

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

ENVIRONMENTAL STUDIES

PROJECT TITLE:

WATER POLLUTION AND MEASURES TO  
CONTROL IT

NAME : SANJAY MONDAL  
COLLEGE ROLL NO : SNUG/089/19  
DEPARTMENT : SANSKRIT  
YEAR : 2020  
SIGNATURE : Sanjay Mondal

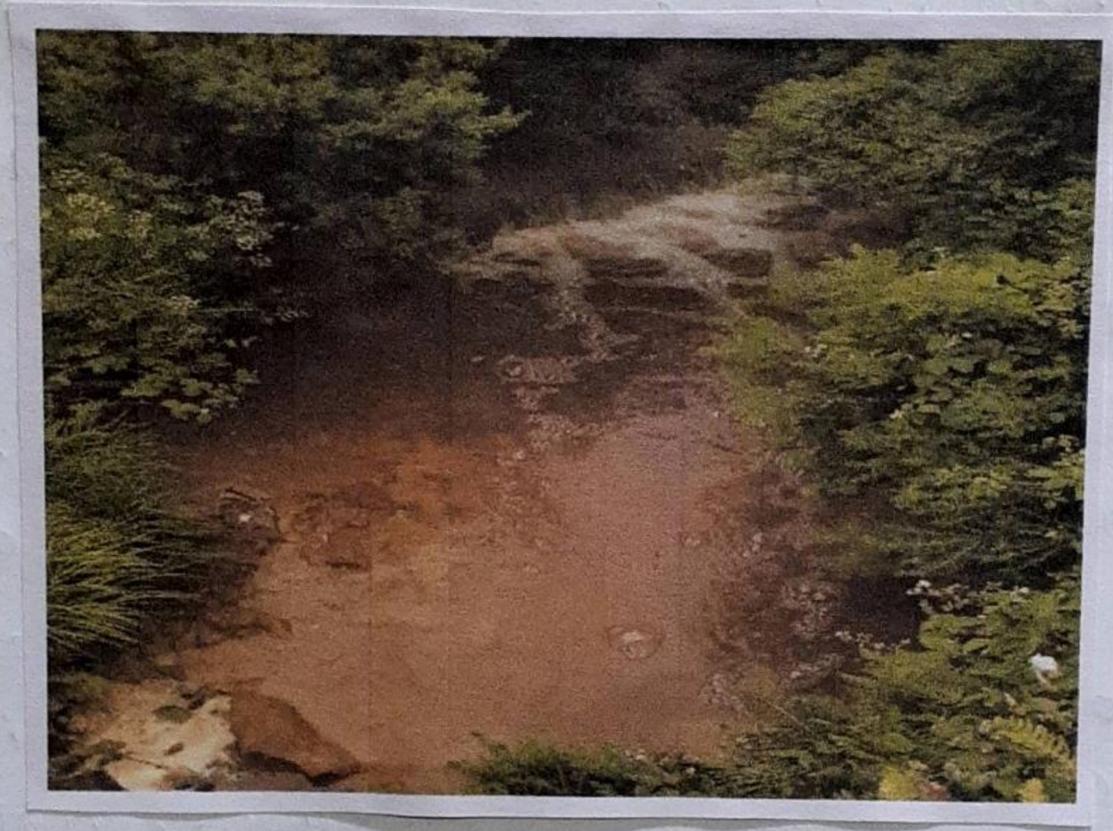
## ● Introduction to water pollution :-

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. It has been suggested that water pollution is the leading worldwide cause of death and diseases. Water pollution accounted for the deaths of 1.8 million people in 2015.

## ● Water pollution :-

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 water environment. For example, releasing inadequately treated wastewater into natural water bodies can lead to degradation of



⇒ Marine pollution

aquatic ecosystems. In turn, this can lead to public health problems for people living downstream. They may use the same polluted river water for drinking or irrigation. Water pollution is the leading worldwide cause of death and disease; e.g. due to water-borne diseases.

### • Types :

#### ■ 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 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. In fact, the 10 largest emitters of oceanic plastic pollution worldwide are, from the most to the least, China, Indonesia, Philippines, Vietnam, Sri Lanka, Thailand, Egypt, Malaysia, Nigeria, and Bangladesh largely through the rivers Yangtze, Indus, Yellow, Hai, Nile, Ganges, Amur, and the Mekong and accounting for 90 percent of all the



→ Farmer water pollution

plastic that reaches the the world's oceans.

### ■ 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.

### ● 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 contami-

nants that enter a waterway from a single, identifiable source, such as a pipe or ditch. Example of sources in this category include discharges from a sewage treatment plant, a factory, or a city storm drain.

### ▣ NON-point sources :-

Nonpoint source 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.

### ● 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 discoloration. While many of the chemicals and substances that are regulated may be naturally occurring the concentration usually determines what is a nature component of water



⇒ pathogens

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 water-borne 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:

- Burkholderia pseudomallei
- Cryptosporidium parvum
- Giardia lamblia
- Salmonella
- Norovirus and other viruses
- Parasitic worms including the Schistosoma type.

### ● Organic, inorganic and macroscopic contaminants :-

contaminants may include organic and inorganic substances. Many of the chemical



⇒ organic, Inorganic contaminants

substances are toxic.

▣ Organic water pollutants include:-

- Detergents
- Disinfection by-products found in chemically disinfected drinking water, such as chloroform.
- Food processing waste, which can include oxygen-demanding substances, fats and grease.
- Insecticides and herbicides, a huge range of organohalides and other chemical compounds.
- Volatile organic compounds, such as industrial solvents; from improper storage.
- Perchlorate
- Various chemical compounds found in personal hygiene and cosmetic products.

▣ Inorganic water pollutants include:-

- Acidity caused by industrial discharges
- Ammonia from food processing waste.
- Chemical waste as industrial by-products.
- Heavy metals from motor vehicles and acid mine drainage.

- Secretion of creosote preservative into the aquatic ecosystem.

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

- Trash or garbage discarded by people on the ground, along with accidental dumping of rubbish, that are washed by rainfall into storm drains and eventually discharged into surface water.

- Shipwrecks, large derelict ships.

### ● Change in temperature :-

Thermal pollution is the rise or fall in the temperature of a natural body of water caused by human influence. A common cause of thermal pollution, results in a change in 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, and foster invasion by new thermophilic species. Urban runoff may also elevate temperature in surface waters.

## ○ Measurement :-

Water pollution may be analyzed through several broad categories of methods: physical, chemical and biological. Most involve collection of samples, followed by specialized analytical test. 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 :-

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.

### ▣ 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, chemical oxygen demand, nutrients, metals, zinc, cadmium, oil and grease and pesticides.

### ▣ Biological testing :-

Biological testing involves the use of plant, animal indicators to monitor the health of an aquatic ecosystem. They are any biological species of species whose function, population, can reveal what degree of ecosystem is present. one example of a group of bioindicators are the copepods and other small water crustaceans that are present in many water bodies. such organisms can be monitored for changes physiological that may indicate a problem within their ecosystem.



⇒ Municipal wastewater treatment

## ● 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 pollution 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.

### ■ 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-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 do not have safely managed sanitation as of 2017, according to an estimate by the joint Monitoring Programme for water supply and sanitation. 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 needed specialized treatment system. Industries generating large volumes of wastewater typically operate their own treatment systems. Some industrials have been successful at redesigning their manufacturing processes to reduce, through a process called pollution prevention.

### Agricultural wastewater treatment:

#### Non point source controls

Sediment 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.

#### Point source wastewater treatment

Farms with large livestock and poultry operations such as factory farms, are called in the feedlots us and are being subject to increasing government regulation. Animal slurries are usually treated by spray or trickle application to grassland. 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.



→ control of urban runoff

## Erosion and sediment control from construction sites :-

Sediment from construction sites is managed by installation of:

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

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

- Spill prevention and control plans.

## Control of urban runoff (stormwater):

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.

## Data collection:

All the data of this project have been collected from Google, Wikipedia and my friends.

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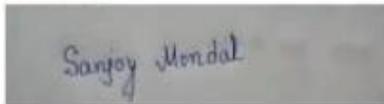


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~~Teacher~~ Teacher's signature

Sanjoy Mondal  
Student Signature

# INTRODUCTION

Environmental Issues :-

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

pollution is any undesirable change in physical, chemical or biological characteristics of air, land, water or soil. Agents that bring about such an undesirable change are called pollutants. In order to control environmental pollution the Government of India has passed the Environment (protection) Act, 1986 to protect and improve the quality of our environment (air, water and soil).

## Air pollution in cities and measures to control it

It is the occurrence or presence of any material or gas in the air in such a concentration which is harmful to man, vegetation, animals and their environment. Substances and factors which cause air pollution are called air pollutants. Air pollution is both natural and anthropogenic. Anthropogenic pollution comes from both mobile and fixed sources. Air pollutants coming directly from the pollution sources are called primary air pollutants ( $\text{CO}$ ,  $\text{SO}_2$ , hydrocarbon). Reaction between two or more primary air pollutants gives rise to secondary air pollutants (ozone, PAN).

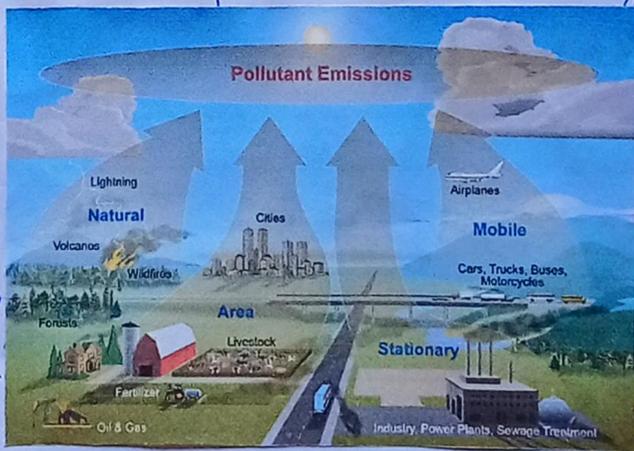
History of air pollution: - The origin of air pollution on the earth can be traced from the times when man started using fire-wood as a means of cooking and heating. Hippocrates has mentioned air pollution in 400 BC. With the discovery and increasing use of coal, air pollution became more pronounced especially in urban areas. It was recognized as a problem 700 years ago in London during the 1st industrial in the form of smoke pollution, which prompted King Edward



I would to make the first antipollution law to restrict people from using coal for domestic heating in the year 1273. In the year 1300 another Act banning the use of coal was passed. Defying the law led to imposition of capital punishment. In spite of this year air pollution became a serious problem in London during the industrial revolution due to the use of coal in industries. The earliest recorded major disaster was the 'London Smog' that occurred in 1952 that resulted in more than 4000 deaths due to the accumulation of air pollutants over the city for five days.

In Europe, around the middle of the 19th century, a black form of the peppered moth was noticed in industrial areas.

Usually the normal peppered moth is well camouflaged on a clean lichen covered tree. However the peppered pattern was easily spotted and picked up by birds on the smoke blackened bark of trees in the industrial area, while the black form remained well camouflaged. Thus while the peppered patterned moths were successful in surviving in clean non-industrial areas



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The black coloured moths were successful in industrial areas. With the spread of industrialization, it has been observed that the black forms are not only seen in peppered moth, but also in many other moths. This is a classic case of pollution leading to adaptation.

Air pollution began to increase in the beginning of the twentieth century with the development of the transportation systems and large-scale use of petrol and diesel. The severe air quality problems due to the formation of photochemical smog from the combustion residues of diesel and petrol engines were felt for the first time in Los Angeles. Pollution due to auto-exhaust remains a serious environmental issue in many developed and developing countries including India.

### Sources of air pollution

The sources of air pollution can be divided into two categories—

#### 1) Natural sources :-

- ⊙ Ash from burning volcanoes, dust from storm, forest fires
- ⊙ Pollen grains from flowers in air



### ii) Anthropogenic (human-made) sources:-

- ① Power stations using coal or crude oil.
- ② Furnaces using coal, cattle dung cakes, firewood, kerosene etc.
- ③ Steam engines used in railways, steamers, motor vehicles, etc.
- ④ Motor and internal combustion engines which run on petrol, diesel, kerosene, etc.
- ⑤ Vegetable oils, kerosene and coal as household fuels.
- ⑥ Sewers and domestic drains emanating foul gases.
- ⑦ Pesticide residues in air

### Major air pollutants

Some major air pollutants are discussed here.  
Carbon dioxide:- Carbon dioxide is one of the major gases which contribute to air pollution. It is mainly produced during the combustion of fuel in factories, power stations, household etc. The increasing  $\text{CO}_2$  in the atmosphere is likely to have the following effects:

- i) Rise in atmosphere temperature due to greenhouse effect.
- ii) Reduced productivity of the marine ecosystem. This is due to the fact that water in the oceans would be more acidic due to increased concentration of  $\text{CO}_2$  in the air, which dissolve in the water.

iii) Global warming: The increased surface temperature would cause melting of continental and mountain glaciers and thus would cause flooding of coastal areas of some countries.

Sulphur dioxide:- It is produced by the burning of coal in powerhouses and automobiles (car, trucks etc).

It cause chlorosis and necrosis of plants, irritation in eyes and injury to the respiratory tract (asthma, bronchitis)

in humans responsible for discoloration and deterioration of buildings.



High concentration of sulphur dioxide in the atmosphere dissolves in rain drops to form sulphuric acid which causes acid rain.

Carbon monoxide:- Carbon monoxide is produced as a result of incomplete combustion of fossil fuels like coal, petroleum and wood charcoal. Automobiles using diesel and petroleum are the major sources of carbon monoxide is more dangerous than carbon dioxide.

It is a poisonous gas which causes respiratory problems. When it reaches the blood stream, due to its high affinity for haemoglobin, it replaces oxygen. It also cause

giddiness, headache and interferes with normal function of the heart.

Fluorides :- On heating, rocks, soils and minerals that contain fluorides, give out hydrogen fluoride gas. This is an extremely toxic gas, which ~~gas~~ causes serious injury to livestock and cattle.

Oxides of nitrogen :- A few oxides of nitrogen, such as nitric oxide (NO), nitrous oxide (N<sub>2</sub>O) and nitrogen dioxide (NO<sub>2</sub>) are produced by natural processes as well as from thermal power stations, factories, automobiles and aircrafts (due to burning of coal and petroleum). They reduce the oxygen carrying capacity of blood, may cause eye irritation and skin cancer in human beings.

Domestic air pollutants :- Smoke from cigarettes, biri, cigar and other such objects ~~to~~ using burning tobacco, burning of coal, firewood, cow dung cakes, kerosene oil and liquified gases are major domestic pollutants. The common pollutant gases emitted during the domestic burning of coal, kerosene oil, firewood, cow dung cakes, etc are carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), sulphur dioxide (SO<sub>2</sub>), etc. The pollution due to these pollutants causes suffocation, eye and lung diseases and low visibility.

The ten main causes of air pollution are -

- a) The burning of fossil fuels.
- b) Industrial Emission.

- ↳ Indoor air pollution.
- d) Wild fires,
- e) Microbial decaying process.
- f) Transportation,
- g) Open burning of garbage waste.
- h) Construction and demolition.
- i) Agricultural Activities.
- j) Use of chemical and synthetic products.

### Effect of Air Pollution

Effect on living things.

Effect on non-living things.

#### Effect on living things

Air pollution and human health:

- i) Irritation of eyes, throat, nose and respiratory system.
- ii) Respiratory damage through tobacco smoke.
- iii) Convulsions, coma due to lead poisoning.
- iv) Cigarette smoking cause cardiovascular diseases, due to cadmium particulates.
- v) Radioactive dust causes genetic effects on the next generation.
- vi) The mercury from combustion of fossil fuel affects the nerves, brain and kidney.

### Air pollution and vegetation:

- i) The direct use of pesticides affect the growth of metabolic activities by destroying chlorophyll and also by disrupting photosynthesis.
- ii) Rise of ozone causes Necrosis i.e. Damaging the leaves.
- iii) The rise of  $\text{NO}_2$  causes Abscission i.e. Premature fall of leaves - results in reduction in crop production.
- iv) Rise in  $\text{SO}_2$  causes Chlorosis i.e. Yellowing of the leaves.

### Air pollution and animals:

- i) When the animals during grazing consume the particulate coated plants mainly with fluorine, lead, arsenic they get affected, resulting into illness or poisoning or even death.
- ii) The pets also suffer due to the lung diseases.
- iii) When animals are fed with oil cakes or grass, the remains of insecticides/pesticides settled on vegetation, harm the digestive system very severely.

### Effect on living non-livings

#### Effect on metals:

- i) Corrosion or abrasion of metals.
- ii) The acid gases like  $\text{O}_3$ ,  $\text{SO}_2$ ,  $\text{NO}_2$  affect the strength of the textile.
- iii) The building material gets affected by  $\text{SO}_2$  and acid rains.
- iv)  $\text{SO}_2$  and acid gases affect the quality of paper and leather.
- v) The paints get decoloured by  $\text{SO}_2$  and  $\text{H}_2\text{S}$ .

## Effect on climate:

- i) Carbon cycle is broken.
- ii)  $\text{CO}_2$  is heavy gas and has capacity to absorb the heat. Rise of  $\text{CO}_2$  has caused the global warming.
- iii) The release of CFC gases have made an impact on ozone layer due to the ozone depletion, cosmic rays reaches to earth increasing temperature of earth.

## Control of Air pollution

### a) Electrostatic Precipitator:

i) It is most effective device to remove over 99% of particulate matter present in the exhaust from a thermal power plant.



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

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

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

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

b) Scrubber: The industries which produce  $\text{SO}_2$  as a by product must have scrubbing mechanism installed in them. In this method, effluents containing sulphur dioxide are

passed through a slurry of water and crushed limestone ( $\text{CaCO}_3$ ).

### Control of Automatic Exhaust:

i) Automobiles are major cause for atmospheric pollution atleast in the metro cities. Proper maintenance of automobiles along with use of lead free petrol or diesel can reduce the pollutants they emit.

ii) Catalytic converters have costly metals like platinum-palladium and rhodium as catalysts. Exhaust gases first pass through catalytic converter. Hydro-



carbons which have been left unburnt are oxidised to produce carbon dioxide and water. Carbon monoxide is also oxidised to form  $\text{CO}_2$ . However, nitrogen oxide splits up to form nitrogen gas. Automobiles fitted with catalytic converter should not use leaded petrol because lead inactivates the catalyst of the converter.

Image list



Image . 1



Image . 2



Image . 3

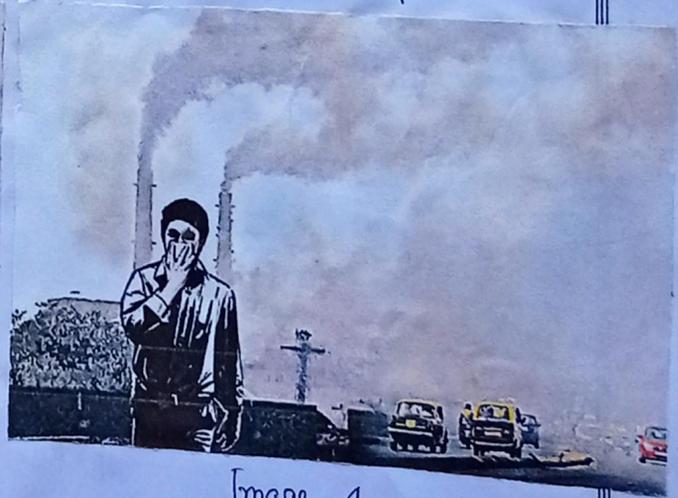


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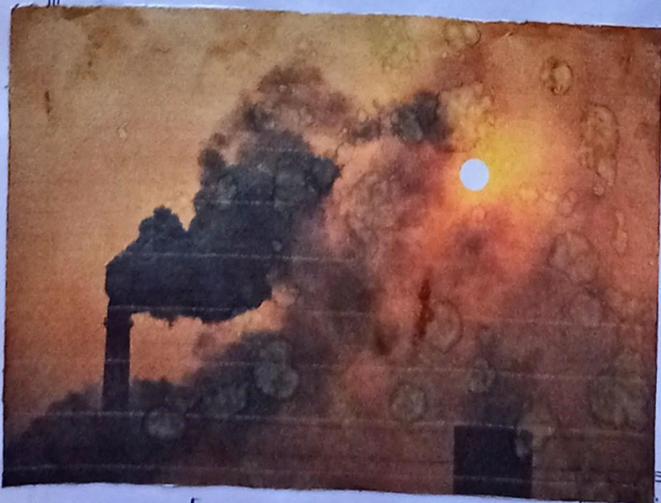


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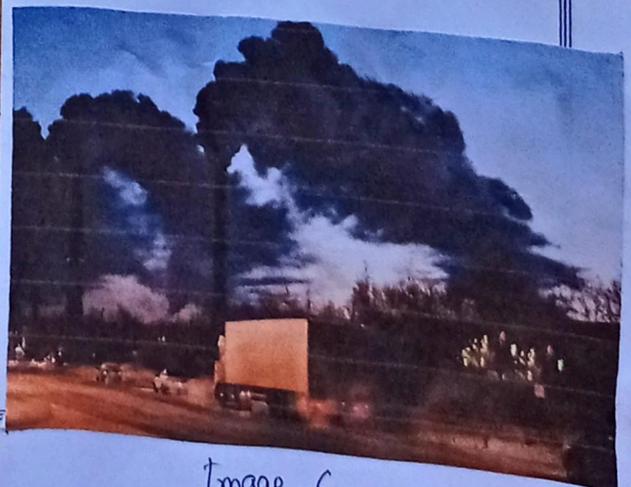


Image . 6

## CONCLUSION

The air (Prevention & control of Pollution) Act, 1981: The Act deals with the preservation of air quality and the control of air pollution with a concern for the detrimental affects of air pollution on human health and also <sup>on</sup> the biological world. In 1987, important ammendment to Air Act 1981 was made and noise was recognised as an air pollutant.

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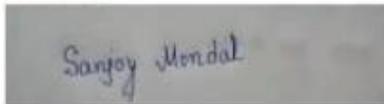


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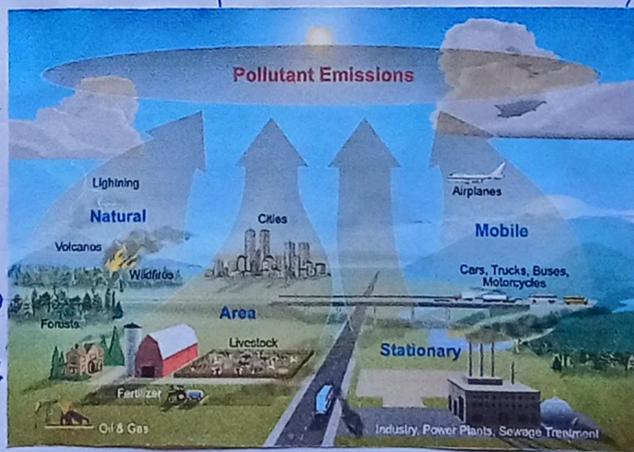
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giddiness, headache and interferes with normal function of the heart.

Fluorides :- On heating, rocks, soils and minerals that contain fluorides, give out hydrogen fluoride gas. This is an extremely toxic gas, which ~~gas~~ causes serious injury to livestock and cattle.

Oxides of nitrogen :- A few oxides of nitrogen, such as nitric oxide (NO), nitrous oxide (N<sub>2</sub>O) and nitrogen dioxide (NO<sub>2</sub>) are produced by natural processes as well as from thermal power stations, factories, automobiles and aircrafts (due to burning of coal and petroleum). They reduce the oxygen carrying capacity of blood, may cause eye irritation and skin cancer in human beings.

Domestic air pollutants :- Smoke from cigarettes, biri, cigar and other such objects ~~to~~ using burning tobacco, burning of coal, firewood, cow dung cakes, kerosene oil and liquified gases are major domestic pollutants. The common pollutant gases emitted during the domestic burning of coal, kerosene oil, firewood, cow dung cakes, etc are carbon monoxide (CO), carbon dioxide (CO<sub>2</sub>), sulphur dioxide (SO<sub>2</sub>), etc. The pollution due to these pollutants causes suffocation, eye and lung diseases and low visibility.

The ten main causes of air pollution are -

- a) The burning of fossil fuels.
- b) Industrial Emission.

- ↳ Indoor air pollution.
- d) Wild fires,
- e) Microbial decaying process.
- f) Transportation,
- g) Open burning of garbage waste.
- h) Construction and demolition.
- i) Agricultural Activities.
- j) Use of chemical and synthetic products.

### Effect of Air Pollution

Effect on living things.

Effect on non-living things.

#### Effect on living things

Air pollution and human health:

- i) Irritation of eyes, throat, nose and respiratory system.
- ii) Respiratory damage through tobacco smoke.
- iii) Convulsions, coma due to lead poisoning.
- iv) Cigarette smoking cause cardiovascular diseases, due to cadmium particulates.
- v) Radioactive dust causes genetic effects on the next generation.
- vi) The mercury from combustion of fossil fuel affects the nerves, brain and kidney.

### Air pollution and vegetation:

- i) The direct use of pesticides affect the growth of metabolic activities by destroying chlorophyll and also by disrupting photosynthesis.
- ii) Rise of ozone causes Necrosis i.e. Damaging the leaves.
- iii) The rise of  $\text{NO}_2$  causes Abscission i.e. Premature fall of leaves - results in reduction in crop production.
- iv) Rise in  $\text{SO}_2$  causes Chlorosis i.e. Yellowing of the leaves.

### Air pollution and animals:

- i) When the animals during grazing consume the particulate coated plants mainly with fluorine, lead, arsenic they get affected, resulting into illness or poisoning or even death.
- ii) The pets also suffer due to the lung diseases.
- iii) When animals are fed with oil cakes or grass, the remains of insecticides/pesticides settled on vegetation, harm the digestive system very severely.

### Effect on living non-livings

#### Effect on metals:

- i) Corrosion or abrasion of metals.
- ii) The acid gases like  $\text{O}_3$ ,  $\text{SO}_2$ ,  $\text{NO}_2$  affect the strength of the textile.
- iii) The building material gets affected by  $\text{SO}_2$  and acid rains.
- iv)  $\text{SO}_2$  and acid gases affect the quality of paper and leather.
- v) The paints get decoloured by  $\text{SO}_2$  and  $\text{H}_2\text{S}$ .

## Effect on climate:

- i) Carbon cycle is broken.
- ii)  $\text{CO}_2$  is heavy gas and has capacity to absorb the heat. Rise of  $\text{CO}_2$  has caused the global warming.
- iii) The release of CFC gases have made an impact on ozone layer due to the ozone depletion, cosmic rays reaches to earth increasing temperature of earth.

## Control of Air pollution

### a) Electrostatic Precipitator:

i) It is most effective device to remove over 99% of particulate matter present in the exhaust from a thermal power plant.



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

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

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

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

b) Scrubber: The industries which produce  $\text{SO}_2$  as a by product must have scrubbing mechanism installed in them. In this method, effluents containing sulphur dioxide are

passed through a slurry of water and crushed limestone ( $\text{CaCO}_3$ ).

### Control of Automatic Exhaust:

i) Automobiles are major cause for atmospheric pollution atleast in the metro cities. Proper maintenance of automobiles along with use of lead free petrol or diesel can reduce the pollutants they emit.

ii) Catalytic converters have costly metals like platinum-palladium and rhodium as catalyst. Exhaust gases first pass through catalytic converter. Hydro-



carbons which have been left unburnt are oxidised to produce carbon dioxide and water. Carbon monoxide is also oxidised to form  $\text{CO}_2$ . However, nitrogen oxide splits up to form nitrogen gas. Automobiles fitted with catalytic converter should not use leaded petrol because lead inactivates the catalyst of the converter.

Image list



Image . 1



Image . 2



Image . 3

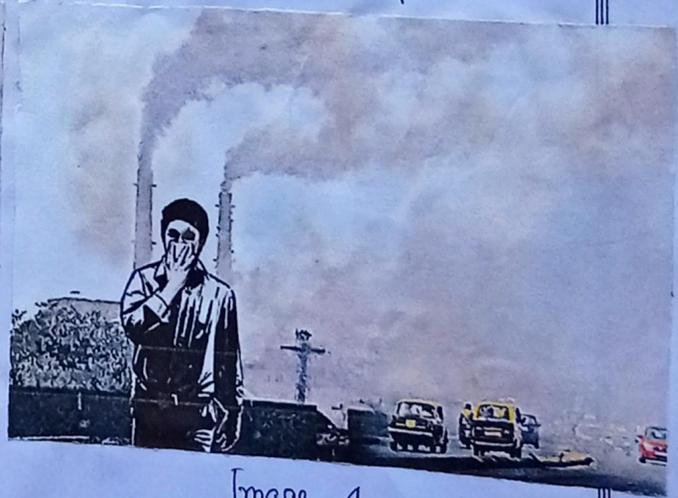


Image . 4

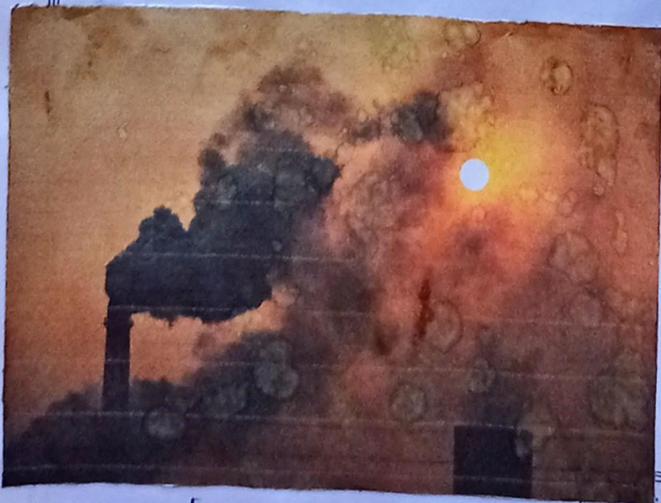


Image . 5

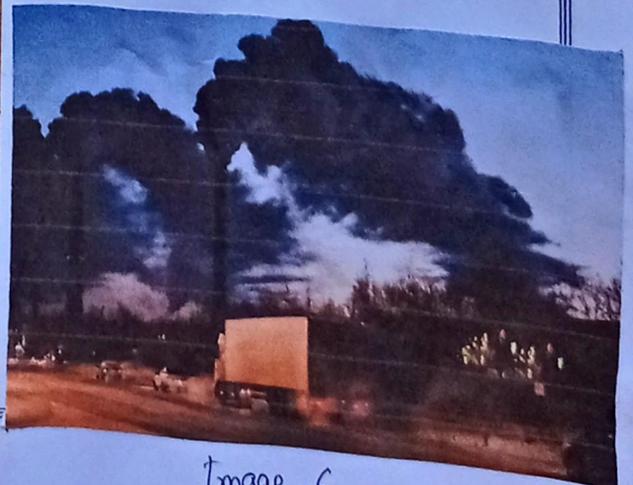


Image . 6

## CONCLUSION

The air (Prevention & control of Pollution) Act, 1981: The Act deals with the preservation of air quality and the control of air pollution with a concern for the detrimental affects of air pollution on human health and also <sup>on</sup> the biological world. In 1987, important ammendment to Air Act 1981 was made and noise was recognised as an air pollutant.

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

ENVIRONMENTAL STUDIES

PROJECT TITLE:

*Nitrogen cycle and its importance  
for living beings*

NAME : SANTANU DAS  
COLLEGE ROLL NO : PHUG/076/19  
DEPARTMENT : PHYSICS  
YEAR : 2020  
SIGNATURE : *Santanu Das*

## CONTENTS

- what is Nitrogen cycle
- Stages
- In marine Ecosystem
- Importance
- Conclusion
- Acknowledgement
- Certificate.

## ▣ Nitrogen cycle definition

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

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

## ▣ What is Nitrogen cycle?

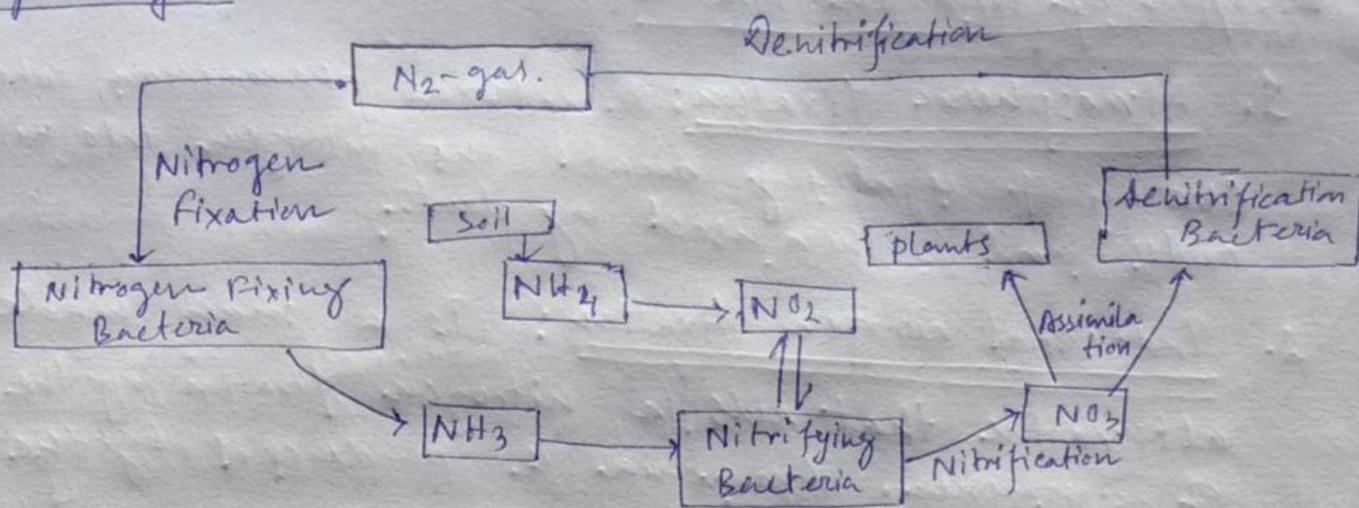
Nitrogen cycle is a biogeochemical process through which nitrogen is converted into many form, consecutively passing from the atmosphere to the soil to organisms and back into the atmosphere.

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

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

Inorganic form of nitrogen are found in abundance in the atmosphere. The nitrogen is made available to plants by symbiotic bacteria which can convert the inert nitrogen into a usable form — such as nitrites and nitrates

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

Nitrogen cycle

### Stages of Nitrogen Cycle:

Process of Nitrogen Cycle consists of the following steps — Nitrogen fixation, Nitrification, Assimilation, Ammonification and Denitrification, the process take place in several stages and are explained below.

#### 1. 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 ( $NH_3$ ).

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

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

## Types of Nitrogen Fixation

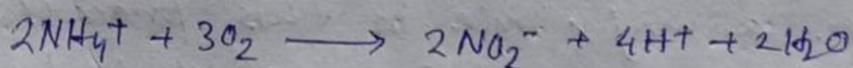
1. Atmospheric fixation: A natural phenomenon, where the energy of lightning breaks the nitrogen into nitrogen oxides and is then used by plants.
2. Industrial nitrogen fixation: Is a man made alternative that aids in nitrogen fixation by the use of ammonia. Ammonia is produced by the direct combination of nitrogen and hydrogen and later, it is converted into various fertilisers such as urea.
3. Biological nitrogen fixation:

We already know that nitrogen is not usable directly from the air for plants and animals. Bacteria like *Rhizobium* and blue-green algae transform the unusable form of nitrogen into other compounds that are more readily usable. These nitrogen compounds get fixed in the soil by these microbes.

## Nitrification

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

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



## Assimilation

Primary producers — plants takes 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

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

## Denitrification

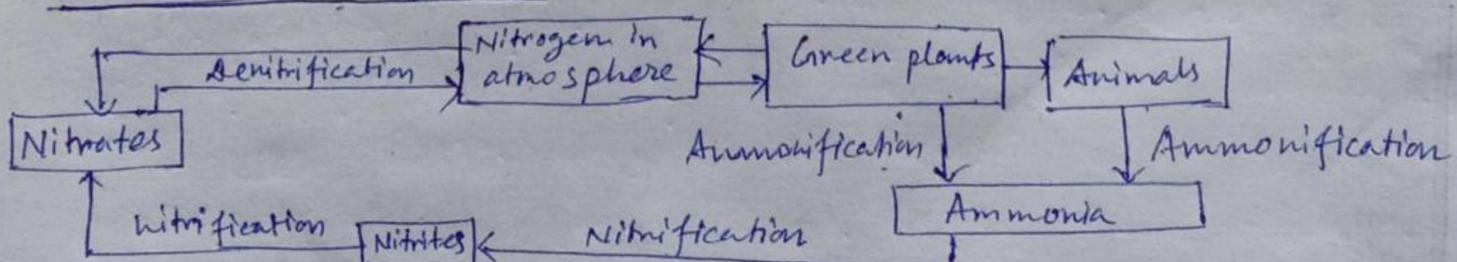
Denitrification is the process in which the nitrogen compounds makes its way back into the atmosphere by converting nitrate ( $\text{NO}_3^-$ ) into gaseous nitrogen ( $\text{N}_2$ ). This process of the nitrogen cycle is the final stages and occurs in the absence of oxygen. Denitrification is carried out by the denitrifying bacterial species - Clostridium and Pseudomonas. which will process nitrate to gain oxygen and gives out free or 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 forms 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 the rocks is released into the plants due to the weathering of rocks.

## Schematic Diagram:



## ▣ Importance of Nitrogen cycle:

Importance of the nitrogen cycle are as follows:

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

Nitrogen is also cycled by human activities such as combustion of fuels and the use of nitrogen fertilisers. These process, increase the levels of nitrogen containing compounds in the atmosphere. The fertilisers containing nitrogen are washed away in lakes and rivers and results in eutrophication.

### Conclusion:

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

ACKNOWLEDGEMENT

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

Date:

Santanu Das

Signature of the  
Student

■ CERTIFICATE ■

Certified that the project work submitted  
by Santanu Das is done under the supervision  
of my honorable sir as a part of curriculaam for  
the partial fulfilment of the class - UG 2nd  
Semester.

Date:

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

# RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

PROJECT TITLE:

Water Pollution and measures to Control it.

NAME : Santanu Mandal  
COLLEGE ROLL NO : CHUG 1061/19  
DEPARTMENT : CHEMISTRY  
YEAR : 2020  
SIGNATURE : Santanu Mandal

## ● Introduction :-

British poet W.H. Auden once noted, "Thousands have lived without love, not one without water?"

John Todd said, "Our liquid planet glows like a soft blue sapphire in the hard-edged darkness of space. There is nothing else like it in the solar system. It is because of water."

Water is the essential element that makes life on earth possible. Without water there would be no life. Yet, while we all know water is crucial for life, we trash it anyway. We usually take for granted. It flows from our taps when they are turned on and we remained complete careless about that. Like good health we ignore water when we have it.

The widespread problem of water pollution is jeopardizing our health. Unsafe water kills more people each year than war and all other forms of violence combined. Meanwhile our drinkable water sources are finite i.e. less than 1% of the earth's freshwater is actually accessible to us. Without taking any positive action, the challenges will only increase by 2050, when global demand for freshwater is expected to be one-third than it is now.

Still, we are not hopeless against the threat to clean water. To better understand the problem here we will discuss about an overview of what water pollution is, what causes it and how we can prevent it.

● What is water Pollution?

↳ Water pollution occurs when harmful substance often chemicals or microorganisms - Contaminate a stream, river lake, Ocean, aquifer, or any other waterbody, degrading water quality and rendering it toxic to humans and to the environment.

● Types of sources of water Pollution:-

① Point source: When contamination occurs from a single source and that source be readily identified as it has a definite place where it enters water, then that source is called as point source. Though, this pollution originates from a specific place, it can affect miles of waterways and Ocean.

Examples - Municipal and industrial discharge pipes, waste water, discharged from a manufacturing unit, oil refinery etc.

It can be from leaking septic systems and illegal dumping also.

The EPA has act has set limits on what can be discharged by a facility directly into a body of water to regular point source solution.



② Non-Point Sources: Non-Point source of Pollution is the opposite of point source pollution, with pollution released in a wide area. Non-Point source of pollution is harder to identify and harder to address. It is pollution that comes from a many places all at once.

Example: Picture a city street during a thunderstorm. As rainwater flows over a asphalt, it washes away drops of oil that leaked from car engine, particles of tire rubber, dog waste and trash. The runoff goes into a storm sewer and ends up in a nearby river, so, Runoff is a major cause of non-point source pollution.

● Also, in urban area, people use water from a definite waterbody (Pond, river etc) in many purpose and also various chemicals mixed with that waterbody from agricultural field with the runoff of rain-water. This is also a kind of non-point source of water pollution.

⊛ The pollution from non-point source also very difficult to regulate. Since there is no single, identifiable culprit.

② Different Categories of water pollution:

↳ Ground water Pollution: Groundwater is one of our least visible but most critical natural resources. With rainfall, it becomes groundwater as it seeps deep into the earth, filling up rocks, crevices and porous space of an aquifer, which is an underground storehouse of water.

Groundwater gets polluted when contaminants such as fertilizers, pesticides, and waste leaching from landfills and septic systems, making their way into an aquifer making groundwater free of contaminants can be difficult to impossible as well as costly.

↳ Surface water pollution: Surface water covers about 70% of the earth, filling our oceans, lakes, rivers and including all blue bits in the world. Surface water from fresh water surfaces other than sea accounts for more than 60% of water delivered to us hence.

Nutrient pollution that includes nitrates and phosphates which plants and animals need to grow, causes major pollution in the freshwater sources due to farm waste and fertilizer runoff. Municipal and industrial waste discharge and also individual dumping directly into waterways contribute their fair share of toxins.

As per the Environmental protection agency of U.S, As per nearly 50% of our rivers, streams one third of our lakes and ponds are polluted and unfit for swimming, fishing and drinking.

③ Ocean water Pollution: 80% of Ocean pollution or marine pollution originates on land along the coast or far inland. Streams and rivers carry contaminants such as chemicals, nutrients and heavy metals that are carried from farms, factories and cities into our bays and estuaries and from there finally they reach the ocean.

Marine debris, particularly plastic is blown away by the wind or washed away in storm via drains and sewers. Our seas sometimes get polluted by big and small oil spills and leaks and are also ~~soaking~~ soaking up carbon.

④ Transboundary: A boundary line can't contain water pollution on a map. Transboundary pollution happened when contaminated water from one country spilled into other countries water. It can result from a disaster like an oil spill or the slow, downriver creep of industrial agricultural or municipal discharge.



## ● Causes and effects of water pollution:

### ① Sewage and domestic waste:-

Nearly 75% of water pollution is due to sewage and domestic. A mere 0.1% impurities make domestic wastes.

As per human uses

Sewage generally includes biodegradable pollutants like human faecal matter animal wastes and many dissolved organic compounds like - Carbohydrates, proteins, fats, urea etc. These pollutants

Under natural processes are rapidly decomposed.



Effect: In water, organic wastes provided nutrition for many decomposers like bacteria. These breakdown the organic part by using bulk of oxygen and cause deficiency of oxygen in water that kills the fishes and other animals (aquatic).

Anaerobic bacteria in oxygen deficient produces foul smelling gases. These give rise to many other pollutants like  $H_2S$ ,  $NH_3$  etc. Organic sulphide and methane also produced by those bacteria that makes the water brownish and turbid.

② Industrial wastes and effluents: The individual industrial wastes and their effluents include poisonous materials like acids, alkalis, chromium, etc. Phenols, cyanides, insecticides, agricultural chemicals, hydrogen sulphides, heavy metals such as Cu, Pb, Zn, and Hg.

↳ Effects:

- The water becomes toxic and deoxygenated so this can't support aquatic life.
- Mercury (Hg) enters the food chain, kills fish, and poisons the remaining fauna.
- Mercury causes Minamata disease, people feeding on this aquatic forms develop numbness of limbs and lips, impairment in speech hearing and vision, meningitis and genetic disorders.
- Oils deplete oxygen of water inhibit plankton growth and photosynthesis. Sea birds also harmful.
- Organic phosphates and nitrates enhance growth of algal blooms.
- Black foot diseases is caused by chronic exposure to As. Also, exposure of As may cause skin lesions, skin cancer, lungs cancer etc.



③ Dumping:- Dumping of solid wastes and litters in water bodies cause by huge problems. Litters include glass, plastic, aluminium, styrofoam etc. Different things take different time to degrade in water.

effect: They effect the aquatic plants and animals.

④ Mining activities: Mining is the process of crushing the rock and extracting coal and other minerals from the underground. These elements, when extracted, in the raw form, contain harmful chemicals and can increase the number of toxic elements when mixed up with water, mining activities emit a large amount of metal waste and sulphides from the rocks which is harmful to water.

↳ effect: Release of toxic chemicals in water may cause health problems of aquatic animals as well as of human.

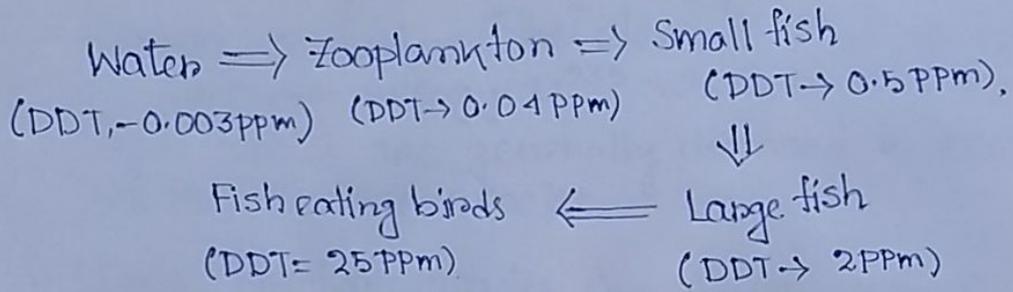
⑤ Accidental leakage:- A ship carrying a large quantity of oil spill oil in sea if met an accident.

⇒ In 1967 large oil tanker Torrey Canyon met an accidental and release 10000 ton crude oil in sea of southern England.

⑥ Insecticides and Pesticides: Insecticides and biologically active chemicals that are used for pest control. These include D.D.T, B.H.C,  $cuSO_4$  and aldrin etc. Aquatic microorganisms absorb them in fats and oils. Fish feeding on these zooplanktons and phytoplanktons rapidly spread in through other trophic levels.

Effects:

Biomagnification: Aquatic microorganisms absorb the insecticides in fats and oils. Fish feeding on these zooplanktons and phytoplanktons further concentrate these pesticides still more. The increased accumulation of these toxic substance in the food chain at higher trophic level is called biological magnification. Many species of predatory like commonants, hawks, and large fishes shown serious adverse effects from this accumulation.



⑦ Situation: Excessive agricultural and forestry practices cause soil erosion (removal of top fertile soil) during heavy rain and through rain water soil particles mixed with rivers on any other waterbodies.

Effects: The water becomes muddy which fails to support much plant growth due to poor light.

⑧ Thermal pollution: Heated waste water from various powerplants and industries, which raise the Temp of water to a harmful level is called thermal pollution.

⑨ Detergents and fertilizers: Detergents are washing material in water which cause soapiness. These form a film around organic waste.  
 Some of the fertilizers such as nitrates and phosphates are used in agriculture to increase the crops yield, reach into rivers and ponds through irrigation rainfall and damage, where they seriously disturb the aquatic system.

effects:

When such waters are used by animals, the nitrates of polluted water become reduced to toxic nitrite in their body by intestinal bacteria. The nitrites in the body combine with haemoglobin to cause a serious disease called methaemoglobinemia or Blue baby syndrome.

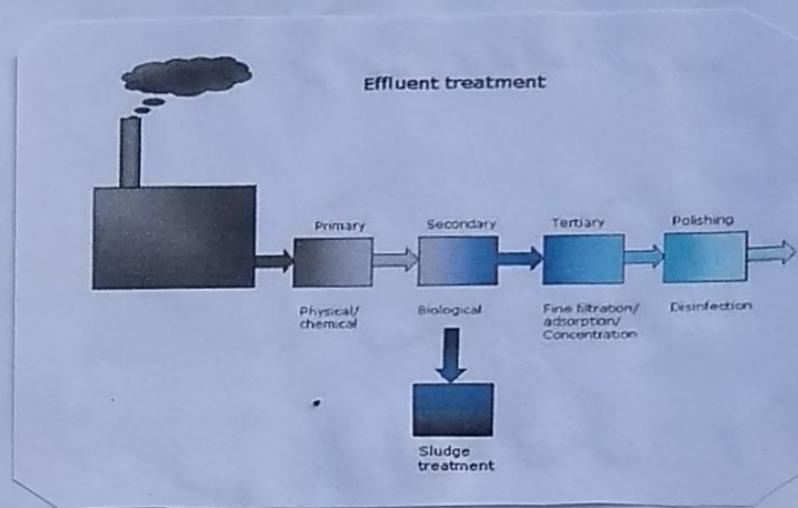
⑩ Radioactivity: Nuclear energy produced using nuclear fission or fusion. The element that is used in production of nuclear energy,  $U^{235}$  which is very toxic chemical, these wastes are generally disposed in nearby waterbody of the nuclear reactor.

↳ Effects: Nuclear wastes can have serious environment hazards, if not disposed of properly. Release of nuclear wastes in fresh water will cause major water pollution and death of aquatic organism. Few major accidents have already taken place in Russia and Japan.

## • Prevention measure of water pollution;

It is very important to prevent the polluting of water bodies and remove existing contaminants or reducing the concentration of these contaminants so as make it fit for desired use. So, now will follow some of the ways of treating polluted water.

① Industrial waste water treatment: The raw sewage is needed to be treated correctly in a water treatment plant before it can be safely release into the environment. To reduce the toxicity of waste, it is passed through a number of chambers and chemical process in water treatment plant.



Industries that generate wastewater with high concentrations of organic matter, toxic pollutants, need specialized treatment system. e.g - air flotation system.

## ② Erosion and sediment:

Firstly to stop erosion and sedimentation of loose soil particles we have to plant more and more less trees. Specially beside waterbodies that can prevent erosion of soil very much. Also, to stop sedimentation of various hard particles in waterbodies from construction site, we may apply silt fence. also, we can use separate sediment basins from waterbody.



## ③ Retention basin for controlling urban runoff:

Effective control of urban runoff involves reducing the velocity and flow of storm water, as well as reducing pollutant discharge. Nowadays, retention basins are mainly used which are separated from general waterbodies, for discharge of urban runoff.

## ④ Denitrification: When nitrates present in water get converted into gas, it is known as denitrification. It is an ecological approach that prevents leaching of nitrates in the soil.

## ⑤ Ozone waste water treatment: The Ozone waste water treatment method has become very popular. In this method, an ozone generator breaks down the pollutants in water. Ozone oxidises bacteria, organic material molds and other contaminants in water.

⑥ Septic tanks: Septic tanks treat ~~to~~ sewage right right at the place of the location where it originates instead of treating it in any far-away plant or sewage system. This system is usually put to use at the individual building level. The sewage gets separated into solid and liquid components and treated.

● Conclusion: Water Pollution is mainly cause of our undisciplined actions and irresponsibility. Mainly, we humans are creating problems that consequently we will also carry the burden of these problems. So, let's just realize how important our mother nature. It is our only source of living. Let's not destroy it nor pollute it. Let us act for a change we need and we should help, save and conserve our water which are very crucial to maintain the balance of nature. Absolutely, there are many simple ways in how we can help and can stop polluting water.

## ACKNOWLEDGEMENT

I convey my deep sense of gratitude to sir, for suggestion the way to find suitable for the development in the preparation of the project work. I owe to him the facilities, valuable guidance and constant help-through out the course of investigation.

Date - 14/11/20

Santanu Mandal  
Signature of the  
Student

## CERTIFICATE

Certified that ~~we~~ the project work submitted by ~~Re~~ Santanu Mandal is done under the supervision of my honourable sir as a part of curriculum for the Partial fulfilment of the class - UG 2nd semester.

Date -

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

# **RAMAKRISHNA MISSION RESIDENTIAL COLLEGE(AUTONOMOUS)**



**NARENDRAPUR**

**ENVIRONMENTAL STUDIES**

**PROJECT TITLE : Corona Pandemic & role of  
common people to control it.**

**NAME : SANTANU PRADHAN**

**COLLEGE ROLL NO : PHUG/205/19**

**DEPARTMENT : PHYSICS**

**YEAR : 2020**

**SIGNATURE : *Santanu Pradhan***

## Project: Corona pandemic and role of common people to control it.

### Introduction:

A pandemic is defined as "occurring over a wide geographic area and affecting an exceptionally high proportion of the population." The last pandemic reported in the world was the H<sub>1</sub>N<sub>1</sub> flu pandemic in 2009.

### Source of this pandemic:

On 31 December 2019, a cluster of cases of pneumonia of unknown cause, in the city of Wuhan, Hubei in China, was reported to the World Health Organisation. In January 2020, a previously unknown new virus was identified, subsequently named the 2019 novel coronavirus, and samples obtained from cases and analysis of the virus' genetics indicated that this was the cause of outbreak. This novel coronavirus was named Coronavirus Disease 2019 (COVID-19) by WHO in ~~Feb~~ February 2020. The virus is referred to as SARS-CoV-2 and the associated disease is COVID-19.

### Aims and

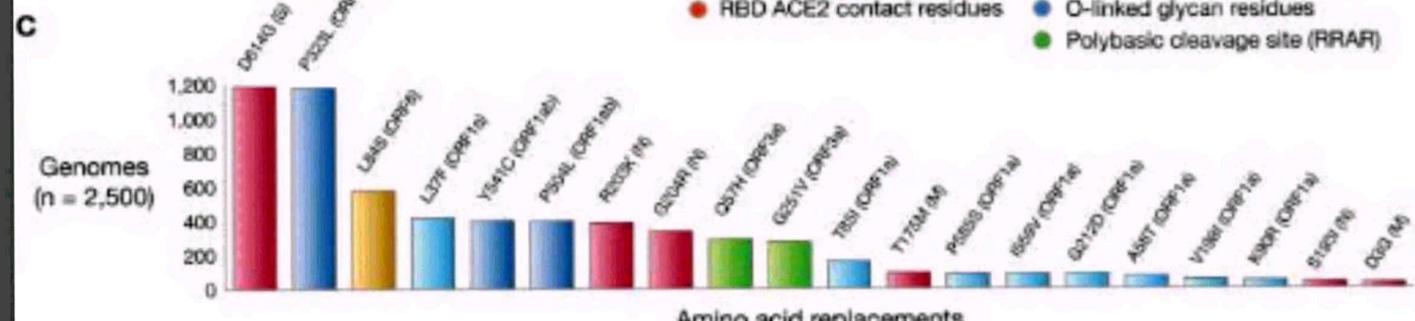
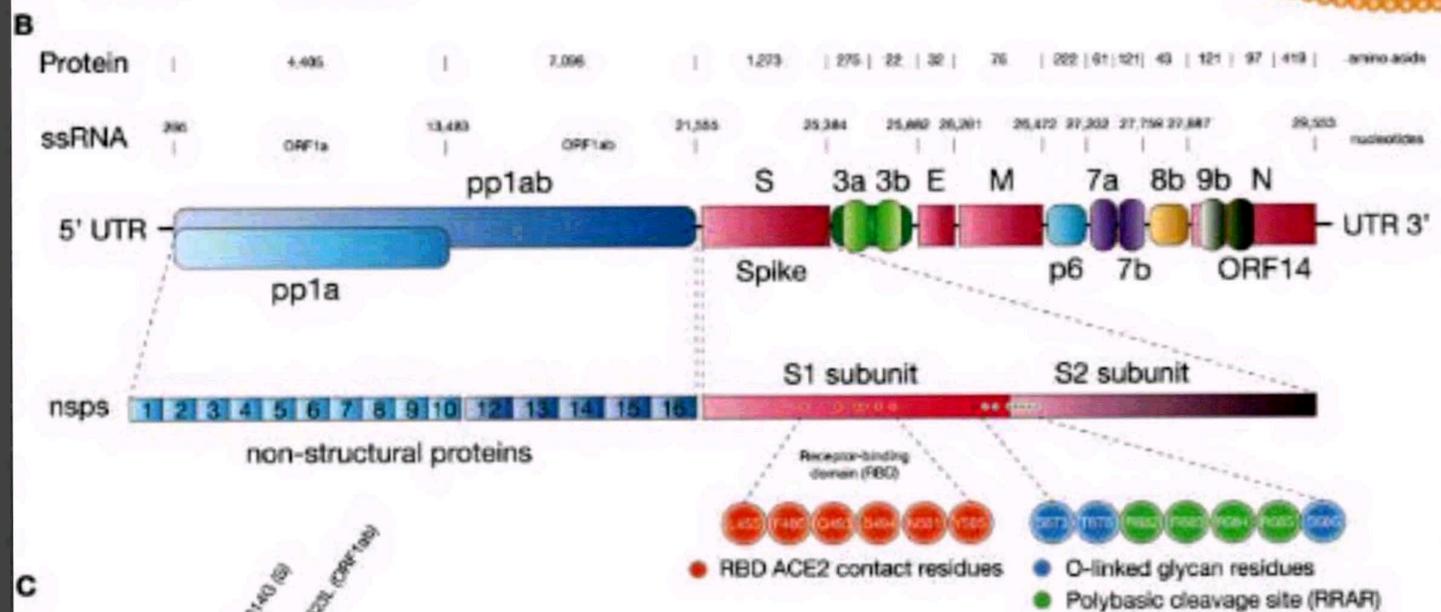
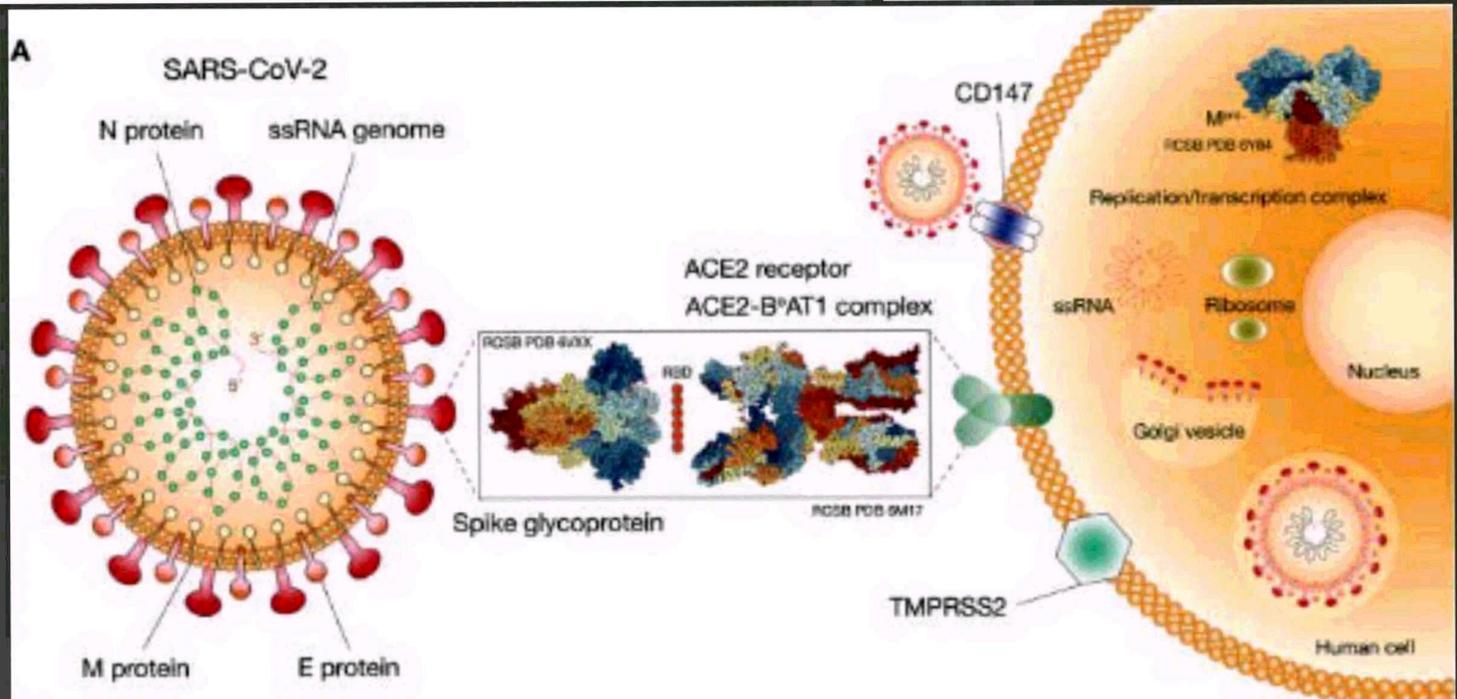
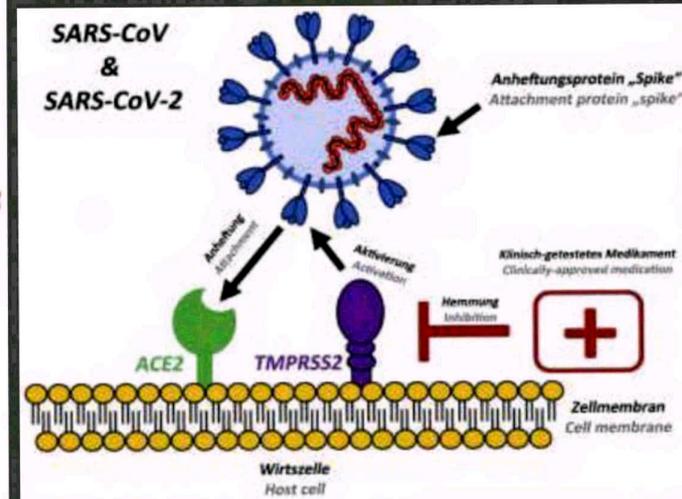
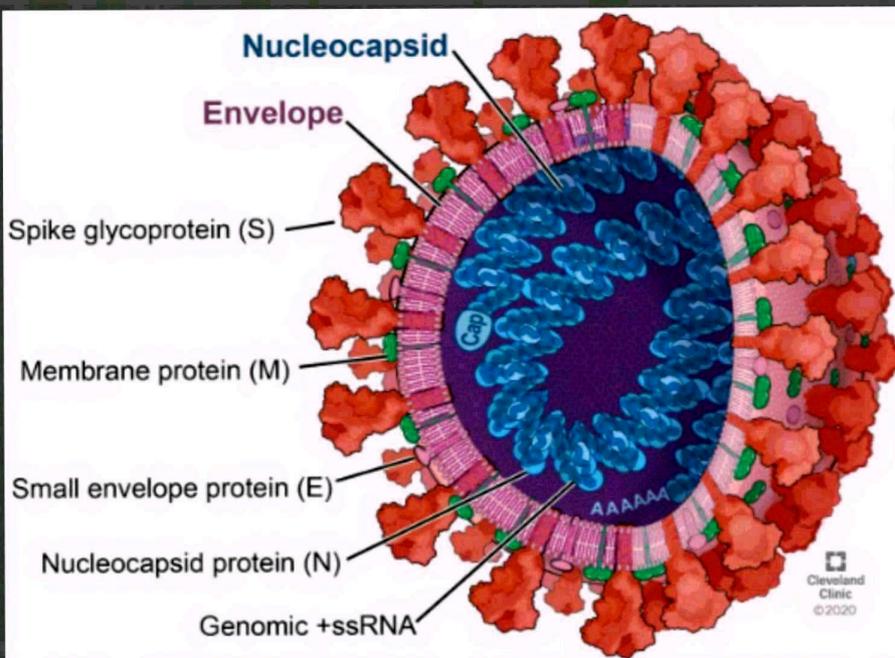
### Aims and Applications of this project:

Common people in World about more than  $\frac{3}{4}$ th of the total population. We as a responsible youth of the country, India, should participate in this battle against the zoonotic disease. Now, let's understand the role of common people in this battle.

Actually, the <sup>main</sup> aims of this project is to create awareness among the people and teach them how to handle this pandemic situation wearing masks, PPE, and washing hands with sanitizer repeatedly.

### Structure of COVID-19 virus :-

It is a spherical or pleomorphic enveloped particles containing single-stranded (positive-sense) RNA associated with a nucleoprotein within a capsid comprised of matrix protein. The envelope bears club-shaped glycoprotein projections. Some coronaviruses also contain a hemagglutinin-esterase protein.



Coronaviruses possess the largest genomes among all known RNA viruses, with G+C contents varying from 32% to 43%. Variable numbers of small ORFs are present between the various conserved genes (ORF1ab, spike, envelope, membrane and nucleocapsid) and downstream to the nucleocapsid gene in different coronavirus lineages. The viral genome contains distinctive features, including a unique N-terminal fragment within the spike protein. Genes for the major structural proteins in all coronaviruses occur in the 5'-3' order as S, E, M and N.

There are three or four viral proteins in the coronavirus membrane. The most abundant structural protein is the membrane (M) glycoprotein; it spans the membrane bilayer three times, leaving a short NH<sub>2</sub>-terminal domain outside the virus and a long COOH terminus inside the virion.

How does the infection occur?

Coronaviruses are zoonotic, meaning that the viruses are transmitted between animals and humans. It has been determined that MERS-CoV was transmitted from dromedary camels to humans and SARS-CoV from civet cats to humans. The source of SARS-CoV-2 (COVID) is yet to be determined, but investigations are ongoing to identify the zoonotic source to the outbreak.

(i) Transmission of COVID-19: Evidence is still emerging, but current information is indicating that human-to-human transmission is occurring. The routes of transmission of COVID-19 remains unclear at present but evidence from other coronaviruses and respiratory diseases indicates that the disease may spread through large respiratory droplets and direct or indirect contact with infected secretions.

The incubation period of COVID-19 is currently understood to be between 2 to 14 days. This means that if a person remains well after 14 days after being in contact with a person with confirmed COVID-19 they are not infected.

(ii) Clinical Presentation: Typically Coronaviruses present with respiratory symptoms. Among those who will become infected, some will show no symptoms. Those who do develop symptoms may have a mild to moderate, but self-limiting disease with symptoms similar to the seasonal flu. Symptoms may include:

- ① Respiratory symptoms.
- ② Fever.
- ③ Cough.
- ④ Shortness of breath.

5) Breathing difficulties.

6) Fatigue.

7) Sore throat.

A minority of group of people will present with more severe symptoms and will need to be hospitalised, most often with pneumonia, and in some instances, the illness can include ARDS, sepsis and septic shock.

Emergency warning signs where immediate medical attention should be sought include.

① Difficulty breathing or shortness of breath.

② Persistent pain or pressure in the chest.

③ New confusion or inability to arouse.

④ Bluish lips or face.

Corona Cases: In world - 235 countries are affected with corona viruses.

Confirmed cases: 38,348,719

Recovered : 28,354,860

Deaths : 1,090,250

In India:-

Confirmed cases: 7,239,389

Recovered : 6,381,927

Deaths : 110,586

Diagnostic process: A COVID-19 diagnostic testing kit has been developed and is available in clinical testing labs.

High-Risk Populations:

The virus that causes COVID-19 infects people of all ages. However, evidence to date suggests that two groups of people are at a higher risks of getting severe COVID-19 disease.

① Older people (people over 70 years of age): This may be due to

(i) Ageing is associated with a decline in immune function.

(ii) Higher risk of co-morbidities (Diabetes, Heart Disease, Lung Conditions, Cancer).

(iii) Residence/Location - Many older people live in care homes or nursing facilities, where the disease can spread more rapidly.

② People with serious chronic illness such as:

(i) Diabetes.

(ii) Cardiovascular disease.

(iii) Chronic respiratory disease.

(iv) Cancer

(v) Hypertension.

(vi) Chronic liver disease.

# Clinical Presentation of Covid-19

## Asymptomatic Infection

Absence of clinical signs and symptoms of the disease and normal chest X-ray or CT scan associated with a positive test for SARS-CoV-2

## Mild Infection

Upper airway symptoms such as fever, fatigue, myalgia, cough, sore throat, runny nose and sneezing. Pulmonary clinical exam is normal. Some cases may not have fever and others may experience gastrointestinal symptoms such as nausea, vomiting, abdominal pain, and diarrhea.

## Moderate Infection

Clinical signs of pneumonia. Persistent fever, initially dry cough, which becomes productive, may have wheezing or crackles on pulmonary auscultation but shows no respiratory distress. Some individuals may not have symptoms or clinical signs, but chest CT scan reveals typical pulmonary lesions.

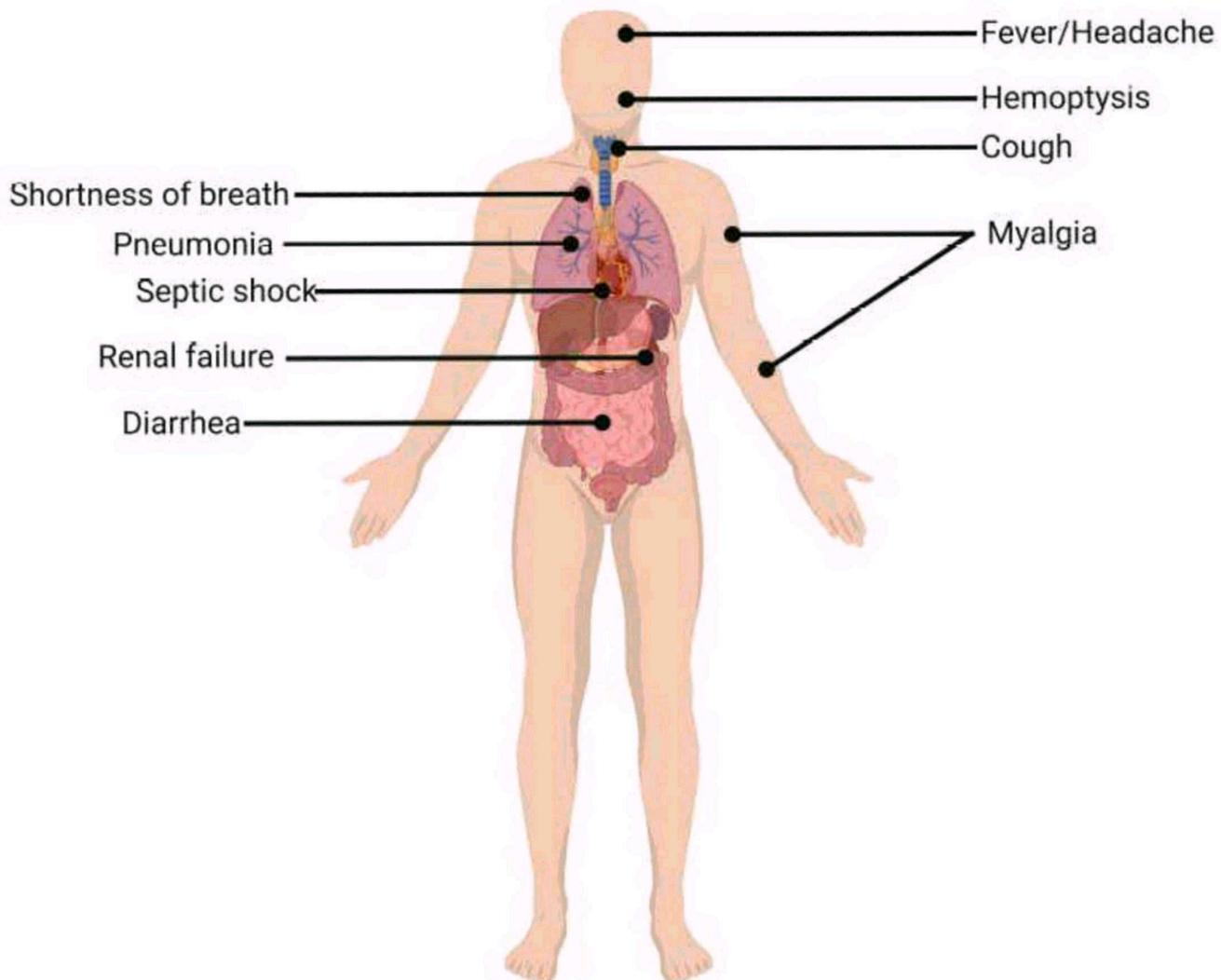
## Severe Infection

Initial respiratory symptoms may be associated with gastrointestinal symptoms such as diarrhea. The clinical deterioration usually occurs in a week with the development of dyspnea and hypoxemia (blood oxygen saturation  $[SaO_2] < 94\%$ )

## Critical Infection

Patients can quickly deteriorate to acute respiratory distress syndrome or respiratory failure and may present shock, encephalopathy, myocardial injury or heart failure, coagulopathy, acute kidney injury, and multiple organ dysfunction.

## Clinical presentation of patients with CoVID-19



Risk for pregnant women and newborns: The risk for adverse maternal and neonatal outcomes associated with COVID-19 is largely unknown, but medical experts suspect symptoms of COVID-19, may be more severe in pregnant compared to non-pregnant women. This may be due to changes in their bodies and immune systems pregnant women can be badly affected by some respiratory infections. Women with COVID-19 can breastfeed and have close contact with their newborn, but they should diligently perform respiratory and hand hygiene. No evidence so far that babies have active coronavirus transmitted from mothers.

### Preventing Transmission:-

The WHO suggested the following basic preventative measures to protect against the new coronavirus.

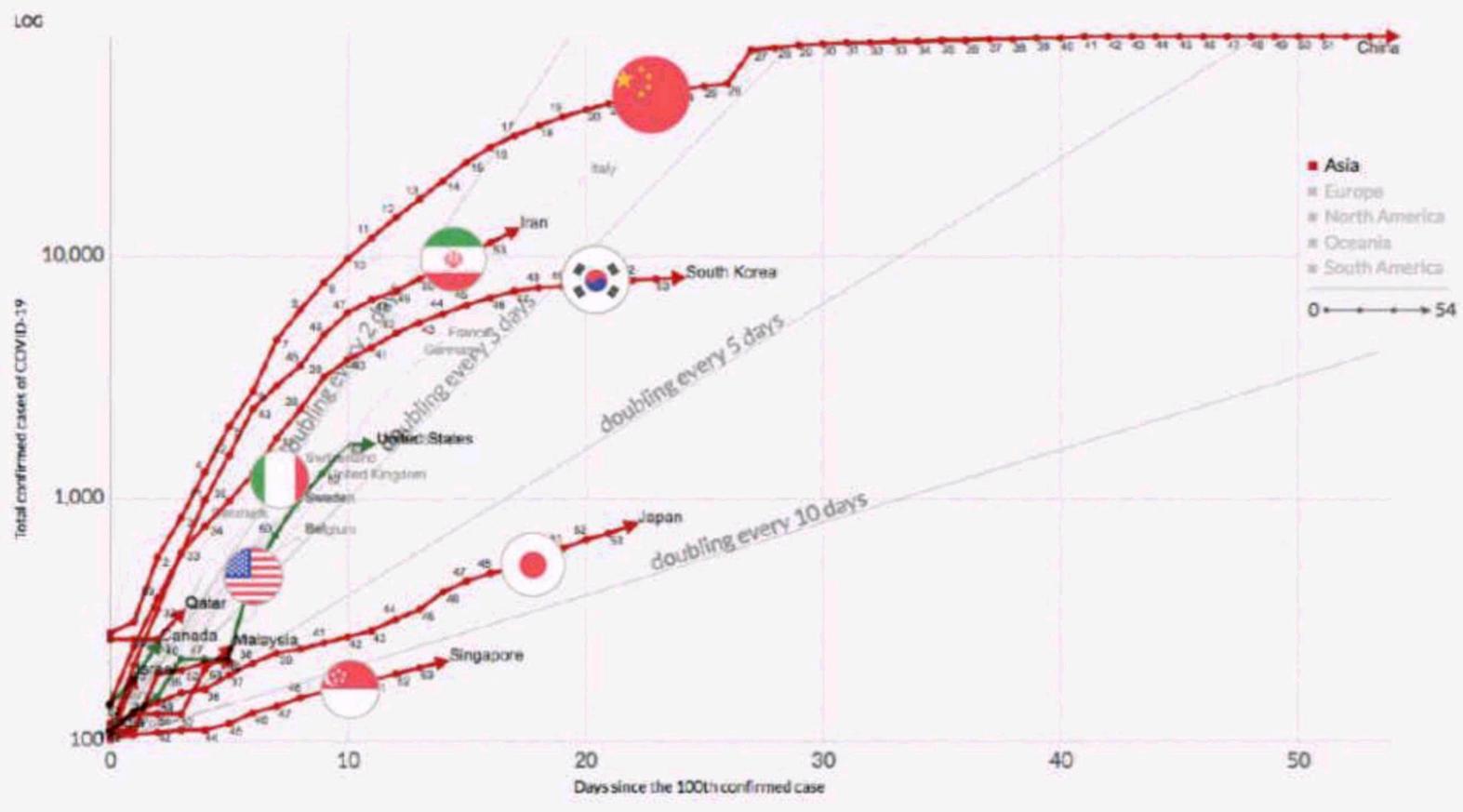
- 1) Stay up to date with the latest information on the COVID-19 outbreak through WHO updates or your local and national public health authority.
- 2) Perform hand hygiene frequently with an alcohol-based hand rub if your hands are not visibly dirty or with soap and water if hands are dirty.
- 3) Avoid touching your eyes, nose and mouth.
- 4) Practice respiratory hygiene by coughing or sneezing into a bent elbow or tissue and then ~~immediately~~ immediately disposing of the tissue.
- 5) Wear a medical mask if you have respiratory symptoms and performing hand hygiene after disposing of the mask.
- 6) Maintain social distancing (approximately 2 meters) from individuals with respiratory symptoms.
- 7) If you have a fever, cough and difficulty breathing seek medical care.

### Role of common people to control it:

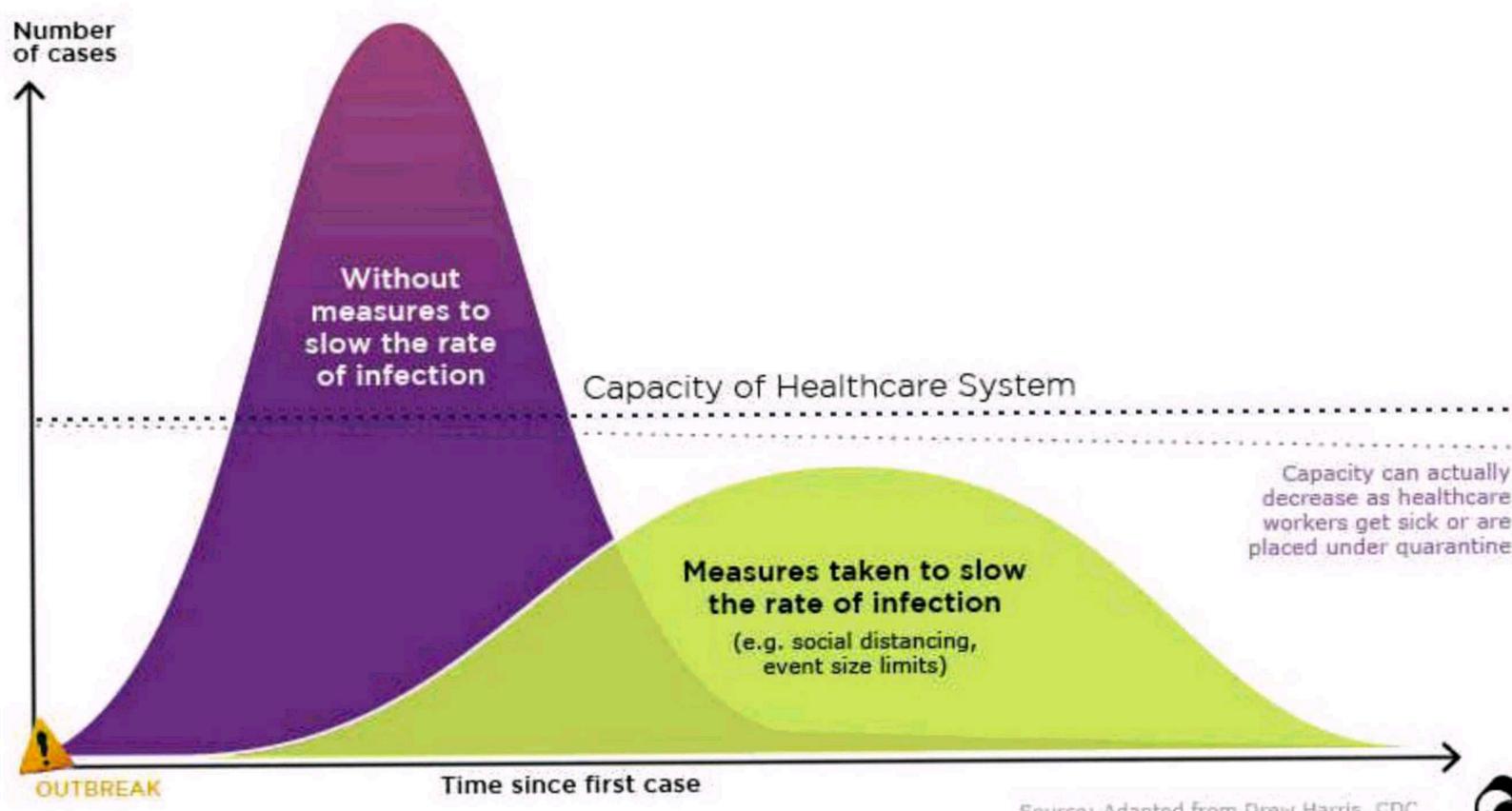
Restoring to fear or panic, our members are providing a more impactful response: informing themselves and helping others. To join their efforts and do your part, follow three simple actions:

- 1) Stay informed and ensure others do too.:

As fear spreads faster than facts, inform yourself about the virus. Deepen your knowledge and point others to trusted information. This will go a long way to debunk myths and build resilience in your community.



### Flattening the COVID-19 Case Curve



Source: Adapted from Drew Harris, CDC

## 2) Take action to keep your community safe:

When you are young and healthy, your risk of developing severe illness is lower. So consider those in your community who are most ~~vulnerable~~ vulnerable, including older persons and persons with pre-existing medical conditions (such as high blood pressure, heart disease, lung disease, cancer or diabetes). Do your best to support them.

## 3) Speak up to ensure your organisation does the right thing.

Organisations ~~and~~ and employers play a big role in combating the virus. Encourage your office to take precautions: for example, ensure spaces ~~are~~ are clean and hygienic, promote regular hand-washing, test remote working and communicate clearly to employees.

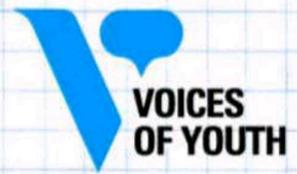
## Role of youth to fight against COVID-19:-

Youth in India constitutes about more than  $\frac{1}{4}$ th of total population. We as a responsible youth of this country should participate in this battle against the zoonotic disease. Now let's understand the role of youth in this battle. To name some of them from the canvas of history—Lenin, the Russian youth had a major contribution to the Russian revolution likewise Mazzini and Bhagat Singh also contributed their rate for country. This battle can be won by helping the government in this time of ~~emergency~~ exigency. We can spread the right awareness in our Dosti, Family, XYZ, etc. 24\*7 Whatsapp group with the right information about the Virus. Whatsapp/Social media groups always have as much as traffic on our roads. Let's spread the right message among your acquaintances during this situation.

Every religious activity has been on halt in lieu of corona-virus outbreak. still if we see any of the gathering around. It's our responsibility to guide and report if required. The Constitution of India, is the holy book for every Indian citizen and every order ~~we~~ must be accepted as a commandment. We live in a democracy and we have every right to put our thoughts on the table but this is the time to unite and stand with our government.

The outbreak of coronavirus has also affected the mental health of humans as everyone reacts differently to stressful situations. So in this hour of stress/anxiety let's spread the right knowledge, right humours, right videos and ensure them that we are going to win this battle. To understand better "It is not the Corona-virus which is dangerous but it is the ~~qu~~ quick spread which is a threat." Let's us do our part and participate in this battle by staying at home.

# COVID19 youth actions



**Mark the actions you've taken to fight the coronavirus.** Take a screenshot and share it with friends and family so others can learn how to help.



Took care of my mental health



Kept learning at home



Checked on my loved ones



Practiced physical distancing, but stayed connected



Went live on social media to spread accurate information



Sent kind messages to people having a hard time



Called someone living in isolation



Listened to music, read a book or played a game



Ate healthy and did some exercise



Helped my siblings play and learn at home



Made sure I didn't put myself or others at risk



Taught someone how to wash their hands properly



Followed UNICEF and WHO on social media



Stepped in when family or friends shared misinformation



Called out racism and discrimination



Stayed at home to protect myself and others

Visit [Voicesofyouth.org](https://www.voicesofyouth.org) to learn more

Com a chegada do Coronavírus no Brasil, a juventude tem papel fundamental, tanto na disseminação de informações verdadeiras, quanto na mudança de comportamento.

Por isso, esteja atento e fique por dentro das últimas orientações divulgadas pelo Governo Federal no site <https://www.gov.br> e no aplicativo "Coronavirus-SUS" <https://www.gov.br/pt-br/apps/coronavirus-sus>.

Ter conhecimento sobre as formas de transmissão, prevenção e principais sintomas são essenciais no combate ao Coronavírus.

## Dicas de prevenção:

Lavar as mãos frequentemente com água e sabonete por pelo menos 20 segundos, respeitando os 5 momentos de higienização. Se não houver água e sabonete,

- Usar um desinfetante para as mãos à base de álcool;
- Lave as mãos com água e sabão ou use álcool em gel;
- Cubra o nariz e boca ao espirrar ou tossir;
- Evite aglomerações se estiver doente;
- Mantenha os ambientes bem ventilados;
- Não compartilhe objetos pessoais.



## Quais são os principais sintomas:

febre e tosse ou dificuldade para respirar.



## Como ocorre a transmissão:

Ocorre pelo ar ou por contato pessoal com secreções contaminadas, como:



Gotículas de saliva



Espirro



Tosse



Catarro



Contato pessoal próximo, como toque ou aperto de mão



Contato com objetos ou superfícies contaminadas, seguido de contato com a boca, nariz ou olhos.

## Seja responsável

Então seja responsável, não divulgue fake news, mas sim conteúdos de interesse público que ajudem na conscientização. Mude hábitos que coloquem outras pessoas em risco, como ir a festas, bares e prefira ficar em casa.

Tenha consciência de que uma atitude sua afeta a vida de muitas pessoas. Essa é a hora de agir com solidariedade e de pensar no próximo, para que juntos possamos enfrentar essa epidemia.



## Conclusion:

The Coronavirus, a pandemic has made us realize that we all are connected and this entire world is a family. Although connected, medical experts suggested social distancing as one of the perfect solution to fight against the evil. Our honourable Prime Minister - Narendra Modi Ji indicated how COVID-19 chain can be splintered with the 21 days country lock-down. But to Flatten the curve of COVID-19, the lockdown must be respected and accepted by 130 crore Indians altogether.

# RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

PROJECT TITLE:

= 5. : Nitrogen cycle and its importance  
for living beings :=

NAME : SANTANU SINGH  
COLLEGE ROLL NO : PHUGA / 138 / 19  
DEPARTMENT : PHYSICS  
YEAR : 2020  
SIGNATURE : Santanu Singh

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1

=: BONAFIDE CERTIFICATE :=

This is Certify that SANTANU SINGH  
Bsc first year student (Roll No:-  
PHUGC/138/19) of Ramakrishna Mission  
Residential College (Autonomous),  
Department of Physics has done  
project on, 'Nitrogen cycle and its  
importance for living beings' under  
the supervision and Guidance  
of Prof. Narayan Chandra Maity,  
Department of Environmental Studies,  
RKMRC, Narendrapur.

\_\_\_\_\_  
(Signature)

Santanu Singh

Date:- 01.11.2020

Date:

Prof. Narayan Chandra Maity  
Department of Environmental Studies  
RKMRC, Narendrapur.

2.

## =: 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 (Ex- nitrate, ammonia) and organic (Ex- nucleic acids) forms. Thus, nitrogen undergoes

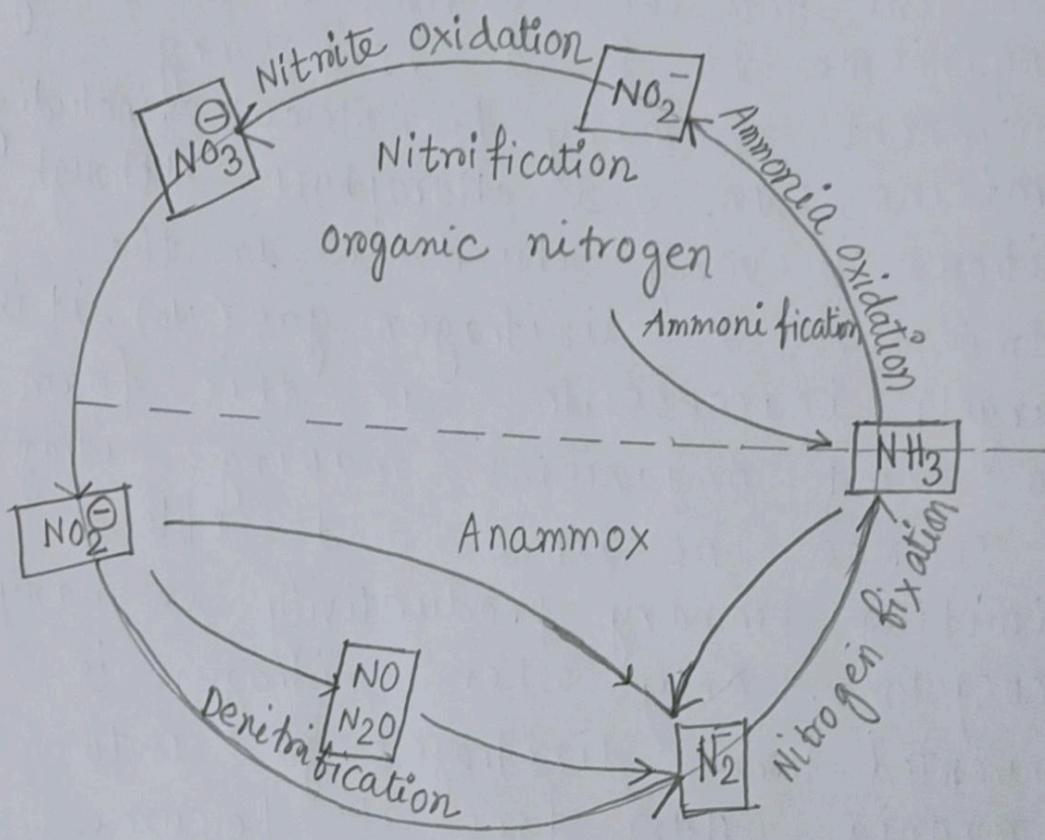


Figure: Transformations in the nitrogen cycle.

3.

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, 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.

4.

## =: Nitrogen is Key to Life: =

Nitrogen is a key element in the nucleic acids, DNA and RNA which are the most important of all biological molecules and crucial for all living things. DNA carries the genetic information, which means the instructions for how to make up a life form. When plants do not get enough nitrogen, they are unable to produce amino acids. Without amino acids, plants cannot make the special proteins that the plant cells need to grow. Without enough nitrogen, plant growth is affected negatively. With too much nitrogen, plants produce excess biomass or organic matter, such as stalks and leaves, but not enough root structure. In extreme cases, plants with very high levels of nitrogen absorbed from soils can poison farm animals that eat them.

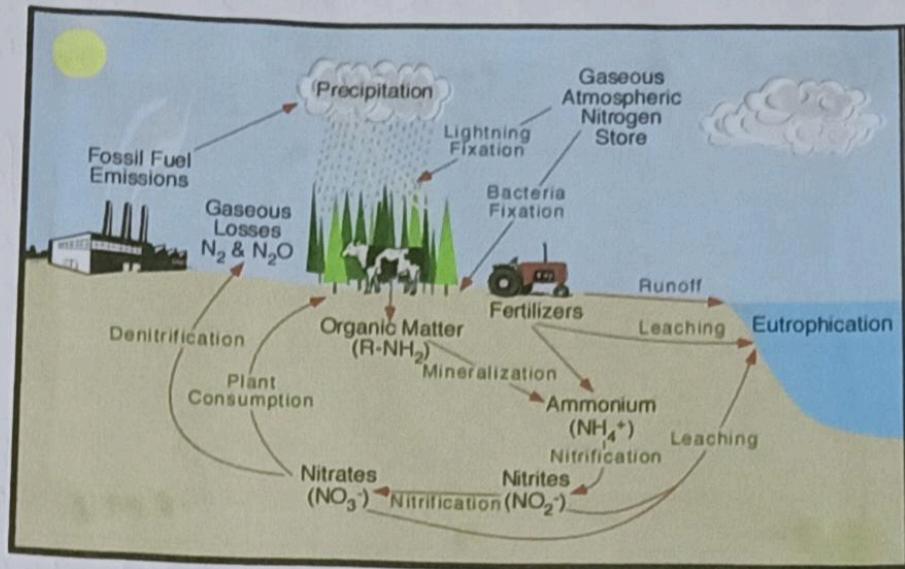


Fig:- Nitrogen cycle in Nature.

5.

## =: Nitrogen Cycle: =

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

6.

There are five states in the nitrogen cycle:

1. Fixation or Volatilization
2. Assimilation
3. Ammonification
4. Nitrification
5. Denitrification.

In this process, microbes in the soil turn nitrogen gas ( $N_2$ ) into volatile ammonia ( $NH_3$ ), so the fixation process is called volatilization. Leaching is where certain forms of nitrogen become dissolved in water and leak out of the soil, potentially polluting waterways.

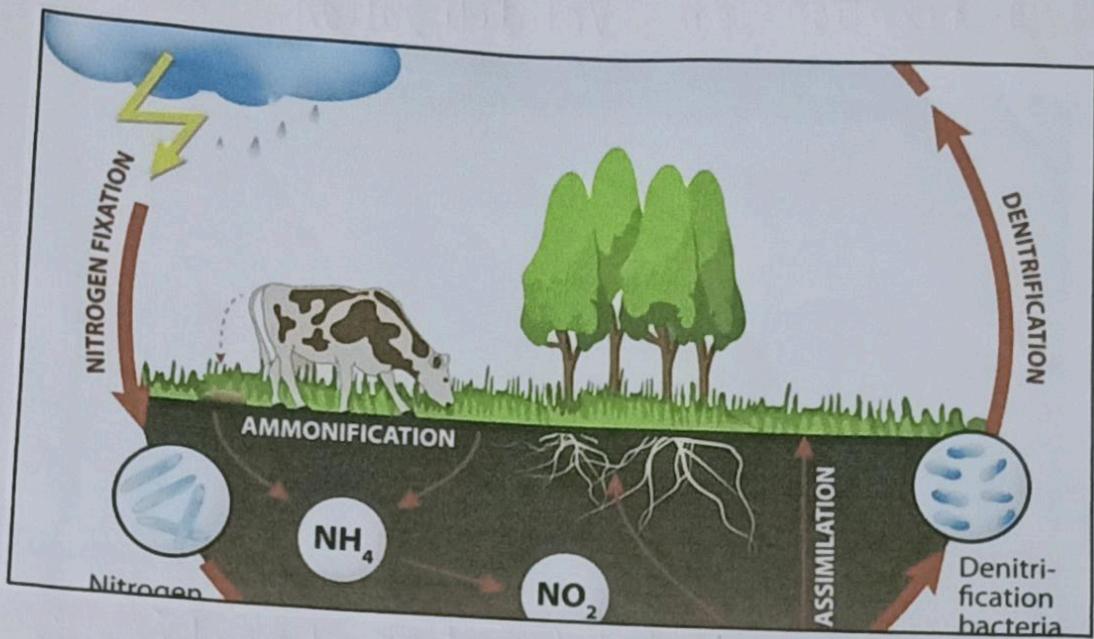


Fig: - Nitrogen Fixation and Denitrification and Ammonification.

## = : Nitrogen Fixation : =

In this state, nitrogen moves from the atmosphere into the soil. Earth's atmosphere contains a huge pool of nitrogen gas ( $N_2$ ). But this nitrogen is unavailable to plants, because the gaseous form cannot be used directly by plants without undergoing a transformation. To be used by plants, the  $N_2$  must be transformed through a process called nitrogen fixation.

Fixation converts nitrogen in the atmosphere into forms that plants can absorb through their root systems.

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

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then enter soils through rain or snow. Nitrogen can also be fixed through the industrial process that creates fertilizers. This form of fixing occurs under high heat and pressure during which atmospheric nitrogen and hydrogen are combined to form ammonia ( $\text{NH}_3$ ) which may then be processed further, to produce ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ), a form of nitrogen that can be added to soils and used by plants.

Most nitrogen fixation occurs naturally in the soil, by bacteria. Some bacteria attach to plant roots and have a symbiotic relationship with the plant. The bacteria get energy through photosynthesis and in return they fix nitrogen into a form the plant needs. The fixed nitrogen is then carried to other parts of the plant and is used to

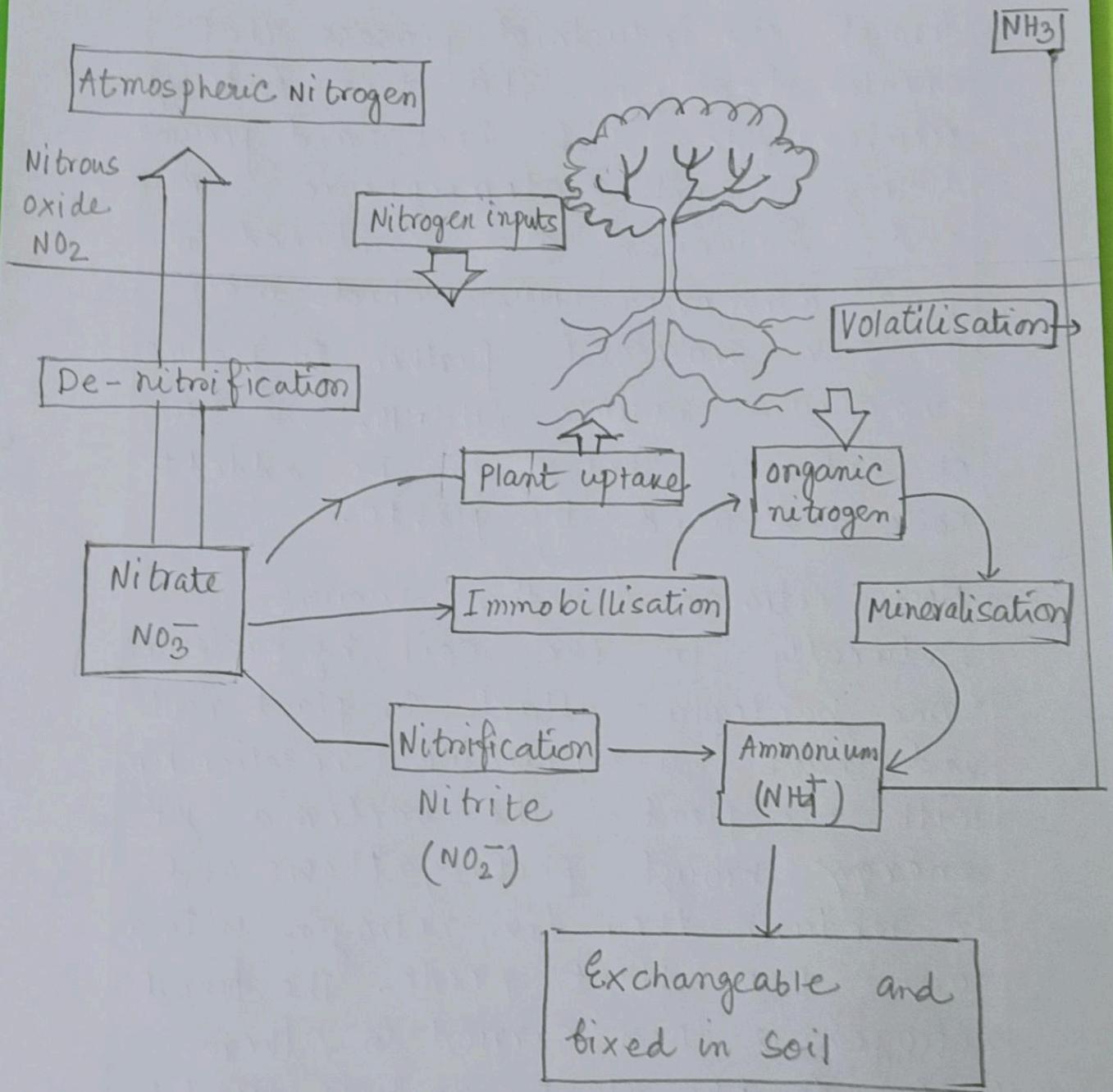


Fig:- Stages of the Nitrogen cycle

9.

form plant tissues, so the plant can grow. Other bacteria live freely in soils or waters and can fix nitrogen without this symbiotic relationship. These bacteria can also create forms of nitrogen that can be used by organisms.

### : Assimilation :

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

amino acids between Rhizobia bacteroids and plants. The plant provides amino acids to the bacteroids so ammonia assimilation is not required and the bacteroids pass amino acids back to the plant, thus forming an interdependent relationship. While many animals, fungi, and other heterotrophic organisms obtain nitrogen by ingestion of amino acids, nucleotides, and other small organic molecules other heterotrophs are able to utilize inorganic compounds, such as ammonium as sole N sources. Utilization of various N sources is carefully regulated in all organisms.

11.

### = : Ammonification : =

When a plant or animal dies or an animal expels waste, the initial form of nitrogen is organic. Bacteria or fungi convert the organic nitrogen within the remains back into ammonium ( $\text{NH}_4^+$ ), a process called ammonification or mineralization.

Enzymes involved are:

1. GS: Glu Synthetase (Cytosolic & Plasmic)

2. GOGAT: Glu 2-oxoglutarate aminotransferase

(Ferredoxin & NADH dependent)

3. GDH: Glu Dehydrogenase:

i) minor role in ammonium assimilation

ii) Important in amino acid catabolism.

## ∴ Nitriification ∴

During nitrification the ammonia in the soils, produced during mineralization, is converted into compounds called nitrites,  $\text{NO}_2^-$ , and nitrates,  $\text{NO}_3^-$ . Nitrates can be used by plants and animals that consume the plants. Some bacteria in the soil can turn ammonia into nitrites. Although nitrite is not usable by plants and animals directly, other bacteria can change nitrites into nitrates—a form that is usable by plants and animals. This reaction provides energy for the bacteria engaged in this process. The bacteria that we are talking about are called nitrosomonas and nitrobacter. Nitrobacter turns nitrites into nitrates; nitrosomonas transforms ammonia to nitrites. Both kinds of bacteria can act only in the presence of  $\text{O}_2$ .

### → : Denitrification : =

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

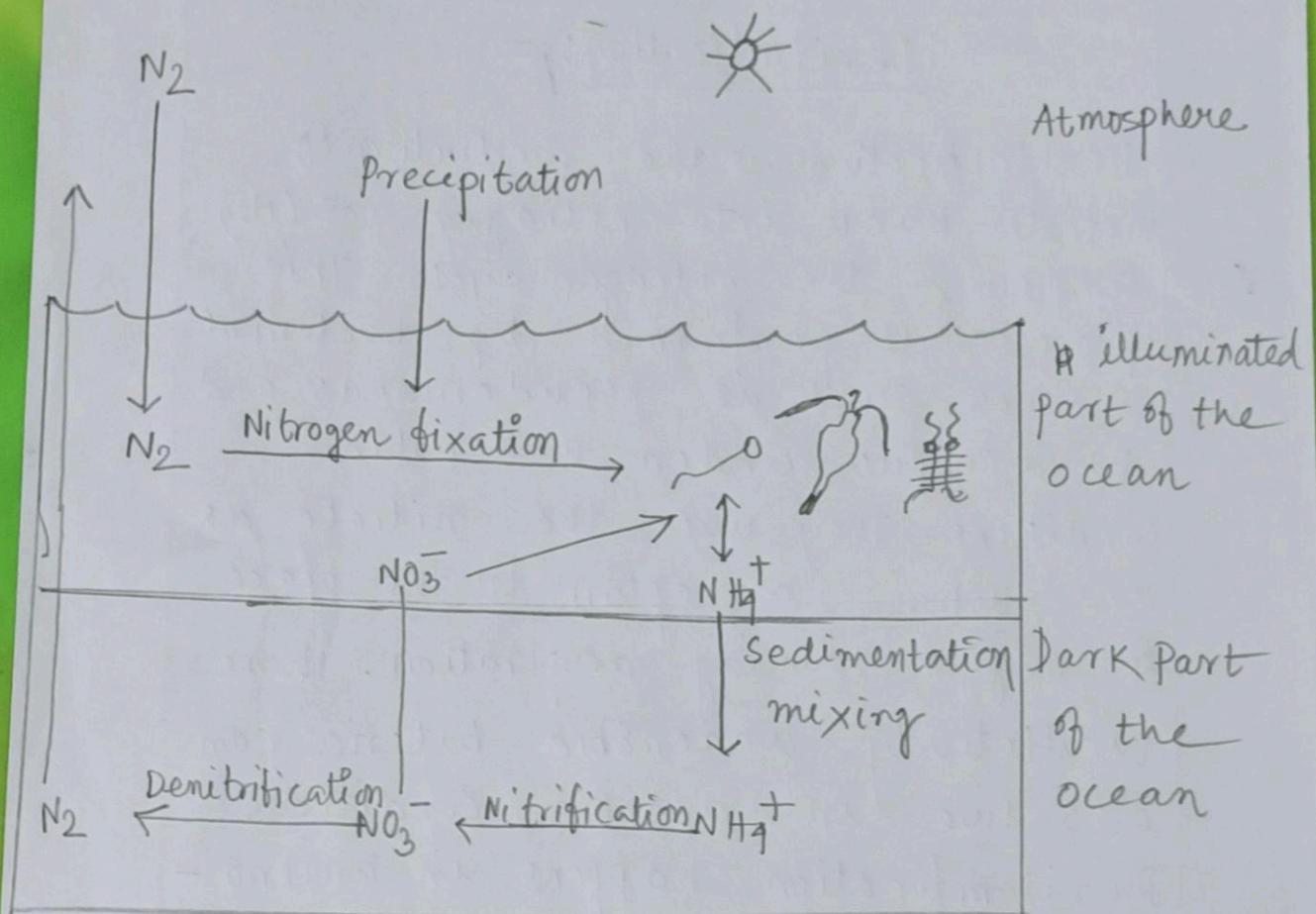


Fig:- Schematic diagram of the  $N_2$  cycle in the ocean.

14.

### =: 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 have proved that the nitrogen from these rocks is related into the plants due to the weathering of rocks.

## Unbalancing the Nitrogen Cycle:

It takes a great deal of energy to convert atmospheric nitrogen into biologically useful forms, ecosystems have ~~and~~ evolved to get by on fairly modest amounts of organic nitrogen. From forest fires to farming to burning fossil fuels, human activities have been altering the natural nitrogen cycle for centuries. Human practices that add reactive nitrogen to ecosystems can change ecological balances. Farming, for example, is a relatively nitrogen intensive activity. Crops deplete nitrogen in the soil, therefore many farmers use man made fertilizers in order to augment nitrogen levels. Unfortunately in its nitrate form, nitrogen is extremely soluble and is readily leached from the soils into ground water reservoirs which feed into lakes and streams. In heavily

16.

agricultural areas, fertilizers are the primary source of nitrogen pollution. Where livestock is raised, animal wastes that are rich in nitrogen - if not properly managed - can also be carried by rainwater into nearby bodies of water.

In areas with large human populations, most of the reactive nitrogen that is introduced into the environment by human activity comes from food and food processing. As with other animals, human wastes are nitrogen rich. This is especially the case with the large amounts of food protein that most Americans consume.

There are a variety of consequences of nitrogen pollution. A major source of reactive nitrogen is atmospheric deposition which comes largely from transportation emissions, as a

17.

nitrogen oxides ( $\text{NO}_x$ ) are released through the exhaust. These emissions are a key ingredient in the formation of ground level ozone (smog). Another form of reactive nitrogen - nitric acid ( $\text{HNO}_3$ ) - is an important ingredient in the creation of acid rain.

One of the most serious consequences of nitrogen pollution is over-nutrition or eutrophication, of aquatic ecosystems. Nitrogen leaches into the soil, and eventually into standing bodies of water, causing an unnaturally high level of nitrogen in the water. This eutrophication harms aquatic ecosystems by fueling excessive algae growth which overshadows the water surface and deprives other aquatic organisms of necessary sunlight. When the algae die, the oxygen consumed in the decomposition process can further deprive other aquatic organisms of needed oxygen. In extreme cases, eutrophication can result in the total die-off of fish in lakes

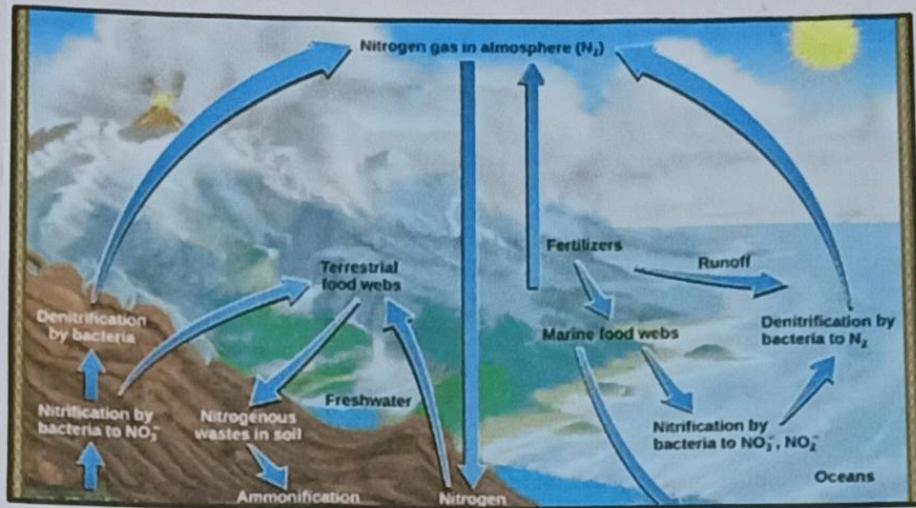


Fig:- Importance of  $N_2$  cycle in Nature and also our ecosystem.

## Importance

Importance of the nitrogen cycle are as follows:

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

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Conclusion:

1. Nitrogen is abundant in the atmosphere but it is unusable to plants or animals unless it is converted into nitrogen compounds.
2. Nitrogen-fixing bacteria play a crucial role in fixing the atmospheric nitrogen into nitrogen compounds that can be used by the plants.
3. The plants absorb the usable nitrogen compounds from the soil through their roots. Then, these nitrogen compounds are used for the production of proteins and other compounds in the cell.
4. Animals assimilate nitrogen by consuming these plants or other animals that contain nitrogen. Humans consume proteins from these plants and animals and then, the nitrogen assimilates into our system.

5. During the final stages of the nitrogen cycle, bacteria and fungi help decompose organic matter, where the nitrogenous compounds get dissolved into the soil which is again used by the plants.

6. Some bacteria then convert these nitrogenous compounds in the soil and turn it into nitrogen gas. Eventually it goes back to the atmosphere.

7. These sets of processes repeat continuously and thus maintain the percentage of nitrogen in the atmosphere.

## = : ACKNOWLEDGEMENT : =

I would like to express my special thanks of gratitude to my teacher Prof. Narayan Chandra Maity who gave me the golden opportunity to do this wonderful project on 'Nitrogen cycle and its importance for living beings', which also helped me in doing a lot of Research and i came to know about so many new things.

I would also like to extend my gratitude to the Principal Maharaj Swami Shastrajnananda and Coordinator of Examinations Department Br. VIKAS Maharaj for providing me with all the facility that was required. Secondly i would also like to thank my parents and friends who helped me a lot in finishing this project within the limited time.

Date:

01.11.2020

Santanu Singh  
Bsc 1<sup>st</sup> yr, Physics

## = : The End : =

# RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

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1

=: BONAFIDE CERTIFICATE :=

This is Certify that SANTANU SINGH Bsc first year student (Roll No:- PHUGC/138/19) of Ramakrishna Mission Residential College (Autonomous), Department of Physics has done project on, 'Nitrogen cycle and its importance for living beings' under the supervision and Guidance of Prof. Narayan Chandra Maity, Department of Environmental Studies, RKMRC, Narendrapur.

\_\_\_\_\_  
(Signature)

Santanu Singh

Date:- 01.11.2020

Date:

Prof. Narayan Chandra Maity  
Department of Environmental Studies  
RKMRC, Narendrapur.

2.

## =: 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 (Ex- nitrate, ammonia) and organic (Ex- nucleic acids) forms. Thus, nitrogen undergoes

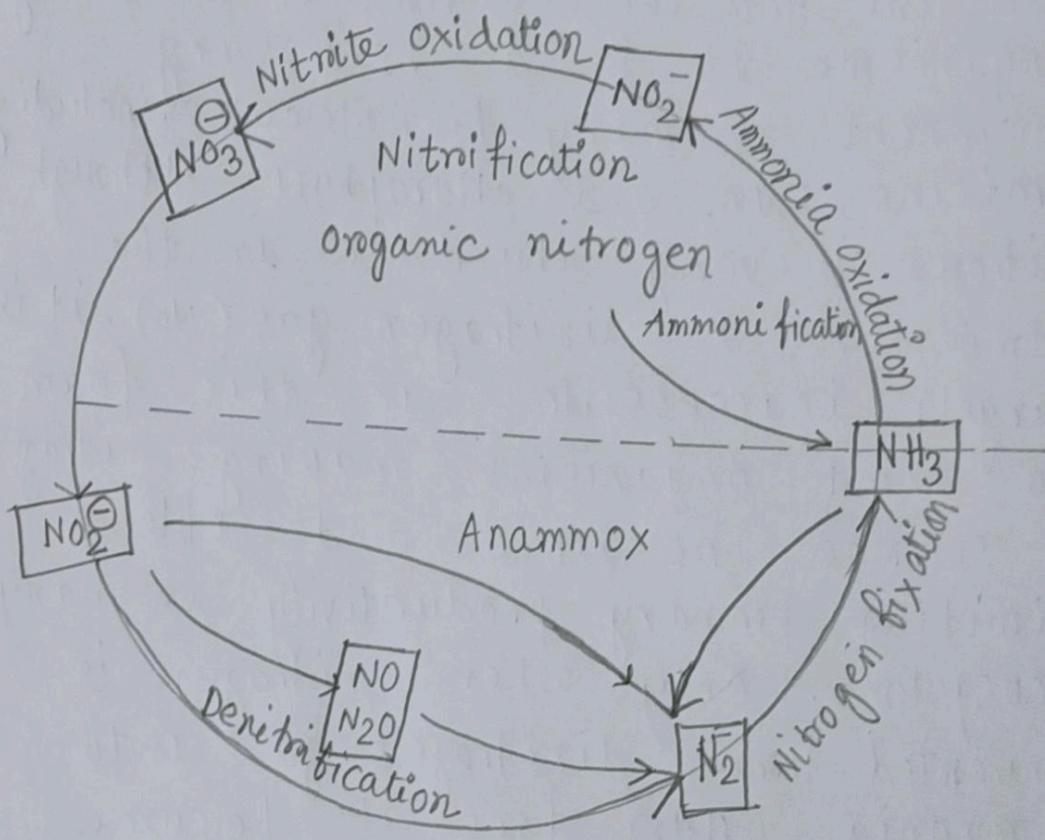


Figure: Transformations in the nitrogen cycle.

3.

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.

4.

## ∴ Nitrogen is Key to Life ∴

Nitrogen is a key element in the nucleic acids, DNA and RNA which are the most important of all biological molecules and crucial for all living things. DNA carries the genetic information, which means the instructions for how to make up a life form. When plants do not get enough nitrogen, they are unable to produce amino acids. Without amino acids, plants cannot make the special proteins that the plant cells need to grow. Without enough nitrogen, plant growth is affected negatively. With too much nitrogen, plants produce excess biomass or organic matter, such as stalks and leaves, but not enough root structure. In extreme cases, plants with very high levels of nitrogen absorbed from soils can poison farm animals that eat them.

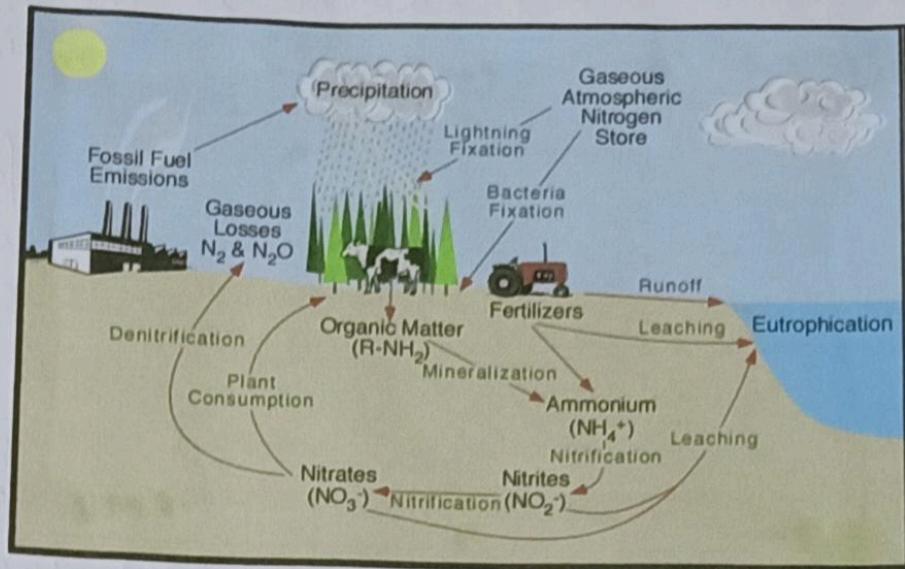


Fig:- Nitrogen cycle in Nature.

5.

## =: Nitrogen Cycle: =

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

6.

There are five states in the nitrogen cycle:

1. Fixation or Volatilization
2. Assimilation
3. Ammonification
4. Nitrification
5. Denitrification.

In this process, microbes in the soil turn nitrogen gas ( $N_2$ ) into volatile ammonia ( $NH_3$ ), so the fixation process is called volatilization. Leaching is where certain forms of nitrogen become dissolved in water and leak out of the soil, potentially polluting waterways.

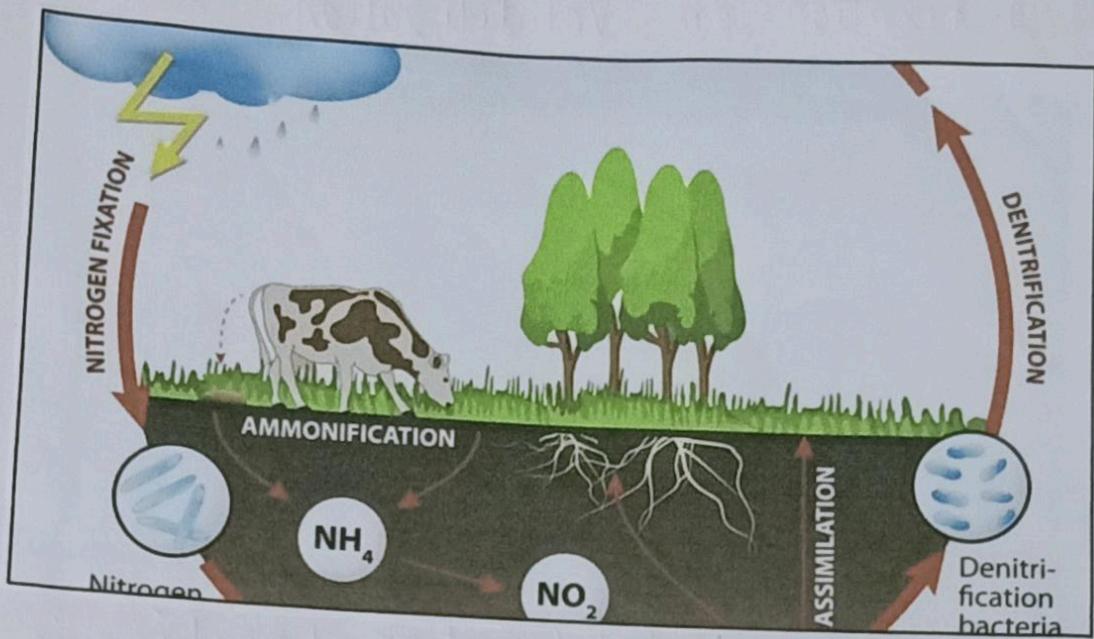


Fig: - Nitrogen Fixation and Denitrification and Ammonification.

## = : Nitrogen Fixation : =

In this state, nitrogen moves from the atmosphere into the soil. Earth's atmosphere contains a huge pool of nitrogen gas ( $N_2$ ). But this nitrogen is unavailable to plants, because the gaseous form cannot be used directly by plants without undergoing a transformation. To be used by plants, the  $N_2$  must be transformed through a process called nitrogen fixation.

Fixation converts nitrogen in the atmosphere into forms that plants can absorb through their root systems.

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

8.

then enter soils through rain or snow. Nitrogen can also be fixed through the industrial process that creates fertilizers. This form of fixing occurs under high heat and pressure during which atmospheric nitrogen and hydrogen are combined to form ammonia ( $\text{NH}_3$ ) which may then be processed further, to produce ammonium nitrate ( $\text{NH}_4\text{NO}_3$ ), a form of nitrogen that can be added to soils and used by plants.

Most nitrogen fixation occurs naturally in the soil, by bacteria. Some bacteria attach to plant roots and have a symbiotic relationship with the plant. The bacteria get energy through photosynthesis and in return they fix nitrogen into a form the plant needs. The fixed nitrogen is then carried to other parts of the plant and is used to

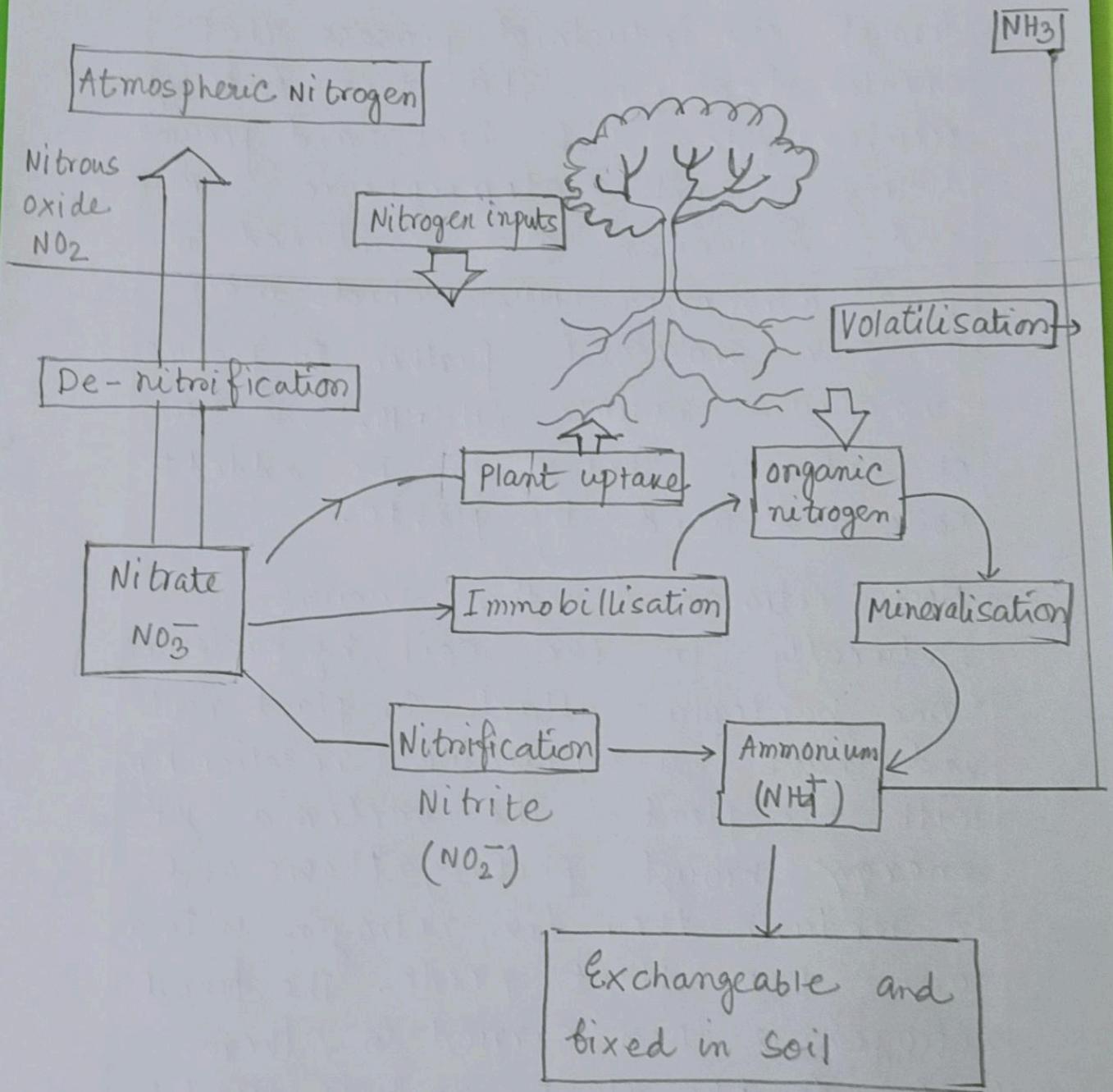


Fig:- Stages of the Nitrogen cycle

9.

form plant tissues, so the plant can grow. Other bacteria live freely in soils or waters and can fix nitrogen without this symbiotic relationship. These bacteria can also create forms of nitrogen that can be used by organisms.

### : Assimilation :

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

amino acids between Rhizobia bacteroids and plants. The plant provides amino acids to the bacteroids so ammonia assimilation is not required and the bacteroids pass amino acids back to the plant, thus forming an interdependent relationship. While many animals, fungi, and other heterotrophic organisms obtain nitrogen by ingestion of amino acids, nucleotides, and other small organic molecules other heterotrophs are able to utilize inorganic compounds, such as ammonium as sole N sources. Utilization of various N sources is carefully regulated in all organisms.

11.

### = : Ammonification : =

When a plant or animal dies or an animal expels waste, the initial form of nitrogen is organic. Bacteria or fungi convert the organic nitrogen within the remains back into ammonium ( $\text{NH}_4^+$ ), a process called ammonification or mineralization.

Enzymes involved are:

1. GS: Glu Synthetase (Cytosolic & Plasmic)

2. GOGLAT: Glu 2-oxoglutarate aminotransferase

(Ferredoxin & NADH dependent)

3. GDH: Glu Dehydrogenase:

i) minor role in ammonium assimilation

ii) Important in amino acid catabolism.

## ∴ Nitriification ∴

During nitrification the ammonia in the soils, produced during mineralization, is converted into compounds called nitrites,  $\text{NO}_2^-$ , and nitrates,  $\text{NO}_3^-$ . Nitrates can be used by plants and animals that consume the plants. Some bacteria in the soil can turn ammonia into nitrites. Although nitrite is not usable by plants and animals directly, other bacteria can change nitrites into nitrates—a form that is usable by plants and animals. This reaction provides energy for the bacteria engaged in this process. The bacteria that we are talking about are called nitrosomonas and nitrobacter. Nitrobacter turns nitrites into nitrates; nitrosomonas transforms ammonia to nitrites. Both kinds of bacteria can act only in the presence of  $\text{O}_2$ .

### → : Denitrification : =

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

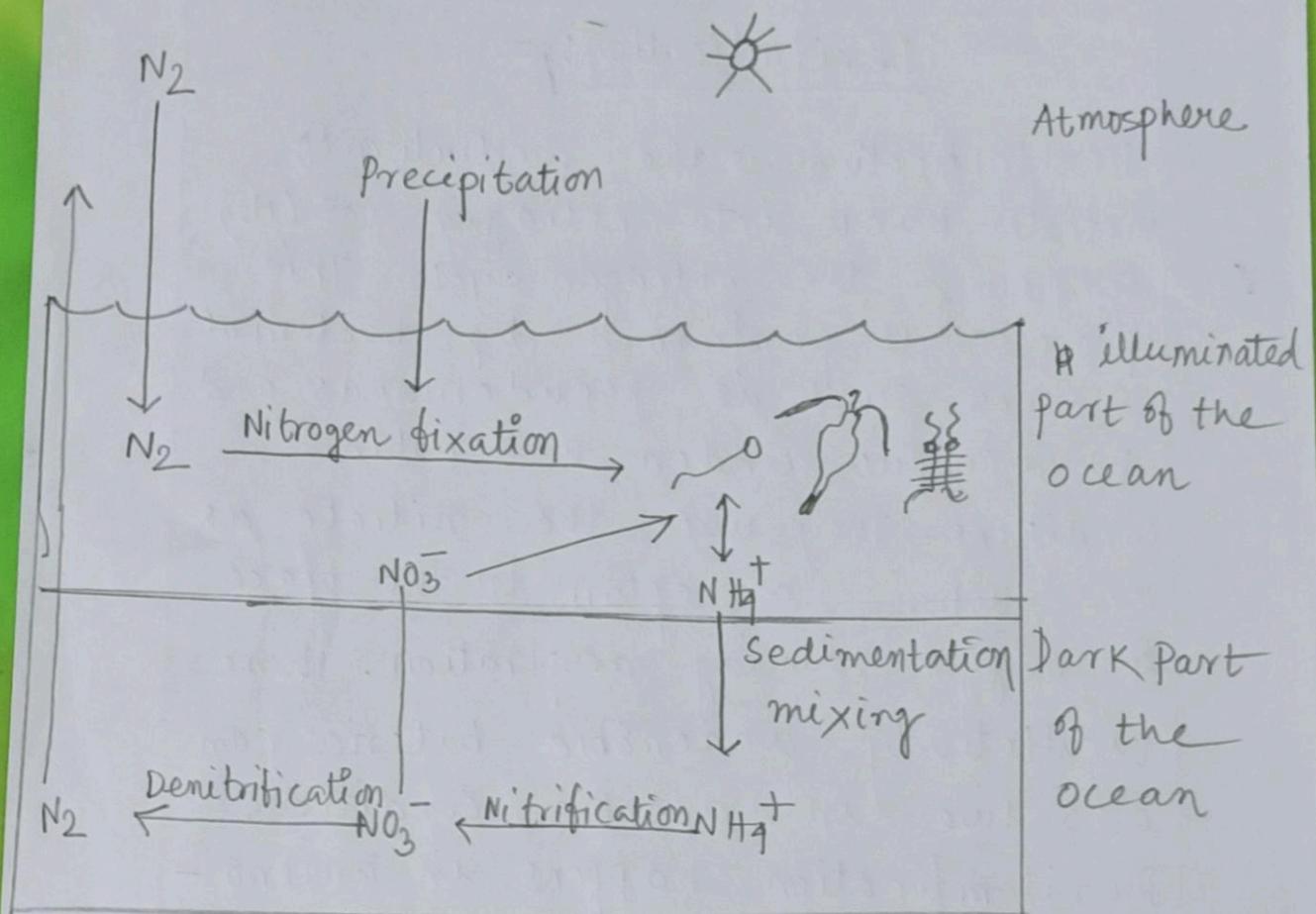


Fig:- Schematic diagram of the  $N_2$  cycle in the ocean.

14.

### =: 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 have proved that the nitrogen from these rocks is related into the plants due to the weathering of rocks.

## Unbalancing the Nitrogen Cycle:

It takes a great deal of energy to convert atmospheric nitrogen into biologically useful forms, ecosystems have ~~and~~ evolved to get by on fairly modest amounts of organic nitrogen. From forest fires to farming to burning fossil fuels, human activities have been altering the natural nitrogen cycle for centuries. Human practices that add reactive nitrogen to ecosystems can change ecological balances. Farming, for example, is a relatively nitrogen intensive activity. Crops deplete nitrogen in the soil, therefore many farmers use man made fertilizers in order to augment nitrogen levels. Unfortunately in its nitrate form, nitrogen is extremely soluble and is readily leached from the soils into ground water reservoirs which feed into lakes and streams. In heavily

16.

agricultural areas, fertilizers are the primary source of nitrogen pollution. Where livestock is raised, animal wastes that are rich in nitrogen - if not properly managed - can also be carried by rainwater into nearby bodies of water.

In areas with large human populations, most of the reactive nitrogen that is introduced into the environment by human activity comes from food and food processing. As with other animals, human wastes are nitrogen rich. This is especially the case with the large amounts of food protein that most Americans consume.

There are a variety of consequences of nitrogen pollution. A major source of reactive nitrogen is atmospheric deposition which comes largely from transportation emissions, as a

17.

nitrogen oxides ( $\text{NO}_x$ ) are released through the exhaust. These emissions are a key ingredient in the formation of ground level ozone (smog). Another form of reactive nitrogen - nitric acid ( $\text{HNO}_3$ ) - is an important ingredient in the creation of acid rain.

One of the most serious consequences of nitrogen pollution is over-nutrition or eutrophication, of aquatic ecosystems. Nitrogen leaches into the soil, and eventually into standing bodies of water, causing an unnaturally high level of nitrogen in the water. This eutrophication harms aquatic ecosystems by fueling excessive algae growth which overshadows the water surface and deprives other aquatic organisms of necessary sunlight. When the algae die, the oxygen consumed in the decomposition process can further deprive other aquatic organisms of needed oxygen. In extreme cases, eutrophication can result in the total die-off of fish in lakes

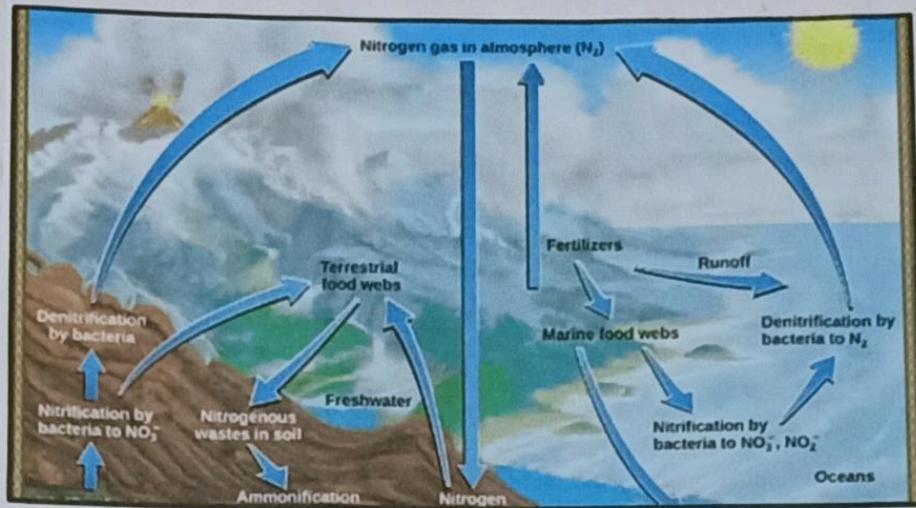


Fig:- Importance of  $N_2$  cycle in Nature and also our ecosystem.

## Importance

Importance of the nitrogen cycle are as follows:

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

19.

Conclusion:

1. Nitrogen is abundant in the atmosphere but it is unusable to plants or animals unless it is converted into nitrogen compounds.
2. Nitrogen-fixing bacteria play a crucial role in fixing the atmospheric nitrogen into nitrogen compounds that can be used by the plants.
3. The plants absorb the usable nitrogen compounds from the soil through their roots. Then, these nitrogen compounds are used for the production of proteins and other compounds in the cell.
4. Animals assimilate nitrogen by consuming these plants or other animals that contain nitrogen. Humans consume proteins from these plants and animals and then, the nitrogen assimilates into our system.

5. During the final stages of the nitrogen cycle, bacteria and fungi help decompose organic matter, where the nitrogenous compounds get dissolved into the soil which is again used by the plants.

6. Some bacteria then convert these nitrogenous compounds in the soil and turn it into nitrogen gas. Eventually it goes back to the atmosphere.

7. These sets of processes repeat continuously and thus maintain the percentage of nitrogen in the atmosphere.

= : ACKNOWLEDGEMENT : =

I would like to express my special thanks of gratitude to my teacher Prof. Narayan Chandra Maity who gave me the golden opportunity to do this wonderful project on 'Nitrogen cycle and its importance for living beings', which also helped me in doing a lot of Research and i came to know about so many new things.

I would also like to extend my gratitude to the Principal Maharaj Swami Shastrajnananda and Coordinator of Examinations Department Br. VIKAS Maharaj for providing me with all the facility that was required. Secondly i would also like to thank my parents and friends who helped me a lot in finishing this project within the limited time.

Date:

01.11.2020

Santanu Singh  
Bsc 1<sup>st</sup> yr, Physics

= : The End : =

# RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

PROJECT TITLE:

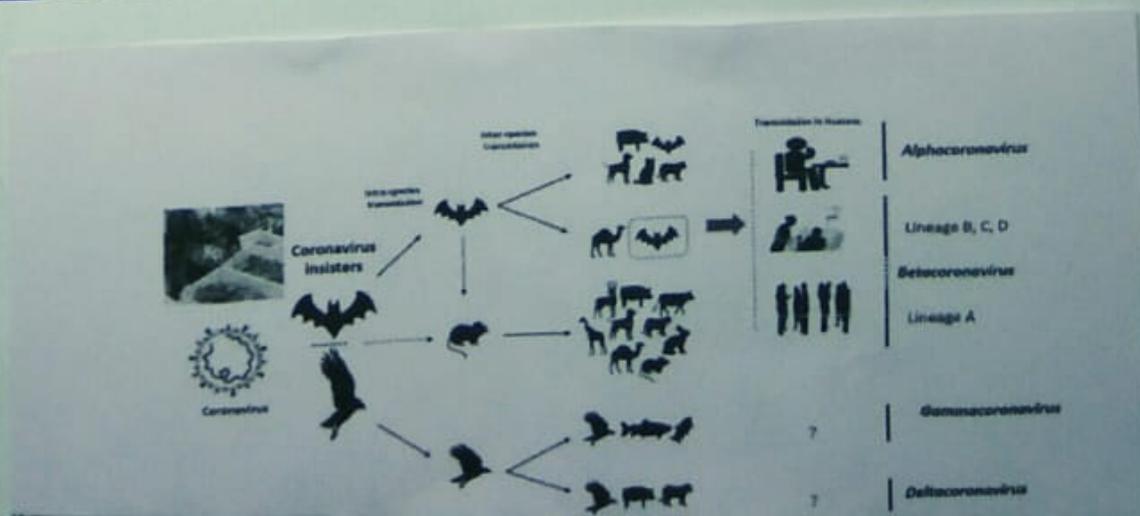
"Corona Pandemic and role of common people to control it"

NAME : Saptarshi Dash  
COLLEGE ROLL NO : PHUG/239/19  
DEPARTMENT : Physics  
YEAR : 2020  
SIGNATURE : Saptarshi Dash

## 1. Abstract:

The coronavirus disease 19 (COVID-19) is a highly transmittable and pathogenic viral infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which emerged in Wuhan, China and spread around the world. Genomic analysis revealed that SARS-CoV-2 is phylogenetically related to severe acute respiratory syndrome-like (SARS-like) bat viruses, therefore bats could be the possible primary reservoir. The intermediate source of origin and transfer to humans is not known, however, the rapid human to human transfer has been confirmed widely. There is no clinically approved antiviral drug or vaccine available to be used against COVID-19. However, few broad-spectrum antiviral drugs have been evaluated against COVID-19 in clinical trials, resulted in clinical recovery. In the current review, we summarize and comparatively analyze the emergence and pathogenicity of COVID-19, infection and previous human coronaviruses severe acute respiratory syndrome coronavirus (SARS-CoV) and middle east respiratory syndrome coronavirus (MERS-CoV). We also discuss the approaches for developing effective vaccines and therapeutic combinations to cope with this viral outbreak.

## Graphical abstract:



## 2. Introduction:

Coronaviruses belong to the Coronaviridae family in the Nidovirales order. Corona represents crown-like spikes on the outer surface of the virus; thus, it was named as a coronavirus. Coronaviruses are minute in size (65-125 nm in diameter) and contain a single-stranded RNA as a nucleic material, size ranging from 26 to 32 Kbs in length. The subgroups of coronaviruses family are alpha ( $\alpha$ ), beta ( $\beta$ ), gamma ( $\gamma$ ) and delta ( $\delta$ ) coronaviruses. The severe acute respiratory syndrome coronavirus (SARS-CoV), H5N1 influenza A, H1N1 2009 and middle East respiratory syndrome coronavirus (MERS-CoV) cause acute lung injury (ALI) and acute respiratory distress syndrome (ARDS) which leads to pulmonary failure and result in fatality. These viruses were thought to infect only animals until the world witnessed a severe acute respiratory syndrome (SARS) outbreak caused by SARS-CoV, 2002 in Guangdong, China. Only a decade later, another pathogenic coronavirus, known as Middle East respiratory syndrome coronavirus (MERS-CoV) caused an endemic in Middle Eastern countries.

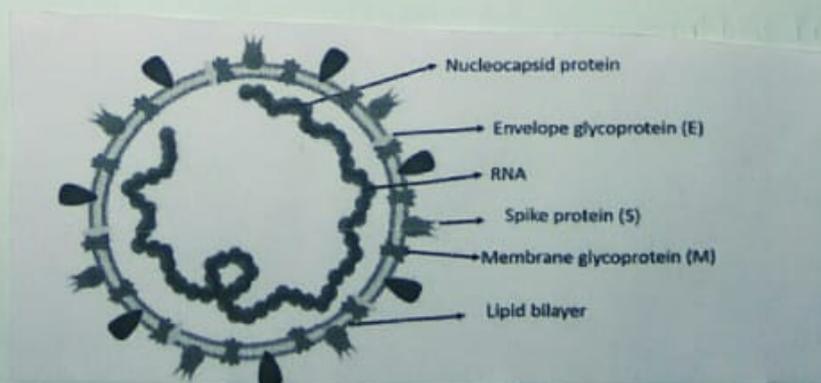


Fig-1 Structure of respiratory syndrome causing human coronavirus

Recently at the end of 2019, Wuhan an emerging business hub of China experienced an outbreak of a novel coronavirus that killed more than eighteen hundred and infected over seventy

thousand individuals within the first fifty days of the epidemic. This virus was reported to be a member of the  $\beta$  group of coronaviruses. The novel coronavirus was named as Wuhan coronavirus or 2019 novel coronavirus (2019-nCoV) by the Chinese researchers. The International committee on Taxonomy of Viruses (ICTV) named the virus as SARS-CoV-2 and the disease as COVID-19. In the history, SARS-CoV (2003) infected 8093 individuals with mortality rate of 9% across 26 countries in the world, on the other hand, novel corona virus (2019) infected 53.3 Million people with mortality rate of 2.9%, across 217 countries worldwide. It shows that the transmission rate of SARS-CoV-2 is higher than SARS-CoV and the reason could be the genetic recombination event at S protein in the RBD region of SARS-CoV-2 may have enhanced its transmission ability. In this project we will discuss the origination and role of common people to control it briefly. We further discuss the associated infectiousness and biological features of SARS and MERS with a special focus on COVID-19.

### Comparative analysis of emergence and spreading of Coronaviruses:

In 2003, the Chinese population was infected with a virus causing Severe Acute Respiratory Syndrome (SARS) in Guangdong Province. The virus was confirmed as a member of the Beta-coronavirus subgroup and was named SARS-CoV. The infected patients exhibited pneumonia symptoms with a diffused alveolar injury which lead to acute respiratory distress syndrome (ARDS). SARS initially emerged in Guangdong, China and then spread rapidly around the globe with more than 8000 infected persons and 776 deceases. A decade later in 2012, a couple

of Saudi Arabian nationals were diagnosed to be infected with another coronavirus. The detected virus was confirmed as a member of coronaviruses and named as the Middle East Respiratory Syndrome coronavirus (MERS-CoV). The World Health Organization reported that MERS-coronavirus infected more than 2428 individuals and 838 deaths. MERS-CoV is a member beta-coronavirus subgroup and phylogenetically diverse from other human-CoV. The infection of MERS-CoV initiates from a mild upper respiratory injury while progression leads to severe respiratory disease, similar to SARS-coronavirus, patients infected with MERS-coronavirus suffer pneumonia, followed by ARDS and renal failure.

Recently, by the end of 2019, WHO was informed by the Chinese government about several cases of pneumonia with unfamiliar etiology. The outbreak was initiated from the Huanan seafood market in Wuhan city of China and rapidly infected more than 50 people. The live animals are frequently sold at the Huanan seafood market such as bats, frogs, snakes, birds, marmots and rabbits. On 12 January 2020, the National Health Commission of China released further details about the epidemic, suggested viral pneumonia. From the sequence-based analysis of isolates from the patients, the virus was identified as a novel coronavirus. Moreover, the genetic sequence was also provided for the diagnosis of viral infection. Initially, it was suggested that the patients infected with Wuhan coronavirus induced pneumonia in China may have visited the seafood market where live animals were sold or may have used infected animals or birds as a source of food. However, further investigations revealed that some individuals contracted the infection even with no record of visiting the seafood market. These observations indicated a human to the human spreading capability of

this virus, which was subsequently reported in more than 200 countries of the world. The human to human spreading of the virus occurs due to close contact with an infected person, exposed to coughing, sneezing, respiratory droplets or aerosols. These aerosols can penetrate the human body (lungs) via inhalation through the nose or mouth.

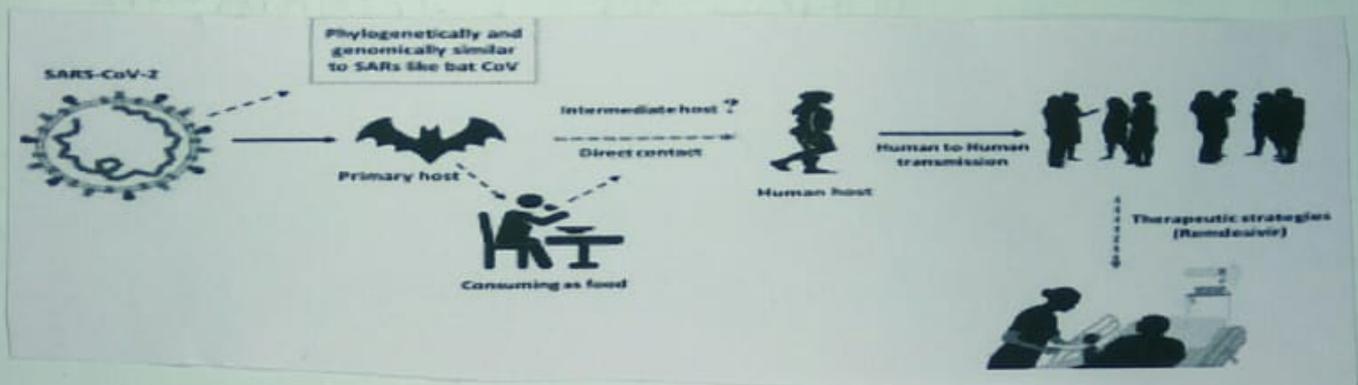


Fig-2

Fig.2. The key reservoirs and mode of transmission of coronaviruses (suspected reservoirs of SARS-CoV-2 are red encircled); only  $\alpha$  and  $\beta$  coronaviruses have the ability to infect humans, the consumption of infected animal as a source of food is the major cause of animal to human transmission of the virus and due to close contact with an infected person, the virus is further transmitted to healthy persons. Dotted black arrow shows the possibility of viral transfer from bat whereas the solid black arrow represent the confirmed transfer.

### Primary reservoirs and hosts of coronaviruses :

The source of origination and transmission are important to be determined in order to develop preventive strategies to contain the infection. In the case of SARS-CoV,

the researchers initially focused on raccoon dogs and palm civets as a key reservoir of infection. However, only the samples isolated from the civets at the food market showed positive results for viral RNA detection, suggesting that the civet palm might be secondary hosts. In 2001 the samples were isolated from the healthy persons of Hongkong and the molecular assessment showed 25% frequency rate of anti-bodies against SARS-coronavirus. These indications suggested that SARS-coronavirus maybe circulating in humans before causing the outbreak in 2003. Later on, Rhinolophus bats were also found to have anti-SARS-CoV antibodies suggesting the bats as a source of viral replication. The Middle East respiratory syndrome (MERS) coronavirus first emerged in 2012 in Saudi Arabia. MERS-coronavirus also pertains to beta-coronavirus and having camels as a zoonotic source or primary host. In a recent study MERS-coronavirus was also detected in Pipistrellus and Perimyotis bats, proffering the bats are the key host and transmitting medium of the virus. Initially a group of researchers suggested snakes be the possible host, however, after genomic similarity findings of novel coronavirus with SARS-like bat viruses supported the statement that not snakes but only bats could be the key reservoirs. Further analysis of homologous recombination revealed that receptor binding spike glyco protein of novel coronavirus is developed from a SARS-CoV (CoVZXC21 or CoVZC45) and a yet unknown Beta-CoV. Nonetheless, to eradicate the virus, more work is required to be done in the aspects of the identification of the intermediate zoonotic source that caused the transmission of the virus to humans.

Table-1 Comperative analysis of biological features of SARS-CoV and SARS-CoV-2

Features	SARS-CoV	SARS-CoV-2
Emergence date	November 2002	December 2019
Area of emergence	Guangdong, China	Wuhan, China
Date of fully controlled	July 2003	Not controlled yet
Key hosts	Bat, palm civets and Raccoon dogs	Bat
Number of countries infected	26	217
Entry receptor in humans	ACE 2 receptor	ACE 2 receptor
Sign and symptoms	Fever, malaise, myalgia, headache, diarrhoea, shivering cough and shortness of breath	Cough, Fever and shortness of breath
Disease caused	SARS, ARDS	SARS, COVID-19
Total infected patients	8098	53.3 M
Total recovered patients	7322	34.7 M
Total died	776 (9.6% mortality rate)	1.3 M (3.5% mortality rate)

### Key features and entry mechanism of human coronavirus:

All coronaviruses contain specific genes in ORF1 downstream regions that encode proteins for viral replication, nucleocapsid and spikes formation. The glycoprotein spikes on the outer surface of coronaviruses are responsible for the attachment and entry of the virus to host cells. The receptor

-binding domain (RBD) is loosely attached among viruses, therefore, the virus may infect multiple hosts. Other coronaviruses mostly recognize aminopeptidases or carbohydrates as a key receptor for entry to human cells while SARS-CoV and MERS-CoV recognize Exo peptidases. The entry mechanism of a coronavirus depends upon cellular proteases which include, human airway trypsin-like protease (HATP), cathepsins and transmembrane protease serine 2 (TMPRSS2) that split the spike protein and establish further penetration changes. MERS-coronavirus employs dipeptidyl peptidase 4 (DPP4), while HCoV-NL63 and SARS-coronavirus require angiotensin-converting enzyme 2 (ACE2) as a key receptor. SARS-CoV-2 possesses the typical coronavirus structure with spike protein and also expressed other polyproteins, nucleoproteins and membrane proteins such as RNA polymerase, 3-chymotrypsin-like protease, helicase, glycoprotein, and accessory proteins. The spike protein of SARS-CoV-2 contains a 3-D structure in the RBD region to maintain the van der Waals forces. The 399 glutamine residue in the RBD region of SARS-CoV-2 is recognized by the critical lysine 31 residue on the human ACE2 receptor. The entire mechanism of pathogenicity of SARS-CoV-2, from attachment to replication is well mentioned below.

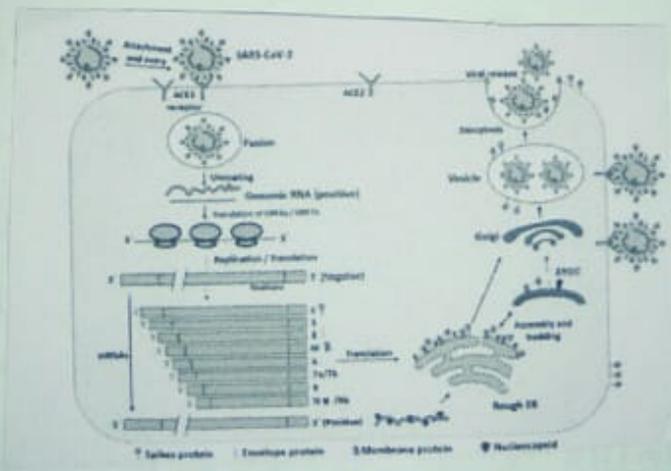


Fig-3

Fig-3 - The life cycle of SARS-CoV-2 in host cells; begins its life cycle when S protein binds to the cellular receptor ACE2. After receptor binding, the conformation change in the S protein facilitates viral envelope fusion with the cell membrane through the endosomal pathway. Then SARS-CoV-2 releases RNA into the host cells. Genome RNA is translated into viral replicase polyproteins PP1a and 1ab, which are then cleaved into small products by viral proteinases. The polymerase produces a series of subgenomic mRNAs by discontinuous transcription and finally translated into relevant viral proteins. Viral proteins and genome RNA are subsequently assembled into virions in the ER and Golgi and then transported via vesicles and released out of the cell. ACE2, angiotensin-converting enzyme 2; ER, endoplasmic reticulum; ER-Golgi intermediate compartment.

Genomic Variations in SARS-CoV-2:

The genome of the SARS-CoV-2 has been reported over 80% identical to the previous human coronavirus (SARS-like bat CoV). The structural proteins are encoded by the four structural genes, including spike (S), envelope (E), membrane (M) and nucleocapsid (N) genes, The orf1ab is the largest gene in SARS-CoV-2 which encodes the pp1ab protein and 15 nsps. The orf1a gene encodes for pp1a protein which also contains 10 nsps. According to the evolutionary tree, SARS-CoV-2 lies close to the group of SARS-coronaviruses. Recent studies have indicated notable variations in SARS-CoV and SARS-CoV-2 such as the absence of 8a protein and fluctuation in the number of amino acids in 8b and 3c protein in SARS-CoV-2. It is also reported that spike glycoprotein of the Wuhan coronavirus is modified via homologous recombination.

The spike glycoprotein of SARS-CoV-2 is the mixture of bat SARS-CoV and not known  $\beta$ -CoV. In a fluorescent study, it was confirmed that the SARS-CoV-2 also uses the name ACE2 (angiotensin-converting enzyme 2) cell receptor and mechanism for the entry to host cell which is previously used by the SARS-CoV. The single N501T mutation in SARS-CoV-2's spike protein may have significantly enhanced its binding affinity for ACE2.

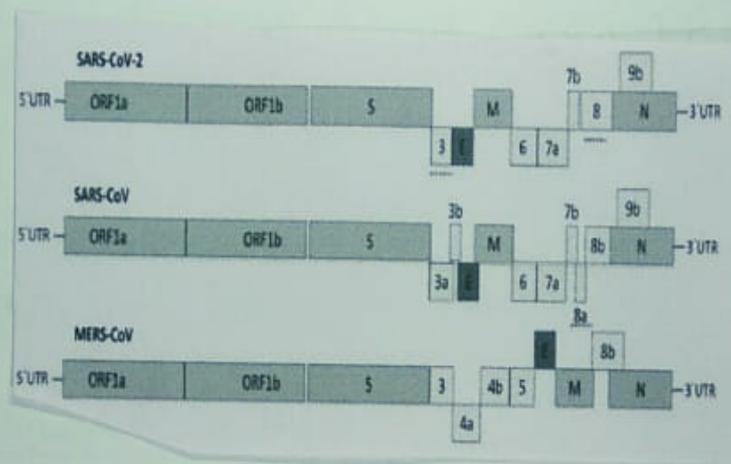


Fig-4

Fig-4. Betacoronaviruses genome organization; the Betacoronavirus for human (SARS-CoV-2, SARS-CoV and MERS-CoV) genome comprises of the 5'- untranslated region (5'-UTR), open reading frame (orf) 1 a/b (green box) encoding non structural proteins (nsp) for replication, structural proteins including spike (blue box), envelope (maroon box), membrane (pink box), and nucleocapsid (cyan box) proteins, accessory proteins (light grey boxes) such as orf 3, 6, 7a, 7b, 8 and 9b in the SARS-CoV-2 genome, and the 3'- untranslated region (3'-UTR). The dotted underlined in red are the protein which shows key variation between SARS-CoV-2 and SARS-CoV. The length of nsp and orfs are not drawn in scale.

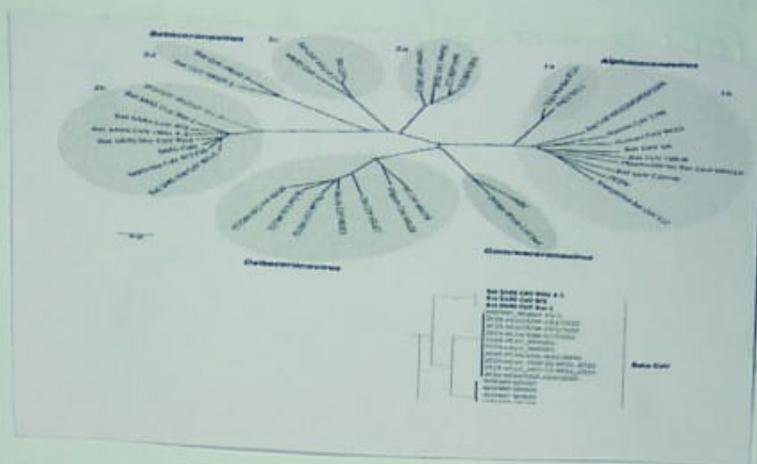


fig-5

Fig-5. Phylogenetic tree of coronaviruses (content in red is the latest addition of newly emerged SARS-CoV-2 and WFSMP Wuhan-Hu-1 is used as a reference in the tree); the phylogenetic tree showing the relationship of Wuhan-Hu-1 (denoted as red) to selected coronaviruses is based on nucleotide sequences of the complete genome. The viruses are grouped into four genera (prototype shown): ~~Alpha~~ Alphacoronavirus (sky blue), Betacoronavirus (pink), Gammacoronavirus (green) and Deltacoronavirus (~~green~~ <sup>light blue</sup>). ~~and~~ subgroup clusters are labeled as 1a and 1b for the Alphacoronavirus, and 2a, 2b, 2c, and 2d for the Betacoronavirus. This tree is based on the published trees of Coronavirinae and reconstructed with sequences of the complete RNA-dependent RNA polymerase-coding region of the representative novel coronaviruses (maximum likelihood method using MEGA 7.2 software). Severe acute respiratory syndrome coronavirus (SARS-CoV); SARS-related coronavirus (SARSr-CoV); MERS-CoV; porcine enteric diarrhea virus (PEDV); Wuhan seafood market pneumonia (Wuhan-Hu-1). Bat CoV RaT 613 showed high sequence identity to SARS-CoV-2.

## The major obstacle in research progress:

Animal models play a vital role to uncover the mechanisms of viral pathogenicity from the entrance to the transmission and designing therapeutic strategies. Previously, to examine the replication of SARS-CoV, various animal models were used which showed the symptoms of severe infection. In contrast to SARS-CoV, no MERS-CoV pathogenesis was observed in small animals. Mice are not vulnerable to infection by MERS coronavirus due to the non-compatibility of the DPP4 receptor. As the entire genome of the 2019-novel coronavirus is more than 80% similar to the previous human SARS-like bat CoV, previously used animal models for SARS-CoV-2 can be utilized to study the infectious pathogenicity of SARS-CoV-2. The human ACE2 receptor is recognized by both SARS and Novel coronaviruses. Conclusively, TALEN or CRISPR-mediated genetically modified hamsters or other small animals can be utilized for the study of the pathogenicity of novel CoV. SARS-CoV has been reported to replicate and cause severe disease in Rats (F344), where the sequence analysis revealed a mutation at spike glycoprotein. Thus, it could be another suitable option to develop spike glycoprotein-targeting therapeutics against novel coronaviruses. Recently, mice models and clinical isolates were used to develop any therapeutic strategy against SARS-CoV-2 induced COVID-19. In a similar study, artificial intelligence prediction was used to investigate the inhibitory role of the drug against SARS-CoV-2, SARS-CoV-2 infected patients were also used to conduct randomized clinical trials.

It is now worldwide collaborate the design a suitable model and investigate the in vivo mechanisms associated with pathogenesis of SARS-CoV-2.

## ROLE OF COMMON PEOPLE TO CONTAIN OR CHECK THE SPREAD OF COVID-19

There is no vaccine available against COVID-19, But researchers from different countries and government of countries worldwide are trying to get invent a vaccine of that. Initially, interferons & nebulization; broad-spectrum antibiotics, and anti-viral drugs were used to reduce the viral load, however, only remdesivir has shown promising impact against the virus. Remdesivir only and in combination with chloroquine or interferon beta significantly blocked the SARS-CoV-2 replication and patients were declared as clinically recovered.

However as vaccine is not discovered yet so awareness among the people and obeying the government policies are the only remedy here.

### MEASURES TO BE TAKEN:

1. The World Health Organisation has warned that alcohol consumption could increase health risks for a person who becomes infected with the virus so people have to avoid drinking alcohol.
2. As elderly patients of COVID-19 are the most vulnerable so we have to take measures and policies that can help them from going outside home for work and then they can stay inside room that will help them <sup>protect themselves</sup> from COVID-19 infection.

### 3. Avoid touching eyes, nose and mouth:

Our hands touch door handles, keyboards, taps and numerous other surfaces, so the virus could easily be picked up this way. Rubbing tired eyes or touching nose or mouth could transfer the virus from our hands to body so we have to avoid it.

COVID-19 can be transmitted by people with the virus coughing or sneezing, releasing tiny contaminated droplets into the air, putting anyone within range in danger of inhaling them. These droplets can travel more than a metre from the infected person allowing them to settle on any surfaces ready to be transferred to anyone that touches the surface.

The virus can live on some surfaces for several days. Data from the 2003 SARS outbreak, which was a similar illness to the latest coronavirus showed the virus could contaminate plastered walls for up to a day and a half, plastic and stainless steel for 72 hours, and glass for 96 hours, so it's likely the mobile phone, tablet or computer screen you are reading this on could harbour COVID-19 for up to four days, and be transferred to anyone touching the screen.

Adopting good hygiene is one of the most effective weapons to slow or prevent the virus spreading. Here are six things you can do to protect ourselves, mentioned above and below.

#### ④ Wash our hands regularly:

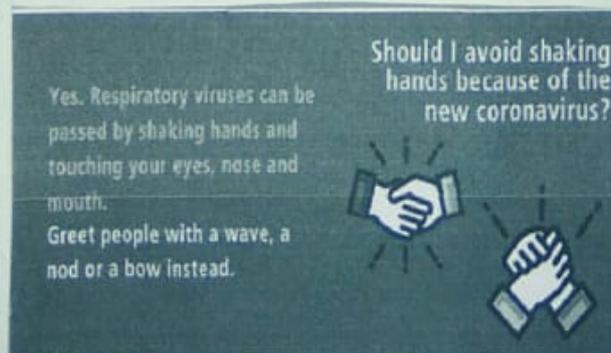
cleaning hands thoroughly and often using plenty of soap and water or an alcohol-based hand rub to kill any virus on hands. Scrub for at least 20 seconds, making sure clean fingers, thumbs and palms will ensure people's safety.

#### ⑤ Practise respiratory hygiene:

If we cough or sneeze, ~~use~~ we have to use a tissue ~~then~~ and throw it in the trash afterwards. If we don't have a tissue, cough into the crook of your arm instead of using hand. If possible, avoid coughing or sneezing near other people that will stop spreading the virus.

#### ⑥ Maintain Social Distancing:

We have to be aware of people around us and keep our distance from anyone coughing or sneezing. Stay at least 1 metre away to prevent inhaling the small liquid droplets sprayed by coughs and sneezes.



#### ⑦ If any symptoms develop, seek medical care early:

Stay at home is the advice if you feel unwell and if you develop a fever, cough or difficulty breathing seek

medical attention. Call in advance of your visit, and follow the advice of your local health provider - they will have the most up-to-date information on the situation in your area.

### ⑥ Stay informed:

Accurate information about COVID-19 and its spread is essential. But beware, because there is a lot of misinformation, scaremongering and fake news floating around on social media that can hamper efforts to contain the virus.

The latest information is available by visiting trusted sources like WHO's information page.

Critically abide by the lockdown and Unlock stages ~~impo~~ guidelines imposed by government of India as we are citizen of India and also to install the 'Arogya Setu' app for updated information.

### Conclusion:

Last but not the least we have to say that as vaccine is not available so awareness <sup>and activeness</sup> among the people specially youth to protect the society from this virus is highly solicited.

## Certificate

This is to certify that Saptarshi Dash, B.sc first year student (Roll no - PHUG/237/19) of Ramakrishna Mission Residential College (Autonomous), Narendrapur, Department of Physics has done the project on

"Corona pandemic and role of common people to control it"

under the supervision and guidance of Prof. Narayan Chandra Maity, Department of Environmental studies, RKMRC, Narendrapur.

Saptarshi Dash

Date - 15/11/2020

(Signature)

Prof. Narayan Chandra  
Maity

RKMRC, Narendrapur.

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

PROJECT TITLE:

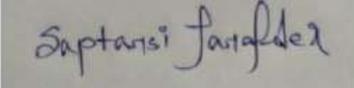
AIR POLLUTION IN CITIES AND MEASURES  
TO CONTROL IT

NAME : Saptarsi Tarafder

COLLEGE ROLL NO : PHUG/137/19

DEPARTMENT : Physics

YEAR : 2020

SIGNATURE : 

## Air pollution in cities and measures to control it :

From the beginning of human civilization man started to exploit the nature. In twenty first century massive urbanization not only making disaster to the nature but creating major issues to the man also. In cities these pollutions are intensified specially air pollution. Air pollution is creating major health issues which is a major problem.

### Air pollution :

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

### Air pollutants in the cities and sources :

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

Different pollutants and sources are:

i) Carbo-di-oxide ( $CO_2$ ):

$CO_2$  is the main green house gas which causes global warming. It reduces the  $O_2$  in air. It mainly produces by cars and industries due to burning of fossils fuel.

ii) Sulphur oxides ( $SO_x$ ):

$SO_x$  in the air converted to  $H_2SO_4$  in moist. It causes acid rain. It is also poisons. It is mainly produces by fossil fuel. Cars and petrochemical industries are common source of it.

iii) Nitrogen Oxides ( $NO_x$ ):

$NO_x$  is also a common green house gas and poisonous too. It is mainly produced by cars.

iv) Carbomonoxide (CO):

$CO$  is very poisonous gas which may cause death if inhaled in large amount. It is also form by burning fossil fuel.



Air pollution by cars

## → Volatile Organic Compound :

VOC are well known outdoor air pollutant. They are very organic compound generally used as solvent eg - benzene, isopentene, terpenes, methanol etc. They are very poisonous gas. It is seen that they cause cancer.

$CH_4$  is also a VOC which is not poisonous but having a serious green house effect.

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

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

## → Others :

CO, phosphine, smoke of etc. are also air pollutant.



*Air pollution by industries*

## Cause of pollution in Air in cities:

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- 2) large no. of cars and industries operators in small area.
- 3) less regulation of pollution sources.
- 4) Very poor tree and land ratios.

## Effects of air pollution:

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

### 1) Smog

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Due to photochemical reaction smog is composed of ground level ozone ( $O_3$ ), PAN (peroxyacetyl nitrate). Smog is a major problem in cities like Los Angeles, New Delhi, Lahore etc.



Smog



*Before and after smog*

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

### ii) Heat Island :

Due to high concentration of greenhouse and low tree cities are now heated above the normal temperatures. This increases storm and rain wind.

### iii) Health effects :

#### → Mortality :

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

#### → Cardiovascular Disease :

A 2007 review of evidence found that ambient air pollution exposure found that ambient

air pollution exposure is a risk factor correlating with increased total mortality from cardiovascular defects.

### iii) Lung disease :

Research has demonstrated increased risk of developing asthma and COPD from increased exposure to traffic-related air pollution. Additionally air pollution has been associated with increased hospitalization and mortality from asthma and COPD.

### iv) Cancer :

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

### v) Affect children and other animals :

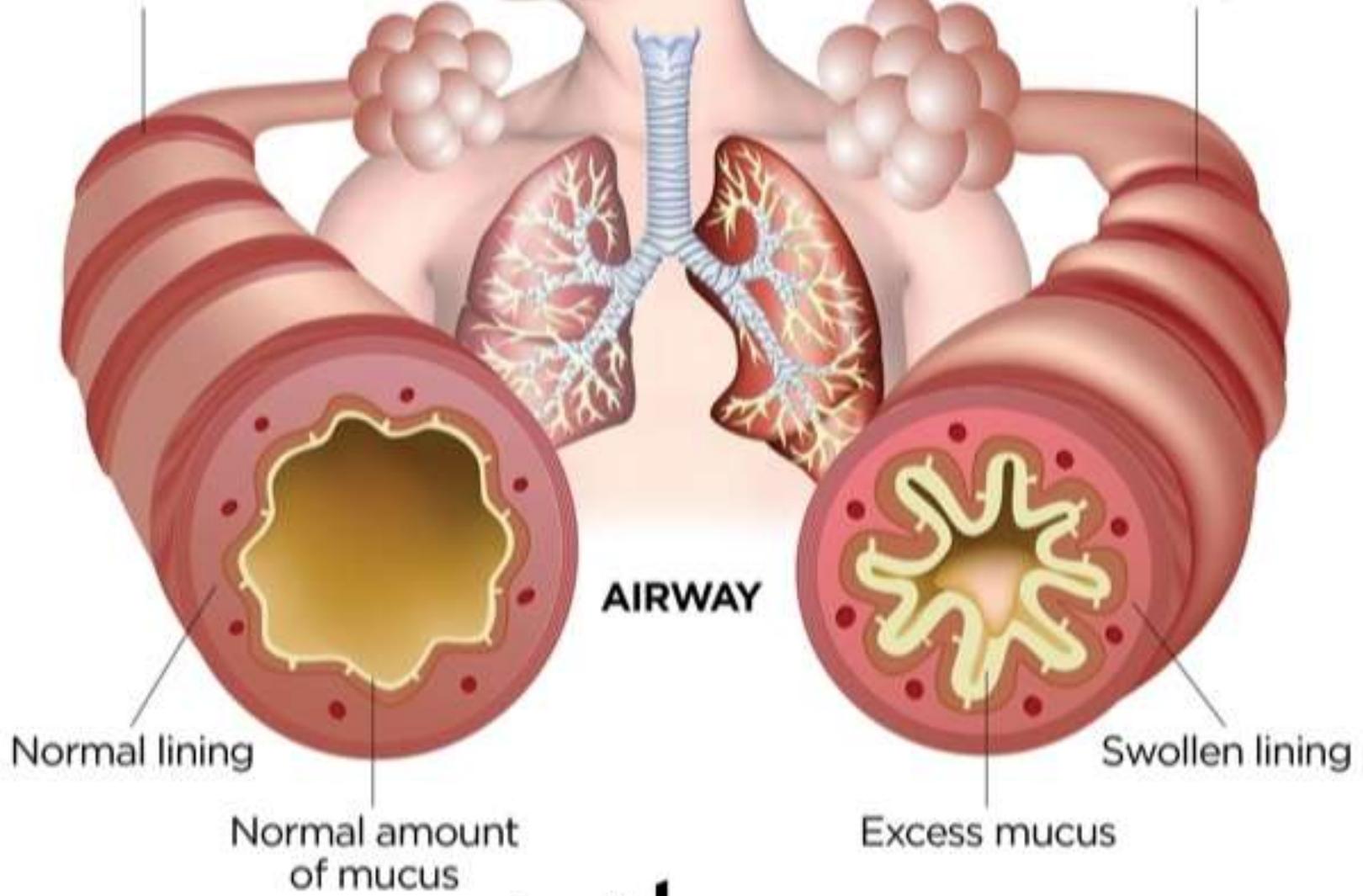
Due to pollution children are highly affected. Many disease and death happen every year due to air pollution. Little animals and

**NORMAL LUNG**

**ASTHMATIC LUNG**

Muscle relaxed

Muscle tightens



**AIRWAY**

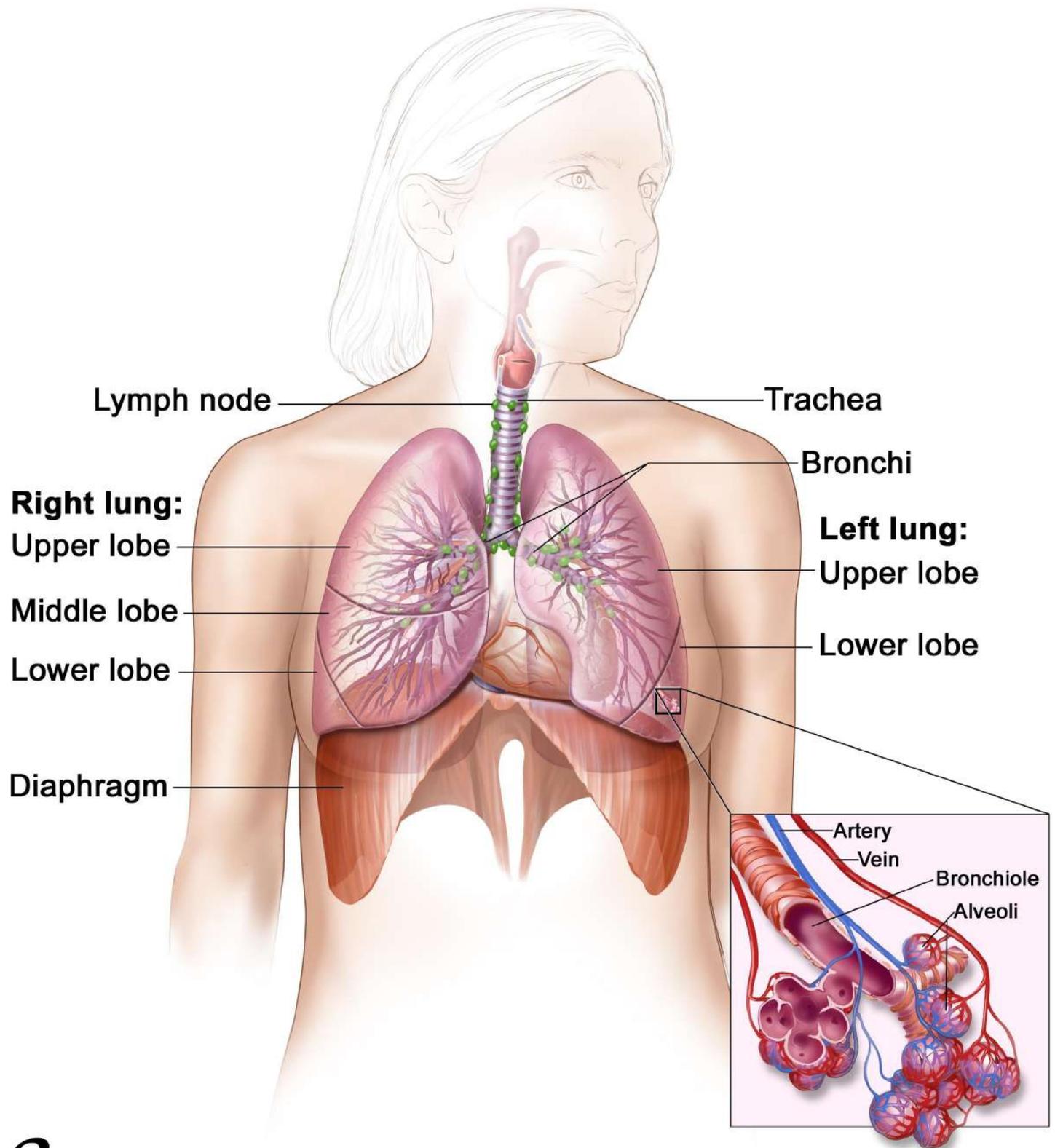
Normal lining

Normal amount  
of mucus

Swollen lining

Excess mucus

*Asthma*



# Lung cancer

birds are also affecting causing the ecological  
dissbalance.

→ Economic effects :

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

Measures to control Air pollution :

Various pollution control technologies  
and strategies are available to reduce air pollution.  
Which are following :-

→ land use planning :

Using land in proper manner, increase  
forest areas in cities, removing heavy industry  
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→ Reduction of fossil fuel :

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

## → Plantation of trees :

Trees are natural controller of air pollution. Several like snake plant, eucalyptus, aiglonima etc. not only absorb  $\text{CO}_2$  but also absorb VOCs.

## → Control Devices :

The following items are commonly used as pollution control devices in industries and transportation. If these devices can be used we can reduce the level of pollution.

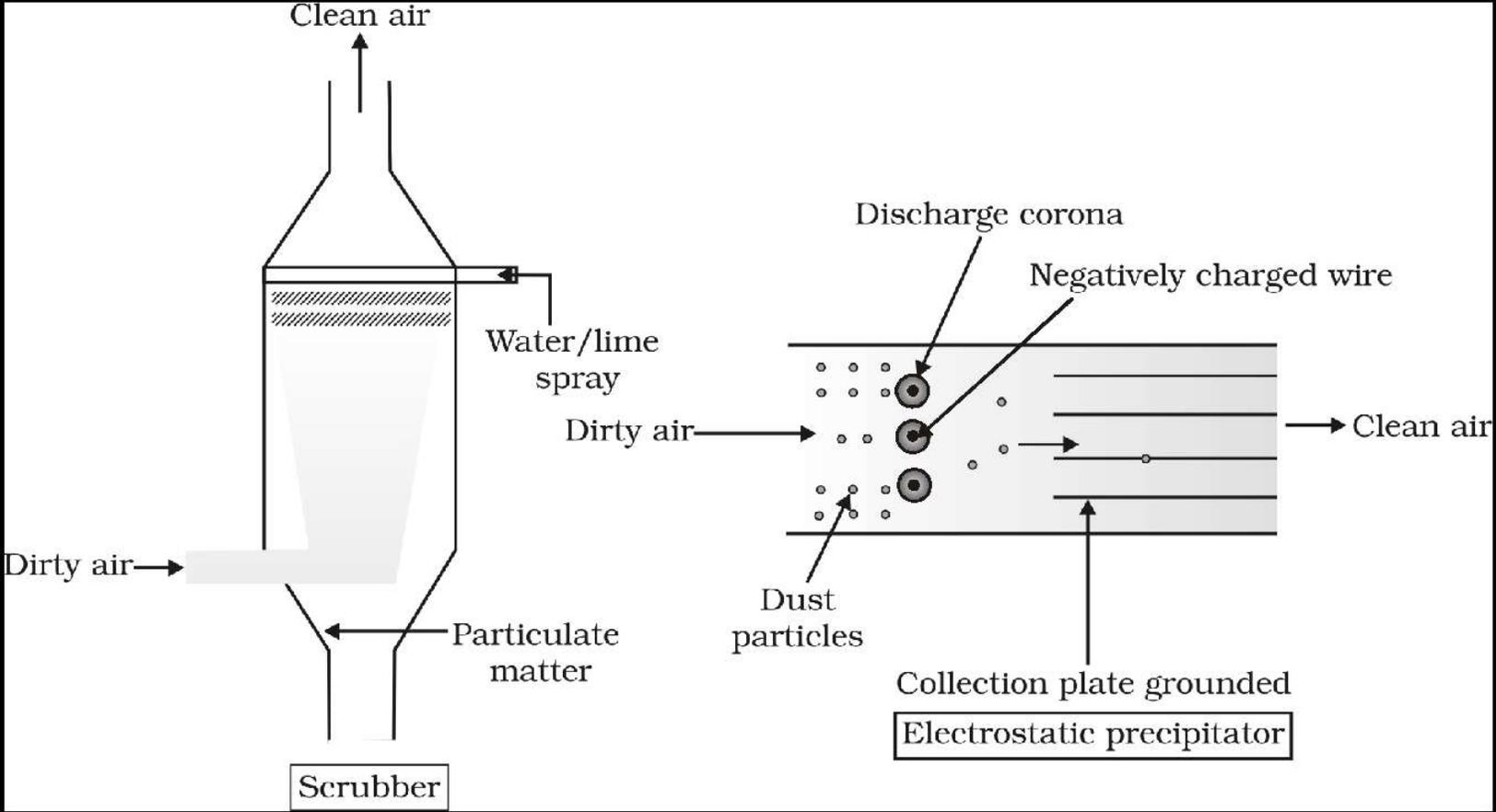
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★ Mechanical collectors (dust cyclones, multicyclone) etc.

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★ Particulate scrubbers is a wet scrubber which remove gases like  $\text{SO}_x$ ,  $\text{NO}_x$  and  $\text{CO}$ ,  $\text{CO}_2$  as well as SPM.





Baghouse

## Scrubber :

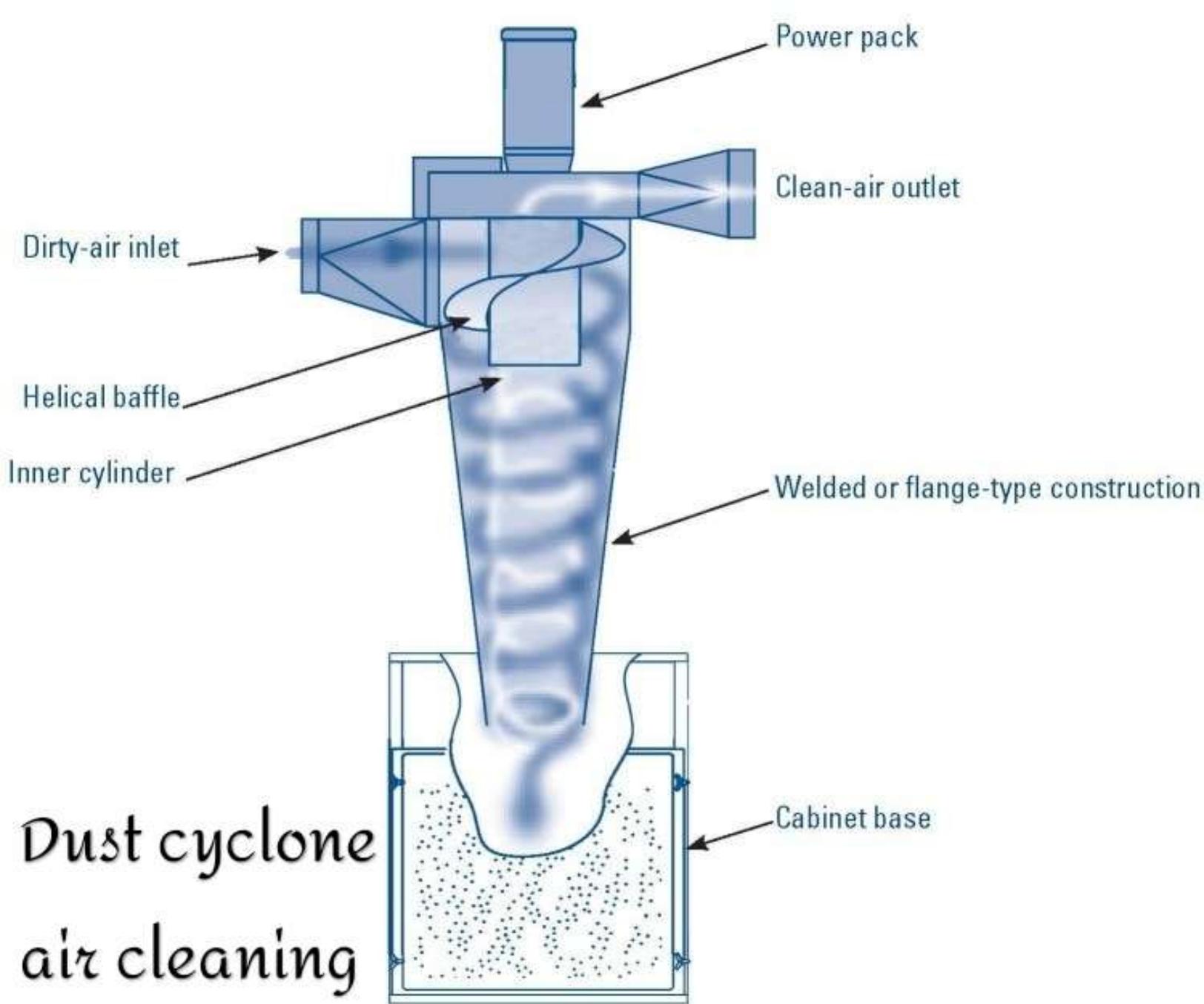
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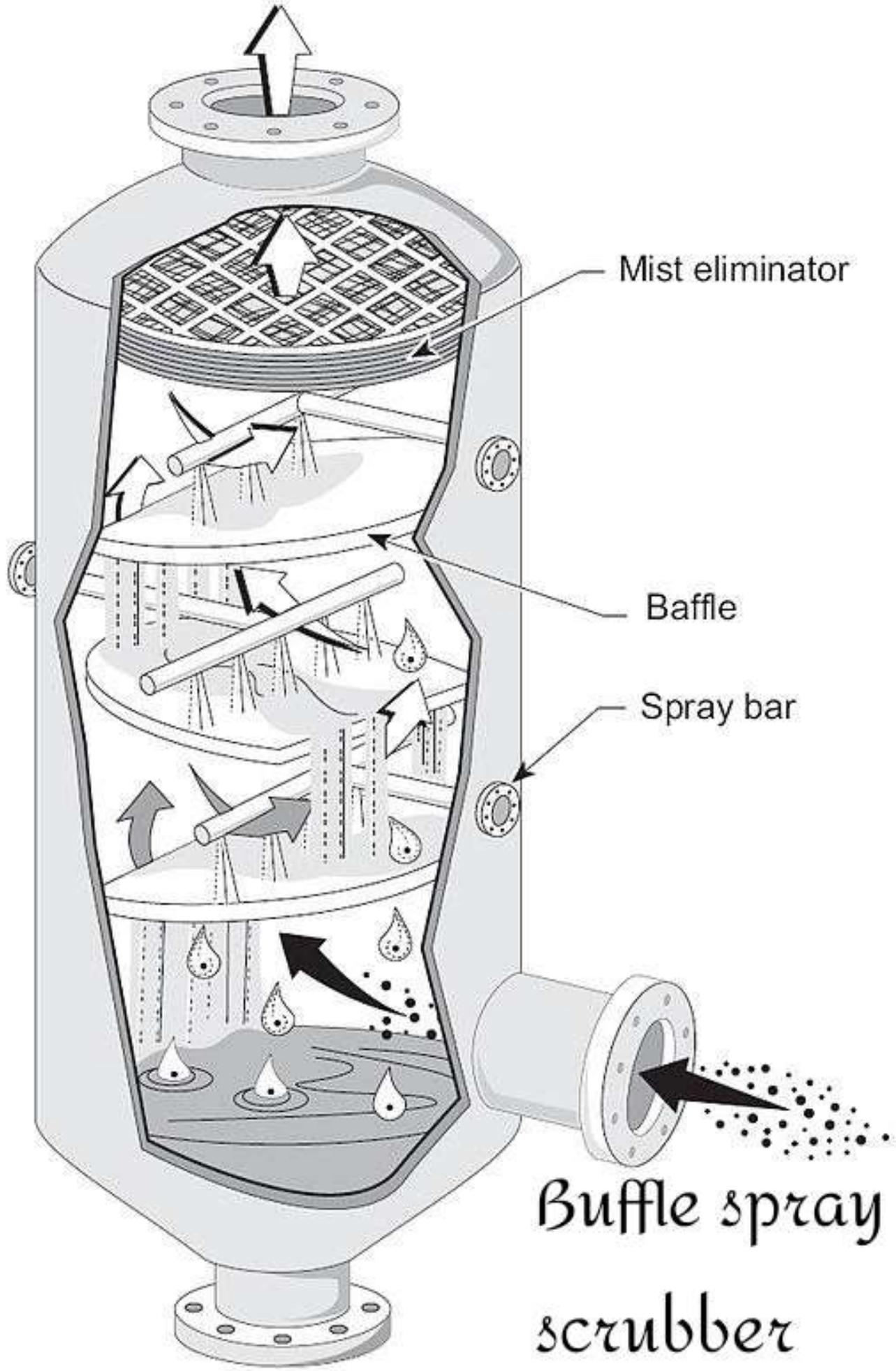
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There are different tools to control Nox emission. Which are:

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## SO<sub>2</sub> control :

$SO_2 + H_2O = H_2SO_4$  as  $SO_2$  became  $H_2SO_4$  as  $SO_2$  because  $H_2SO_4$  in moist wet scrubber is useful.

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Vehicle emission can be control by using new engines, biofuel, We also need to increase electric cars. Odd-Even system employed in Delhi is also a very good technique.

## f) Public Awareness :

Public awareness is the key to stop any kind of environmental pollution. Because human is the main cause of pollution. If people are educated to stop pollution then it is just a matter of awareness.

## g) Governmental and Repolitical steps :

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

## Conclusion :

Cities are the economic life lines of any century. Educational, economic, industrial power houses are majorly located in cities but air pollution causing lots of damage. So we need to reduce air pollution as much as soon as possible to improve our lives.

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Date: 15th November, 2020

Saptarsi Jaiswal  
signature of the student

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Certified that the project work submitted by  
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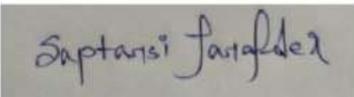


NARENDRAPUR

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PROJECT TITLE:

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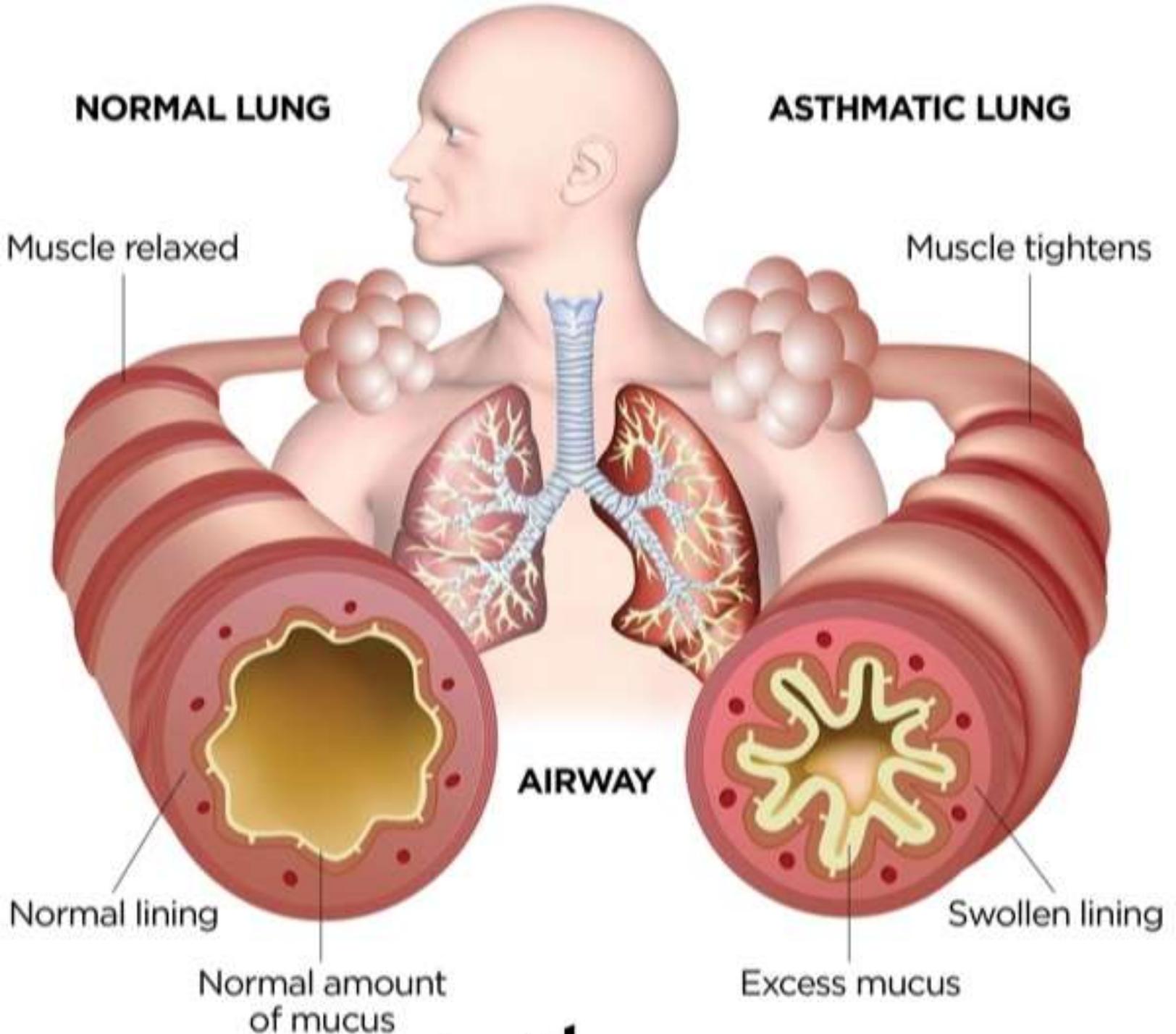
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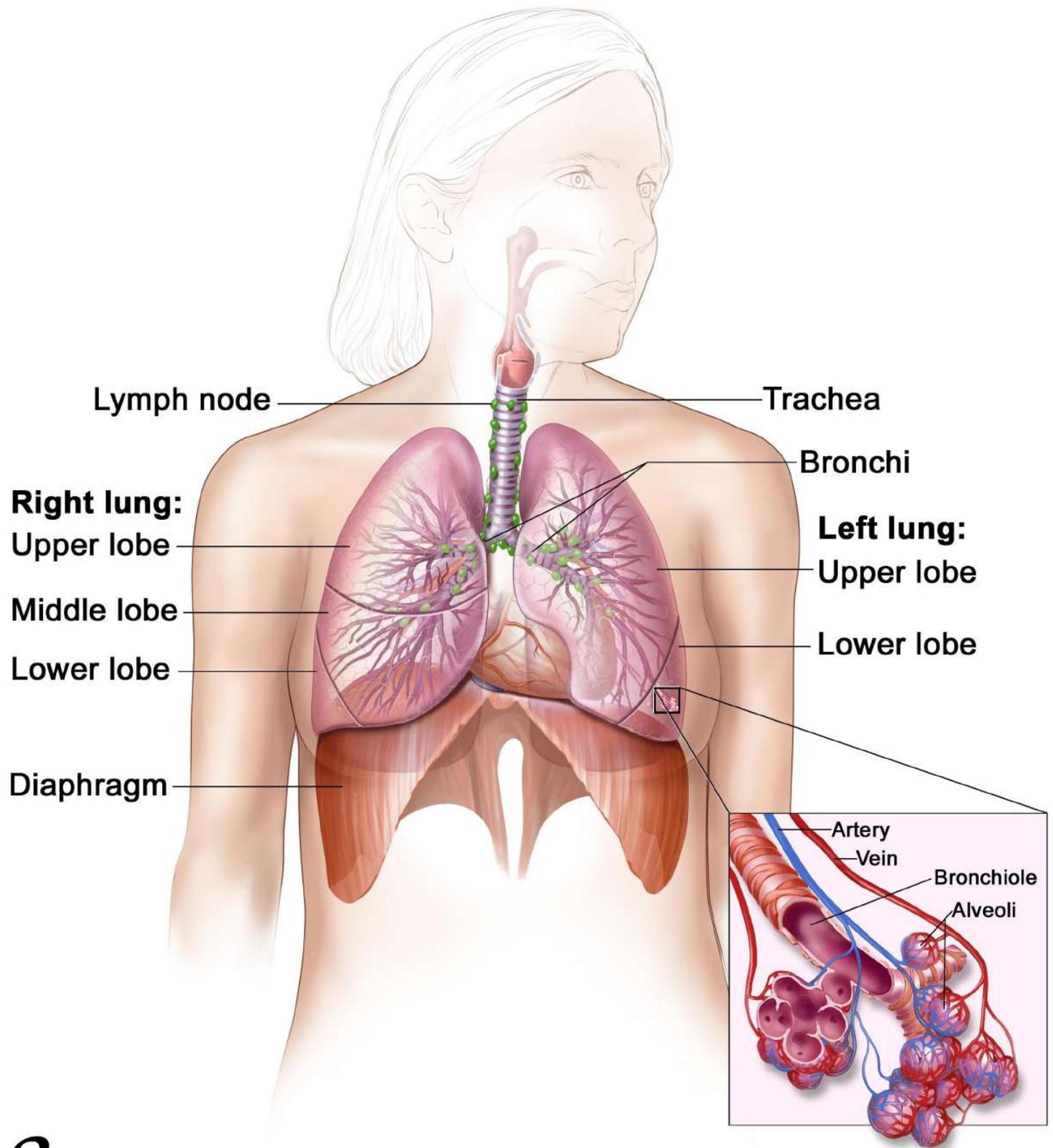
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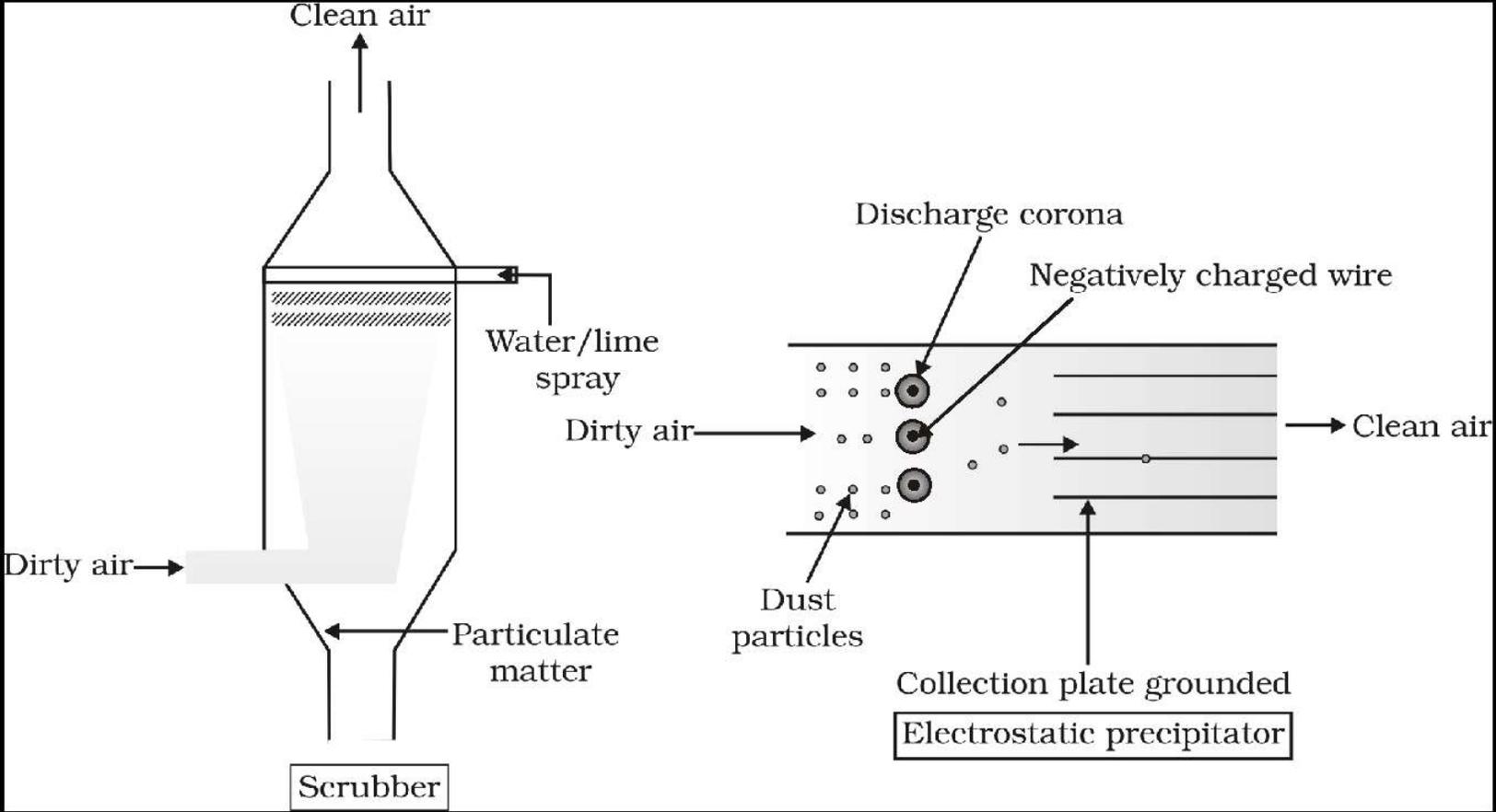
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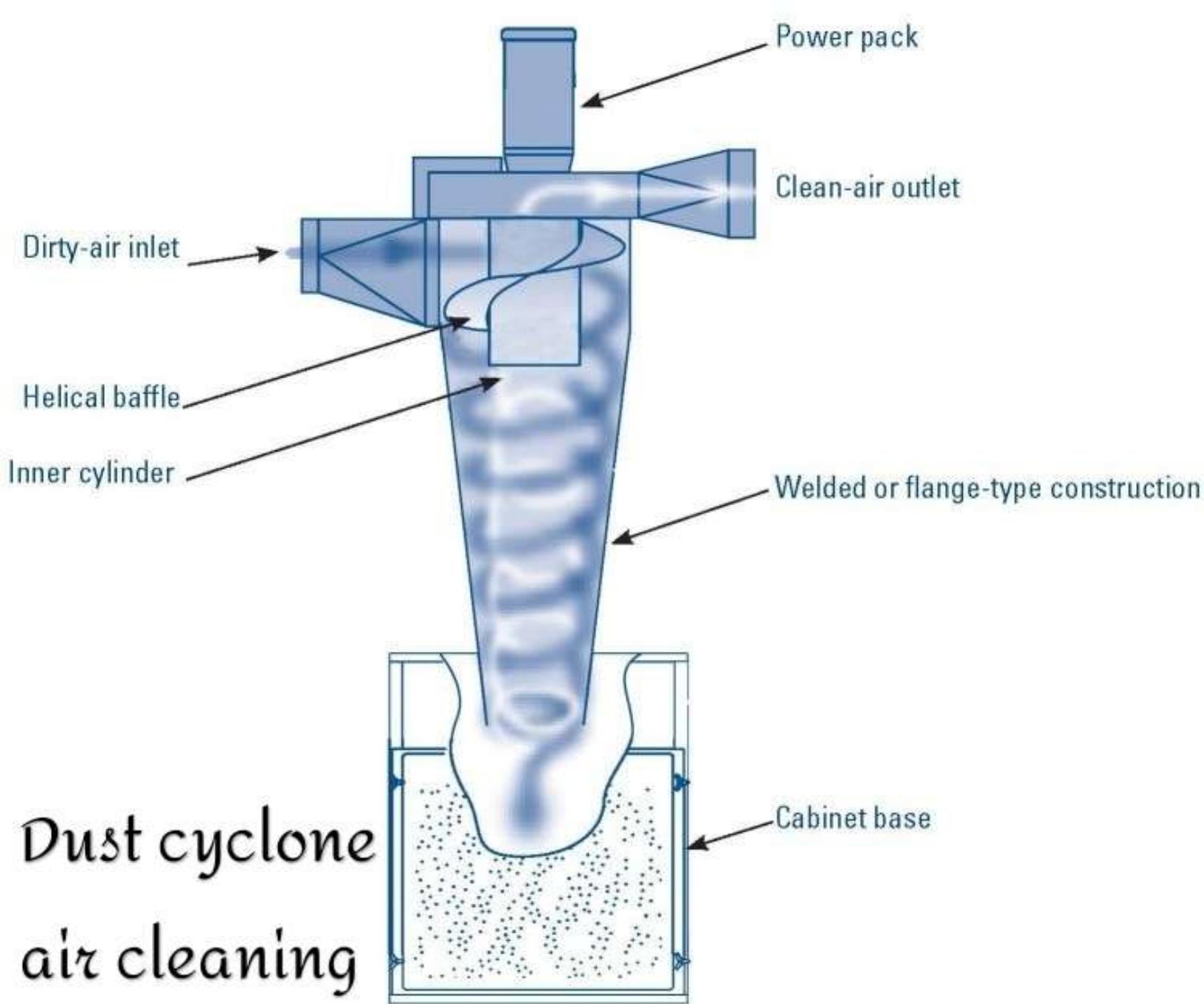
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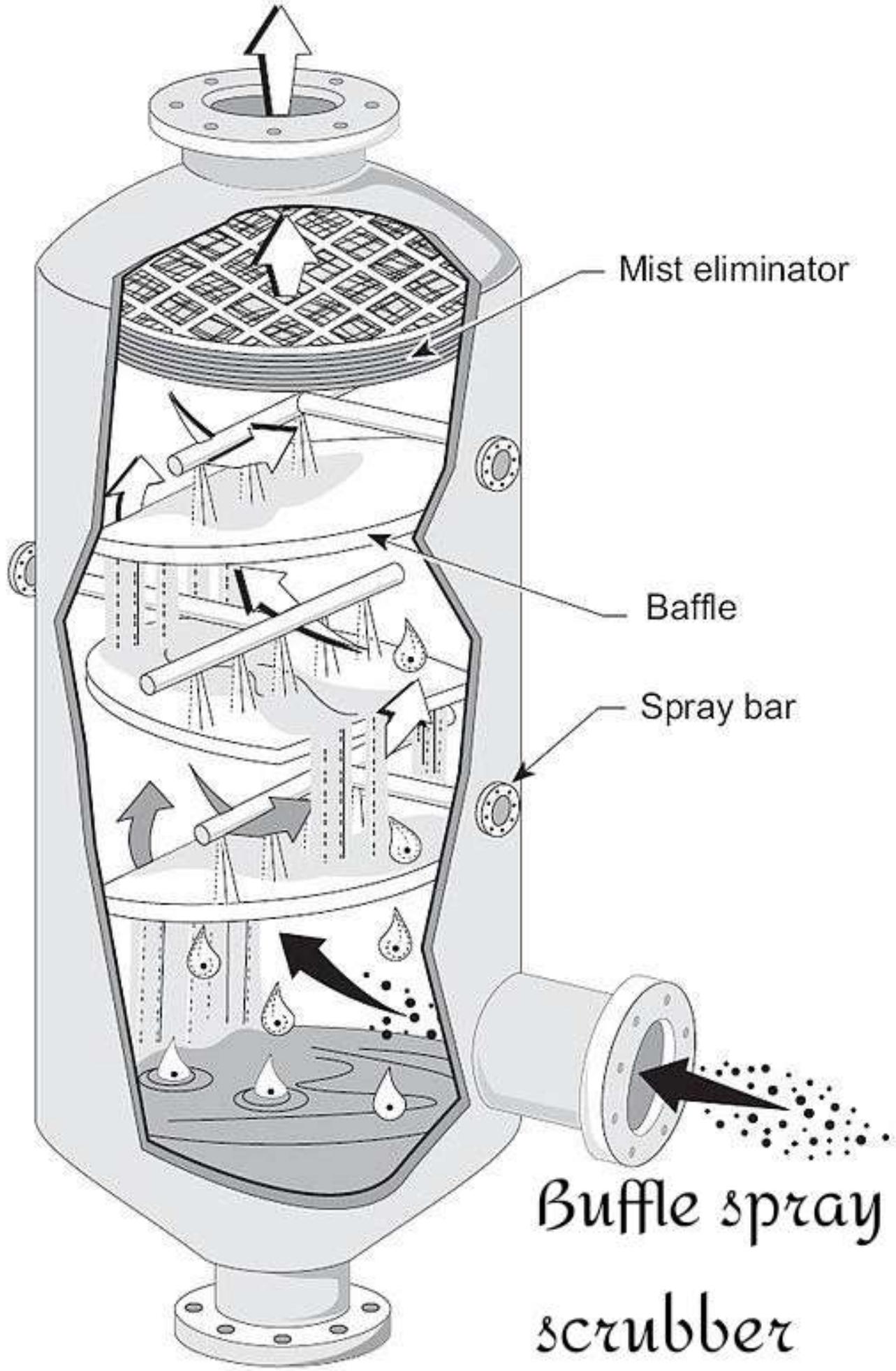
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Saptarsi Jaiswal  
signature of the student

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VA 2nd Semester.

Date

Signature of the  
teacher

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE  
NARENDRAPUR

ENVIRONMENTAL STUDIES

PROJECT TITLE :

Nitrogen Cycle and it's importance for living beings

NAME : SATTIK BISWAS

COLLEGE ROLL NO : STUG/168/19

DEPARTMENT : Statistics

YEAR : 2020

SIGNATURE : Sattik Biswas

# CONTENTS

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- 1 What is Nitrogen Cycle
- 2 Stages
- 3 In Marine Ecosystem
- 4 Importance
- 5 Conclusion
- 6 Acknowledgement
- 7 Certificate

## Nitrogen Cycle Definition

"Nitrogen Cycle is a biogeochemical process which transform the inert nitrogen present in the atmosphere to a more usable form of living organisms."

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

## What is Nitrogen Cycle?

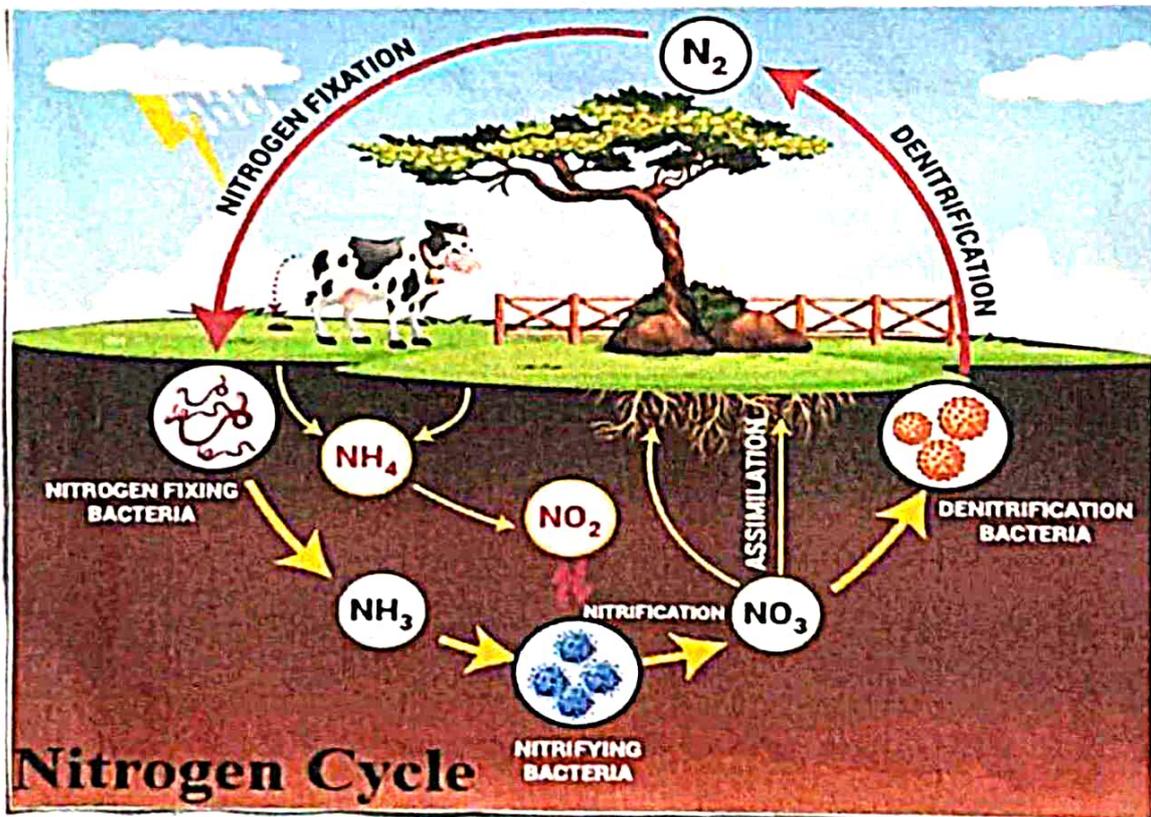
Nitrogen cycle is a biogeochemical process through which nitrogen is converted into many forms, consecutively passing from the atmosphere to the soil to organism and back into the atmosphere.

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

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

Inorganic forms of nitrogen are found in abundance in the atmosphere. The nitrogen is made available to plants by symbiotic bacteria which can convert the inert nitrogen into a usable form — such as nitrites and nitrates.

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



## Stages of Nitrogen Cycle

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

### 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 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 combine gaseous nitrogen with hydrogen to form ammonia.

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

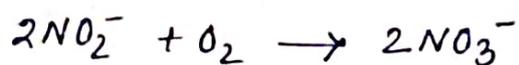
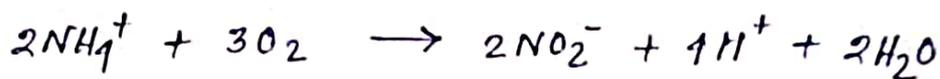
### ● Types of Nitrogen Fixation

1. Atmospheric fixation: A natural phenomenon where the energy of lightning breaks the nitrogen into nitrogen oxides and is then used by plants.
2. 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.
3. Biological nitrogen fixation: We already know that nitrogen is not usable directly from the air for plants and animals. Bacteria like *Rhizobium* and blue-green algae transform the unusable form of nitrogen into other compounds that are more readily usable. These nitrogen compounds get fixed in the soil by these microbes.

## ① Nitrification

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

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



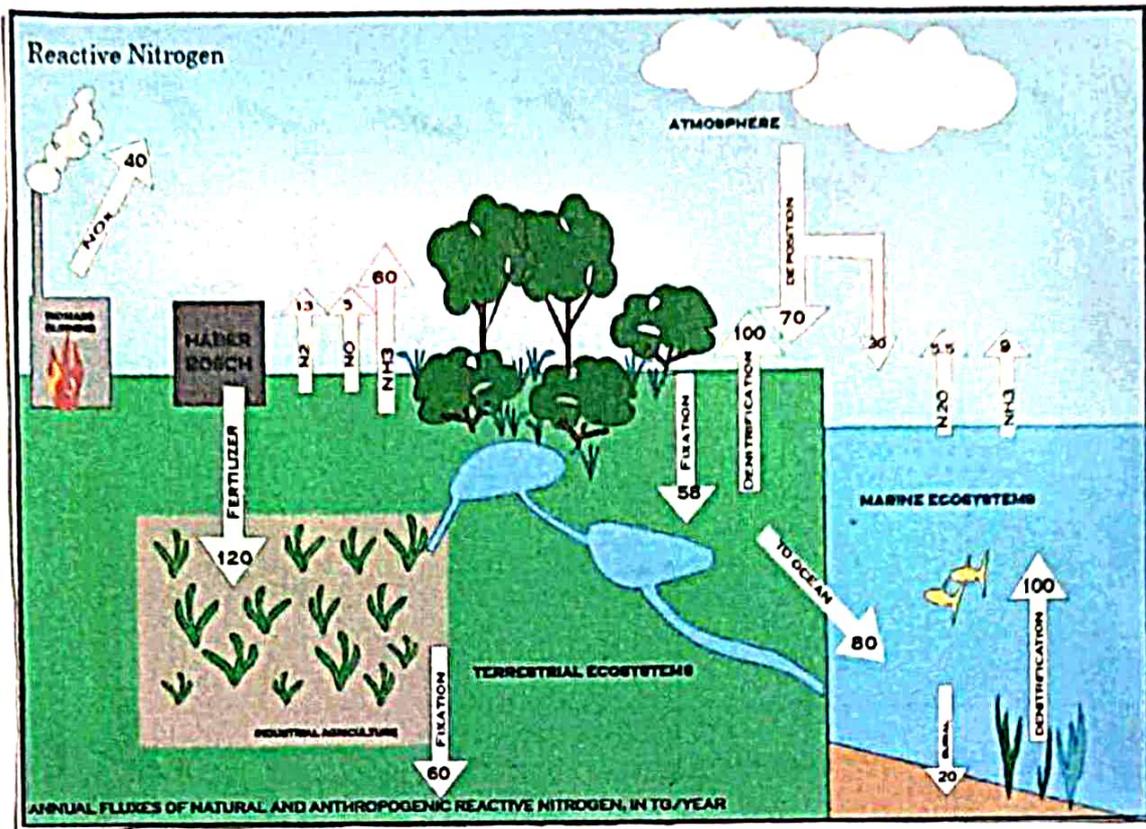
## ① Assimilation

Primary producers — plants takes in the nitrogen compounds from the soil with the help of their roots, which are available in the form of ammonia, nitrite ion, nitrate ion 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.

## ① 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 processes.



## ③ Denitrification

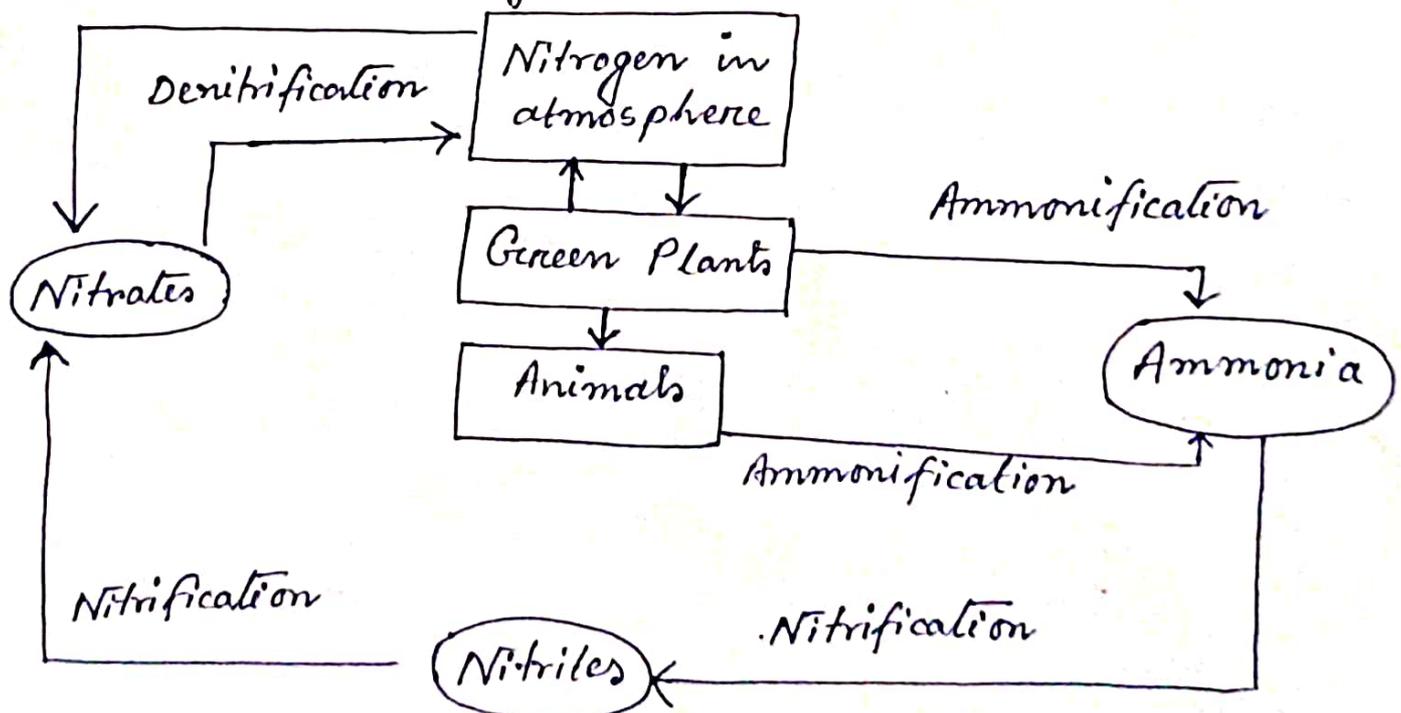
Denitrification is the process in which the nitrogen compounds makes its way back into the atmosphere by converting nitrate ( $\text{NO}_3^-$ ) into gaseous nitrogen ( $\text{N}_2$ ). This process of the nitrogen cycle is the final stages and occurs in the absence of oxygen. Denitrification is carried 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 have proved that the nitrogen from these rocks is released into the plants due to the weathering of rocks.

## Schematic Diagram



## Importance of Nitrogen Cycle

Importance of the nitrogen cycle are as follows:

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

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

## Conclusion

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

## ▣ ACKNOWLEDGEMENT ▣

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## CERTIFICATE

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

Date -

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Signature of the Teacher

RAMAKRISHNA MISSION RESIDENTIAL COLLEGE



NARENDRAPUR

## ENVIRONMENTAL STUDIES

PROJECT TITLE:

Corona Pandemic and Role of Common  
People to Control it

NAME : SAYAK NAG  
COLLEGE ROLL NO : MTUG1/067/19  
DEPARTMENT : Mathematics  
YEAR : 2020  
SIGNATURE : Sayak Nag

## TOPIC

### CORONA PANDEMIC AND ROLE OF COMMON PEOPLE TO CONTROL IT

The Coronavirus, a pandemic has made us realize that we all are connected and this entire world is like a family. Although connected, medical experts have suggested that social distancing and wearing of masks are some of the most perfect solution to fight against the new evil.

From March 25, India's honourable Prime Minister Shri Narendra Modi initiated the most extreme step in the mitigation strategy of COVID-19, i.e., the lockdown. This is a very courageous step taken by the Indian government, and as responsible citizens, we all need to abide by its instructions. If we are instructed to remain at home, we

need to!

Most countries follow the containment, delay, and mitigation step-wise strategy to follow COVID-19.

In the very early stage, people who had recently travelled to other countries were tested positive, which means that they were affected by the coronavirus. This is the 'stage of imported cases'. India followed the 'containment strategy'. At this stage, we isolated these patients, tracked their contacts, and quarantined them.

Then we had the second stage, of 'local transmission', wherein contacts of the patients developed the disease. At this stage, Indian public health officials continued contact-tracing & also instituted the 'delay measures' in the form of social distancing, wearing of masks and closed offices, schools and colleges and advised against large gatherings like weddings.

Next, India expects the stage of 'community spread'. In this stage, people with no history of contact with visitors from foreign countries or with their contacts acquire the COVID-19 infection.

The last and most extreme stage 'is the epidemic phase, where we can have hundreds or thousands of patients with the disease within the country.

In this stage of the epidemic, the most reliable control measure is an extreme mitigation step known as 'lockdown'. But by this time, several hundred patients were already dead in these countries.

Every religious activity has been on halt in lieu of coronavirus outbreak. Still if we see any of the gathering around. It's our responsibility to guide and report if required. The Constitution of India is the holy book for every

Indian citizen and every-order must be accepted as a commandment. We live in a democracy and we have every right to put our thoughts on the table but this is the time to unite and stand with our government.

The outbreak of corona-virus has also affected the mental health of humans as everyone reacts differently to stressful situations. To understand better "It is not the Corona-virus which is dangerous but it is the quick spread which is a threat". So, let us do our part and participate in this battle by staying at home.

There are some strategies with lower economic consequences. For example, a few countries are following a strategy of building herd immunity. In this case there won't

be any lockdown. The logic behind this idea is that by exposing younger people to the virus, most individuals in the community will develop immunity, and this 'herd immunity' will subsequently protect the vulnerable population.

The pitfall of this strategy is the possibility of a large number of vulnerable people succumbing to the disease, overwhelming the healthcare system, and potentially resulting in a catastrophic scenario. The United Kingdom initially followed the herd immunity strategy but later realised its impracticality and quickly moved to delay and mitigate.

Other countries, such as the Netherlands, following a strategy similar to herd immunity. Though the Netherlands has closed schools, colleges and officials, there is no lockdown and there are no restrictions on the

people's movement. Sweden is also following this strategy.

So, is the Indian strategy the right one? Yes, we believe in the containment, delay and mitigation strategy similar to most other countries. But unlike most other countries, we quickly transitioned from containment to delay and then from delay to extreme mitigation. We believe our strategy will help our country reduce the impact of the COVID-19 outbreak. As a responsible citizen, we must follow all the measures recommended by our government.

The Access to COVID-19 Tools (ACT) Accelerator, is a groundbreaking global collaboration to accelerate development, production, and equitable access to COVID-19 tests, treatments and vaccines.

Launched at the end of April 2020, at an event co-hosted by the Director-General of the World Health

Organization (WHO), the President of France, the President of the European Commission, and the Bill and Melinda Gates Foundation, the Access to COVID-19 Tools (ACT) Accelerator brings together governments, scientists, businesses, civil society and philanthropists and global health organizations.

These organizations have joined forces to speed up an end to the pandemic by supporting the development and equitable distribution of the tests, treatments and vaccines the world needs to reduce mortality and severe disease, restoring full societal and economic activity globally in the near term, and facilitating high-level control of COVID-19 disease in the medium term.

The world is in the midst of a COVID-19 pandemic. As WHO and partners work together on the response - tracking the pandemic, advising on critical interventions, distributing vital medical supplies to those in need - they are racing to find a vaccine.

These vaccines save millions of lives each year. Vaccines work by training and preparing the body's natural defences like the immune system, to recognize and fight off the viruses and bacteria they target. If the body is exposed to those disease-causing germs later, the body is immediately ready to destroy them, preventing illness.

Immunization currently prevents 2-3 million deaths every year from diseases like diphtheria, tetanus, pertussis, influenza and measles. There are now vaccines to prevent more than 20 life-threatening

diseases, and work is ongoing at unprecedented speed to also make COVID-19 a vaccine-preventable disease.

Under development, there are currently more than 100 COVID-19 vaccine candidates, with a number of these in the human trial phase. WHO is working in collaboration with scientists, business, and global health organizations through the ACT Accelerator to speed up the pandemic response. When a safe and effective vaccine is found, COVAX (led by WHO, GAVI and CEPI) will facilitate the equitable access and distribution of these vaccines to protect people in all countries. People most at risk will be prioritized.

Moreover, the R&D Blueprint was activated to accelerate diagnostics, vaccines and therapeutics for this novel coronavirus. The Blueprint aims to improve coordination between scientists and global health

professionals, accelerate the research and development process, and develop new norms and standards to learn from and improve upon the global response.

The draft landscape of COVID-19 vaccine candidates contains information on vaccine candidates collected through public information (e.g. clinical trial registries) and information that were directly provided by vaccine developers to WHO. The landscape is generally updated twice a week, based on the latest information, including those we receive from scientists and research.

WHO has published the target product profiles for COVID-19 vaccines, which describes the preferred and minimally acceptable profiles for human vaccines for long term protection of persons at high ongoing risk of COVID-19, and for reactive use in outbreak

settings with rapid onset of immunity. We have also published the criteria for prioritization of vaccines for clinical trials.

The proposed attributes and criteria provide considerations for the evaluation and prioritization of COVID-19 candidate vaccines to be considered for further development by WHO. The target audience include vaccine scientists, product developers, manufacturers, regulators and funding agencies.