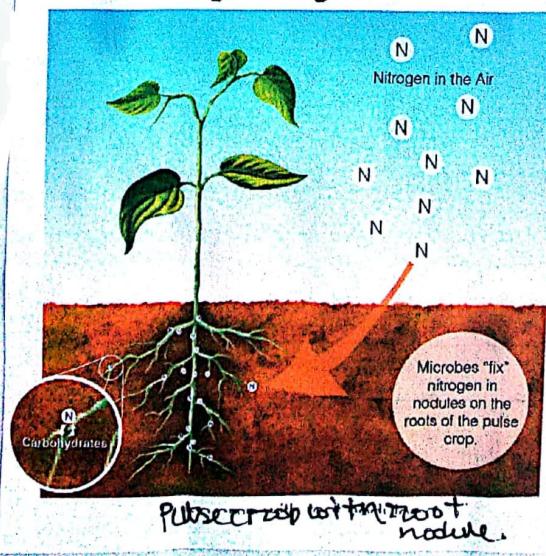
The nitrogen-fixing microbe could be free-living or symbiotic! Example - free-living nitrogen-fixing aerobic microbes are Azotobacter and Beijerinckia, while Rhodospirillum is anaerobic.

- Symbiotic biological nitrogen fixation.

One symbiotic biological nitrogen fixing association is the legume-bacteria relationship. Species of rod-shaped Rhizobium has such relationship with root of plants like alfalfa, sweet pea etc. The root nodules are small outgrowth on the roots. The microbe Frankia also produces N₂-fixing nodules on the roots of non-leguminous plants (e.g. Aleurus (e.g. Alnus)).

Nodule formation involves a sequence of multiple interactions between Rhizobium and roots of the host plant. Rhizobium bacteria contact a susceptible root hair, and repeated division eventually forms nodule. Nodules contain all the necessary biochemical components, such as the enzyme nitrogenase and leghaemoglobin. Nitrogenase catalyses the conversion of atmospheric nitrogen to ammonia.

Plant Fixing Nitrogen



Ammonia is the first stable product of nitrogen fixation. The reaction is as follows:

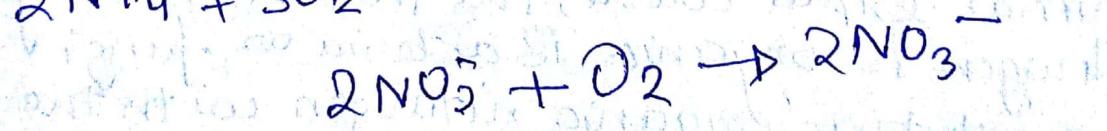


It requires anaerobic conditions. The ATP requirement is fulfilled through the respiration of the host cells.

NITRIFICATION:

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

The reaction involved in the process of nitrification is as follows:



Assimilation:

Plants can absorb nitrate or ammonium from the soil by their root hair. If nitrate is absorbed, it is first reduced to nitrite ion and then ammonium ions.

for incorporation into amino acids, nucleic acids and chlorophyll. In plants that have 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. Other heterotrophic organisms obtain nitrogen by ingestion of amino acids, nucleotides and other small organic molecules. Utilization of various N sources is carefully regulated in all organisms.

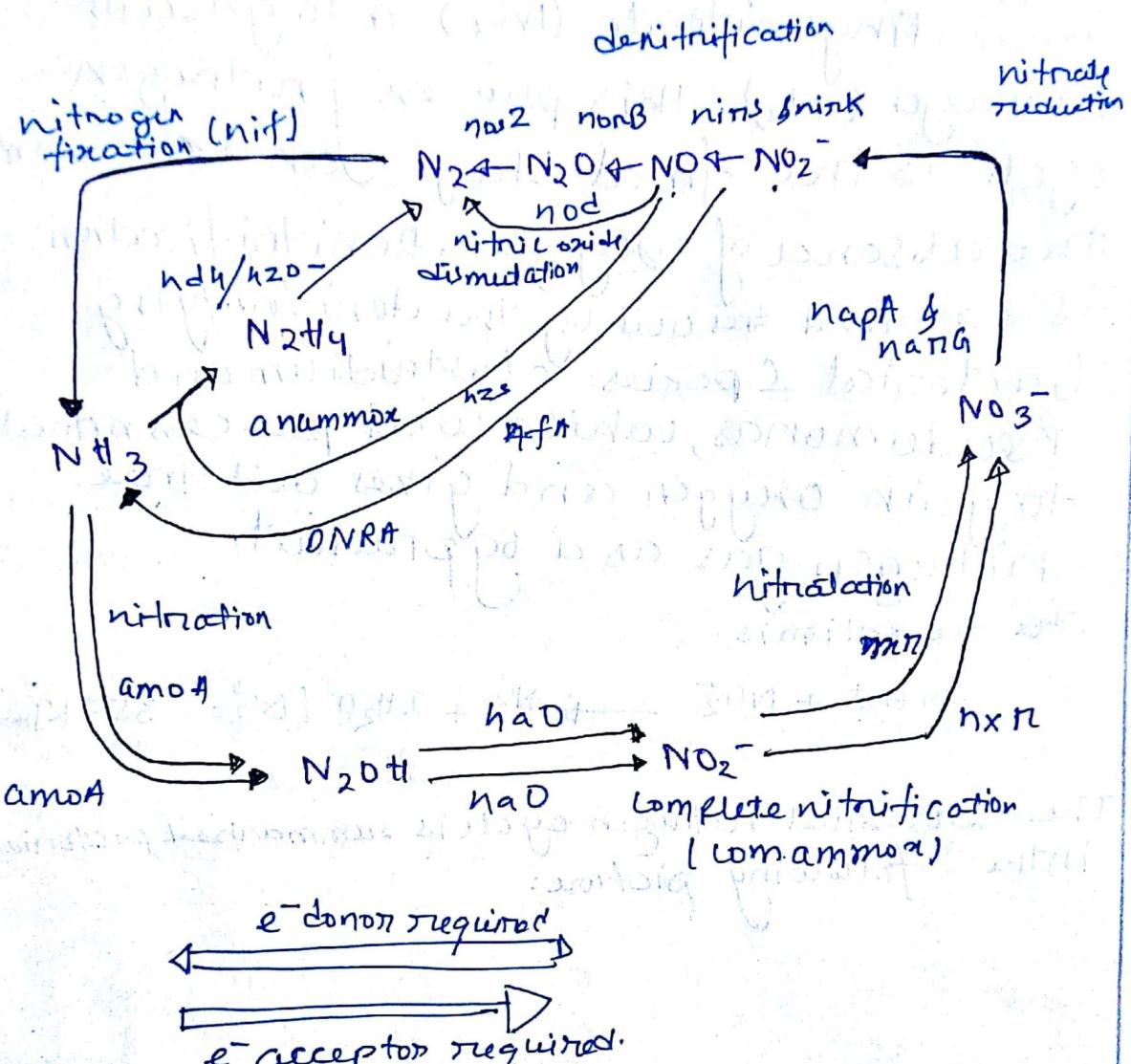
Ammonification:

When a plant or animal dies or an animal excretes waste, the initial form of nitrogen is organic. Bacteria or fungi convert the organic nitrogen into the remains back into ammonium (NH_4^+) a process called ammonification. Enzymes involved are:

- GS: Glut synthetase (cytosolic & plastid)
- GOGAT: Glut 2-oxoglutarate aminotransferase

- GDH: Glu Dehydrogenase:

- Minor role in ammonium assimilation.
- Important in amino acid catabolism



A schematic representation of the microbial nitrogen cycle.

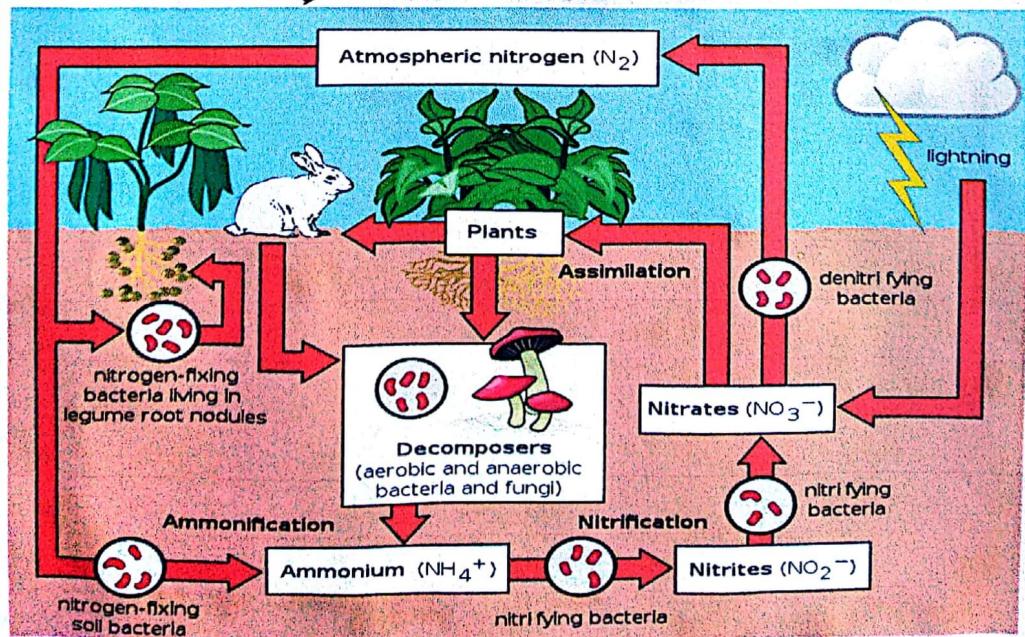
Denitrification:

Denitrification is the process in which the nitrogen compounds make its way back into the atmosphere by converting nitrate (NO_3^-) into gaseous nitrogen (N_2). This process of nitrogen cycle is the final stage (and occurs in the absence of oxygen). Denitrification is carried out by the denitrifying bacterial species *Clostridium* and *Pseudomonas*, which will process nitrate to gain oxygen and gives out free nitrogen gas as a byproduct.

The reaction is



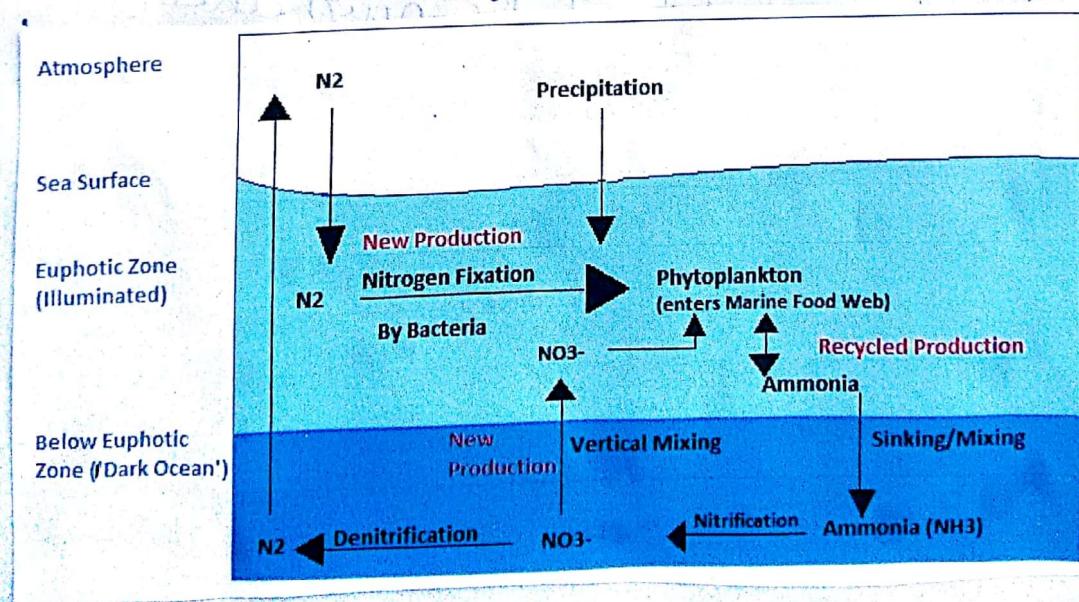
The terrestrial nitrogen cycle is summarised pictorially in the following picture:



Nitrogen cycle in Marine ecosystem.

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

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



Pictorial representation of marine nitrogen cycle

Importance of Nitrogen Cycle:

Nitrogen is very essential for the sustenance of life. Plants cannot use atmospheric nitrogen directly and hence nitrogen needs to be made available to them through other processes in the process of nitrogen cycle. Nitrogen cycle is one of the many biogeochemical cycles occurring in nature ensuring the availability of nitrogen to various organisms in the form they can utilize & continuation of availability of nitrogen.

- The delicate balance of substances that is important for maintaining life is an important area of research, and the balance of nitrogen in the environment is no exception. When plants lack nitrogen they become yellowed, with stunted growth and produce smaller fruits and flowers. Without nitrogen, it is estimated that we would lose up to one third of the crops we rely on for food but at the same time excessive nitrogen can pollute soil & water. So, nitrogen cycle ensures availability of nitrogen in usable form to plants.

• Nitrogen is key to life: Nitrogen is a key element in the nucleic acids DNA & 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 how to makeup a life form. The most important amide-life form is asparagine and glutamine - found in plants as a structural part of proteins. They are formed from two amino acids, namely aspartic acid & glutamic acid respectively by addition of another amino group to each. When plants do not get enough nitrogen, they are unable to produce amino acids. Without amino acids, plant cannot make the special proteins that the plant cells need to grow. Without enough nitrogen, plant growth is affected negatively. Also high level of nitrogen can poison farm animals that eat them. Nitrogen cycle ensures the production of proper amino acid by ensuring availability of nitrogen.

- It helps the plants to synthesize chlorophyll from the nitrogen compounds.
- The Nitrogen cycle helps in converting inert nitrogen gas into a usable form for the plants through the biochemical processes.

- In the process of ammonification, the bacteria helps in decomposing the animal & plant matter which indirectly helps to clean up the environment.
- The NO_3^- & NO_2^- helps in enriching the soil with nutrients for cultivation.

Nitrogen is also cycled by human activities such as combustion of fuels and the use of nitrogen fertilizers. These processes increase the levels of nitrogen-containing compounds in the atmosphere. The fertilizers containing nitrogen are washed away in lakes and rivers which leads to more use of oxygen in various processes and eventually to eutrophication.

CONCLUSION:

Nitrogen is abundant in the atmosphere but it is unusable to the plants, animals unless it is converted to nitrogen compounds. The nitrogen cycle processes ensures this through nitrogen fixation, nitrification, and eventually the use of it through assimilation and finally release of nitrogen through denitrification. It is extremely important as nitrogen forms part of important biochemicals of the living world like amino acids which forms DNA, RNA. Also, human activities lead to excessive nitrogen in the atmosphere and may have harmful effects. So control of human activities which releases excessive nitrogen is required.

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

ENVIRONMENTAL STUDIES

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■ Introduction -

Water pollution happens when toxic substances enter water bodies such as lakes, rivers, oceans and so on. Getting dissolved in them, lying suspended in the water or depositing on the bed. This degrades the quality of water.

Not only does this spell disaster for aquatic ecosystems, the pollutants also seep through and reach the ground water, which might end up in our households as contaminated water we use in our daily activities, including drinking. Water is typically referred to as polluted when it is impaired by anthropogenic contaminants. Natural phenomena such as volcanoes algae bloom, storms and earthquake also cause major changes in water quality and the ecological status of water.

water pollution is a major global problem. It requires ongoing evaluation and revision of water resource policy at all levels (international down to individual surfaces aquifers and wells). It has been suggested that water pollution is the leading world wide cause of death and diseases. Water pollution accounted for the deaths of 1.8 million people in 2015.

The organization "Global Oceanic Environmental Surveys" (GOES) consider water pollution as one of the main environmental problems that can present a ~~day~~ danger for the existence of life on earth in the next decades. One of the main concerns, is that water pollution, heat phytoplankton who produce 70% of oxygen and remove a large part of carbon dioxide on earth. The organization

proposes a number of measures for fixing the situation, but they should be taken in the next 10 years for being effective. India and China are two countries with high levels of water pollution. An estimated 580 people in India die of water pollution related illness (including waterborne diseases) every day. About 90 percents of the water in the cities of China is polluted.

Types of water pollution -

• Surface water pollution -

Surface water pollution includes pollution of rivers, lakes and oceans. A subset of surface water pollution is marine pollution.

• Marine pollution:-

One common path of entry by contaminants to the sea are rivers. An example is directly discharging sewage and industrial waste into the ocean. Pollution such as this occurs particularly in developing nations. Large gyres (vortexes) in the oceans trap floating plastic debris. Plastic debris can absorb toxic chemicals from ocean pollution, potentially poisoning any creatures that eats it.

Many of these long-lasting pieces end up in the stomachs of marine birds and animals. This results in obstruction of digestive pathways, which leads to reduced appetite or even starvation. There are a variety of secondary effects stemming not from the original pollutant, but a derivative condition. An example is silt-bearing surface runoff, which can inhibit the penetration of sunlight through

the water column, hampering photosynthesis in aquatic plants.

• Groundwater pollution-

Interactions between groundwater and surface water are complex. Consequently, groundwater pollution, also referred to as groundwater contamination, is not as easily classified as surface water pollution. By its very nature, groundwater aquifers are susceptible to contamination from sources that may not directly affect surface water bodies. The distinction of point vs non-point source may be irrelevant in some situations.

Analysis of groundwater contamination may focus on soil characteristics and site geology, hydrology, hydrogeology and the nature of the contaminants. Causes of groundwater pollution include naturally-occurring (geogenic), on site sanitation systems, sewage, fertilizers and pesticides, commercial and industrial leaks, hydraulic fracturing, land fill leachate.

■ Measurement of quality of water-

There are two main ways of measuring the quality of water. One is to take samples of the water and measures the concentrations of different chemicals that it contains. If the chemicals are dangerous or the concentrations are too great, we can regard the water as polluted. Measurements like this are known as chemical indicators of water quality. Another way to measure water quality involves examining the fish, insects, and

other invertebrates that the water will support. If many different types of creatures can live in a river, the quality is likely to be very good; if the river supports no fish life at all, the quality is obviously much poorer. Measurements like this are called biological indicators of water quality.

Categories of pollution sources -

Surface water and groundwater have often been studied and managed as separate resources even though they are interrelated. Surface water seeps through the soil and becomes groundwater. Conversely, groundwater can also feed surface water sources. Sources of surface water pollution are generally grouped into two categories based on their origin.

• Point sources -

Point source water pollution refers to contaminants that enter a waterway from a single, identifiable source, such as a pipe or ditch. Examples of sources in this category include discharges from a sewage treatment plant, a factory, or a city storm drain.

The U.S. Clean Water Act (CWA) defines point sources for regulatory enforcement purposes. The CWA definition of point source was amended in 1987 to include municipal storm sewer systems, as well as industrial storm water, such as from construction sites.

• Non-point sources -

Non-point sources pollution refers to diffuse contamination that does not originate from a single discrete source. This type of pollution is often the cumulative effects of small amounts of contaminants gathered from a large area. A common example is the leaching out of nitrogen compounds from fertilized agricultural lands. Nutrient runoff is storm water from "sheet flow" over an agricultural field or a forest are also cited as examples of non-point source pollution.

Contaminated storm water washed off of parking lots, roads and highways, called urban runoff, is sometimes included under the category of non-point sources. This runoff becomes a point source because it is typically channeled into storm drain systems and discharged through pipes to local surface waters.

■ Causes of water pollution -

Most water pollution does not begin in the water itself. Around 80 percent of ocean pollution enters our seas from the land. Virtually any human activity can have an effect on the quality of our water environment. When farmers fertilize the fields, the chemicals they use are gradually washed by rain into the groundwater or surface waters nearby. Sometimes the causes of water pollution are quite surprising. Chemicals released by smokestacks (chimneys) can enter the atmosphere and then fall back to earth as rain, entering seas, rivers, and lakes and causing water pollution. That's called atmospheric deposition. Water pollution has many different

causes including pathogenic microorganisms, putrescible organic waste, plant nutrients, toxic chemicals, sediments, heat, petroleum, and radioactive substances. Several types of water pollutants are considered below.

- Domestic sewage - This is the primary source of pathogens (disease causing micro-organisms) and putrescible organic substances. Because pathogens are excreted in feces, all sewage from cities and towns is likely to contain pathogens of some type, potentially presenting a direct threat to public health. Putrescible organic matter presents a different sort of threat to water quality. As organics are decomposed naturally in the sewage by bacteria and other micro-organisms, the dissolved oxygen content of the water is depleted. This endangers the quality of lakes and streams, where high levels of oxygens are required for fish and other aquatic organisms to survive. Even sewage-treatment processes reduce the levels of pathogens and organics in waste water, but they do not eliminate them completely. Domestic sewage is also a major source of plant nutrients, mainly nitrates and phosphate. Excess nitrates and phosphates in water promote the growth of algae, sometimes causing unusually dense and rapid growths known as algal blooms. When the algae die, oxygen dissolved in the water declines because micro-organisms use oxygen to digest algae during the process of decomposition. Anaerobic organisms then metabolize the organic wastes, releasing gases such as methane and hydrogen sulfide, which are harmful to the aerobic forms of life. The process by which a lake

changes from a clean, clear condition - with a relatively low concentration of dissolved nutrients and a balanced aquatic community - to a nutrient-rich, algae-filled state and thence to an oxygen-deficient, waste-filled conditions is called eutrophication. However, when it is accelerated by human activity and water pollution, it can lead to the premature aging and death of a body of water.

- Nutrients - suitably treated and used in moderate quantities, sewage can be a fertilizer. It returns important nutrients to the environment, such as nitrogen, phosphorus, which plants and animals need for growth. The trouble is sewage is often released in much greater quantities than the natural environment can cope with. Chemical fertilizers used by farmers also add nutrients to the soil which drain into rivers and seas and add to the fertilizing effect of the sewage. Together, sewage and fertilizers can cause a massive increase in the growth of algae or plankton that overwhelms huge areas of oceans, lakes or rivers. This is known as a ~~bad~~ harmful algal bloom. It is harmful because it removes oxygen from the water that kills other forms of life, leading to what is known as dead zone. The Gulf of Mexico has one of the world's most spectacular dead zone.

- Waste water -

A few statistics illustrate the scale of the problem that waste water can cause. Around half of all ocean pollution is caused by sewage and waste water. Each year, the world generates perhaps 5-10 billion tons of industrial waste, much of which is pumped untreated into rivers, oceans and other waterways. In the US alone,

around 400,000 factories take clean water from rivers and many pump polluted waters back in their place. However, there have been major improvements in waste waters treatment recently. Since 1970, in US, the Environmental Protection Agency (EPA) has invested about 70 billion dollars in improving water treatment plants that, as of 2015, serve around 88 percent of the US population. However, another 271 billion dollars is still needed to update and upgrade the system.

Factories are point source of water pollution, but quite a lot of water is polluted by ordinary people from non point sources, this is how ordinary water becomes waste water in the first place. Virtually everyone pours chemicals of one sort of another down their drains or toilets. Even detergents used in washing machine and dishwashers eventually end up in our rivers and oceans. So do the pesticides we use on our gardens. A lot of toxic pollution also enters waste water from highway runoff. Highways are typically covered with a cocktail of toxic chemicals—~~every thing~~ from spilled fuel and brake fluid to bits of worn tires and exhaust emissions. When it rains, these chemicals wash into drains and rivers. It is not unusual for heavy summer rainstorms to wash toxic chemicals into rivers in such concentrations that they kill large numbers of fish overnight. It has been estimated that, in one year, the highway runoff from a single large city leaks as much oil into our water environment as a typical tanker spill. Some highway runoff runs away into drains; others can pollute ground water or accumulate in the land next to a road, making it increasingly toxic as the year goes by.

- Chemical waste -

Detergents are relatively mild substances. At the opposite end of the spectrum are highly toxic chemicals such as PCBs. They were once widely used to manufacture electronic circuit boards, but their harmful effects have now been recognized and their use is highly restricted in many countries. Nevertheless, an estimated half million tons of PCBs were discharged into the environment during the 20th century. In a classic example of transboundary pollution, traces of PCB's have even been found in birds and fish in the Arctic. They were carried there through the oceans, thousands of miles from where they originally entered the environment. Although PCBs are widely banned, their effects will be felt for many decades because they last a long time in the environment without breaking down.

Another kind of toxic pollution comes from heavy metals, such as lead, cadmium and mercury. Lead was once commonly used in gasoline, though its use is now restricted in some countries. Mercury and cadmium are still used in batteries. Until recently, a highly toxic chemical called tributyltin (TBT) was used in paints to protect boats from the ravaging effects of the oceans. Ironically, however, TBT gradually recognized as a pollutant, boats painted with it were doing as much damage to the oceans as the oceans were doing to the boats.

- Radioactive waste -

At high enough concentrations radioactive waste can kill; in lower concentrations it can cause cancers and other illnesses.

- Oil pollution -

Petroleum (oil) pollution occurs when oil from roads and parking lots is carried in surface runoff into water bodies. Accidental oil spills are also a source of oil pollution - as in the devastating spills from the tanker Exxon Valdez (which released more than 260,000 barrels in 1989) and the Deepwater Horizon oil rig (more than 4 million barrels in 2010). Oil slicks eventually move toward shore, harming aquatic life and damaging recreation areas.

- Plastics -

Plastic is one of the most common materials used for making virtually every kind of manufactured object from clothing to automobile parts; plastic is light and floats easily so it can travel enormous distances across the oceans, most plastics are not biodegradable which means that things like plastic bottle tops can survive in the marine environment for a long time.

Plastics presents a major hazard to seabirds, fish and other marine creatures. For example, plastic fishing lines and other debris can strangle or choke fish. About half of all the world's seabird species are known to have eaten plastic residues. In one study of 450 shearwaters in the North Pacific, over 80 percent of the birds were found to contain plastic residues in their stomachs.

- Alien species -

Pollution can be biological as well as chemical. In some part of the world, alien species are a major problem. Outside their normal environment, they have no natural predators, so they rapidly run wild.

crowding out the usual animals or plants that thrive there. Common examples of alien species include zebra mussels in the Great Lakes of the USA, which were carried there from Europe by ballast water.

- Sediments -

Sediment resulting from soil erosion can be carried into water bodies by surface runoff. Suspended sediments interferes with the penetration of sunlight and upsets the ecological balance of a body of water. Also it can disrupt the reproductive cycles of fish and other forms of life, and when it settles out of suspension it can smother bottom-dwelling organisms.

- Thermal pollution -

Heat is considered to be a water pollutant because it decreases the capacity of water to hold dissolved oxygen in solution, and it increases the rate of metabolism of fish.

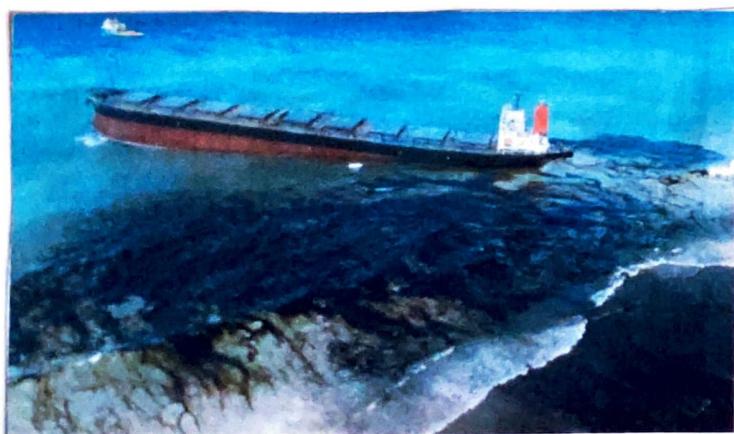
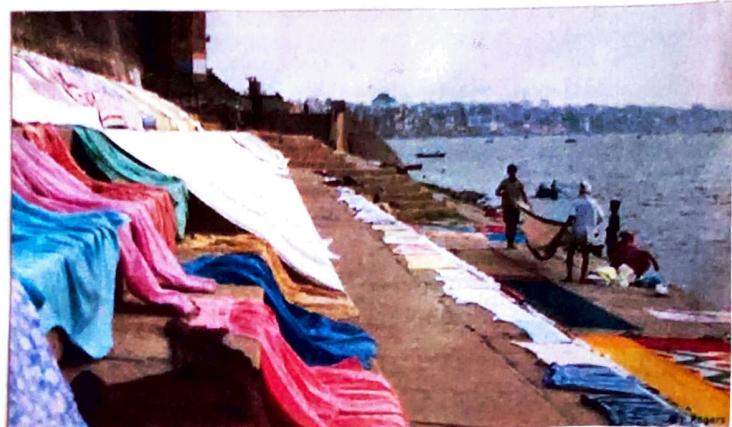
Valuable species of game ~~fish~~ fish cannot survive in water with very low levels of dissolved oxygens. A major source of heat is the practice of discharging cooling water from power plants into rivers, the discharged water may be as much as 15°C (27°F) warmer than the naturally occurring water.

CAUSE OF WATER POLLUTION:-



WASTE WATER
OF
FACTORIES

WASHING OF
CLOTHES



OIL SPILLAGE
IN
OCEAN

DEPOSITION OF
PLASTICS
IN MARINE WATER





BATHING OF DOMESTIC ANIMAL



GARBAGE DEPOSITION IN WATER BODY



CLEANING OF WATER BODY

■ Control of pollution -

- Municipal wastewater treatment -

In urban areas of developed countries, municipal wastewater is typically treated by centralized sewage treatment plants. Well-designed and operated system can remove 90 percent or more of the pollutant load in sewage. Some plants have additional system to remove nutrients and pathogens, but these more advanced treatment steps get progressively more expensive.

Nature based solutions are also being used instead of centralized treatment plants. Cities with sanitary sewer overflows or combined sewer overflows employ one or more engineering approaches to reduce discharges of untreated sewage, including:

- utilizing a green infrastructure approach to improve storm water management capacity throughout the system, and reduced the hydraulic overloading of the treatment plant.

- repair and replacement of leaking and malfunctioning equipment.
- increasing overall hydraulic capacity of the sewage collection system.

- On-site sanitation and safely managed sanitation -

Households or business not served by a municipal treatment plant may have an individual septic tank, which pre-treats the wastewater on site and infiltrates it into the soil. Improperly designed or installed septic systems can cause groundwater pollution.

Globally, about 4.5 billion people do not have safely managed sanitation as of 2017 according to an estimate by the joint

monitoring programme for waste supply and sanitation. Lack of access to sanitation often leads to water pollution e.g. via the practice of open defecation, during rain events or floods, the human faeces are moved from the ground where they were deposited into surface waters. Simple pit latrines may also get flooded during rain events. The use of safely managed sanitation services would prevent this type of water pollution.

- Industrial wastewater treatment-

Some industrial facilities generate wastewater that is similar to domestic sewage and can be treated by sewage treatment plants. Industries that generate wastewater with high concentrations of organic matter toxic pollutants or nutrients such as ammonia, need specialized treatment systems. Some industries install a pre-treatment system to remove some pollutants and then discharge the partially treated wastewater to the municipal sewer system. Industries generating large volumes of wastewater typically operate their own treatment systems. Some industries have been successful at redesigning their manufacturing processes to reduce or eliminate pollutants, through a process called pollution prevention.

To remove heat from wastewater generated by power plants or manufacturing plants the following technologies are used

- cooling ponds, man-made bodies of water designed for cooling by evaporation, convection and radiation.

- Cooling towers, which transfer waste heat to the atmosphere through evaporation or heat transfer.
- cogeneration a process where waste heat is recycled for domestic

on industrial heating purposes.

- Agricultural wastewater treatment:-

- A) Non point source controls-

Sediment washed off field is the largest source of agricultural pollution in the US. Farmers may utilize erosion controls to reduce runoff flows and retain soil on their fields. Common techniques include contour plowing, crop mulching, crop rotation, planting perennial crops and installing riparian buffers.

Nutrients are typically applied to farmland as commercial fertilizer, animal manure or spraying of municipal or industrial wastewater or sludge. Nutrients may also enter runoff from crop residues, irrigation water, wildlife, and atmospheric deposition. Farmers can develop and implement nutrient management plans to reduce excess application of nutrients and reduce the potential for nutrient pollution.

To minimize pesticide impacts, farmers may use integrated pest management techniques to maintain control over pests, reduce reliance on chemical pesticides, and protect water quality.

- B) Point source wastewater treatment-

Farms with large livestock and poultry operation, such as factory farms, are called concentrated animal feeding operations or feedlots in the US and are being subject to increasing government regulation. Animal slurries are usually treated by containment in anaerobic lagoons before disposal by spray or trickle application to grassland. Constructed wetlands are sometimes used to facilitate treatment of animal wastes. Some animal slurries are treated by

mixing with straw and composted at high temperature to produce a bacteriologically sterile and friable manure for soil improvement.

- Erosion and sediment control from construction sites

Sediment from construction sites is managed by installation of-

- erosion controls, such as mulching and hydroseeding and sediment controls such as sediment basins and silt fences.

Discharge of toxic chemicals such as motor fuels and concrete washout is prevented by use of-

spill prevention and control plans and specially designed containers and structures such as overflow controls and diversion berms.

- Control of urban runoff

Effective control of urban runoff involves reducing the velocity and flow of storm water, as well as reducing pollutant discharges.

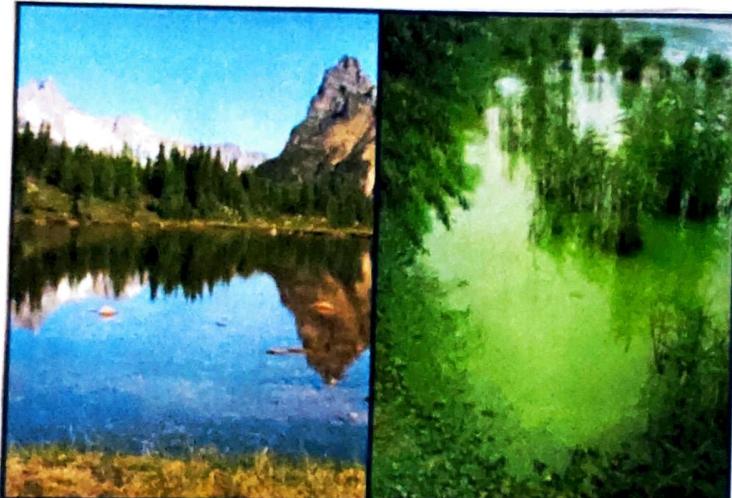
Local governments use a variety of storm water management techniques to reduce the effects of urban runoff. These techniques, called best management practices for water pollution in the U.S. may focus on water quantity control, while others focus on improving water quality, and some perform both functions. Pollution prevention practices include

low-impact development techniques, installation of green roofs and improved chemical handling. Runoff mitigation systems include infiltration basins, bioretention systems, constructed wetlands, retention basins and similar devices. Thermal pollution from runoff can be controlled by storm water management facilities that absorb the runoff or direct it into groundwater, such as bioretention systems and infiltration basins.

EFFECT OF WATER POLLUTION:-

(18)

OVERUSING OF PLASTIC
CAUSING
DEATH OF MARINE ANIMAL



NEUTRIET SEDIMENTATION
CAUSES
EUTROPHICATION OF
WATER



DEATH OF MARINE FISHES DUE TO
WATER POLLUTION



CHANGES IN CORAL REEVES
DUE TO
WATER POLLUTION
(WITH REFERENCE TO YEAR)

A CKNOWLEDGEMENT

I would like to express my special thanks of gratitude to my environmental science teacher Narayan Maity, Souvik Bhattacharya for their able guidance and support in completing my project.

I would also like to extend my gratitude to the principal maharaj Swami Shastrijnananda for providing me with all the faculty that was required.

DATE:

12th November, 2020

Anpan Gariah

STUG/049/19

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

ENVIRONMENTAL STUDIES

PROJECT TITLE:

**NITROGEN CYCLE AND ITS IMPORTANCE
FOR LIVING BEINGS**

NAME : ARUNAVA DAS

COLLEGE ROLL NO : CSUG/210/19

DEPARTMENT : COMPUTER SCIENCE

YEAR : 2020

SIGNATURE : Arunava Das

NITROGEN CYCLE AND ITS IMPORTANCE FOR LIVING BEINGS

■ Introduction: Nitrogen is more essential than the other elements for nutrition of organisms. It is the source of proteins and nucleic acids. and in the sense it is essential for life. Nitrogen is the main component of organic substances like amino acid, DNA, RNA, chlorophyll etc, present in the protoplasm. Nitrogen is present in the environment in a wide variety of chemical forms including organic nitrogen, ammonium (NH_4^+), nitrite (NO_2^-), nitrate (NO_3^-), nitrous oxide (N_2O), nitric oxide (NO). Atmosphere is the reservoir of free gaseous nitrogen as it constitutes nearly 78% of the atmosphere by volume. But free nitrogen can't be utilised directly by the by the organisms, with the exception of few nitrogen fixing bacteria. Only when nitrogen is converted from dinitrogen gas to ammonia (NH_3), it becomes available to primary users. Changing from one form to another, organism use nitrogen for growth and in some cases energy as nitrogen undergoes many different transformation in the ecosystem. Because of the importance of nitrogen in all ecosystem and significant impact from human activities, nitrogen and its transformation have received a great deal of attention.

NITROGEN CYCLE

- Definition: "The cyclic process by which organisms take their nitrogen from the nature and from the organisms to the nature again and maintain its equilibrium, is called nitrogen cycle."

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

- Stages of Nitrogen Cycle:

Process of Nitrogen Cycle consists of the following steps -

- Nitrogen Fixation,
- Nitrification
- Assimilation
- Ammonification
- Denitrification

These process take place in several stages.
~~are optional~~

Atmospheric
Nitrogen (N_2)

Cloud

SUN

Lightning

Rain



Nitric oxide

Nitrogen peroxide
+ water

Nitric oxide +
Mineral Salt



Algae taken
Nitrogen



Absorption of
Nitrogen by
microbes



Death

Urea

Ammonia

Nitrite (NO_2)

Decomposing microbes
Nitrifying microbes

Nitrate (NO_3)

② Nitrogen Fixation: Atmospheric nitrogen must be processed, or "fixed" to be used by plants.

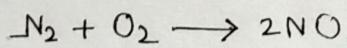
During the process of Nitrogen fixation, the inert form of nitrogen gas is deposited into soils from the atmosphere and surface waters, mainly through precipitation. Later, the nitrogen undergoes a set of changes, in which two nitrogen atoms get separated and combined with hydrogen to form ammonia.

Some fixation occurs in lightning strikes, but most fixation is done by free living or symbiotic bacteria. Azotobacter and Rhizobium also have a major role in this process. These bacteria consists of a nitrogenase enzyme which has the capability to combine gaseous nitrogen with hydrogen to form ammonia.

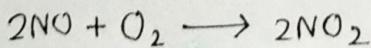
Today, about 30% of the total fixed nitrogen is manufactured in ammonia chemical plant.

a) Natural Fixation:

During flash or lightning in the sky, the atmospheric nitrogen combine with oxygen to produce nitric oxide (NO).



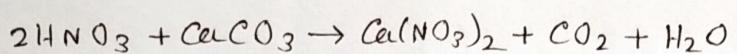
This nitric oxide again oxidised by oxygen produces nitrogen dioxide.



This nitrogen dioxide which reacts with rain water or water vapour produces nitrous acid and comes down to the soil.



Those two acids which react with different metallic salts (potassium, calcium etc) produce nitrate compounds and increase the amount of nitrogen in the soil.



b) Industrial Nitrogen Fixation :

Is a man-made alternative that aids in nitrogen fixation by the use of ammonia. Ammonia is produced by the direct combination of nitrogen and hydrogen and later, it is converted into various fertilisers such as urea.

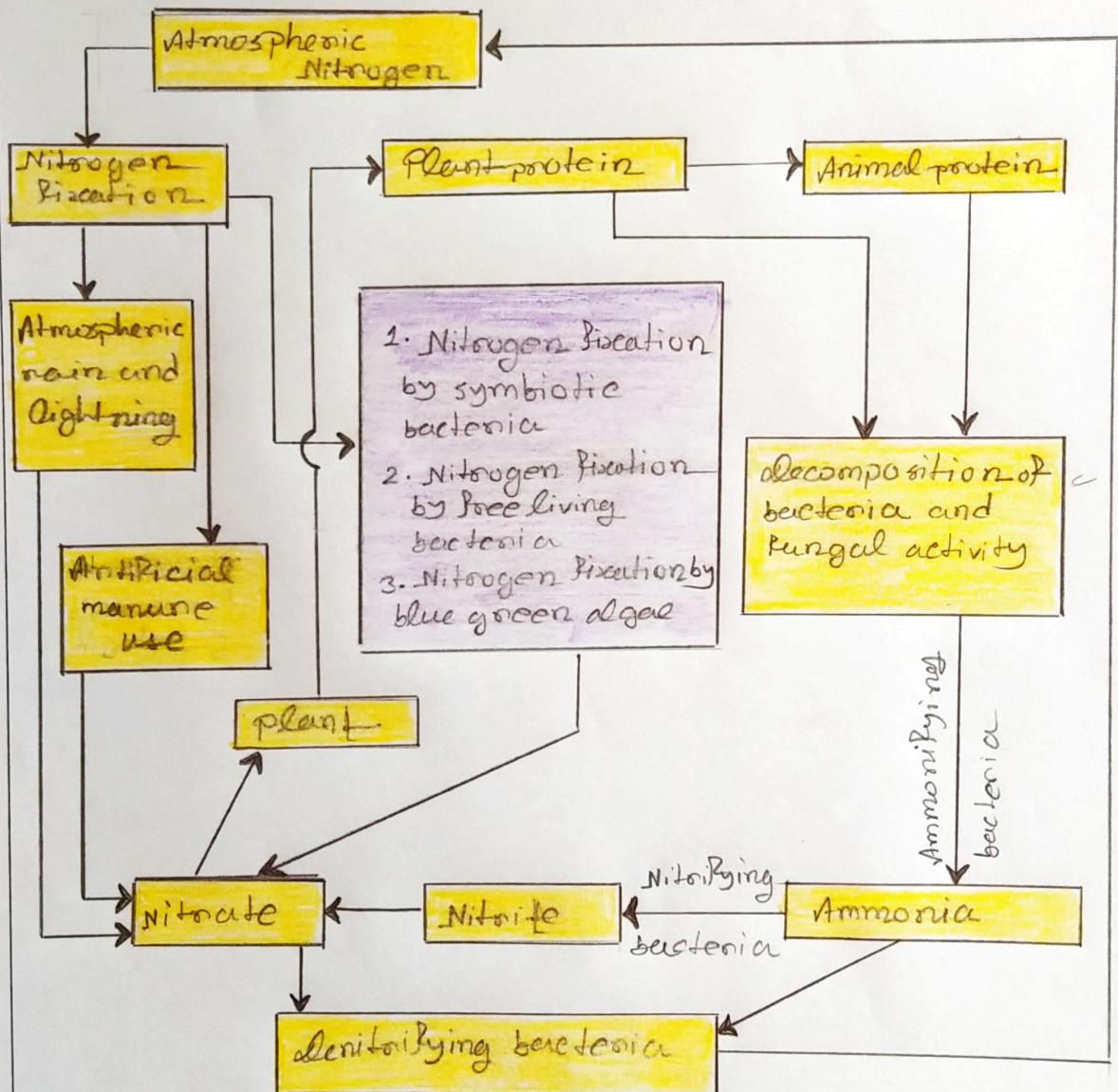
c) Biological Nitrogen Fixation :

We all know that nitrogen is not usable directly by from the air for plants and animals. In this process the microbes of soil fix the atmospheric nitrogen through a process of nitrogen fixation and convert them into nitrogenous compound (NH_3).

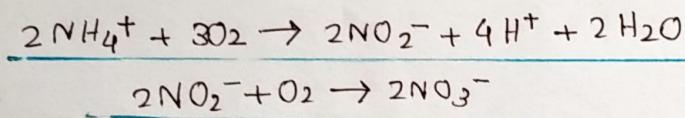
It takes place in two ways :

By free living bacteria like Azotobacter, Clostridium, Chromatium, Pseudomonas and by symbiotic bacteria mainly carried out by the activities of Rhizobium species.

The 'leg-haemoglobin' is present in the leguminous plants which are able to fix the atmospheric nitrogen and converted into ammonia (NH_3).



⑥ Nitrification: The conversion of ammonia to nitrate is performed primarily by soil-living bacteria and other nitrifying bacteria. In the primary stage of nitrification, the oxidation of ammonium ion (NH_4^+) is performed by bacteria such as the Nitrosomonas species, which convert ammonia to nitrites (NO_2^-). Other bacterial species, such as the Nitrobacter, are responsible for the oxidation of the nitrites into nitrates (NO_3^-). This conversion is very important as ammonia gas is toxic to plants.



⑦ Assimilation: Primary producers plants take nitrogen from the soil, by absorption through their roots in the form of either nitrate ions or ammonium ions. All nitrogen obtained by animals can be traced back to the eating of plants in some stage of the food chain.

⑧ Ammonification: When plants or animals die, the nitrogen present in the organic matter is released back into the soil. The decomposers, namely bacteria or fungi present in the soil, convert the organic matter back into ammonium. This process of decomposition produces ammonia, which is further used for other biological process.

② Denitrification: Denitrification is the way in which ammonia and oxides of nitrogen are converted back to nitrogen by different forms of denitrifying bacteria, namely *Thiobacillus denitrificans*, *Pseudomonas*, *Bacillus cereus* etc. The gaseous nitrogen is released to the atmosphere and cycle continues.

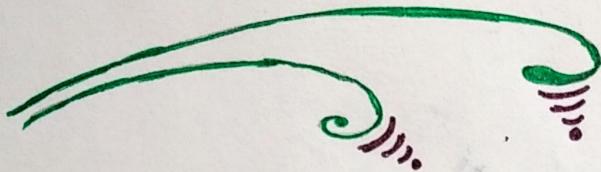
This process is performed by bacterial species such as *Pseudomonas* and *Clostridium* in anaerobic conditions. They use the nitrate as an electron acceptor in the place of oxygen during respiration.

③ Importance of Nitrogen Cycle:

- i) In nature the balanced component of nitrogen is maintained through nitrogen cycle.
- ii) The nitrogen is taking place for the new cell formation in living body which comes through the nitrogen cycle at great length of time.
- iii) It is an essential component of all the cell (unlike life) is made up of protein, Hence life can not exist without nitrogen.
- iv) Helps plants to synthesise chlorophyll from the nitrogen compounds.
- v) Helps in converting inert nitrogen gas into a usable form for the plants through the biochemical process.

- vii) In the process of ammonification, the bacteria help in decomposing the animal and plant matter, which indirectly helps to clean up the environment.
- viii) Nitrates and nitrites are released into the soil, which helps in enriching the soil with necessary nutrients required for cultivation.
- viii) Nitrogen is an integral component of the cell and it forms many crucial compounds and important biomolecules.

CONCLUSION



Nitrogen is arguably 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 transformation, and play a critical role in the cycle of nitrogen in the earth ecosystems. However, as human populations continue to increase, the consequences of human activities continue to threaten our resources and have already significantly altered the global nitrogen cycle.

Narendrapur Ramakrishna Mission Residential Clg

Name : Arya Panja

Roll no : CSUG /245 /19

Topic : Air Pollution

Subject : Environmental Studies.

Contents

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• Introduction	(1)
• Causes behind Air Pollution	(2)
• Effects of Air Pollution	(3)
• Impact of Air Pollution In India.	(4)
• Key Government Initiatives and Policy measures	(5)
• Conclusion	(6)

Introduction

Today, air pollution has emerged as a global health problem and is identified as a major environmental health hazard by agencies such as the World Health Organization (WHO) and governments around the world. An increase in concentration of pollutants - both gaseous and solid - is among the largest health risks in the world and according to the latest data released by WHO, indoor and outdoor air pollution were responsible for 3.7 billion deaths of people aged under 60 in 2012.

What is air pollution?

Air pollution refers to the release of pollutants into the air that are detrimental to human health and the planet as a whole.

Causes behind Air Pollution

There are many causes of air pollution. Some of them are mentioned below:-

- 1) Vehicle exhaust fumes - The number one source of air pollution is vehical exhaust fumes, which happen to release high amounts of carbon-monoxide. So these days, people are looking to rely less on fossil fuels to power cars, leading to less toxic emissions into the environment.
- 2) Fossil fuel based power plants - Fossil fuels present a wide scale problem when they are burnt for energy in power plants. Chemicals like sulphur dioxide are released during the burning process which pollute the air.
- 3) Construction and agricultural activities - On a daily basis, dirt and dust is kicked up into the atmosphere from excavating and demolition type construction activities. Plenty of nasty chemicals get placed into the atmosphere from pesticides and fertilizers which are being used at increasingly higher rate.
- 4) Household activities - Common household chemicals, like bleach, without proper ventilation is a primary source of indoor air pollution. Smoking tobacco through the use of cigarettes also release toxic pollutants into the air.

Effects of Air Pollution

- Global warming — Global warming is a direct consequence of the green house effect which is produced by the high emission of CO_2 and methane into the atmosphere. Most of the emissions are produced by the industry.
- Climate change — another consequence of global warming. When the temperature of the planet increases there is a disturbance in the usual climatic cycles.
- Acid rain — The gas emitted by industries, power-plant heating and transport are very toxic. Those gases include sulphur dioxides and nitrogen oxides which react with water molecules of clouds.
- Respiratory health problems — Inhalation of toxic agents directly affects the lungs and other organs
- Deterioration of fields — Acid rain, climatic change and smog all damage the Earth's surface which are a direct consequence of air pollution. Hence it directly affects agriculture, changing crop cycles and the composition of food we eat.

Impact of Air Pollution in India.

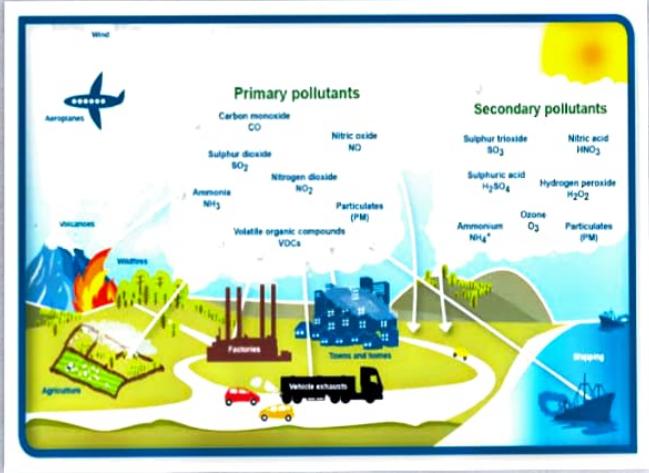
Air pollution, both indoors and outdoors, have had a significant impact on the health of citizens as well as the economy.

1. Air pollution is among the leading causes of death in India.
The global burden of disease report has ranked outdoor air pollution as the fifth leading cause of death in India and indoor air pollution as the third leading cause.
2. Negative impact of agricultural productivity.
A recent research study "Recent climate and air pollution impacts on Indian agriculture" by scientists at the University of California.
3. Cost of air pollution amounts to 3% of the GDP.
A world bank report titled 'Diagnostic Assessment of Selective Environmental Challenges in India' highlighted that the annual cost of air pollution, specifically pollution from particulate matter (burning of fossil fuels) amounts to 3% of the GDP of the country, outdoor air pollution accounting for 1.7% of the total 3% of GDP, and the other 1.3% by indoor air pollution.

Key Government Initiatives and Policy Measures

Amid growing concerns pertaining to rising air pollution, government of India has taken various initiatives as well as introduced policies to address the issue. In order to prevent and control air pollution, the Parliament of India enacted the Air (Prevention and Control of Pollution) Act, 1981 on 29th March 1981. The Central Pollution Control Board (CPCB), a statutory organization under the Ministry of Environment & Forests (MoEF) has been entrusted with the responsibility of ensuring ambient air quality and has been conferred and assigned the power and functions to achieve the stipulated objective.

- i) Steps to curb vehicular emission
- ii) Reduce the dependence on biomass burning in rural areas and villages,
- iii) Renewable Energy - aim is to reduce dependency on coal,
- iv) National 'Air Quality Index' to enable common man to understand Air Quality.



Conclusion

Air pollution is a complicated issue and negatively impacts the health of citizens as well as the economy of the country. The Government of India and the state governments have recognized the adverse effect of air pollution and there is increased seriousness about addressing the air quality issue among all the stake-holders. Furthermore recent efforts such as the launch of National Air Quality Index Point to the need for enhancing public awareness on the quality of air they are breathing. A shift towards renewable energy is part of the plan to reduce dependency on fossil fuels as well as provide clean energy to households. It is important that a comprehensive, integrated and long term plan of action involving co-ordination between different ministries and departments, is drawn to address the issue, reduce air pollution and ensure the citizens breathe clean air.

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

ENVIRONMENTAL STUDIES

PROJECT TITLE: NITROGEN CYCLE

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COLLEGE ROLL NO : ENUGI/180/19
DEPARTMENT : ENGLISH
YEAR : 2020
SIGNATURE : Arya Raja.

NITROGEN CYCLE

- AN ENVIRONMENTAL SCIENCE PROJECT

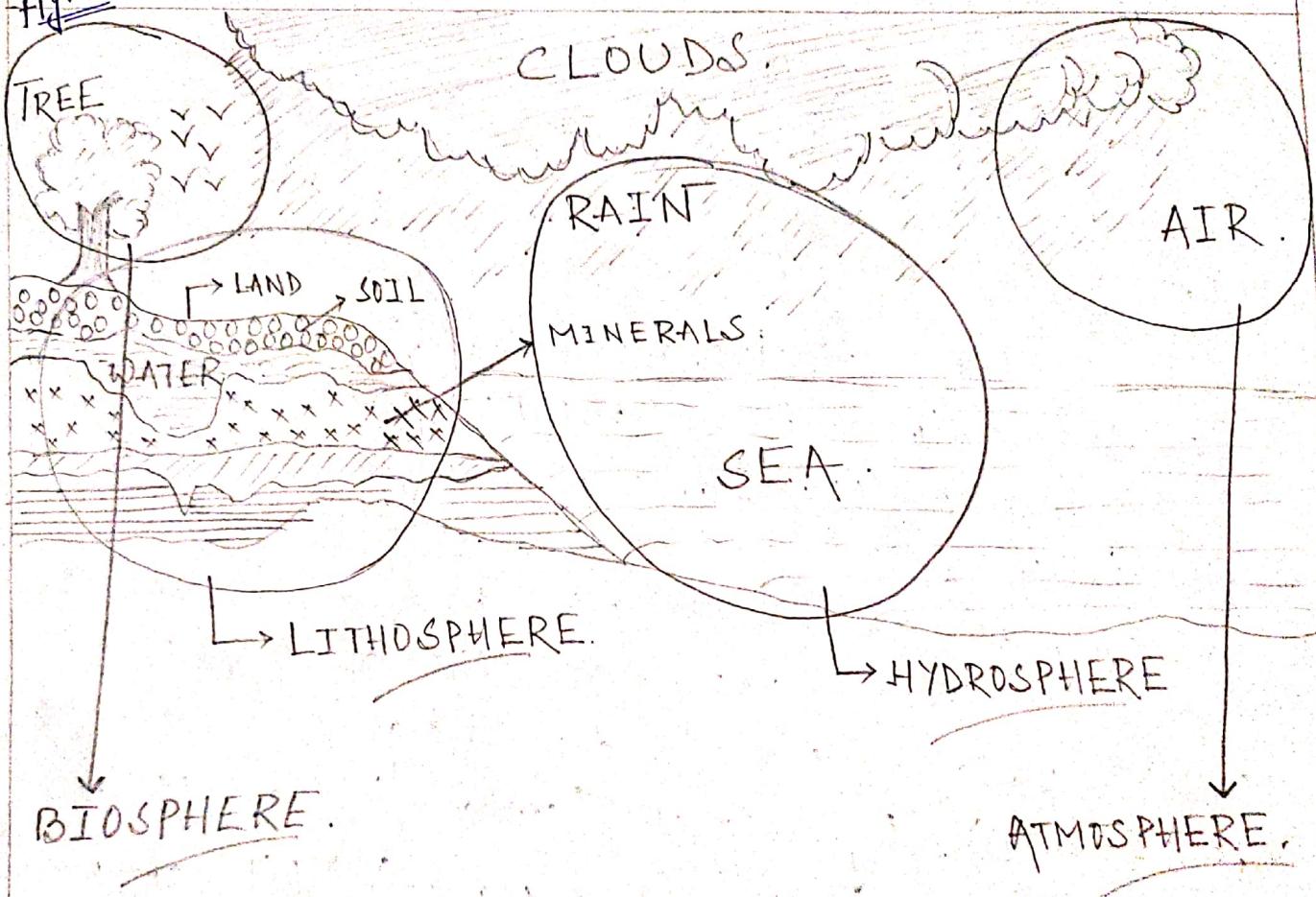
INTRODUCTION :

Our environment can be said to be divided into certain spheres which are the reservoirs or the home of the various units of the environment and may be called as the abode of the various components of environment.

These spheres are the atmosphere (which contains the air, different gases, water vapour, clouds, etc.), hydrosphere (containing all the water, glaciers, ice caps etc of the planet), lithosphere (comprising of the land, soil, rocks, minerals, sediments etc) and the biosphere (containing all the living organisms). But these are not isolated chambers, each sphere is interconnected with all the other spheres which maintains the balance of the environment via certain processes known as the Biogeochemical Processes. One of the most important of these cycles is the Hydrological cycle commonly known as the Water Cycle that connects

the Hydrosphere with the Biosphere through the Atmosphere. Similarly, Nitrogen cycle is one of the most important Biogeochemical cycles.

Fig. 01



A Representative Diagram showing the different Spheres of our Environment.

- **Biogeochemical Process** or cycle is the way in which an element, or compound like water moves between its various living and non-living forms and locations in the Biosphere through movements via the other spheres.

CONTENTS :

1. Forms of Nitrogen
2. Nitrogen Fixation
3. Nitrification
4. Assimilation
5. Ammonification
6. Denitrification
7. Industrial Process
8. Importance of Nitrogen Cycle.
9. Pollution

NITROGEN is mainly found in its stable gaseous form in the atmosphere. It is found in a diatomic form as N_2 and it is the most abundant gas in our atmospheric composition comprising of more than 70% of all gases in our atmosphere. However it is not so abundant in the other spheres in other forms. So, the main source of nitrogen is the atmospheric gaseous form.

FORMS OF NITROGEN:-

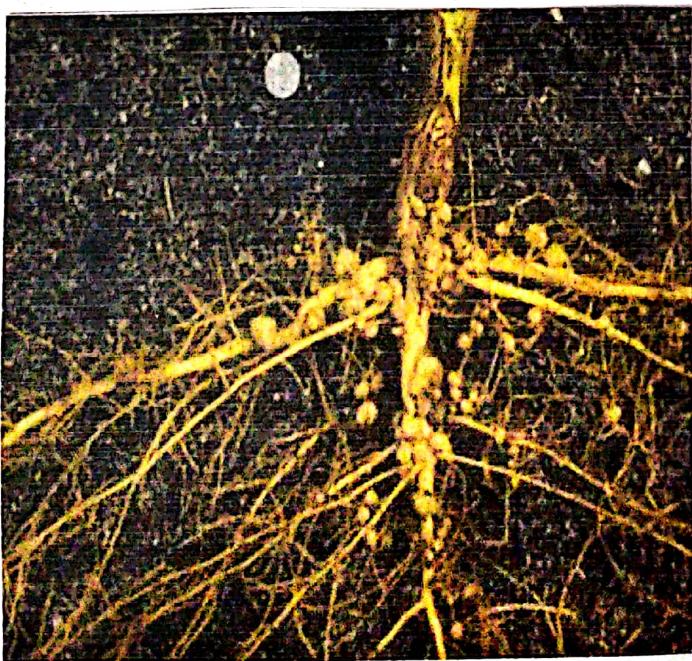
Nitrogen is present in the environment in many forms like organic Nitrogen, ammonia (NH_3), ammonium ion (NH_4^+), nitrite (NO_2^-), nitrate (NO_3^-) and of course Nitrogen gas (N_2). But because the major source of all nitrogen is the extremely stable gaseous form which cannot be used by the living organisms generally, the nitrogen cycle becomes an inevitable process for life to go on since nitrogen as an element is the building block that constitutes our amino acids, our nucleic acids including D.N.A and R.N.A and also the proteins. Hence, it is perhaps safe to call this element as the building block of life along with carbon.

NITROGEN FIXATION:

So, this huge reserve of gaseous N_2 has to "fixed" or transformed into a form that can be used by plants or autotrophs and subsequently by all life forms. A lot of this occurs by the action of lightning. Lightning converts N_2 to NO_3^- ions directly. But the bulk of this process of "fixing" occurs by certain free living and some symbiotic bacteria known as the Diazotrophs. These microbes convert N_2 into NH_3 by the action of an enzyme called nitrogenase that they have

and then the bacteria convert it into an organic form. Most of this biological N₂ fixation occurs by the action of the Mo-Nitrogenase enzyme found in the variety of bacteria and also some Archaea.

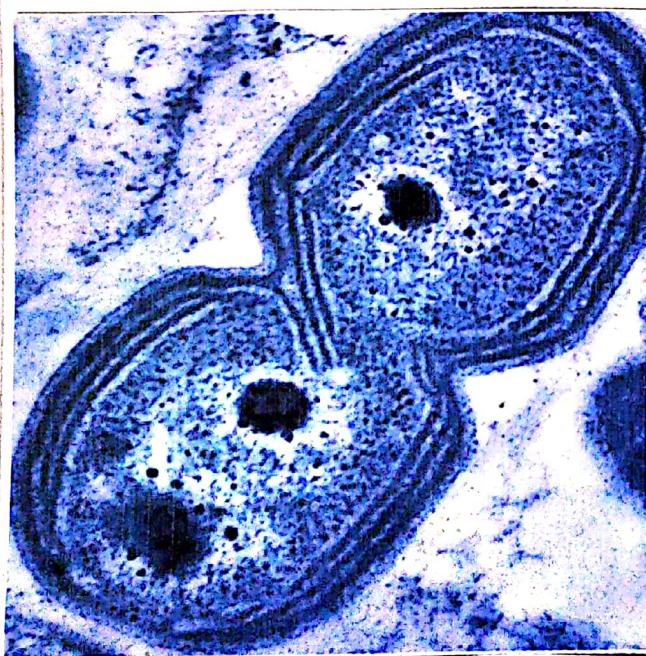
- Diazotrophs include free living bacteria like Azotobacter sp. and include symbiotic bacteria like Rhizobium sp.! The rhizobium live in the root nodules of leguminous plants like pea and maintain a symbiotic relation where they gain shelter and carbohydrates from the plants in exchange for producing ammonia. This is why leguminous plants can increase nitrogen content of the soil and thus make it more fertile.



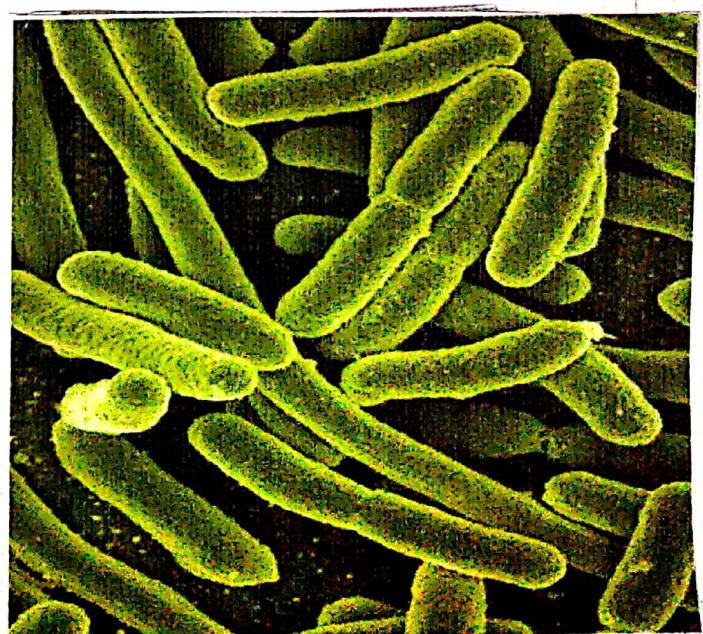
The root nodules of legumes where rhizobia are found.

NITRIFICATION:-

This is the process of transforming various unusable forms of Nitrogen into the nitrate form in general and specifically the conversion of ammonia into nitrates. NH_3 gas is toxic to the plants hence this step is very important. After the fixation by diazotrophs, the NH_4^+ is oxidized by bacteria like *Nitrosomonas* sp. to form NH_3 which is then converted to NO_2^- or nitrites. Another species, like the *Nitrobacter* convert the NO_2^- into the nitrate or NO_3^- that can be used by the plants.



Nitrosomonas under
microscope



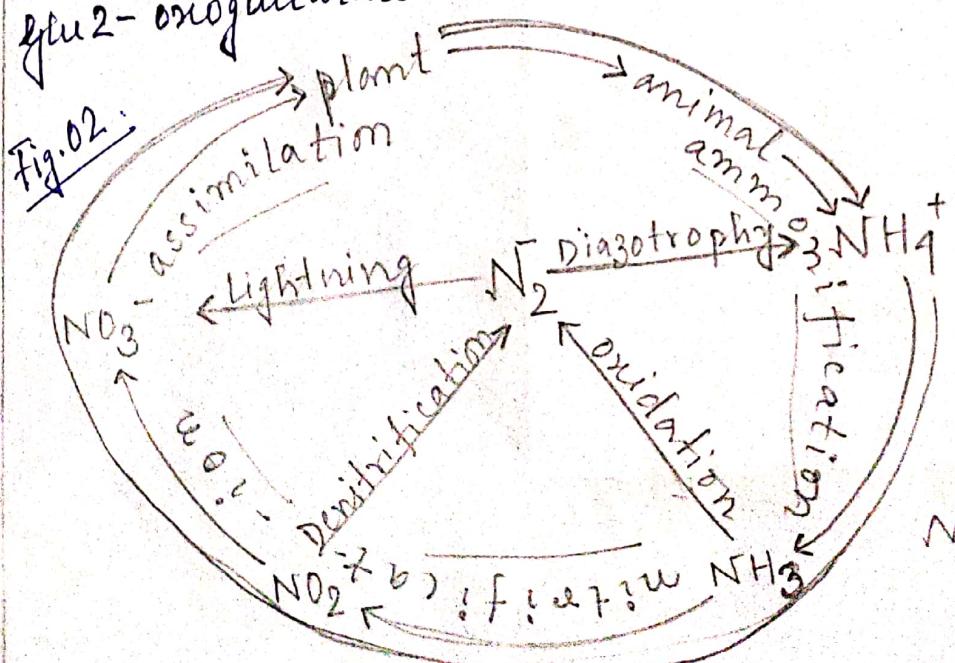
Nitrobacter under
the microscope

ASSIMILATION:-

Plants can absorb nitrates and ammonium ions from the soil by their root hairs. This process along with the incorporation of these ions into amino acids and nucleic acids for biological processes is called assimilation. There is a very complex relation between the legumes and rhizobium where a complex process of exchange of amino acids between the two parties takes place. Chlorophyll is also a product of assimilation.

AMMONIFICATION:-

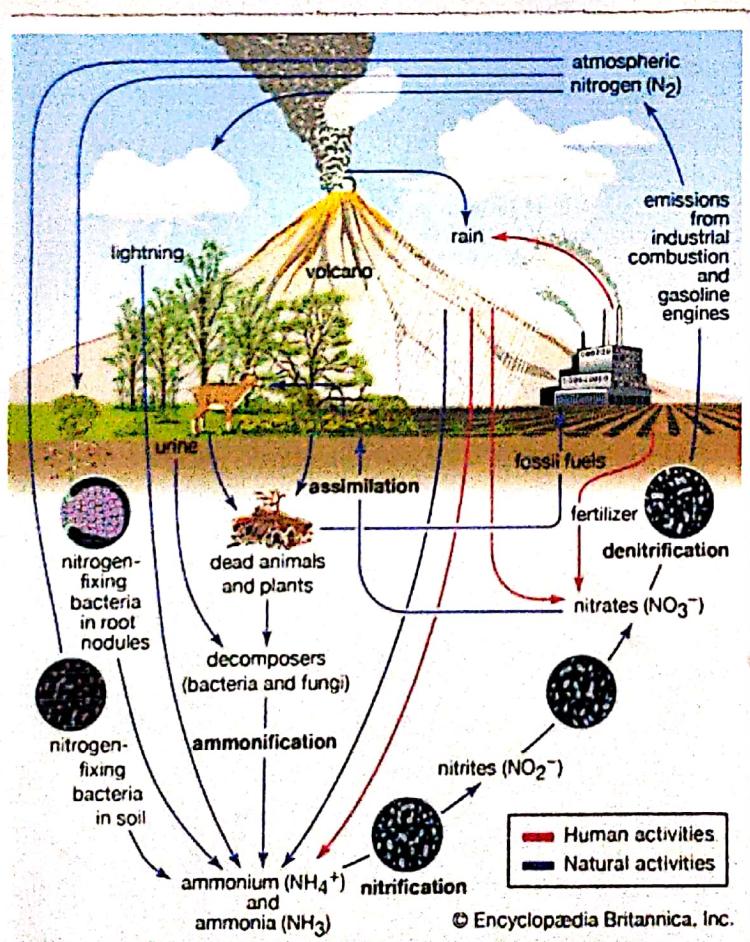
The basic form of nitrogen into the various excreta of animals and the dead bodies of living organisms is organic. Ammonification is process of conversion of this organic nitrogen into ammonium ion or NH_4^+ by bacteria or fungi. This process is also called mineralization. The enzymes involved in the process are: Gln synthetase, Glu^2 -oxoglutamate aminotransferase, Glu Dehydrogenase, etc.



Classical Representation of the Nitrogen Cycle.

DENITRIFICATION:-

This is the process of reduction of the nitrates into the stable nitrogen gas (N_2) that then returns to the atmosphere thus completes the entire nitrogen cycle. This process is done by some species of bacteria like Pseudomonas sp. and Paracoccus sp. among others. This is the link that joins the biosphere and the atmosphere in the case of the nitrogen cycle and maintains the balance that keeps the entire nitrogen content of the environment.

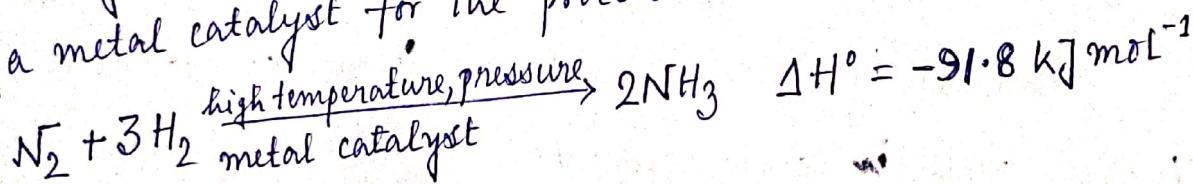


Detailed
Diagram of
the
Nitrogen cycle.

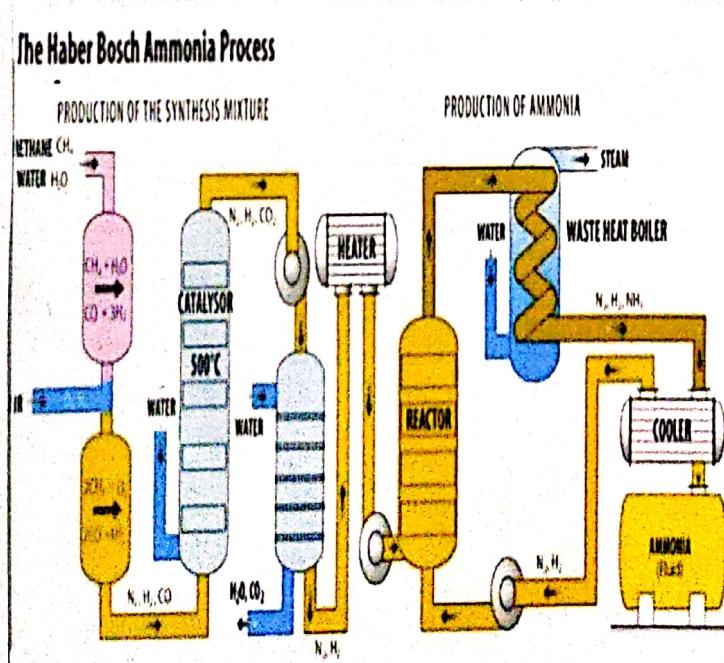
INDUSTRIAL PROCESS :-

In today's date, nearly 30% of all the nitrogen fixation occurs by the industrial process known as the Haber-Bosch Process. It is used in the production of synthetic fertilizers containing nitrogen used to enrich the nitrogen content of agricultural land artificially.

- **Haber Bosch Process** uses high temperatures and pressures to convert nitrogen gas and a hydrogen source (natural gas or petroleum) into ammonia. Named after its inventors the German chemists Fritz Haber and Carl Bosch, it also uses a metal catalyst for the process.



The Haber Bosch Ammonia Process



Detailed
Diagram of
the
Haber-Bosch
Process.

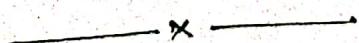
IMPORTANCE OF NITROGEN CYCLE:-

The Nitrogen cycle is of particular importance because it is essential for the functioning of various ecological activities like primary production of autotrophs and decomposition. The availability of nitrogen affects the rate of these life sustaining processes. Moreover, nitrogen forms a basic element that is an essential component of all our nucleic acids including R.N.A and D.N.A while also being a building block of the amino acids of our bodies thus being responsible in the creation of both plant and animal protein. Hence, importance of nitrogen cycle in our ecosystem is huge.

POLLUTION:-

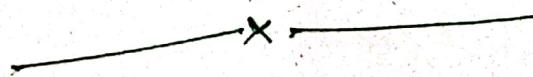
Human interference with the global Nitrogen cycle can have adverse effects on the natural environmental system and also human health. Increased use of artificial fertilizers can increase nitrate levels in the soil which can be harmful in the long run. Anions are highly soluble in water and soil cannot retain much of them so these find their way into the ground water or nearby water sources. Water can be polluted with nitrates even by the agricultural run-off from the fields. This is in effect negative in two aspects. Firstly, NO_3^- can interfere with the blood oxygen levels.

in infants causing a disease called methemoglobinemia. Also, the nitrate enriched run off into nearby ponds, lakes etc. causes a process called eutrophication where due to the enrichment certain plants and especially algae begin to grow disproportionately ultimately leading to algal bloom. These grow so much that they consume all nutrients of the water body leading to hampering of all other forms of marine life in the water. Moreover, due to the ready availability of nitrates in the soil, the symbiotic relation between plants and nitrogen fixing bacteria is hampered thus eventually being responsible for the loss of natural fertility of the soil. This is the reason why now use of artificial fertilizers is being regulated or even banned in many a places.



ACKNOWLEDGEMENTS :-

This project would not have been possible without the contribution of a lot of people that has been pivotal in the completion of it. First of all, I must concede my gratefulness towards our Environmental Sciences teachers who besides taking our scheduled classes have always encouraged us to take up a positive outlook towards our environment and made us understand the importance of being eco-friendly. I would also like to extend my gratitude towards our college administration for managing and making possible the online classes and evaluation even during these difficult times. Last but not the least, I need to thank my friends and my parents for the support that they provided me with during my time spent in the work of this project.



BIBLIOGRAPHY:-

The following sources of information and materials have been very helpful in this project:

- Textbook for Environmental Studies for Undergraduate Courses of All Branches Of Higher Education by Erach Bharucha for University Grants Commission.
- N.C.E.R.T Textbook of Biology for Class XI
- wikipedia.org
- google images
- getty images
- Britannica Encyclopaedia

~ THE ~
END ::

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

ENVIRONMENTAL STUDIES

PROJECT TITLE:

Corona pandemic and role of
common people to control it.

NAME : ASIM DAS
COLLEGE ROLL NO : PHUG/247/19
DEPARTMENT : Physics
YEAR : 2020
SIGNATURE : Asim Das

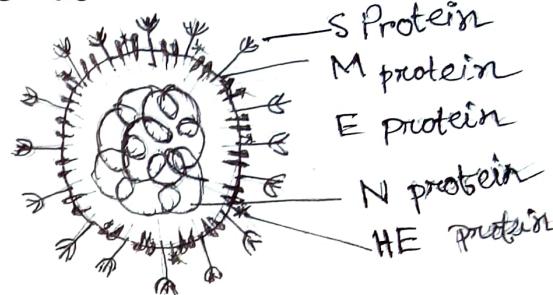
Corona Pandemic

Role of common people to control it

Structure of coronavirus :

① Coronavirus (covid-19) belongs to

- REALM - Roboviria
 - PHYLUM - Incertae sedis
 - ORDER - Nidovirales
 - FAMILY - Coronaviridae
 - SUB-FAMILY - Orthocoronaviridae
- ② SARS-CoV-2 particles are spherical and has proteins called spikes



Properties

- Enveloped virion
- Positive sense
- Single stranded
- Largest RNA virus

- 80-160 nanometers in diameter
- Genome ranges from 26-31 kbs
- 5 structural proteins

Structural proteins :

- * S - Spike protein : S protein together with HE protein assist in viral entry to the human cell.
- * S protein attaches to the receptor protein ACE2.
- * This protein has crown-like appearance. Hence it name is 'corona'.
- * N (Nucleocapsid) : ✓ Ribonucleoprotein type protein. ✓ N protein forms a complex with RNA assist in viral assembly.
- * E (Envelope) : ✓ It form the viral envelope. ✓ E₁ is a matrix glycoprotein-transmembrane protein.
- * E₂ is a Peptidogenic - Fusion protein.
- * M (Membrane) : ✓ M proteins form the viral envelope
- * HE (Hemagglutinin esterase) : Hemagglutinin is a peptidomer with a role in hemagglutensis.

(2)

COVID-19 symptoms

Main symptoms are -

(As per Centers for Disease Control and Prevention - USA)

* The following symptoms may appear 2-14 days after exposure to the new Coronavirus (COVID-19)

1. Fever or chills

2. Cough

7. New loss of taste or smell

3. Shortness of breath or difficulty breathing

4. Fatigue

8. Sore throat

5. Muscle or body aches

9. Congestion or runny nose

6. Headache

10. Nausea or Vomiting

11. Diarrhea

50%

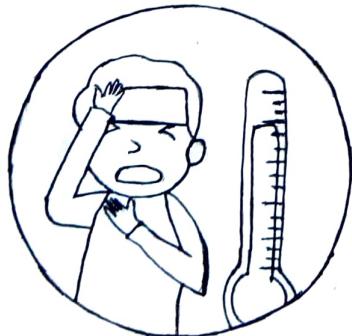
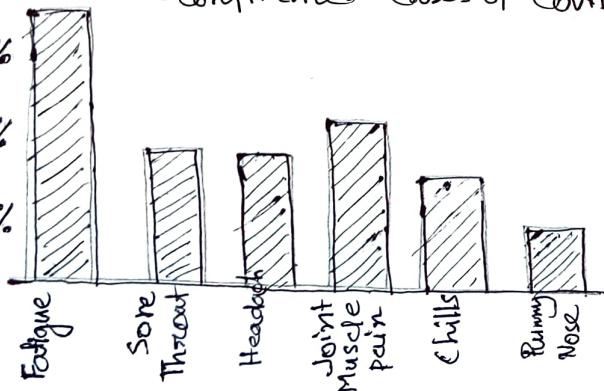
10%

30%

20%

10%

Percentage of Laboratory
-confirmed Cases of COVID-19



Fever or chills



cough



Shortness of breath

Symptoms : COVID-19

As a pandemic:

1. First identified at Hubei Province, WUHAN, China.
At Dec 1st, 2019 a patient ~~was~~ get pneumonia, later he identified as a corona patient.
2. Dec 31, 2019 : The World Health Organization (WHO) is alerted by Chinese officials about dozens of pneumonia-like cases in the city of Wuhan.
3. Jan. 1 : The U.S. Centers for Disease Control and Prevention identify a seafood market in Wuhan suspected to be at the centre of the outbreak.
4. Jan. 7 : China reports its first known death from an illness caused by the new coronavirus. The patient was a 61-year old man in Wuhan.
5. Jan. 13 : The WHO reports a case in Thailand, the first time it has been detected outside China.
6. Jan 16 : Japan confirms its first case of infection with the novel coronavirus. - Later on South Korea.
7. The US announces its first confirmed coronavirus case on Jan. 21, 2020.
8. Jan 23 : Many country closed their borders. China places Wuhan under quarantine. All flights and trains are cancelled.
9. Jan 30 : The WHO declares the outbreak a global public health emergency as more than 9,000 cases are reported worldwide, including in 18 countries beyond China.
10. Feb 11 : After death of several people in several country WHO announces the disease caused by the novel coronavirus will be known by the official name COVID-19

1. March 6: Trump signs an \$8.3-billion emergency spending package to combat the outbreak as the number of global cases hits 100,000.

12. March 9: All of Italy and its 60 million residents are placed under lockdown.

March 16: Canada closes its borders to most foreign travellers.

March 16: U.S. researchers give the first shots of an experimental coronavirus vaccine, leading a worldwide hunt for protection as the pandemic surges.

In India: First case was found on 3rd Feb 2020 at Kerala in the body of a student coming from WUHAN. And now this is the biggest crisis now.

● Duty of People:

Till now there is no proper vaccine of COVID-19. Awareness and general treatment can help not to be affected by it.

What to do?

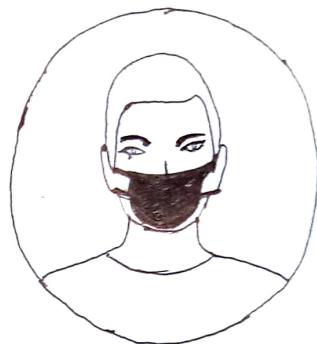
1. Practice to wash hands frequently.

Use soap and water or liquid with Alcohol. It seems to be washed but then also wash the hands.



2. During cough and sneezing use elbow or handkerchief or tissue to cover nose and mouth.

3. Use mask to prevent the spit coming out from mouth and nose.



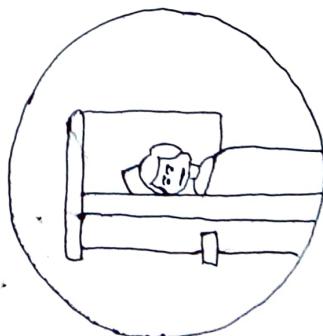
4. Used mask, tissue drop in closed pot. If needed, burn it.



5. Avoid crowded area - Avoid any type gathering, party etc. where more than one people is present.



6. If feel illness (Fever, shortness of breath, cough) then immediately go to doctor. Take paracetamol, hot water etc.



7. If you get covid +ve then atleast 14 day keep yourself under home quarantin.



8) At last help ours Doctors, nures , polices, sweepers , cleaning stuff to fight with this pandemic.

Conclusion: The whole human civilization is in a crisis period. Now our life is in hand of ourselves. We common people should obey above statements. We have to nothing but wait for a new morning.

Thank You

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

ENVIRONMENTAL STUDIES

PROJECT TITLE : "পুরুষের
বাস্তুতন্ত্র ও খাদ্য শৃঙ্খল"

NAME. : ASISH KONAI

COLLEGE ROLL NO : HIUG/143/19

DEPARTMENT. : HISTORY

YEAR. : 2020

SIGNATURE. :

পুরুষের বাস্তুত্ত্ব

প্রমাণ → পুরুষগীতি কর বাস্তুত্ত্ব হল - বাস্তু-ব্যক্তিগত বাস্তুবিদ্যা
 আলোচনা কিম্বালুস জন্মে একটি পুরুষগীতি করয়। বাস্তুবিদ্যা
 হল - বিদ্যুৎ দেখা জানা, এই জানার জীব এবং তাদুর
 পরিপ্রেক্ষণ আনন্দঃ যমক কে আলোচনা করা হয়, 1896 মাল
 শাম্ভু ওন্দোজানী আলোচনা করে পুরুষগীতি হিলেলাস
 আদুর পুরুষ করেন। এক জন 0ikos + এব তার - এব বা
 বাস্তুবিদ্যা এবং Logos করার অর্থ - অধ্যয়ন। পুরুষ, হিলেলাস
 অর্থ - জীবগীতির ব্যক্তিগত
 সম্মত বিজ্ঞানে হন, সাহাতে
 পরিপ্রেক্ষণ কিম্বা অভ্যন্তর
 অর্থে জীব প্রসূতানুসৰি জীব প্রক্রিয়াক ব্যক্তিগত আনন্দ
 হলে। বাস্তুবিদ্যা নির্দিষ্ট ব্যক্তিগত জীব ক জীবগীতির
 একটি ক চারিএ, যাদু ~৩ জোড়া অসূন্দর সাক্ষীত ~ স্বত্ত্ব,
 বাস্তুবিদ্যাত নাইবতন, জীবগীতির জোড়া সহস্রাবক গোপনীয় -
 অসূন্দর, পরিপ্রেক্ষণ মুগ জীবে নিম্নমানুষে কাম্পনালী, আশ্র্য
 বাস্তুত্ত্ব, বাস্তুবিদ্যা জীব সম্মত আলোচনা করা হয়। এব,
 বাস্তুবিদ্যা হল ক্ষেত্রিক হল - বাস্তুত্ত্ব। তব বাস্তুত্ত্ব
 সম্মত আলোচনা করা বাস্তুবিদ্যা মুগ অনেক দুর্দার সাক্ষীত
 হয়।

■ বাস্তুত্ত্বের মুগ উপর → জীবগীতি ৩ জোড়া পরিপ্রেক্ষণ
 কিম্বা নাইবতন জন্মে আনন্দঃ করকৃতি প্রাণীদের নিয়ন্ত্রণ

ଶ୍ରୀହିମାନ୍ତରେ ଚଲେ । ତୀର୍ଥ ଅନୁଷ୍ଠାନକେ ପାଇଁବେ ଯେବେ ପ୍ରଥମ କରୁଥିଲା ନା । ସବୁ ଚିତ୍ରିତ, ପ୍ରାଚୀ ଓ ଲାଇସେନ୍ସ - ଏକାକୀ ବିଜୋଚ ନିଯମ ଏବଂ ବୀର୍ଣ୍ଣ ପରିବାଚିକ କାହାର କୁଳ । କାହା କରିବା ଅପରି ଏହି ଲାଇସେନ୍ସର ମଧ୍ୟ କୌଣସିର ବିନିମୟ । ଏହି ବିନିମୟ ଉପରେ ଶ୍ରୀହିମାନ୍ତର ନିଯମ ଅନୁମତି ଦେଇ । ତୀର୍ଥ ଓ ଡ୍ରୁ ମାନ୍ଦିଲ ମଧ୍ୟ ଲାଗୁଥିବା ପ୍ରେମାଦର୍ଶନ ଆମା-ପ୍ରଦୀପର କାହାର ଲାଭକୁ ଏହାମାତ୍ର ହେଲା - ବ୍ୟାଙ୍ଗତକୁ । ପ୍ରତିକଥା, ଏ ଅମାଲ ଏବଂ ନିଯମର ମାଧ୍ୟମେ କୋଣାର୍କ ପାଇଁବେ । ଶ୍ରୀହିମାନ୍ତର ଏହି ଅନୁଷ୍ଠାନକୁ ଏବୁ ଉତ୍ତର ପରିବାରର ମଧ୍ୟ କୌଣସିର ବିନିମୟ କରିବାକୁ ପାଇଁବାରିକ ଆନୁଷ୍ଠାନିକ କୌଣସିର ବିନିମୟ କରାଯାଇଛି ।

■ ମତମତ → 1935 ମାର୍ଚ୍ଚ ବିଜୁଳୀ ଚିତ୍ରିତ ଯବ୍‌ପ୍ରମାଦ ହୁକୋମିଯାନ୍ତର କୋଣାର୍କ ବ୍ୟାଙ୍ଗର କ୍ଷେତ୍ର । ଲାଇସେନ୍ସ - ଏଇ ଜୁତ ବ୍ୟାଙ୍ଗତକୁ ହେଲା - ଲାଇସେନ୍ସରକାରୀ ମଧ୍ୟକାରୀ ଏବୁ ଗାତରୀଳ ଏବଂ ଲାଇସେନ୍ସରକାରୀ ଅନୁତର ହେତୁ, ରାଜ୍ୟନିକ ଓ ରାଜ୍ୟର ଅନ୍ୟାନ୍ୟ, ଉଦ୍‌ଦେଶ୍ୟ, ଏବୁ ବିଭିନ୍ନ ମଧ୍ୟକାରୀ ଏବୁ ଏହି ମଧ୍ୟକାରୀ ମଧ୍ୟରେ ଏହି ଅନୁତର ପ୍ରେତୋବିତ କରିବା ନିର୍ଦ୍ଦେଶ ।

■ ବ୍ୟାଙ୍ଗତକୁ → ବିଜୁଳୀ ନିମ୍ନ 1974 ମାର୍ଚ୍ଚ ବ୍ୟାଙ୍ଗତକୁ ନିଆଲିଯାତ କରିବାକୁ ମୁହଁ କରିଲା -

1. ବ୍ୟାଙ୍ଗତକୁ ହେଲା ବ୍ୟାଙ୍ଗତକୁ ମୁହଁ କରିବାକୁ ଏବକ । ବ୍ୟାଙ୍ଗତର ପ୍ରଦେଶ ପ୍ରାଚୀର କିମ୍ବା ଗୋପିତ ହୁଏ ।

২. বালুতের কার্যক্রমের নির্দিষ্ট ক্ষেত্র পর্যন্ত অব্যোবহার কোনোর নিম্ন
গতি।

৩. বালুতের মধ্যে সুষৃদ্ধ কান্তুর অসম সংস্কৃতির ইতৃষ্ণু। এই
অবশ্য ব্যক্তির কান্তুর পুর পুরোজুরীর ছবি সাধারণভাৱে
সামাজিক গতে প্রচল।

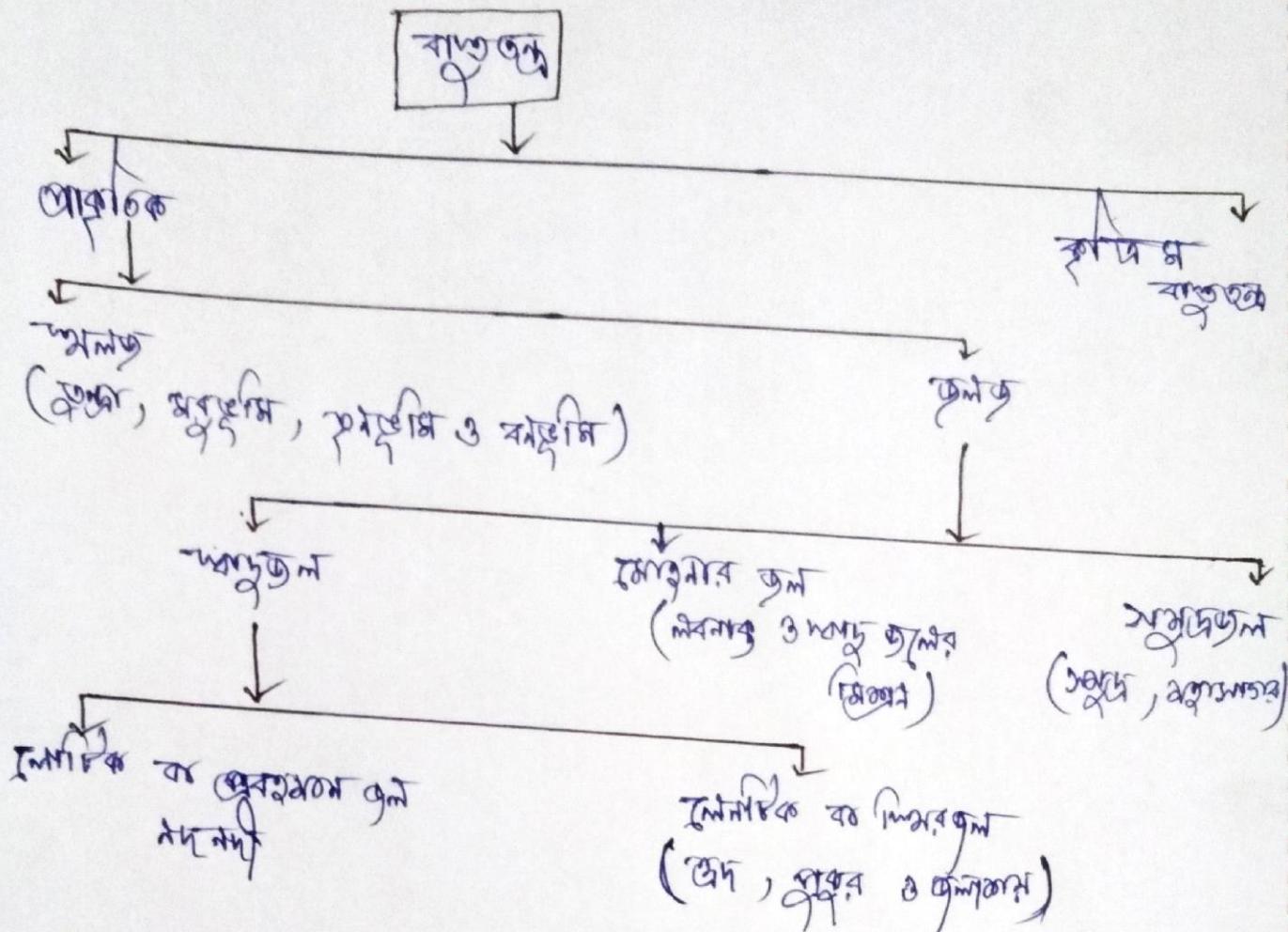
৪. বালুতের মধ্যে সুষৃদ্ধ কান্তুর পুরোজুর পুর সুপুরোজুর
কান্তুর পুর নির্ভরশীল।

৫. কান্তুর অবশ্যন্তে সংস্কৃত প্রাচীন প্রাচীন পুরোজুর পুরোজুর
পুরোজুর পুর পুর পুর পুরোজুর পুরোজুর পুর পুর পুর
নির্ভরশীল ক্ষমতা।

৬. আমেরিক প্রাচীন পুর পুর পুর পুর পুর আমেরিক পুর
পুর পুর পুর পুর পুর পুর পুর পুর পুর পুর পুর পুর পুর

৭. কান্তুর পুর
পুর পুর পুর পুর পুর পুর পুর পুর পুর পুর পুর পুর পুর

বাণিজ্যের একান্তর্দেশ →



এমনই আমাদের আজোয়া বিষয় এনে প্রয়োব
 বাণিজ্য। এটি সবুর আকারিক বা সামাজিক ভূল হিসেবে বল
 যাক। অত্যন্তালোক এবং প্রযোজিত আকারিক ভূল আকৃত স্বর বা
 অনুভূমিক হিসেবে কথও বলে গুরু (যেন শুনে দুঃখ)।

'বাণিজ্য' একটি বুলি ভীব সামাজিক একটি প্রযোজন
 কাদ। এই সেলী বা নিম্নীলো মানুষের কালো (বিনোদ) লাইবেলে
 অবস্থাকারী ভীব সহজেই এবং তার পরিপন্থের ভেক্তি চোদন্তালোর
 লাইবেলিক আকৃতিময় চোলানৰ বিষয় আছে, তাক বাণিজ্য স্ব।

পুরুষের বাণিজ্য অসম কল্পনা বাণিজ্যের মধ্যে প্রথম। পুরুষের বাণিজ্যকে সামাজিক বাণিজ্যের দল বাণিজ্য এবং জনসচ পুরুষের দীর্ঘমাত্রায় দ্বি-পুরুষের দল আবণ্ড মানে।

- পুরুষের বাণিজ্যের সমীক্ষা → পুরুষের বাণিজ্যের বাণিজ্য বলতে বেশীর অকার্য লক্ষণের ফলে জনসচামূহ চীব পুরুষের অক্ষয় হওয়া
সমীক্ষা। পুরুষের বাণিজ্য তিনী সুপরিকল্পনা দ্বারা উৎপন্ন করা হওয়া।
পুরুষের বাণিজ্যের সমীক্ষা →
 1. কলের মধ্যে চীবমানসমূহের আবণ্ড করা।
 2. বিশেষ প্রজাতির সুপরি কলের ছাঁচ এক মাত্র।
 3. একাধি জৈবিক পদ্ধতি যা সেগুলি কল, চীব।
এবং গোৰী মধ্যে এক উপর সুপরি উৎপন্ন করা।

- পুরুষ, বাণিজ্যের বিশিষ্ট → বিশেষ বাণিজ্য মধ্যে পুরুষের বাণিজ্যের বৃক্ষত হল কৃষকী বিশিষ্টের বৃক্ষত দল দুরুত্ব অঙ্গীকৃত হল →

- i) মানুষ কল → পুরুষের বাণিজ্য দল রোপিক বাণিজ্য - অসম অঙ্গীকৃত বৃক্ষত কৃষকী কলের মানুষ অঙ্গীকৃত।
- ii) ধূম → পুরুষের বাণিজ্য অসমকোর বা স্থানীয় বাণিজ্য দল পুরুষের বাণিজ্যের বৃক্ষত লাভ।
- iii) বিশেষ → এই বাণিজ্যকুল বৃক্ষত কৃষকী কলের আবণ্ড।

i) বিশ্ব দ্রুত \rightarrow বিশ্ব অঞ্চলিক জীব পৃষ্ঠারের বিশ্ব দ্রুত বস্তুগুলি
ক্ষয়, উদ্যম-প্রক্রিয়া এল মাত্র কলের বিশ্ব দ্রুত দ্রুত
মাত্র, সর্বজ্ঞান $\frac{3}{3}$ বিশ্ব বিশ্ব গুণ মাত্র বিশ্ব বস্তুগুলি বস্তুগুলি বস্তুগুলি আছে।

v) বিশ্ব সাক্ষৰ \rightarrow কিছু পৃষ্ঠার বাণিজ্য দ্রুত দ্রুত হতে পার
(মাত্র অন্তর রক্তুল) অন্তর অন্তর পৃষ্ঠা পৃষ্ঠা হতে
পারে।

■ বাণিজ্য গচ্ছ \rightarrow বিশ্ব জুড়ে মাত্র বিশ্ব বিশ্ব অভ্যন্তর
পৃষ্ঠার বাণিজ্য গচ্ছ, বিশ্ব জুড়ে মানবিকৃতি দ্রুত \rightarrow

ii) অন্তর মোহন \rightarrow জুল অক্ষীয়ত- O₂, CO₂ ও লৈবন।

iii) চোট মোহন \rightarrow অলি, বাতাস, জাহি, ও অক্ষীয়ত প্রযোজক।

iv) জুল মোহন \rightarrow জুল অধিকার সংস্থাত জুল মোহন, জাহি,
জাহি, এবং ইত্যাদি।

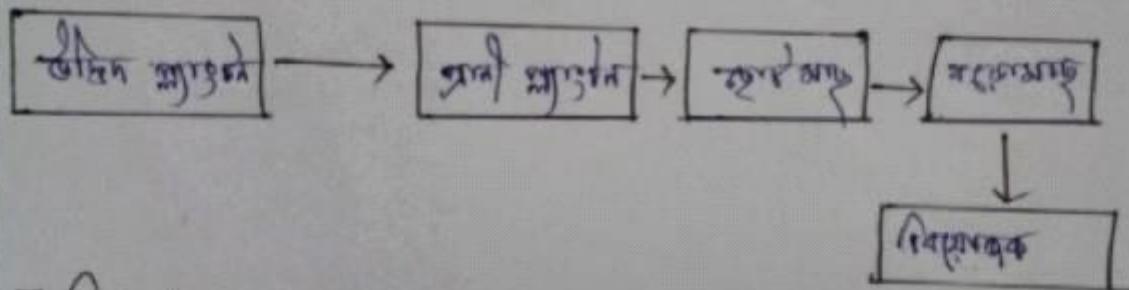
■ অন্তর মোহন মাত্র মোহন দ্রুত দ্রুত দ্রুত \rightarrow

i) মুকুট \rightarrow মুকুট মুকুট, মুকুট, মুকুট, মুকুট
মুকুট,

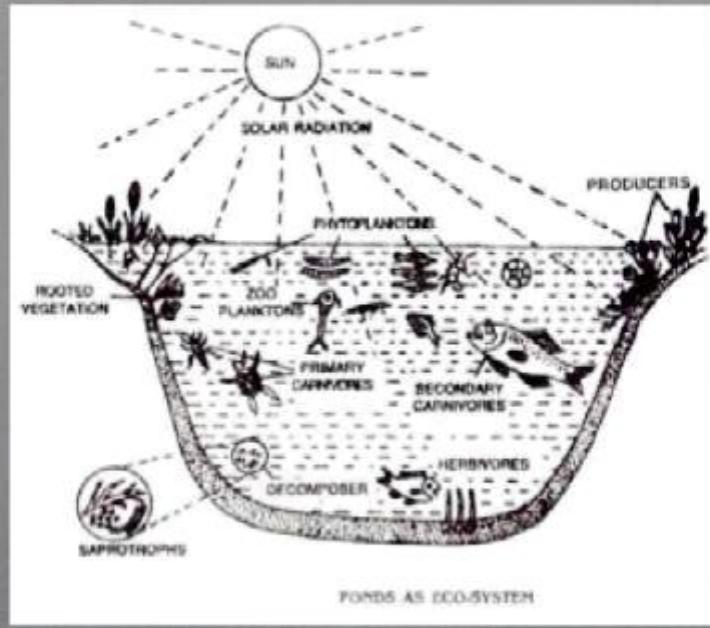
ii) মুকুট \rightarrow মুকুট মুকুট, মুকুট মুকুট, মুকুট, মুকুট,
কাঁচুট, বুঁ, মুকুট, মুকুট মুকুট,

iii) विलोक्य → लालेकासा, छपाक, काम्पी, और अवाम्पी;
साथसे हजारी।

अग्रे, दूसरी काले अम्बाये एवं तीसरे अम्बाये जैसे विलोक्य
जागुला का लोहा, भारतीय हजारी। एवं आम्बाये जैसे विलोक्य
द्वारे अवलोकन करते। अग्रे अम्बाये विलोक्य द्वारे अद्वितीय भारत
लोकों का अभी भारतीय हजारी। द्वितीय अम्बाये द्वारे भारतीय,
लोकों का अभी भारतीय हजारी; तृतीय अम्बाये विलोक्य द्वारे विलोक्य,
एवं, अम्बाये द्वारे विलोक्य द्वारे भारतीय हजारी, उत्तर विलोक्य के अभी
लोकों का अभी विलोक्य द्वारे विलोक्य द्वारे भारतीय हजारी।

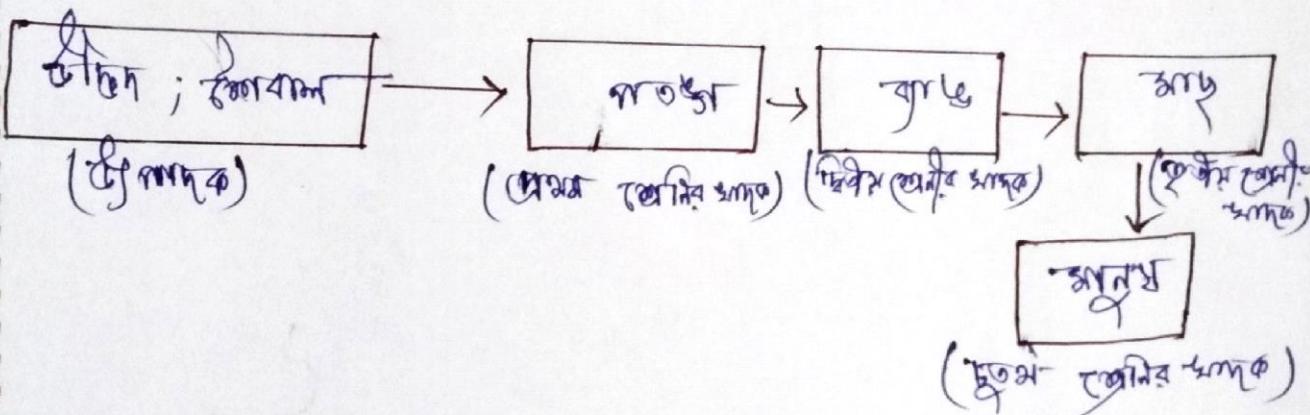


पृष्ठ :



ଆମ୍ବାତୁ ଖେଳ

ଆମ୍ବା-ଆମ୍ବାରେ ଯାଥିକରି ପୁଣି କହିଛନ୍ତି ଶ୍ରୀ ମନୀଷ ପ୍ରେମଲିଙ୍ଗିତେ
ଆମ୍ବାଜୀବି ଉପାଦ୍ରିକର ବନ୍ଧୁ ମେହି ପ୍ରେମଲିଙ୍ଗିର ଆବଶ୍ୟକ କଷାୟଗୋଚିର
କୁଣ୍ଡ ଅବାହିତ ହନ୍ତି । କାହାକୁ ଆମ୍ବାର ଏହି ଓରିକ ପରିମାଣ ଆମ୍ବାତୁଖେଳ
ବାଲି । ବିଜ୍ଞାନୀ ଓ ଆମ୍ବାର ମୁଠେ, “ଉପାଦ୍ରିକ ବନ୍ଧୁ ଆବଶ୍ୟକ କଷାୟଗୋଚିର
ମିଳେ ଆମ୍ବାତୁଖେଳ କଷାୟଗୋଚିର ମେହି ପ୍ରେମଲିଙ୍ଗିର
ପୋଢ଼ିଲାର କ୍ଷାରିଳକ ଆମ୍ବାତୁଖେଳ ସୁନ୍ଦର ।” ଦେଉଳି ପାଇଁ ; ଏବେଳି
କିମ୍ବା କୂଳର ଆମ୍ବାତୁଖେଳର ପରିମାଣ କାହାକୁ ଅବାହିତ ମିଳିବାଲୁ ହିଁ ।



- ଆମ୍ବାତୁ ଖେଳର ବିବରଣ୍ୟ → ଆମ୍ବାତୁଖେଳର ବିବରଣ୍ୟକୁ ବୁଝି →
 - i) ଆମ୍ବାତୁଖେଳ କୌଣସି ପ୍ରକାଶରେ ମୁହଁକ ଅବଶ୍ୟକ ପରିମାଣ ଆମ୍ବାର
ଆବଶ୍ୟକ ଅବଶ୍ୟକ ହେଲା ।
 - ii) ଆମ୍ବାତୁଖେଳ କୌଣସି ମୀତେ ପ୍ରକାଶ ମୁହଁକ ଅବଶ୍ୟକ ।
 - iii) ଲୋକ କୌଣସି ଆମ୍ବାତୁଖେଳ କୁ ଅବଶ୍ୟକ ପରିମାଣ ହେଲା ହେଲା ଅବଶ୍ୟକ ।
ଆମ୍ବା-କଷାୟଗୋଚିର ୩ ମୁହଁକ ଆମ୍ବାତୁଖେଳ ।

iv) আনু প্রাণ্যের নিষ্ঠা কর যেকে ছেন্টেন পীঁয়ের সংস্কৃত ও জাতীয়
পরিমাণ বৃদ্ধি করতে চাহুক।

v) আনু প্রাণ্যের উন্নয়নের জন্য অঙ্গীকৃত সংস্কৃত করা চাহুক।

vi) এক-একটি আনু প্রাণ্যের প্রকাশনার সংস্কৃত ও রচক চ-প্রব
জর্জ চাহুক।

■ আনু প্রাণ্যের ইতিবিলোগ → i) আনু-প্রাণ্যের প্রাচীন সময়ে
তিনি বিদ্যুৎ আনু-প্রাণ্যের নৈতি করা আস্তি। আস্তি →

i) মিথী আনুপ্রাণ্য → এখন আনু-প্রাণ্যের প্রাচীন সাদৃশ্য
তাত্ত্বিক প্রাচীন প্রাচীন প্রাচীন প্রাচীন প্রাচীন প্রাচীন
প্রাচীন প্রাচীন প্রাচীন প্রাচীন প্রাচীন প্রাচীন প্রাচীন প্রাচীন
প্রাচীন → আনুপ্রাচীন → বৃক্ষ → মান → পুষ্টি,
(প্রাচীন-সাদৃশ্য) (প্রাচীন-সাদৃশ্য) (প্রাচীন-সাদৃশ্য)

ii) মাতৃবী আনুপ্রাণ্য → এখন আনুপ্রাণ্যের প্রাচীন প্রাচীন
পীঁয়ের বেকার পুষ্টি যেকে কুড়েছে এতে মাকে, আস্তি, বৃক্ষত্ব
গীবীক আস্তি করে মাতৃবী আনুপ্রাণ্যের গাঁচে রহ, একেবারে
বৃক্ষ শীবকে রহেন এবং পুষ্টি গীবীক মাতৃবী রহে।

বৃক্ষ → শান্তি → কৃতি → আনুপ্রোগী,

(iii) कृषीवै अमुख्यम् भूतं च ग्रन्थं
कीर्तये एवते ज्ञानात् कीर्तयते निरुक्तं लोकं अवश्यते वर्णं
एवं लोकुः कृषीवै च विद्यामुक्तं अर्थं आद्यं प्रकृतं।

परमा → कृषि विद्या → वृक्षाक → वृक्षावृत्तिः ।

■ (2) ग्राम अस्त्रेन विद्ये अनुभवी वृक्षावृत्तिः

इ- उत्तरा - उत्तर वृक्षावृत्तिः →

i) विद्येन्द्रिये वृक्षावृत्तिः वृक्षावृत्तिः → इति अमुख्यम् वृत्तिः
 एवं वृक्ष वृक्ष अवृत्तिः वृक्षावृत्तिः वृक्षावृत्तिः वृक्ष वृक्ष
 च- वृक्षावृत्तिः वृक्ष वृक्ष वृक्षावृत्तिः वृक्ष वृक्षावृत्तिः
 एवं । वृक्षावृत्तिः →
 (वृक्षावृत्तिः) → वृक्षावृत्तिः → वृक्षावृत्तिः → वृक्षावृत्तिः
 ↓
 (वृक्षावृत्तिः वृक्ष-वृक्षावृत्तिः)

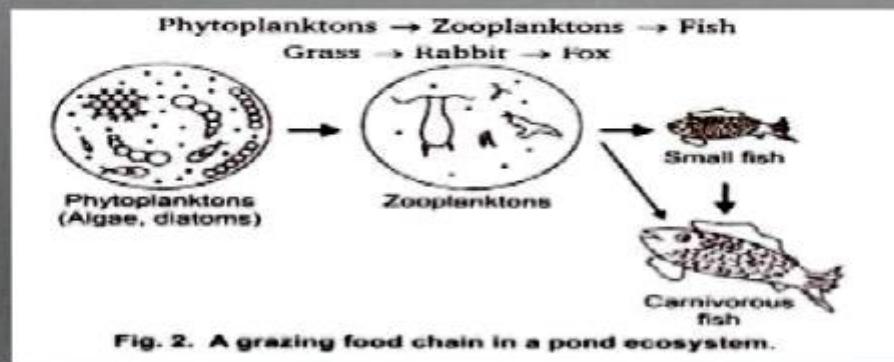
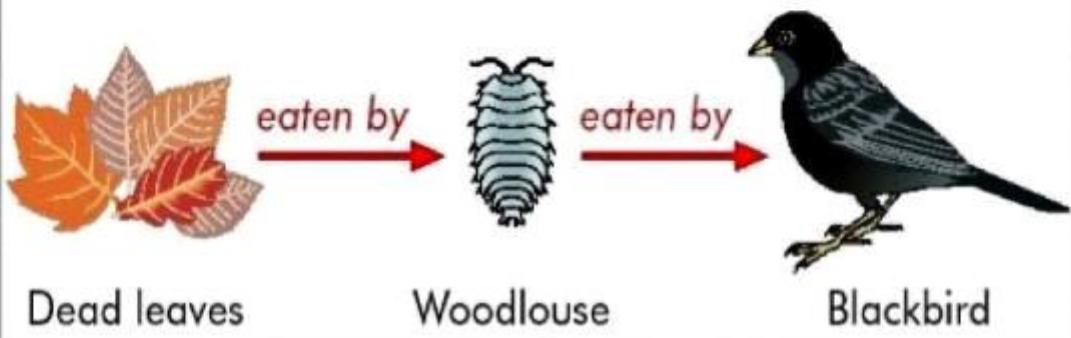


Fig. 2. A grazing food chain in a pond ecosystem.

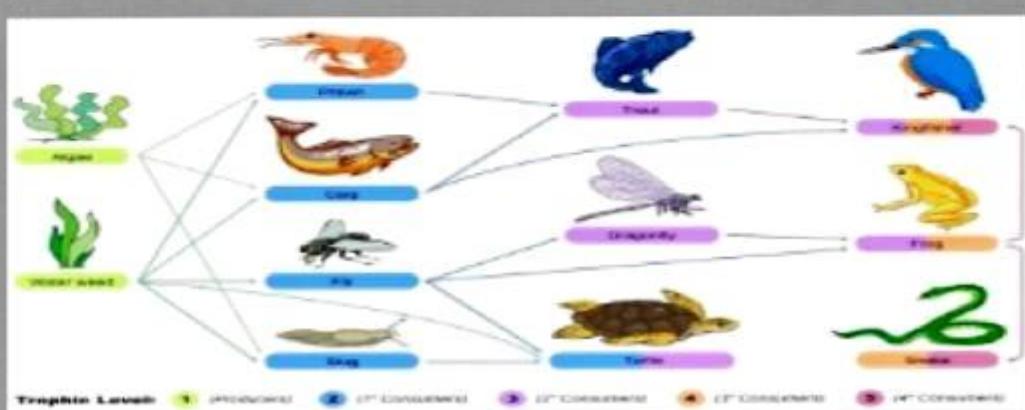
iii) বিমুক্ষ বা তোকার পদ্ধতি \rightarrow কে আপনি জীবনের
বা নিয়ন্ত্রণ সহ কোথে আপনি একে বলে আশীর্বাদ করে থাক
তাক ক্ষমতাক বা তোকার পদ্ধতি বলে।
যেমন \rightarrow পক্ষিগত \rightarrow মাছ \rightarrow কুকুর \rightarrow মাছ,

Detritus Food Chain

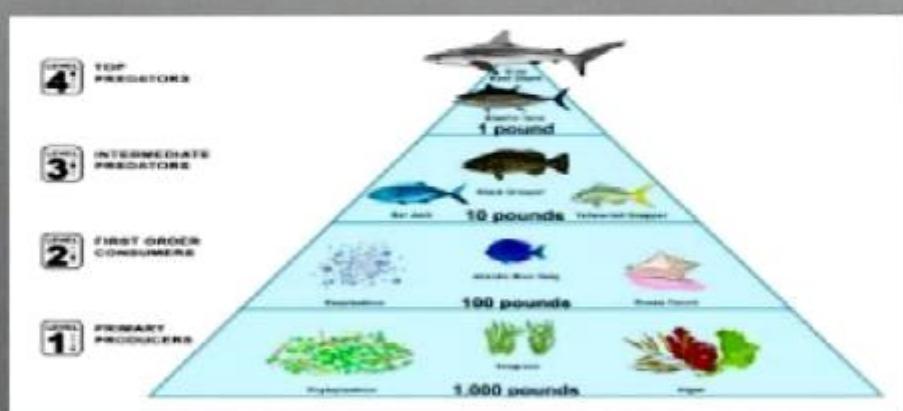


এই অংশের নিয়ে আপনাদের কোন প্রশ্ন বা প্রতিশ্রুতি
জোগাড় করুন আপনাদের অন্তর্ভুক্ত অন্য প্রক্রিয়া
বিশেষজ্ঞদের কাছে আপনাদের কোম্পানি আপনাদের কাছে
প্রশ্রুত, কোম্পানি চোখ ; কুচিলী প্রক্রিয়া কৃত হৃদয়
অবস্থার কুর। অন্যতে আপনাদের কোম্পানি আপনাদের কুর
এবং একে আপনাদের আপনাদের কুর, আপনাদের
সামাজিক কুর হৃদয়, কুচিলী কুর এবং, আপনাদের
কুচিলী সামাজিক আপনাদের কুর, একে আপনাদের
কুচিলী সামাজিক আপনাদের কুর, আপনাদের
কুচিলী সামাজিক আপনাদের কুর ; কুচিলী আপনাদের
কুচিলী সামাজিক আপনাদের কুর ; কুচিলী আপনাদের

आपका इसे आवाहि रखी वह 'Food Web' जैसा 'Food Web' असें। अकारेक आपका आपका त्रिभवन का आपका त्रिभवन देको यह ज्ञान करो। आपका आपका त्रिभवन त्रिभवन रखी वह आपका जैसा, आपका त्रिभवन वापत त्रिभवन वर्षे आपका रखी वह, नीचे चित्र प्रश्नां राखेता ही →



: एवं ये आपका जीवन का वायर समाज → यहाँ ये आपका जीवन का वायर समाज असें। आपका आपका जीवन का वायर जीवन का वायर असें। आपका जीवन का वायर असें।



■ ଆମ୍ବାଜୁଖୁଲେର ଶ୍ରୀପ୍ରକାଶ → ସାହୁଙ୍କେ ଶ୍ରୀକାନ୍ତକୁଳେର ଆଖ୍ୟାୟ

ବୁଝିବା ଆମ୍ବାଜୁଖୁଲେର ଶ୍ରୀପ୍ରକାଶ ଅଧିକାରୀ । ଆମ୍ବାଜୁଖୁଲେର ଆଖ୍ୟାୟ ଖରୋଟି ଶ୍ରୀକାନ୍ତ ରାମକୃଷ୍ଣ କୌଣ୍ଡିଳ ଓ ଶ୍ରୀପ୍ରକାଶ କାମାଳ ଆମ୍ବାଜୁଖୁଲେର ଏଥାନାକୁଟି ରହି । ତଥି, ଆମ୍ବାଜୁଖୁଲେର କାମାଳ ପରିବାର ପ୍ରକାଶକଳାପ ବିପ୍ରିତ ହଲ ଆମ୍ବାଜୁଖୁଲେର ବିଲୁପ୍ତ ରହି ।

■ ■ କୃତକୃତର ଶ୍ରୀକାର → "ପ୍ରକୃତର ସାହୁଙ୍କୁଳ ଓ

"ଆମ୍ବାଜୁଖୁଲ" ଏହି କୃତ ପ୍ରକଳ୍ପ କରିବାର କୁଳ ଆମାର ବିପ୍ରିଯ ବିଜୟକାଳୀନ ପାଇଁ କୃତକୃତର ଶ୍ରୀକାର । ଜୀବନ ଦିନ ମିଦେଣ ନା ଦିଲୁଳ ଏହି ପ୍ରକଳ୍ପର ବୁଲାମ୍ବନ କରି ମର୍ମିତ ହୁଅ ନା । ଗର୍ଭଜାଗ ପ୍ରକଳ୍ପର କର୍ତ୍ତା ଶିଶୁ ବିଭିନ୍ନ ଅଳିପ୍ରକାଶ ଆମ୍ବାଜୁଖୁଲ ରହ ; ଚିମ୍ବ ମୂରି ଓ ଚନ୍ଦ୍ର ମୂରିର କୁଳ ଶିଳ୍ପବିନ୍ଦୁରେ ଧ୍ରୁବିକାଳ ଅନ୍ତର୍ଭିତ୍ତି ।

— X — X —

The End

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

ENVIRONMENTAL STUDIES

PROJECT TITLE:

Water Pollution and measures to control it.

NAME : AVIRUP DEY
COLLEGE ROLL NO : STUG/241/19
DEPARTMENT : STATISTICS
YEAR : 2020
SIGNATURE : Avirup Dey.

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2) Water Pollution (Definition)	1-2
3) Sources of Water Pollution	2-3.
4) Effect of Water Pollution	3-4
5) Measures to control Water Pollution	5-7

Introduction :

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

Water Pollution :

Water is considered polluted if some substance or condition to such a degree that the water can not be used for a specific purpose. Olaniran (1905) defined water pollution to be the presence of excessive amounts of a

pollutant in water in such a way that water can not be used for drinking, bathing, cooking etc other uses. Water Pollution has been a research focus of government and scientists.

Therefore, protecting river water is urgent because of serious water pollution and global scarcity of water resources.



Sources of Water Pollution :

Water Pollution can occur from two sources → i) Point Source
ii) Non-point Source

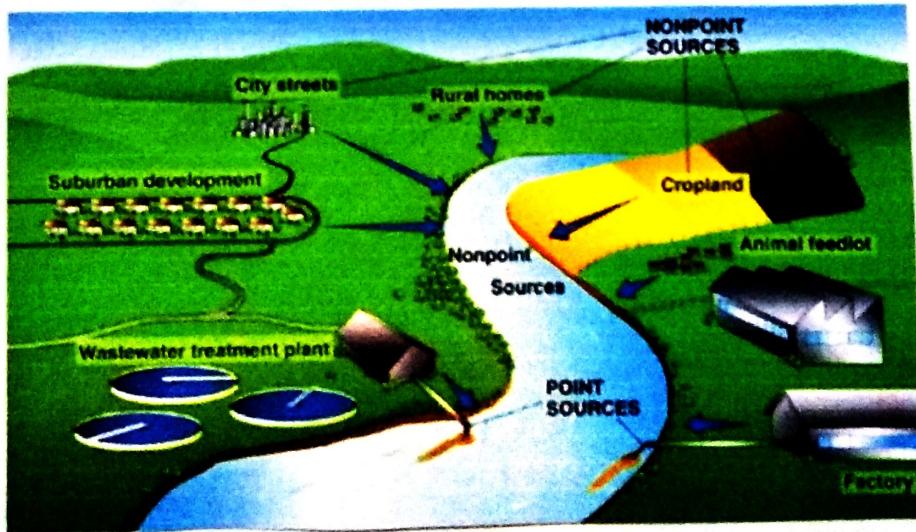
Point Sources of Pollution which are directly identifiable sources. Example includes pipe attached to a factory, oil spill from a tanker, effluents

coming out from industries.

Non-point sources of pollution are those who arrive from different sources of origin. Examples are run off from agriculture, urban waste etc.

Some of the important source of water pollution are —

- 1) Urbanisation
- 2) Agro chemical waste
- 3) Industrial waste
- 4) Sewage and other oxygen demanding wastes
- 5) Radioactive waste
- 6) Climate change.



Effect of Water Pollution :

Water Pollution can bring about disastrous consequences — for instance, a factory that pumped out a toxic waste product into water

directly contributed to causing neurological illness to an entire town for many decades. The following are the effects :-

- 1) Water pollution drastically affects human health; in fact, it can kill.
- 2) It can cause contamination of drinking water - thereby contributing to waterborne illness.
- 3) Water Pollution can cause a phenomenon called eutrophication. This can cause fish and other aquatic organisms to die.



- 4) Toxic elements dissolved in water can make their way to humans through aquatic organisms.
- 5) Water Pollution also leaches chemicals into the soil that may impact the growth of plants, or other food crops.

In 2015 alone, a study revealed that waterborne illness caused 1.8 million deaths worldwide.

Measures to Control Water Pollution:

The key challenges to better management of the water quality comprise of temporal and spatial variation of Rainfall, uneven geographical distribution of surface water resources, persistent droughts, overuse of ground water and contamination drainage, untreated waste water from urban areas etc. Some of the control measures are given below:

- 1) In most countries, waste water from domestic sources is hardly treated, due to sanitation facilities. This waste water, containing highly organic pollutant load, finds its way into surface courses near the vicinity of human habitation from where further water is drawn for use, considerable investments should be done to install the treatment systems.
- 2) With rapid industrialization and urbanization, the water requirement for energy and industrial use is estimated to rise to about 15 percent of the total requirements in 2025. Poor environmental management system, especially in industries, have led to discharge of highly toxic and organic waste-waters. This has resulted in pollution of the surface

and groundwater sources from which water is also drawn for domestic purposes. The enforcement of regulations regarding discharge of industrial waste-water and limits to extraction of groundwater needs to be considerably strengthened, while more incentives are required for promoting waste water reuse and recycling.

3) For the agricultural sector, water and electricity for irrigation are subsidized for political reasons. This leads to wasteful flood irrigation rather than adoption of more optimal practices such as drip irrigation, cropping patterns and farming practices should be encouraged for judicious use of water.

4) In India, the Ganga Action plan and the national river action plan are being implemented for addressing the task of trapping, diversion and treatment of municipal waste water.

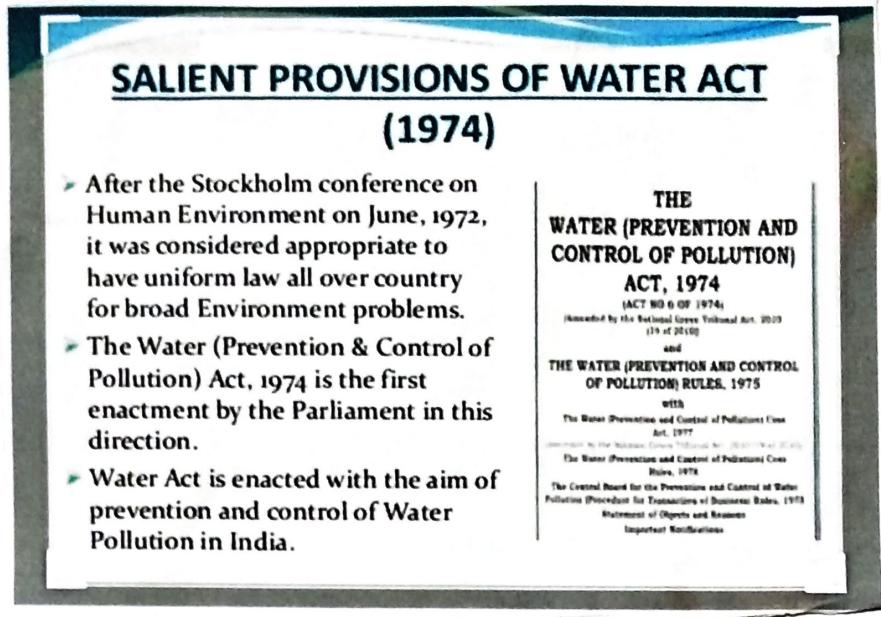
5) The central pollution control Board and state Pollution control Boards composition, terms and conditions of service of members are defined in sections 3-12 of water act, 1974.

The central Board may perform all or any of the following functions, namely:-

i) advise central government about control of Water Pollution.

ii) investigate and research relating to problems of water pollution.

iii) collect, compile and publish technical and statistical data relating to water pollution etc.



6) There should be ban on washing clothes and laundry alongside the river bank.

7) Industries should install Effluent treatment plant (ETP) to control pollution at source.

8) All towns and cities must have sewage Treatment plant (STP) that clean up the sewage effluents.



RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

ENVIRONMENTAL STUDIES

PROJECT TITLE: *water pollution
and measures to control it.*

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COLLEGE ROLL NO : SNUG/085/19
DEPARTMENT : Sanskrit
YEAR : 2020
SIGNATURE : Ayan Adhikari

Introduction of water pollution \Rightarrow water is typically referred to as polluted when it is impaired by anthropogenic contaminants. Due to these contaminants it either does not support a human use, such as drinking water, or undergoes a marked shift in its ability to support its biotic communities, such as fish. Natural phenomena such as volcanoes, algae blooms, storms, and earthquakes also cause major changes in water quality and the ecological status of water.

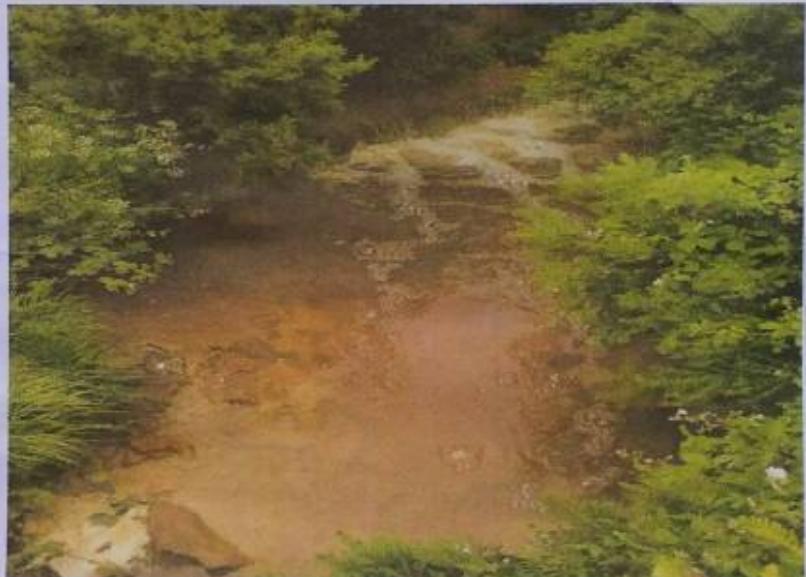
Water pollution is a major global problem. It requires ongoing evaluation and revision of water resource policy at all levels (international down to individual aquifers and wells). It has been suggested that water pollution is the leading worldwide cause of death and diseases. Water pollution accounted for deaths of 1.8 million people in 2015.

India and China are two countries with high levels of water pollution. In addition to the acute problems of water pollution in developing countries, developed countries also continue to struggle with pollution problems.

Water pollution \Rightarrow Water pollution is the contamination of water bodies, usually as a result of human activities. Water bodies include for example lakes, rivers, oceans, aquifers and groundwater. Water pollution results when contaminants are introduced into the natural environment. For example, releasing inadequately treated wastewater into natural water bodies can lead to degradation of aquatic ecosystems. In turn, this can lead to public health problems for people living



water pollution



A polluted river draining an abandoned copper mine on Anglesey

downstream. They may use the same polluted river water for drinking or bathing or irrigation. Water pollution is the leading worldwide cause of death and disease, e.g. due to water-borne diseases.

Water pollution can be classified as surface water or groundwater pollution. Marine pollution and nutrient pollution are subsets of water pollution. Sources of water pollution are either point sources or non-point sources.

The causes of water pollution include a wide range of chemicals and pathogens as well as physical parameters.

Types of water pollution :

■ Surface water pollution : Surface water pollution includes pollution of rivers, lakes and oceans. A subset of surface water pollution is marine pollution.

● Marine pollution : One common path of entry by contaminants to the sea are rivers. An example is directly discharging sewage and industrial waste into the ocean. Pollution such as this occurs particularly in developing nations. Large gyres (vortexes) in the oceans trap floating plastic debris; plastic debris can absorb toxic chemicals from ocean pollution, potentially poisoning any creature that eats it.

■ Ground water pollution : Interactions between groundwater and surface water are complex. Consequently, groundwater pollution, also referred to as groundwater contamination, is not as easily classified as surface water pollution. By its very nature, groundwater aquifers are susceptible to contamination from sources that may

not directly affect surface water bodies. Analysis of groundwater contamination may focus on soil characteristics and site geology, hydrology, and the nature of the contaminants.

Categories of pollution sources → Surface water and groundwater have often been studied and managed as separate resources even though they are interrelated. Surface water seeps through the soil and becomes groundwater can also feed surface water pollution are generally grouped into two categories based on their origin.

- Point sources → point source water pollution refers to contaminants that enter a waterway from a single, identifiable source, such as a pipe or ditch. Examples of sources in this category include discharges from a sewage treatment plant, a factory, or a city storm drain. The U.S. clean water act (CWA) defines point source for regulatory enforcement purposes.

- Non-point sources → Non-point sources pollution refers to diffuse contamination that does not originate from a single discrete source. This type of pollution is often the cumulative effect of small amounts of contaminants gathered from a large area. A common example is the leaching out of nitrogen compounds from fertilized agricultural lands. Nutrient runoff in storm water from "sheet flow" over an agricultural field or a forest, are also cited as examples of non-point source pollution.



Fecal sludge collected from pit latrines is dumped into a river at the Korogocho slum in Nairobi, Kenya.

Contaminants and their sources → the specific contaminants leading to pollution in water include a wide spectrum of chemicals, pathogens and physical changes such as elevated temperature and discolouration. While many of the chemicals and substances that are regulated may be naturally occurring (calcium, sodium, iron, manganese, etc.) the concentration usually determines what is a natural component of water and what is a contaminant. High concentrations of naturally occurring substances can have negative impacts on aquatic flora and fauna.

- pathogens → Disease-causing microorganisms are referred to as pathogens. Pathogens can produce waterborne diseases in either human or animal hosts. Coliform bacteria, which are not an actual cause of disease, are commonly used as a bacterial indicator of water pollution. Other microorganisms sometimes found in contaminated surface waters that have caused human health problems include:

- *Acinetobacter pseudomallei*.
- *Cryptosporidium parvum*.
- *Giardia lamblia*
- *Salmonella*
- Norovirus and other viruses.
- parasitic worms including the schistosoma type.

High levels of pathogens may result from on-site sanitation systems (septic tanks, pit latrines) or inadequately treated sewage discharges.



A garbage collection boom in an urban-area stream in Auckland, New Zealand.

organic, inorganic and macroscopic contaminants →

contaminants may include organic and inorganic substances. Many of the chemical substances are toxic. organic water pollutants include:

- Detergents.
- Disinfection by-products found in chemically disinfected drinking water, such as chloroform.
- Insecticides and herbicides, a huge range of organohalides and other chemical compounds.
- Various chemical compounds found in personal hygiene and cosmetic products.

inorganic water pollutants include:

- Ammonia from food processing waste.
- chemical waste as industrial by products.
- Heavy metals from motor vehicles (via urban storm water runoff) and acid mine drainage.

Macroscopic pollution - large visible items polluting the water - may be termed 'floatables' in an urban storm water context, or marine derelicts when found on the open seas, and can include such items as:

- Trash or garbage (e.g. paper, plastics or food waste) discarded by people on the ground, along with accidental or intentional dumping of rubbish, that are washed by rainfall into storm drains and eventually discharged into surface waters.
- Nurdles, small ubiquitous waterborne plastic pellets.
- shipwrecks, large derelict ships.

Change in Temperature \Rightarrow Thermal pollution is the rise or fall in the temperature of a natural body of water caused by human influence. Thermal pollution, unlike chemical pollution, results in a change in the physical properties of water. A common cause of thermal pollution is the use of water as a coolant by power plants and industrial manufacturers. Elevated water temperatures decrease oxygen levels, which can kill fish and alter food chain composition, reduce species biodiversity, and foster invasion by new thermophilic species. Urban runoff may also elevate temperature in surface waters.

Measurement \Rightarrow Water pollution may be analyzed through several broad categories of methods: physical, chemical and biological. Most involve collection of samples, followed by specialized analytical tests. Some methods may be conducted *in situ*, without sampling, such as temperature. Government agencies and research organizations have published standardized, validated analytical test methods to facilitate the comparability of results from disparate testing events.

■ Sampling \Rightarrow Sampling of water for physical or chemical testing can be done by several methods, depending on the accuracy needed and the characteristics of the contaminant. Many contamination events are sharply restricted in time, most commonly in association with rain events. For this reason "grab" samples are often inadequate for fully quantifying contaminant levels. Scientists gathering this type of data often employ auto-sampler devices that pump increments of water at either time or

discharge intervals.

Sampling for biological testing involves collection of plants and animals from the surface water body. Depending on the type of assessment, the organisms may be identified for biosurveys (population counts) and returned to the water body, or they may be dissected for bioassays to determine toxicity.

- Physical Testing ⇒ common physical tests of water include temperature, solids concentrations (e.g., total suspended solids (TSS)) and turbidity.

- Chemical Testing ⇒ water samples may be examined using the principles of analytical chemistry. Many published test methods are available for both organic and inorganic compounds. Frequently used methods include pH, biochemical oxygen demand (BOD), chemical oxygen demand (COD), nutrients (nitrate and phosphorus compounds), metals (including copper, zinc, cadmium, lead and mercury), oil and grease, total petroleum hydrocarbons (TPH), and pesticides.

- Biological Testing ⇒ Biological Testing involves the use of plant, animal or microbial indicators to monitor the health of an aquatic ecosystem. They are any biological species or group of species whose function, population, or status can reveal what degree of ecosystem or environmental integrity is present. One example of a group of bio-indicators are the copepods and the other small water crustaceans that are present in many water bodies. Such organisms can be monitored for changes (biochemical,



deer island wastewater Treatment plant
serving Boston, Massachusetts and vicinity

physiological, or behavioral) that may indicate a problem within their ecosystem.

Control of pollution :

■ Municipal wastewater Treatment : In urban areas of developed countries, municipal wastewater (or sewage) is typically treated by centralized sewage treatment plants. well-designed and operated systems (i.e., with secondary treatment steps or more advanced treatment) can remove 90 percent or more of the pollutant load in sewage. Some plants have additional systems to remove nutrients and pathogens, but these more advanced treatment steps get progressively more expensive.

Nature-based solutions are also being used instead of (or in combination with) centralized treatment plants.

Cities with sanitary sewer overflows or combined sewer overflows employ one or more engineering approaches to reduce discharges of untreated sewage including:

- utilizing a green infrastructure approach to improve storm water management capacity throughout the system, and reduce the hydraulic overloading of the treatment plant.
- Repair and replacement of leaking and malfunctioning equipment.
- increasing overall hydraulic capacity of the sewage collection system (often a very expensive option).

on-site sanitation and safely managed sanitation :

Households or businesses not served by a municipal treatment plant may have an individual septic tank, which pre-tests the wastewater on site and infiltrates it into the soil. Improperly designed or installed septic

systems can cause groundwater pollution.

Globally, about 4.5 billion people do not have safely managed sanitation as of 2017, according to an estimate by the joint monitoring programme of water supply and sanitation.

Lack of access to sanitation often leads to water pollution, e.g. via the practice of open defecation: during rain events or floods, the human faeces are moved from the ground where they were deposited into surface waters. Simple pit latrines may also get flooded during rain events. The use of safely managed sanitation services would prevent this type of water pollution.

■ Industrial wastewater Treatment : Some industrial facilities generate wastewater that is similar to domestic sewage and can be treated by sewage treatment plants. Industries that generate wastewater with high concentrations of organic matter (e.g. oil and grease), toxic pollutants (e.g. heavy metals, volatile organic compounds) or nutrients such as ammonia, need specialized treatment systems. Some industries install a pre-treatment system to remove some pollutants (e.g. toxic compounds), and then discharge the partially treated wastewater to the municipal sewer system. Industries generating large volumes of wastewater typically operate their own treatment systems. Some industries have been successful at redesigning their manufacturing processes to reduce or eliminate pollutants, through a process called pollution prevention.

To remove heat from wastewater generated by power plants or manufacturing plants the following technologies are used:

- cooling ponds, man-made bodies of water designed for

cooling by evaporation, convection and radiation.

- cooling towers, which transfer waste heat to the atmosphere through evaporation or heat transfer.
- cogeneration, a process where waste heat is recycled for domestic or industrial heating purposes.

■ Agricultural wastewater Treatment :

- non point source controls : Sediment (loose soil) washed off fields is the largest source of agricultural pollution in the United States. Farmers may utilize erosion controls to reduce runoff flows and retain soil on their fields. Common techniques include contour plowing, crop mulching, crop rotation, planting perennial crops and installing riparian buffers.

Nutrients (nitrogen and phosphorus) are typically applied to farmland as commercial fertilizer, animal manure, or spraying of municipal or industrial wastewater (effluent) or sludge. Nutrients may also enter runoff from crop residues, irrigation water, wildlife, and atmospheric deposition. Farmers can develop and implement nutrient management plans to reduce nutrient management plans to reduce excess application of nutrients and reduce the potential for nutrient pollution.

To minimize pesticide impacts, farmers may use integrated pest management (IPM) techniques (which can include biological pest control) to maintain control over pests, reduce reliance on chemical pesticides, and protect water quality.

- point source wastewater treatment : Farms with large livestock and poultry operations, such as factory farms, are called concentrated animal feeding operations or feedlots in the US and are being ~~very~~ subject to increasing



Retention basin for controlling
urban runoff

government regulation. Animal slurries are usually treated by contaminant in anaerobic lagoons before disposal by spray or trickle application to grassland. constructed wetlands are sometimes used to facilitate treatment of animal wastes. Some animal slurries are treated by mixing with straw and composted at high temperature to produce a bacteriologically sterile and friable manure for soil improvement.

- Erosion and sediment control from construction sites:
Sediment from construction sites is managed by installation of:

- erosion controls, such as mulching and hydroseeding, and
- sediment controls, such as sediment basins and silt fences.
- discharge of toxic chemicals such as motor fuels and concrete washout is prevented by use of :
- spill prevention and control plans and
- specially designed containers (e.g. for concrete washout) and structures such as overflow controls and diversion berms.
- control of urban runoff (storm water):

Effective control of urban runoff involves reducing the velocity and flow of storm water, as well as reducing pollutant discharges. Local governments use a variety of storm water management techniques to reduce the effects of urban runoff. These techniques, called best management practices of water pollution (BMPs) in the U.S., may focus on water quantity control, while others focus on improving water quality, and some perform both functions.

Pollution prevention practices include low-impact development techniques, installation of green roofs and improved chemical handling (e.g. management of motor fuels & oil, fertilizers and pesticides). Runoff mitigation systems include

infiltration basins, bioretention systems, constructed wetlands, retention basins and similar devices.

Thermal pollution from runoff can be controlled by storm water management facilities. Facilities that absorb the runoff or direct it into groundwater, such as bioretention systems and infiltration basins. Retention basins tend to be less effective at reducing temperature, as the water may be heated by the sun before being discharged to a receiving stream.

Data collection → All the data of this project have been collected from Google and my friends.

ACKNOWLEDGEMENT

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

I respect and thank prof. N.C. Maity, for providing me an opportunity to do the project work & giving us all support and guidance which made me complete the project work.

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

ENVIRONMENTAL STUDIES

PROJECT TITLE:

Nitrogen cycle and its importance
for human beings

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DEPARTMENT : Computer Science
YEAR : 2020
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NITROGEN CYCLE

Nitrogen is one of the primary nutrients critical for the survival of all living organisms. Although nitrogen is very abundant in the atmosphere, it is largely inaccessible in this form to most organisms. This project explores how nitrogen becomes available to organisms and what changes in nitrogen levels as a result of human activity means to local and global ecosystems.

Introduction

Nitrogen is one of the primary nutrients critical for the survival of all living organisms. It is a necessary component of many biomolecules, including proteins, DNA, and chlorophyll. Although nitrogen is very abundant in the atmosphere as dinitrogen gas (N_2), it is largely inaccessible in this form to most organisms, making nitrogen a scarce resource and often limiting primary productivity in many ecosystems. Only when nitrogen is converted into ammonia (NH_3) does it become available to primary producers, such as plants.

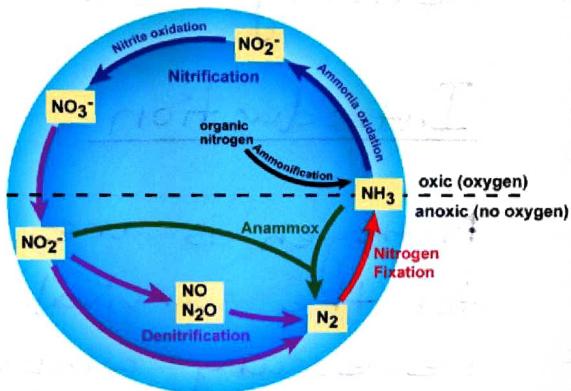
In addition to N_2 and NH_3 , nitrogen exists in many different forms, including both inorganic and organic forms. Thus, nitrogen undergoes

many different transformations in the ecosystem changing from one form to another as organisms use it for growth and, in some cases, energy.

The major transformations of nitrogen are nitrogen fixation, nitrification, denitrification, anammox, and ammonification. The transformation of nitrogen into its many oxidation states is key to productivity in the biosphere and is highly dependent on the activities of a diverse assemblage of microorganisms such as bacteria, archaea and fungi.

Since the mid-1900s, humans have been exerting an ever-increasing impact on the global nitrogen cycle. Human activities, such as making fertilizers and burning fossil fuels, have significantly altered the amount of fixed nitrogen in the Earth's surface.

In fact, some predict by 2030, the amount of nitrogen fixed by human activities will exceed that fixed by natural processes. Increases in available nitrogen can alter ecosystems by increasing primary productivity and impacting carbon storage. Because of the importance of nitrogen in all ecosystems and the significant impact from all human activities, nitrogen and its transformations have received a great deal of attention from ecologists.



Nitrogen Fixation

Nitrogen gas (N_2) makes up nearly 80% of the Earth's atmosphere, yet nitrogen is often the nutrient that limits primary production in many ecosystems. Why is this so? Because plants and animals are not able to use nitrogen gas in that form. For nitrogen to be available to make proteins, DNA, and other biologically important compounds, it must first be converted into a different chemical form. The process of converting N_2 into biologically available nitrogen is called nitrogen fixation. N_2 gas is a very stable compound due to the strength of the triple bond between the nitrogen atoms, and it requires a large amount of energy to break this bond. The whole process requires eight electrons and at least sixteen ATP molecules. As a result, only a select group of prokaryotes, some lightning or certain industrial processes, including the combustion of fossil fuels.



Some nitrogen-fixing organisms are free-living while others are symbiotic associations, which require a close association with a host to carry out the process. Most of the symbiotic associations are very specific and have complex mechanisms that help to maintain the symbiosis. For example, root exudates from legume

Plants serve as a signal to certain species of Rhizobium, which are nitrogen-fixing bacteria. This signal attracts the bacteria to the roots, and a very complex series of events then occur to initiate uptake of the bacteria into the root and trigger the process of nitrogen fixation in nodules that form on the roots.

Some of these bacteria are aerobic, others are anaerobic; some are phototrophic, others are chemotrophic. Although there is great physiological and phylogenetic diversity among the organisms that carry out nitrogen fixation, they all have a similar enzyme complex called nitrogenase that catalyzes the reduction of N_2 to NH_3 , which can be used as a genetic marker to identify the potential for nitrogen fixation. One of the characteristics of nitrogenase is that the enzyme complex is very sensitive to oxygen and is deactivated in its presence. This presents an interesting dilemma for aerobic nitrogen-fixers and particularly for aerobic nitrogen-fixers that are also photosynthetic since they actually produce oxygen. Over time, nitrogen-fixers have evolved different ways to protect their nitrogenase from oxygen.



Genes for nitrogenase are globally distributed and have been found in many aerobic habitats and also in habitats that may be anaerobic or microaerophilic. The broad distribution of nitrogen-fixing organisms display a very broad range of environmental conditions, as might be expected for a process that is critical to the survival of all life on Earth.

Nitrification

Nitrification is the process that converts ammonia to nitrite and then to nitrate and is another important step in the global nitrogen cycle. Most nitrification occurs aerobically and is carried out exclusively by prokaryotes. There are two distinct steps of nitrification that are carried out by distinct types of microorganisms. The first step is the oxidation of ammonia to nitrite, which is carried out by microbes known as ammonia-oxidizers. Aerobic ammonia oxidizers convert ammonia to nitrite via the intermediate hydroxylamine, a process that requires two different enzymes. The process generates a very small amount of energy relative to many other types of metabolism; as a result, nitrosifiers are notoriously very slow growers. Additionally, aerobic ammonia oxidizers are also autotrophs, fixing carbon dioxide to produce organic carbon, much like photosynthetic organisms, but using ammonia as the energy source instead of light.

Unlike nitrogen fixation that is carried out by many different kinds of microbes, ammonia oxidation is less broadly distributed among prokaryotes. Until recently, it was thought that all ammonia oxidation was carried out by only a few types of bacteria in the genera *Leptothrix*, *Thiobacillus*, and *Nitrobacter*. However, in 2005 an archaeon was discovered that could also oxidize ammonia. Since their discovery, ammonia-oxidizing Archaea have often been found to outnumber the ammonia-oxidizing bacteria in many habitats. In the past several years, ammonia-oxidizing Archaea have been found to be abundant in oceans, soils, and salt marshes, suggesting an important role in the nitrogen cycle for these newly discovered organisms.

The second step in nitrification is the oxidation of nitrite to nitrate. This step is carried out by a completely separate group of prokaryotes, known as nitrite-oxidizing bacteria. Similar to ammonia-oxidizers, the energy is generated from the oxidation of nitrite to nitrate is very small, and thus growth yields are very low. In fact, ammonia and nitrite oxidizers must oxidize many molecules of ammonia or nitrite in order to fix a single molecule of CO_2 . For complete nitrification, both ammonia oxidation and nitrite oxidation must occur.



Ammonia oxidizers and nitrite oxidizers are ubiquitous in aerobic environments. They have been extensively studied in natural environments such as soils, estuaries, lakes, and open-ocean environments. However, ammonia and nitrite oxidizers also play a very important role in wastewater treatment facilities by removing potentially harmful levels of ammonium that could lead to the pollution of the receiving waters. Much research has focused on how to maintain stable populations of these important microbes in wastewater treatment plants. Additionally, ammonia and nitrite oxidizers help to maintain healthy aquaria by facilitating the removal of potentially toxic ammonium excreted in fish urine.

Anammox

Traditionally, all nitrification was thought to be carried out under aerobic conditions, but recently a new type of ammonia oxidation occurring under anoxic conditions was discovered. Anammox is carried out by prokaryotes belonging to the Planctomycetes phylum of bacteria. Anammox bacteria oxidize ammonia by using nitrite as the electron acceptor to produce gaseous nitrogen. Anammox bacteria were first discovered in anoxic bioreactors of wastewater treatment plants but have since been found in a variety of aquatic systems, including low-oxygen zones of the ocean, coastal and estuarine sediments, mangroves, and freshwater lakes.

In some areas of the ocean, the anammox process is considered to be responsible for a significant loss of nitrogen. However, some argue that denitrification rather than anammox is responsible for most nitrogen loss in other areas. Whether anammox or denitrification is responsible for most nitrogen loss in the ocean, it is clear that anammox represents an important process in the global nitrogen cycle.



Denitrification

Denitrification is the process that converts nitrate to nitrogen gas, thus removing bioavailable nitrogen and returning it to the atmosphere. Dinitrogen gas (N_2) is the ultimate end product of denitrification, but other intermediate gaseous forms of nitrogen exist. Some of these gases, such as nitrous oxide (N_2O), are considered greenhouse gases, reacting with ozone and contributing to air pollution.

Genus	Phylogenetic Affiliation	Lifestyle
<i>Nostoc, Anabaena</i>	Bacteria (Cyanobacteria)	free-living, aerobic, phototrophic
<i>Pseudomonas, Azotobacter, Methylomonas</i>	Bacteria	free-living, aerobic, chemoorganotrophic
<i>Alcaligenes, Thiobacillus</i>	Bacteria	free-living, aerobic, chemolithotrophic
<i>Methanosarcina, Methanococcus</i>	Archaea	free-living, anaerobic, chemolithotrophic
<i>Chromatium, Chlorobium</i>	Bacteria	free-living, anaerobic, phototrophic
<i>Desulfovibrio, Clostridium</i>	Bacteria	free-living, anaerobic, chemoorganotrophic
<i>Rhizobium, Frankia</i>	Bacteria	symbiotic, aerobic, chemoorganotrophic

Unlike nitrification, denitrification is an aerobic process, occurring mostly in soils and sediments and anoxic zones in lakes and oceans. Similar to nitrogen fixation, denitrification is carried out by a diverse group of prokaryotes, and there is recent evidence that some eukaryotes are also capable of denitrification. Some denitrifying bacteria include species in the genera *Bacillus*, *Paracoccus* and *Pseudomonas*. Denitrifiers are chemoorganotrophs and thus must also be supplied with some form of organic carbon.

Denitrification is important in that it removes fixed nitrogen from the ecosystem and returns it to the atmosphere in a biologically inert form. This is particularly important in agriculture where the loss of nitrates in fertilizer is detrimental and costly. However, denitrification in wastewater treatment plays a very beneficial role by removing unwanted nitrates from the wastewater effluent, thereby reducing the chances that the water discharged from the treatment plants will cause undesirable consequences.

Ecological Implications

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 alterations of the nitrogen cycle in both aquatic and terrestrial ecosystems. Industrial nitrogen fixation has increased exponentially since the 1940s, and human activity has doubled the amount of global nitrogen fixation.

Much of the nitrogen applied to agricultural and urban areas ultimately enters rivers and nearshore coastal systems. In nearshore marine systems, increases in nitrogen can often lead to anoxia or hypoxia, altered biodiversity, changes in food-web structure, and general habitat degradation. One common consequence of increased nitrogen is an increase in harmful algal blooms. Toxic blooms of certain types of dinoflagellates have been associated with high fish and shellfish mortality in some areas. Even without such economically catastrophic effects, the addition of nitrogen can lead to changes in biodiversity and species composition that may lead to changes in overall ecosystem function. Some have even suggested that alterations to the nitrogen cycle may lead to an increased risk of parasitic and infectious diseases among humans and wildlife.

Summary

Nitrogen is arguably the most important nutrient in regulating primary productivity and species diversity in both aquatic and terrestrial ecosystems. Microbial link 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 ecosystems.

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

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

ENVIRONMENTAL STUDIES

PROJECT TITLE:

Nitrogen Cycle and its importance for living beings

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DEPARTMENT : Physics

YEAR : 2020

SIGNATURE : Ayan Kumar Garai

Nitrogen cycle and its importance for living beings

■ Introduction:- Nitrogen is one of the primary nutrients critical for the survival of all living organisms. It is a necessary component of many biomolecules, including proteins, DNA and chlorophyll. Although nitrogen is very abundant in the atmosphere as dinitrogen gas (N_2), it is largely inaccessible in this form to most organisms, making nitrogen a scarce resource and often limiting primary productivity in many ecosystems. Only when nitrogen is converted from dinitrogen gas into ammonia (NH_3) does it become available to primary producers, such as plants.

In addition to N_2 and NH_3 , nitrogen exists in many different forms, including both inorganic (e.g., ammonia, nitrate) and organic (e.g., amino and nucleic acids) forms. Thus, nitrogen undergoes many different transformations in the ecosystem, changing from one form to another as organisms use it for growth and, in some cases, energy. The major transformations of nitrogen are nitrogen fixation, nitrification, denitrification, ammonification. The transformations of nitrogen into its many oxidation states is key to productivity in a biosphere and is highly dependent on the activities of a diverse assemblage of microorganisms, such as bacteria, fungi.

Q What is Nitrogen Cycle :- Nitrogen cycle is a biogeochemical process through which nitrogen is converted into many forms, consecutively passing from the atmosphere to the soil to organism and back into the atmosphere.

It involves several processes such as nitrogen fixation, nitrification, denitrification. Inorganic forms of nitrogen are found in abundance in the atmosphere. This nitrogen is made available to plants by symbiotic bacteria which can convert the inert nitrogen into a usable form - such as nitrites and nitrates.

The stages of Nitrogen cycle are -

Nitrogen Fixation : It is the initial step of the nitrogen cycle. Here, Atmospheric nitrogen (N_2) which is primarily available in an inert form, is converted into the usable form - ammonia (NH_3).

During the process of Nitrogen fixation, the inert form of nitrogen gas is deposited into soils from the atmosphere and surface waters, mainly through precipitation. Later, the nitrogen undergoes a set of changes, in which two nitrogen atoms get separated and combine with hydrogen to form ammonia (NH_4^+).

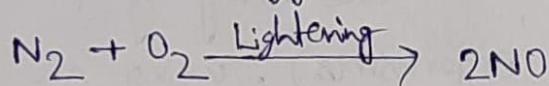
The entire process of Nitrogen fixation is completed by symbiotic bacteria. Azotobacter and Rhizobium also have a

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A point of special interest is that the nitrogenase enzyme complex is highly sensitive to oxygen. It is inactivated when exposed to oxygen, because this reacts with the iron component of the proteins. Although this is not a problem for anaerobic bacteria, it could be a major problem for the aerobic species such as cyanobacteria (which generates oxygen during photosynthesis) and the free-living aerobic bacteria of soils, such as Azotobacter and Beijerinckia. Azotobacter species have the highest known rate of respiratory metabolism of any organism, so they might protect the enzyme by maintaining a very low level of oxygen in their cells.

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Symbiotic nitrogen fixation

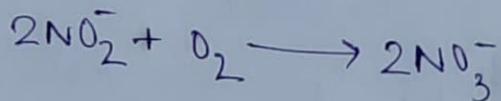
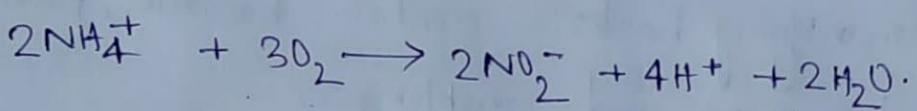
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Nitrification:- In this process, the ammonia is converted into nitrate by the presence of bacteria in the soil. Nitrates are formed by the oxidation of Ammonia with the help of Nitrosomonas bacterium species. Later, the produced nitrites are converted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

The reaction involved in the process of Nitrification is as follows.



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

Ammonification:-

Ammonification is a part of nitrogen cycle, where organisms are provided with essential nitrogen that they need to survive. Ammonification is the process, where microscopic organisms like bacteria or other types of decomposing organisms break down nitrogen containing chemicals from dead organic matter, into simple substances like ammonia. These simpler substances help in sustaining the ecosystem. In simple terms, ammonification is the process of converting natural nitrogen compounds into ammonia.

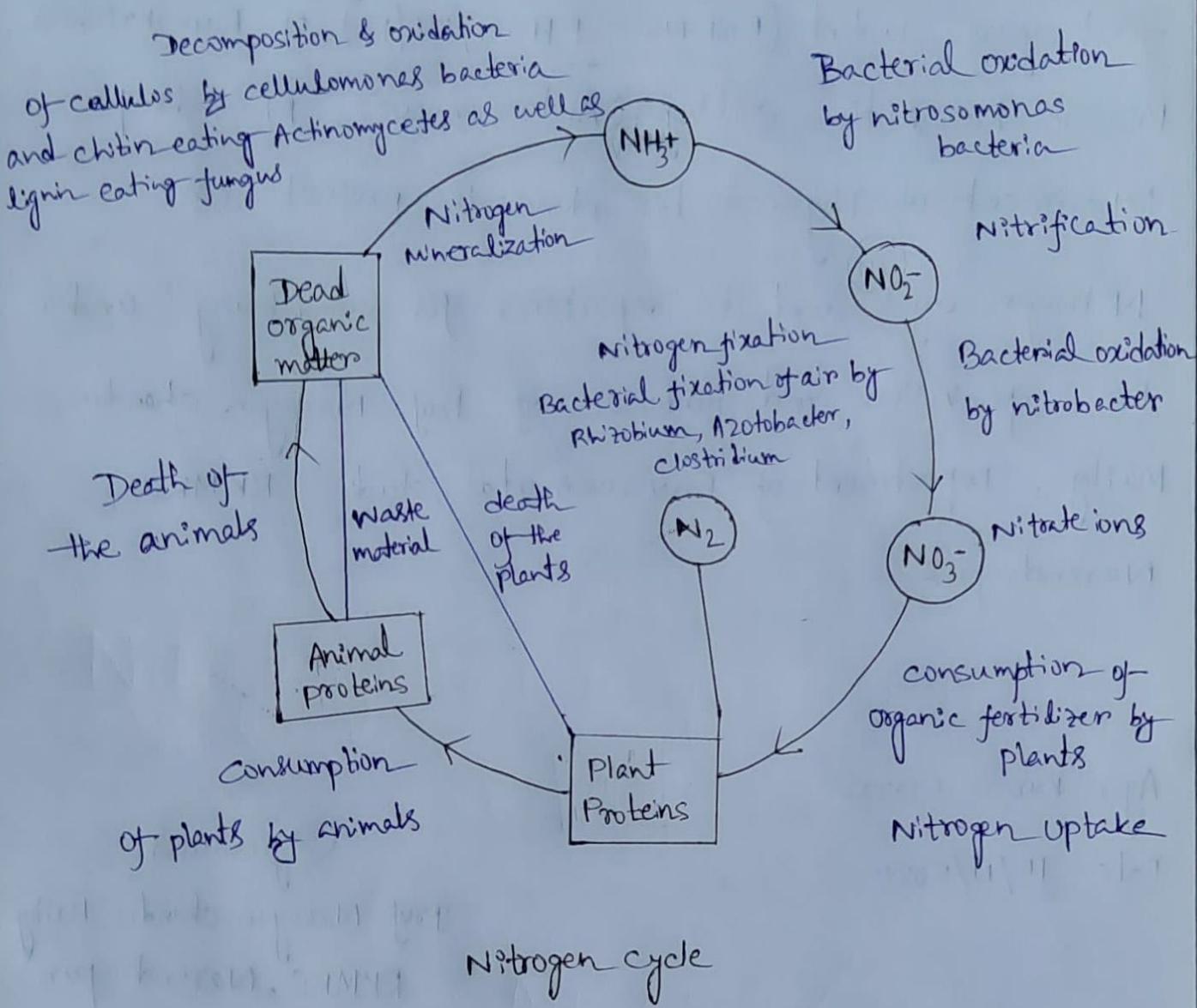
Examples of ammonifying bacteria contain bacillus, proteus, clostridium, pseudomonas and streptomyces.

Implications of Ammonification:

- Nitrogen in the ecosystem should be available in the form that can be used by living species. This is where ammonification plays an important role, as they provide nitrogen to the soil in a manner that lets plants use nitrogen and pass it through the food chain.
- For many species of plants surviving in acidic soils, ammonification is the best method to obtain nitrogen.
- When fertilizers are added into the soil to increase ammonia levels, it might cause overgrowth of algae, which results in toxicity of soil and imbalance in ecosystems.

Denitrification: Denitrification is the process in which the nitrogen compounds makes its way back into the atmosphere by converting nitrate (NO_3^-) into gaseous nitrogen. This process of the nitrogen cycle is the final stage and occurs in the absence of oxygen. Denitrification is carried out by the denitrifying bacterial species - Clostridium and Pseudomonas, which will process nitrate to gain oxygen and gives out free nitrogen gas as a byproduct.

Nitrogen cycle in Marine Ecosystem :- The process of the nitrogen cycle occurs in the same manner in the marine ecosystem as in the terrestrial ecosystem. The only difference is that it is carried out by marine bacteria. The nitrogen containing compounds that fall into the ocean as sediments get compressed over long periods and form sedimentary rock. Due to the geological uplift, these sedimentary rocks move to land. Initially, it was not known that these nitrogen containing sedimentary rocks are an essential source of nitrogen. But recent researches proved that the nitrogen from these rocks is released into the plants due to the weathering of rocks.



Importance for the living beings :- Importance of nitrogen cycle are as follows.

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

Ecological implications of Human Alterations to the Nitrogen cycle :- Many human activities have a significant impact on the nitrogen cycle. Burning fossil fuels, applications of nitrogen based fertilizers and other activities can dramatically increase the amount of biologically available nitrogen in an ecosystem.

In terrestrial ecosystems, the addition of nitrogen can 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 just the nitrogen cycle. Usually in the form of nitrate, can leach out of the soil, enter streams and rivers, and ultimately make its way into our drinking water.

Much of the nitrogen applied to the agriculture and urban areas ultimately enters 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 in food-web structure, and general habitat degradation.

Conclusion :- Nitrogen is arguably 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 ecosystems. However as human populations continue to increase the consequences of human activities continue to threaten our resources and have already significantly altered the global nitrogen cycle.

Certificate

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Date - 15/11/2020

(Signature)

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RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

ENVIRONMENTAL STUDIES

PROJECT TITLE:

Nitrogen Cycle and its importance for living beings

NAME : Ayan Kumar Garai

COLLEGE ROLL NO : PHUGI/136/19

DEPARTMENT : Physics

YEAR : 2020

SIGNATURE : Ayan Kumar Garai

Nitrogen cycle and its importance for living beings

■ Introduction:- Nitrogen is one of the primary nutrients critical for the survival of all living organisms. It is a necessary component of many biomolecules, including proteins, DNA and chlorophyll. Although nitrogen is very abundant in the atmosphere as dinitrogen gas (N_2), it is largely inaccessible in this form to most organisms, making nitrogen a scarce resource and often limiting primary productivity in many ecosystems. Only when nitrogen is converted from dinitrogen gas into ammonia (NH_3) does it become available to primary producers, such as plants.

In addition to N_2 and NH_3 , nitrogen exists in many different forms, including both inorganic (e.g., ammonia, nitrate) and organic (e.g., amino and nucleic acids) forms. Thus, nitrogen undergoes many different transformations in the ecosystem, changing from one form to another as organisms use it for growth and, in some cases, energy. The major transformations of nitrogen are nitrogen fixation, nitrification, denitrification, ammonification. The transformations of nitrogen into its many oxidation states is key to productivity in a biosphere and is highly dependent on the activities of a diverse assemblage of microorganisms, such as bacteria, fungi.

Q What is Nitrogen Cycle :- Nitrogen cycle is a biogeochemical process through which nitrogen is converted into many forms, consecutively passing from the atmosphere to the soil to organism and back into the atmosphere.

It involves several processes such as nitrogen fixation, nitrification, denitrification. Inorganic forms of nitrogen are found in abundance in the atmosphere. This nitrogen is made available to plants by symbiotic bacteria which can convert the inert nitrogen into a usable form - such as nitrites and nitrates.

The stages of Nitrogen cycle are -

Nitrogen Fixation : It is the initial step of the nitrogen cycle. Here, Atmospheric nitrogen (N_2) which is primarily available in an inert form, is converted into the usable form - ammonia (NH_3).

During the process of Nitrogen fixation, the inert form of nitrogen gas is deposited into soils from the atmosphere and surface waters, mainly through precipitation. Later, the nitrogen undergoes a set of changes, in which two nitrogen atoms get separated and combine with hydrogen to form ammonia (NH_4^+).

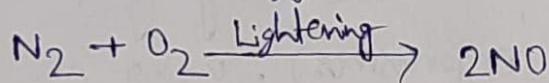
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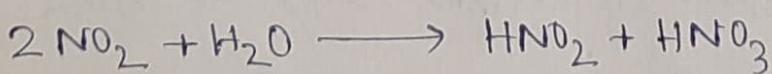
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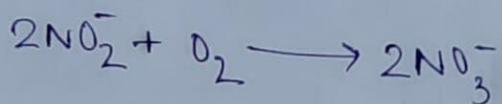
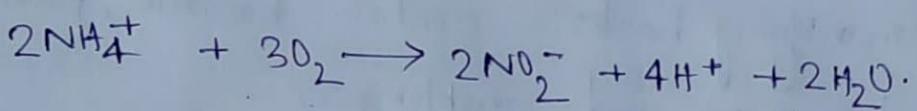
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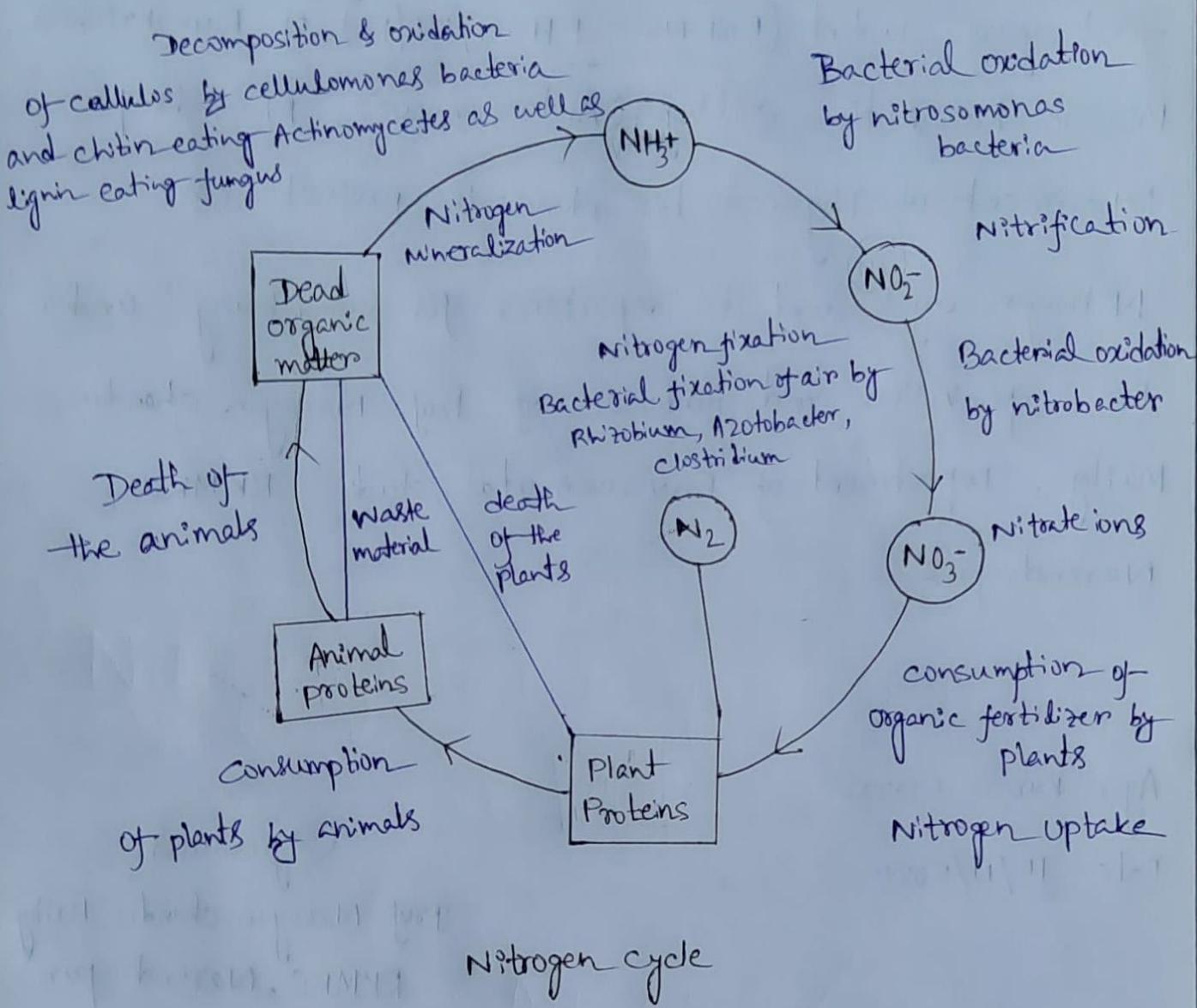
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