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Depletion Of Ozone Layer

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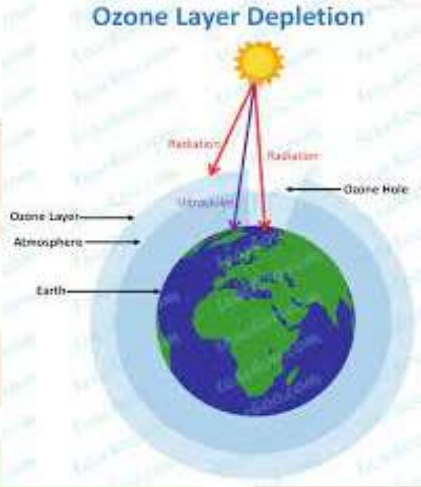


ABSTRACT

" One of the first conditions of HAPPINESS is that the link between MAN and NATURE shall not be BROKEN."

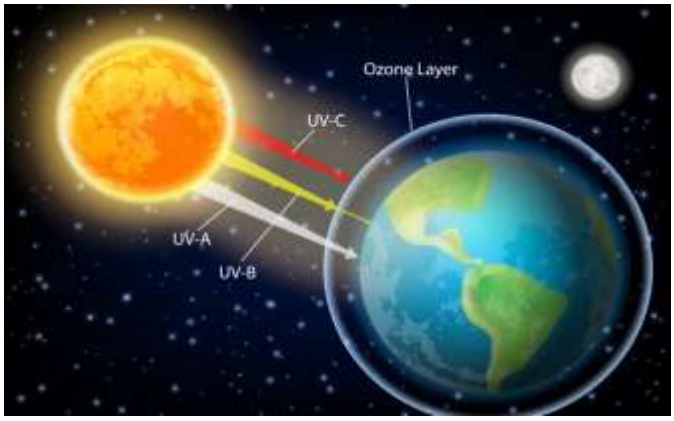
- Leo Tolstoy

Life is a rare phenomenon gifted to the planet EARTH. It is due to the presence of atmosphere made of OZONE LAYER 15-50 km. above earth. The layer protects life on earth surface from harmful UV radiation. Due to man's folly this ozone layer has started depleting gradually. Its cause is imbalance in the ecology of nature created by man in the name of progress. It should never be forgotten that life on the planet is more important than progress. Progress is a priority to save environment for prosperity and wellness of mankind. Without it the progress would be jeopardized. But it should not disturb, damage, or compromise with the ecology of nature. If it does, it is purposeless and futile.

Radiation from the sun includes Ultra-Violet (UV) radiation, along with the visible light. On penetrating the atmosphere and being absorbed by biological tissues, UV radiation damages protein and DNA molecules at the surface of all living things. If the full amount of UV radiation falling on the Stratosphere reached the Earth's surface, it is doubtful that any life would survive.

In the autumn of 1985 , some British atmospheric scientists in India working in Antarctica reported a gaping 'hole' (actually a thinning of one area) in the stratospheric ozone layer of the South pole. News of the ozone 'hole' stimulated an enormous research effort. Many reasons are responsible for ozone depletion Chlorofluorocarbon CFC's , Halons , Methyl Chloroform , Hydrofluorocarbon and some natural causes are the main culprit. A famous proverb **" After every storm the sun will smile"** (For every

problem there is a solution) . Putting cap on no of vehicles and emission of CFCs , eco-friendly household cleaning products , minimize the use of pesticides , ban on use of dangerous nitrous oxide etc. are the necessary measures to prevent the ozone depletion.



THE HOLE IN THE OZONE LAYER

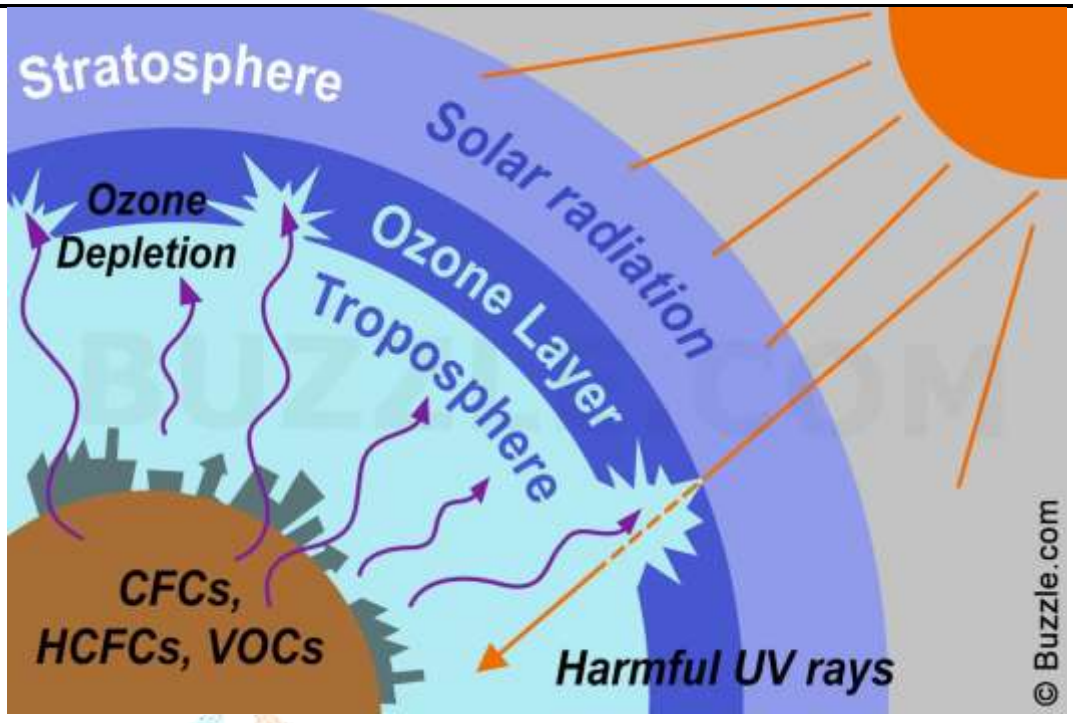
INTRODUCTION

" The ultimate test of man's conscience may be his willingness to sacrifice something today for future generations whose words of thanks will not be heard".

- **Gaylord Nelson**

The first part of this quote is the solution of the problem and the second part of the quote is a hope for better tomorrow.

Nature knows no limits , when it strikes with all its fury it doesn't differentiate between rich and poor , rural and urban, men and women , it just wreaks havoc all under its clutch . Depletion of ozone layer can also cause havoc because emission of greenhouse gases i.e. CFC's Chlorofluorocarbon affected the ozone layer to an alarming limit . the ozone story is a remarkable episode in the human history . From the first warnings in 1974 that something might be amiss in the stratosphere because of a particularly inert and useful industrial chemical, through the developments of Montreal Protocol and the final steps of CFCs phase out that are still being undertaken, the world has shown that it can respond collectively to a clearly perceived global threat. The scientific community has played a crucial role in this episode, first alerting the world and then plunging into intense research programmes to ascertain the validity of the threat and its remedial actions.



EMMISION OF CFCs HCFCs CAUSES OZONE HOLE

DISCOVERY OF OZONE

Ozone is a naturally occurring substance which was first made in the laboratory in 1839 by German scientist Christian Friedrich Schönbein.

WHAT IS OZONE ?

Ozone is a naturally occurring molecule. Ozone is a gas which is present naturally within earth's atmosphere. An ozone molecule is made up of 3 oxygen atoms (the chemical formula O3). Ozone is a bluish coloured gas, pleasant smelling in small concentration and pungent (chlorine-like) smelling as concentration increases . Ozone is harmful to breath. Its concentration is under 10 parts per million, found places near the oceans.

DISCOVERY OF OZONE LAYER

The Ozone Layer was discovered by the French physicists Charles Fabry and Henri Buisson in 1913.

OZONE LAYER

The ozone layer is the common term for the high concentration of ozone that is found in the stratosphere around 15-30km above the earth's surface. It covers the entire planet and protects life on earth by absorbing harmful ultraviolet-B (UV-B) radiation from the sun. Nearly 90% of earth's ozone is in the stratosphere and referred to as the ozone layer. Ozone absorbs a band of ultraviolet radiation called UVB.

WHAT IS UV-B RADIATION ?

Invisible rays that are part of the energy that comes from the Sun. Ultraviolet radiation that reaches the Earth's surface is made up of two types of rays, called UVA (long wave ultraviolet A) and UVB (Short wave ultraviolet B). Ultraviolet light is a form of radiation which is not visible to the human eye. It's in an invisible part of the "electromagnetic spectrum". UV radiation is a form of electromagnetic energy. It can

come from natural sources, such as sunlight, as well as artificial sources, such as lasers, black lights, and tanning beds.

WHY UV-B RADIATION IS BAD ?

UVB rays have slightly more energy than UVA rays. They can damage the DNA in skin cells directly, and are the main rays that cause sunburns. They are also thought to cause most skin cancers.

FORMATION OF OZONE LAYER

O_2 + sunlight → O+O

O +O_2 → O3

Ozone (O3)

Chemically forms when UV hits on stratosphere Oxygen molecules dissociate into atomic oxygen

O_2 ----------> O + O

Atomic oxygen quickly combines with other oxygen molecules to form ozone

O+O2 ----------→ O3

When the sun's rays split oxygen molecules into single atoms, Ozone is created in the atmosphere. These single atoms combine with nearby oxygen to form a three-oxygen molecule - Ozone.

DISCOVERY OF OZONE LAYER DEPLETITION

In 1974, chemists Mario Molina and Frank Sherwood Rowland discovered a link between chlorofluorocarbons (CFCs) and the breakdown of ozone in the stratosphere. In 1985, geophysicist Joe Farman, along with meteorologists Brian G Gardiner and Jon Shanklin published findings of abnormally low ozone concentrations above the Antarctic.

OZONE LAYER DEPLETION

Ozone depletion, gradual thinning of Earth's ozone layer in the upper atmosphere caused by the release of chemical compounds containing gaseous chlorine or bromine from industry and other human activities. The thinning is most pronounced in the polar regions, especially over Antarctica. Ozone depletion is a major environmental problem because it increases the amount of ultraviolet (UV) radiation that reaches Earth's surface, which increases the rate of skin cancer, eye cataracts, and genetic and immune system damage.

Depletion begins when CFC's get into the stratosphere. Ultraviolet radiation from the sun breaks up these CFCs. The breaking up action releases Chlorine atoms. Chlorine atoms react with Ozone, starting a chemical cycle that destroys the good ozone in that area. One chlorine atom can break apart more than 100,000 ozone molecules.

KNOW ABOUT OZONE HOLE

Chemicals containing chlorine and bromine atoms are released to the atmosphere through human activities. These chemicals combine with certain weather conditions to cause reactions in the ozone layer, leading to ozone molecules being destroyed. Depletion of the ozone layer occurs globally, however, the severe depletion of the ozone layer over the Antarctic is often referred to as the 'ozone hole'. Increased depletion has recently started occurring over the Arctic as well.

IMPORTANCE OF OZONE LAYER

Ozone is concentrated in the lower stratosphere between 15 and 50 km above the earth's surface - the so-called 'ozone layer'. Ozone can be produced by numerous chemical reactions, but the main mechanism in the atmosphere for its production and removal is absorption of ultra-violet (UV) radiant energy from the sun. The maintenance of enough stratospheric ozone to absorb harmful UV sunlight is therefore vitally important to all life forms on earth.

IS OZONE “GOOD” OR “BAD”

Ozone can be "good" or "bad" for health and the environment depending on where it's found in the atmosphere. Stratospheric ozone is "good" because it protects living organisms from ultraviolet radiation from the sun. We are spared from the more damaging effects of the UV rays because most of the UV radiation (over 99%) is absorbed by Ozone in the upper Stratosphere. For this reason, Stratospheric Ozone is commonly referred to as the Ozone Shield or the Ozone Layer.

Ground level ozone is "bad" because it can trigger a variety of health problems, particularly for children, the elderly, and people of all ages who have lung diseases such as asthma.

OZONE DEPLETING SUBSTANCES

“Ozone depleting substances are the substances such as chlorofluorocarbons, halons, carbon tetrachloride, hydrofluorocarbons, etc. that are responsible for the depletion of ozone layer.”

List of main ozone-depleting substances and their sources :

Ozone-Depleting Substances	**Sources**
Chlorofluorocarbons (CFCs)	Refrigerators, air-conditioners, solvents, dry-cleaning agents, etc.
Halons	Fire-extinguishers
Carbon tetrachloride	Fire extinguishers, solvents
Methyl chloroform	Adhesives, aerosols
Hydrofluorocarbons	fire extinguishers, air-conditioners, solvents

CAUSES OF OZONE LAYER DEPLETITION

The ozone layer depletion is a major concern and is associated with a number of factors. The main causes responsible for the depletion of the ozone layer are –

Man Made Causes -

- Chlorofluorocarbons (CFCs) & Hydrofluorocarbons (HFCs)

  CFCs was invented by Thomas Midgley in the year 1920s. Chlorofluorocarbons or CFCs are the main cause of ozone layer depletion. These are released by solvents, spray aerosols, refrigerators, air-conditioners, etc. The molecules of chlorofluorocarbons in the stratosphere are broken down by the ultraviolet radiations and release chlorine atoms. These atoms react with ozone and destroy it.

  Hydrochlorofluorocarbons (HCFCs) and halons destroy the earth's protective ozone layer, which shields the earth from harmful ultraviolet (UV-B) rays generated from the sun. CFCs and HCFCs also warm the lower atmosphere of the earth, changing global climate. Hydrofluorocarbons (HFCs) also act to warm the planet. The Minnesota Pollution Control Agency (MPCA) is working with industry, residents and government to reduce the damage done to the ozone layer and global climate by CFCS, HCFCs, HFCs and related chemicals.

- Nitrogenous Compounds

  The nitrogenous compounds such as NO2, NO, N2O are highly responsible for the depletion of the ozone layer.

- Unregulated Rocket Launches

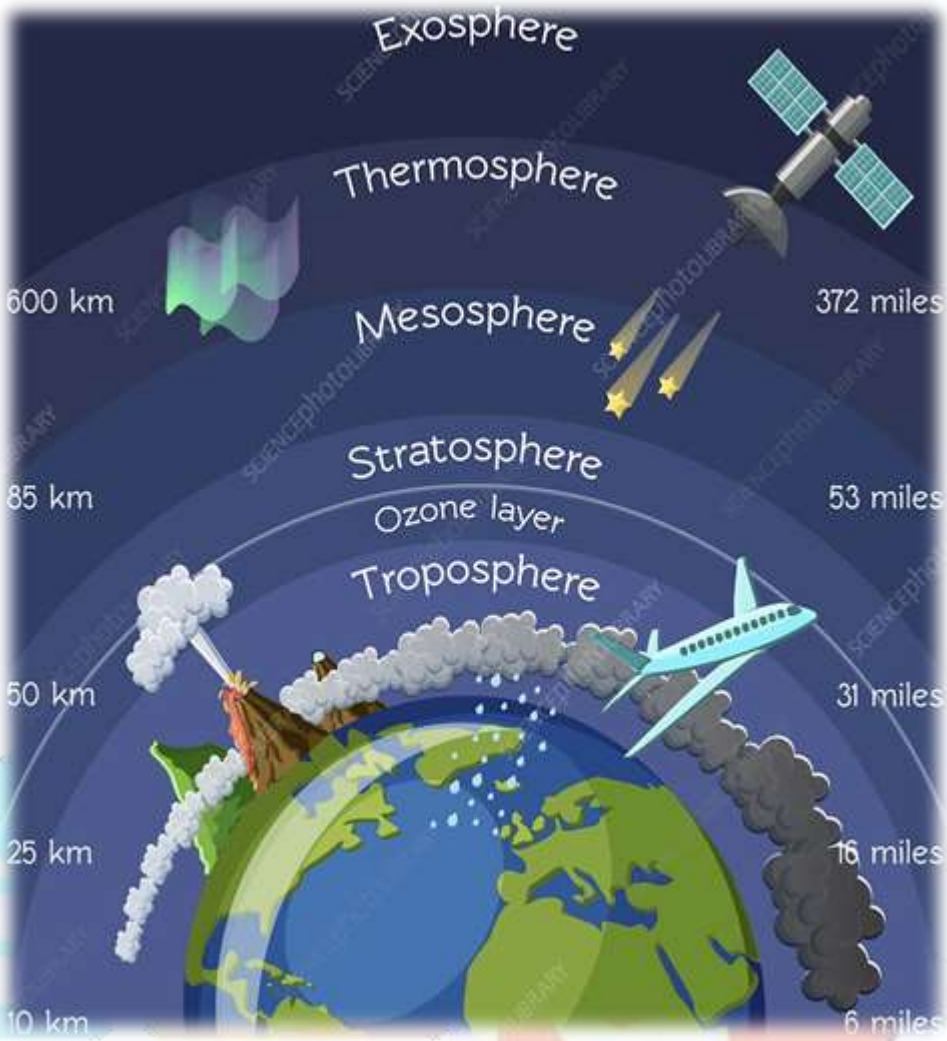
  Researchers say that the unregulated launching of rockets result in much more depletion of ozone layer than the CFCs do. If not controlled, this might result in a huge loss of the ozone layer by the year 2050.

- Global Warming

  Global warming is when the earth heats up. It happens when greenhouse gases trap heat and light from the sun in the earth's atmosphere, which increases the temperature of the air. Carbon dioxide is called a greenhouse gas i.e. CFCs Global warming is affecting many parts of the world. The glaciers have started melting. It may cause polar ice caps to melt. The increase in temperature of atmosphere by 2-3° Celsius may change the world's map. It may cause the sea rises and low lying areas of ice lands to disappear . Can you imagine that most of Italy would be inundated in sea and Mumbai would be wiped out from the map of India. It may cause a break in food chain or chain reaction .The CFC's (Chlorofluorocarbon) have damaged our ozone layer.

Natural Causes –

- The ozone layer has been found to be depleted by certain natural processes such as Sun-spots and stratospheric winds. But it does not cause more than 1-2% of the ozone layer depletion.
- The volcanic eruptions are also responsible for the depletion of the ozone layer. As they release carbon monoxide and decrease nitrogen oxide in the atmosphere .
- Methane from rotting vegetation.



LAYERS OF ATMOSPHERE
CAUSES OF OZONE LAYER DEPLETION

Principal steps in the depletion of stratospheric ozone:-

Emissions

Halogen source gases are emitted at Earth's surface by human activities and natural processes.

Accumulation

Halogen source gases accumulate in the atmosphere, and they are distributed throughout the lower atmosphere by winds and other air motions.

Transport

Halogen source gases are transported to the stratosphere in air currents.

Conversion

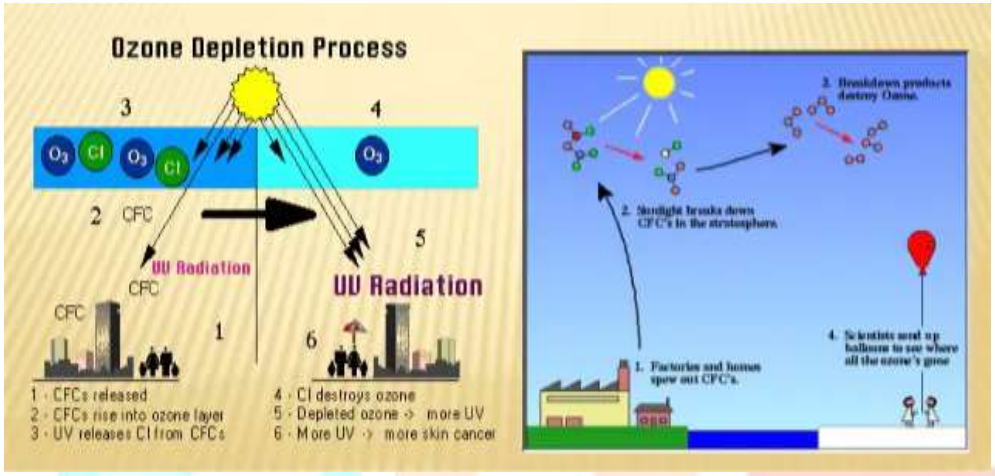
Most halogen source gases are converted in the stratosphere to reactive halogen gases in chemical reactions that involve the Sun's ultraviolet radiation.

Chemical reaction

Reactive halogen gases cause the chemical depletion of stratospheric total ozone over all parts of the globe except tropical latitudes.
Polar stratospheric clouds increase ozone depletion by providing surfaces upon which reactive halogen gases can form, causing severe ozone loss in polar regions in winter and spring.

Removal

Air containing reactive halogen gases returns to the troposphere, and these gases are removed from the air by moisture in clouds and rain.



IMPACTS OF OZONE LAYER DEPLETITION

- Human Health

  Damages DNA which suppresses immune system resulting in increase in infectious diseases e.g. Skin Cancer; Eye Cataracts.

- Plants & Trees

  - Reduces crop production, damage to seeds.
  - Reduces quality of crops.

- Aquatic Organisms

  Damage to plankton, aquatic plants, fish larvae, shrimp, crabs Affects marine food chain.

- Materials

  Degrades paints, rubber, wood, & plastics, especially in tropical regions.

- Ground Level Smog

  Increase in the formation of Ground level ozone as a pollutant .

- High economic cost

  Damages could be in billions of US dollars.

MEASURES TO PREVENT OZONE LAYER DEPLETITION

- Avoid the consumption of gases dangerous to the ozone layer, due to their content or manufacturing process. Some of the most dangerous gases are CFCs (chlorofluorocarbons), halogenated hydrocarbon, methyl bromide and nitrous oxide.
- Minimize the use of cars. The best transport option is urban, bicycle, or walking. If you use a car to a destination, try to carpool with others to decrease the use of cars in order to pollute less and save.
- Do not use cleaning products that are harmful to the environment and to us. Many cleaning products contain solvents and substances corrosive, but you can replace these dangerous substances with non-toxic products such as vinegar or bicarbonate.
- Buy local products. In this way, you not only get fresh products but you avoid consuming food that has travelled long distances. As the more distance travelled, the more nitrous oxide is produced due to the medium used to transport that product.
- Maintain air conditioners, as their malfunctions cause CFC to escape into the atmosphere.
- Some other measures are –
  - Avoid smoking
  - Use unleaded gasoline in vehicles.
  - Equip vehicles with catalytic converter.
  - Replace CFC's with HCFC's Enforcement of Montreal Protocol.
  - Gain a better overall understanding on just how ozone depletion is affecting our planet.
  - Sunglasses with 100% UV block.

INTERNATIONAL MEASURES

- Signed by many countries around the world to reduce the emissions of CFCs.
- The ozone layer is estimated to recover to 1980s levels by 2050 and 1950 levels by 2100 if the world takes consistent preventive measures to ban the production and use of CFCs.
- However, due to the persistent nature and huge amounts. of CFCs in the atmosphere, ozone recovery will take a long time.

NATIONAL LEVEL MEASURES

- Use of CFCs are banned in accordance to the Montreal Protocol.
- Ozone friendly substitutes are developed to replace CFCs in refrigerators, aerosol cans and air CFC-free conditioners.
- For instance, since 1995, Singapore law requires all new cars to be fitted with CFC-free air conditioning systems.

CONNECTION BETWEEN THE OZONE HOLE AND GLOBAL WARMING

Ozone depletion mostly occurs when chlorofluorocarbon CFCs and halons-gases formerly found in the aerosol spray cans and refrigerants – are released into the atmosphere .

The reasons responsible for global warming are electrical pollution , gases released by factories, power plants , burning of fossil fuel like- coal , petroleum , natural gas , vehicles has caused by choking smog (Smoke & Fog) , deforestation and various types of pollution.

Ozone O3 depletion does not cause global warming, but both of these environmental problems have a common cause i.e. human activities that release CFCs & pollutants into the atmosphere altering it.

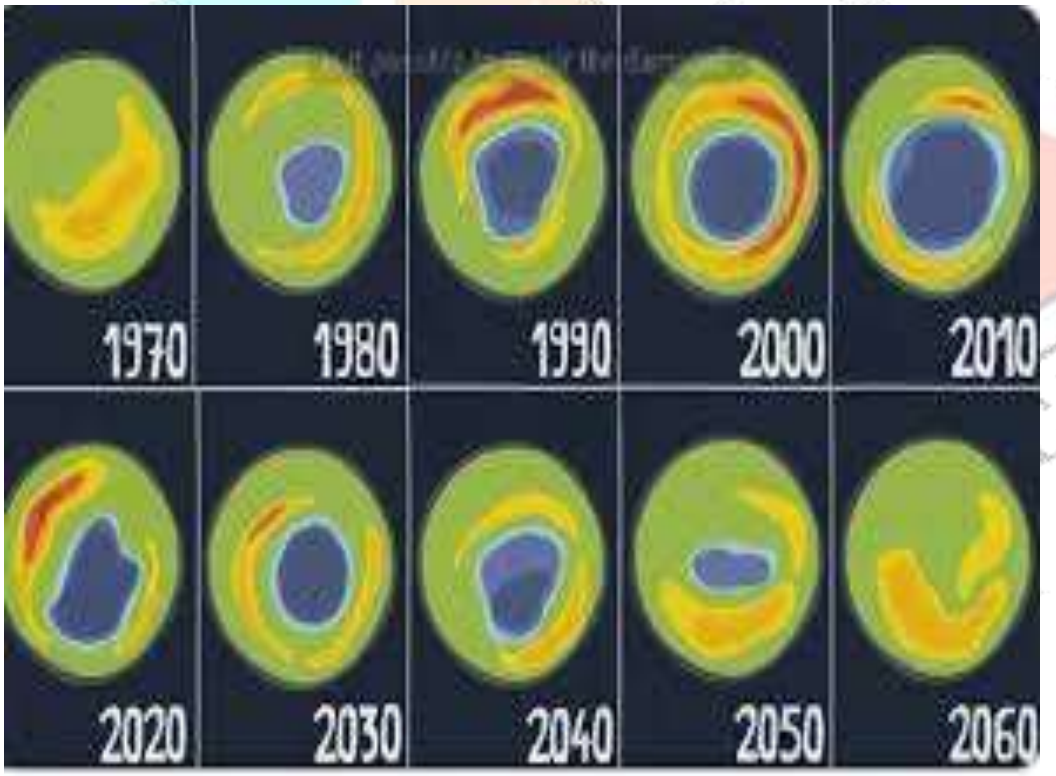
WILL THINGS IMPROVE (Recovery Of The Ozone Layer)

Is there a hope i.e. recovery of the ozone layer- YES

The ozone layer is recovering according to a new report published by the Word Meteorological Organization (WMO) and the UN. "The Scientific Assessment of Ozone Depletion 2018" study is the latest in a series of reports released every four years on the recovery of the ozone in the stratosphere which protects the Earth from UV-B Rays .

The ozone layer has recovered by 1 to 3 percent per decade since 2000 and is forecasted to recover completely in the Northern Hemisphere and mid-latitude areas in the 2030s, followed by the Southern Hemisphere around mid-century, and Antarctica in the 2060s.

The Montreal Protocol on Substances that Deplete the Ozone Layer came into effect in 1987. It sets binding obligations for countries to phase out production of all the major ozone depleting substances. As a result data shows that stratospheric concentrations of ozone depleting substances are declining.



ACCORDING TO WORLD METEOROLOGICAL ORGANIZATION

OZONE HOLE IS HEALING

CONCLUSION

As you sow , so you reap.
Nature reacts if wounds are deep.

Ozone is like a "MOTHER" OF EARTH "… who protects HER child from harmful radiations (Ultra-Violet), If we regard it as a community where we live but if we abuse our earth (environment) SHE will become an Enemy.

Depletion of ozone layer can cause havoc India and all Nations have understood this warning and trying to control the emission standards of CFCs in earth's atmosphere. Because if ozone hole increases and ultimately it can cause miserable and painful devastation of all living organisms on the planet earth. On February 11, 2021, addressing the World Sustainable Development Submit (WSDS) P.M. Modi reiterated that two things will define how the progress journey of humanity will unfold in the times to come – " Health of our people and health of our planet , both of which are interlinked ." The road to SAVE ENVIRONMENT is through ENVIRONMENTAL JUSTICE. There is always tug - of – war between developed and developing countries on who needs to do more to save the environment by reducing EMISIONS . In nutshell ENVIRONMENTAL JUSTICE need be inspired by a VISION OF TRUSTEESHIP where progress and prosperity come with greater compassion for wellness of mankind. So let us take the warning seriously and save the world from total annihilation. We should understand "Like music and art love of nature is a common language that can transcend political or social boundaries ." - **Jimmy Carter .** Therefore all nations have started negotiating agreements and treaties amongst them.

Let us hope for a better tomorrow.

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