OZONE

Ozone: It is a colourless gas that is composed of three atoms of oxygen (O3).

Types of ozone:

Good ozone:

- Good ozone is also called stratospheric ozone which means good ozone is present in the upper atmosphere which is the stratosphere.
- When ozone is present in the stratosphere region, then it forms a protective layer that protects us from the harmful ultraviolet radiation which comes from the sun.

Bad ozone:

- Bad ozone is present on the Earth's surface and it damages human health, vegetation, etc.
- It is harmful to breathe bad ozone.

What is Ozone Layer Depletion?

Ozone layer depletion is the thinning of the ozone layer present in the upper atmosphere. This happens when the chlorine and bromine atoms in the atmosphere come in contact with ozone and destroy the ozone molecules. One chlorine can destroy 100,000 molecules of ozone. It is destroyed more quickly than it is created.

Some compounds release chlorine and bromine on exposure to high ultraviolet light, which then contributes to ozone layer depletion. Such compounds are known as Ozone Depleting Substances (ODS).

The ozone-depleting substances that contain chlorine include chlorofluorocarbon, carbon tetrachloride, hydrochlorofluorocarbons, and methyl chloroform. Whereas, the ozone-depleting substances that contain bromine are halons, methyl bromide, and hydro bromofluorocarbons.

Chlorofluorocarbons are the most abundant ozone-depleting substance. It is only when the chlorine atom reacts with some other molecule, it does not react with ozone.

Causes of Ozone Layer Depletion

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 listed below:

1.Chlorofluorocarbons

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 ultraviolet radiations and release chlorine atoms. These atoms react with ozone and destroy it.

2. Unregulated Rocket Launches

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

3. Nitrogenous Compounds

The nitrogenous compounds such as NO_2, NO, N_2O are highly responsible for the depletion of the ozone layer.

4. Natural Causes

The ozone layer has been found to be depleted by certain natural processes such as:

1. Sun-spots and stratospheric winds, But it does not cause more than 1-2% of the ozone layer depletion.

2. The volcanic eruptions are also responsible for the depletion of the ozone layer.

Ozone Depleting Substances (ODS):

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

Effects Of Ozone Layer Depletion:

1.Effects on Human Health

Humans will be directly exposed to the harmful ultraviolet radiation of the sun due to the depletion of the ozone layer. This might result in serious health issues among humans, such as skin diseases, cancer, sunburns, cataract, quick ageing and weak immune system.

2. Effects on Animals

Direct exposure to ultraviolet radiations leads to skin and eye cancer in animals.

3. Effects on the Environment

Strong ultraviolet rays may lead to minimal growth, flowering and photosynthesis in plants. The forests also have to bear the harmful effects of the ultraviolet rays.

4. Effects on Marine Life

Planktons are greatly affected by the exposure to harmful ultraviolet rays. These are higher in the aquatic food chain. If the planktons are destroyed, the organisms present in the food chain are also affected.

Solutions to Ozone Layer Depletion

The depletion of the ozone layer is a serious issue and various programs have been launched by the government of various countries to prevent it. However, steps should be taken at the individual level as well to prevent the depletion of the ozone layer.

Following are some points that would help in preventing this problem at a global level:

1.Avoid Using ODS

Reduce the use of ozone depleting substances. E.g. avoid the use of CFCs in refrigerators and air conditioners, replacing the halon based fire extinguishers, etc.

2. Minimise the Use of Vehicles

The vehicles emit a large amount of greenhouse gases that lead to global warming as well as ozone depletion. Therefore, the use of vehicles should be minimised as much as possible.

3. Use Eco-friendly Cleaning Products

Most of the cleaning products have chlorine and bromine releasing chemicals that find a way into the atmosphere and affect the ozone layer. These should be substituted with natural products to protect the environment.

4. Use of Nitrous Oxide should be Prohibited

The government should take actions and prohibit the use of harmful nitrous oxide that is adversely affecting the ozone layer. People should be made aware of the harmful effects of nitrous oxide and the products emitting the gas so that its use is minimized at the individual level as well.

Montreal Protocol

is an international treaty designed to protect the ozone layer by phasing out the production of numerous substances that are responsible for ozone depletion. It was agreed on 16 September 1987, and entered into force on 1 January 1989. Since then, it has undergone nine revisions, in 1990 (London), 1991 (Nairobi), 1992 (Copenhagen), 1993 (Bangkok), 1995 (Vienna), 1997 (Montreal), 1998 (Australia), 1999 (Beijing) and 2016 (Kigali) As a result of the international

agreement, the ozone hole in Antarctica is slowly recovering. Climate projections indicate that the ozone layer will return to 1980 levels between 2040 (across much of the world) and 2066 (over Antarctica). Due to its widespread adoption and implementation, it has been hailed as an example of successful international co-operation.

What is the main aim of the Montreal Protocol?

Montreal Protocol was proposed in 1987 to stop the use, production and import of ozone-depleting substances and minimize their concentration in the atmosphere to protect the ozone layer of the earth.

Who was the man who did the most damage to the environment?

One man, however, has had more impact on the environment than any other single organism in Earth's history: **Thomas Midgley Jr**., a chemical engineer and inventor in the early twentieth century. His inventions went on to become one of the primary causes of the depletion of the ozone layer of the Earth's atmosphere:

1.Midgley is best known for introducing a compound called tetraethyl lead (TEL) as an additive for gasoline to prevent engine knocking in cars — the premature ignition of fuel outside of an engine's regular cycle.

2. Another one of Midgley's big contributions was synthesizing one of the first chlorofluorocarbons (CFCs), a series of molecules that are composed only of carbon, chlorine, and fluorine, in various combinations. CFCs were created as safer alternatives to the toxic compounds that were being used at the time as refrigerants in air conditioners and refrigerators. For his creations, Midgley was awarded the 1937 Perkin medal by the American Chemical Society.

Thomas Midgley

Why is the Ozone Layer Hole in the South Pole? Why isn't it in the North Pole?

While ozone loss occurs in both hemispheres year-round, the ozone hole, a large, severe decrease of ozone in the polar regions in Spring, is brought about by a particular set of meteorological conditions and the presence of ozone depleting chemicals in the atmosphere. These meteorological conditions include darkness, a stable polar vortex, and extremely cold temperatures that allow the formation of Polar Stratospheric Cloud (PSC) particles in the ozone layer. When the Sun begins to rise in the Spring, the chlorine compounds in the atmosphere are converted to a highly reactive form, and

the PSC form catalytic surfaces on which heterogeneous chemistry takes place that converts ozone into molecular oxygen, depleting the stratospheric ozone.

While these meteorological conditions occur over the entire continent of Antarctica most every winter, they only occur sporadically and usually over smaller regions in the northern hemisphere. Thus, the ozone holes in the northern hemisphere are less extensive and may not occur during some seasons.

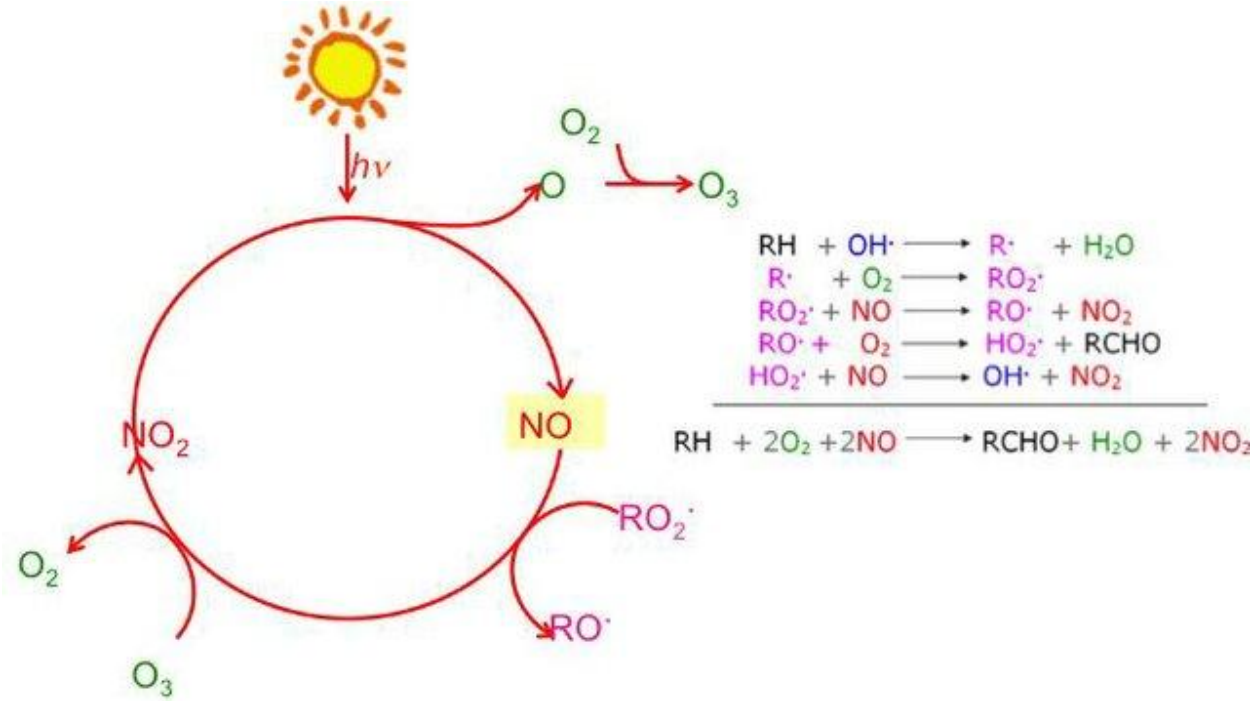
If you are curious as to why these conditions occur so often in the southern hemisphere, it is due to:

1.The geography of a large continental mass surrounded by ocean.

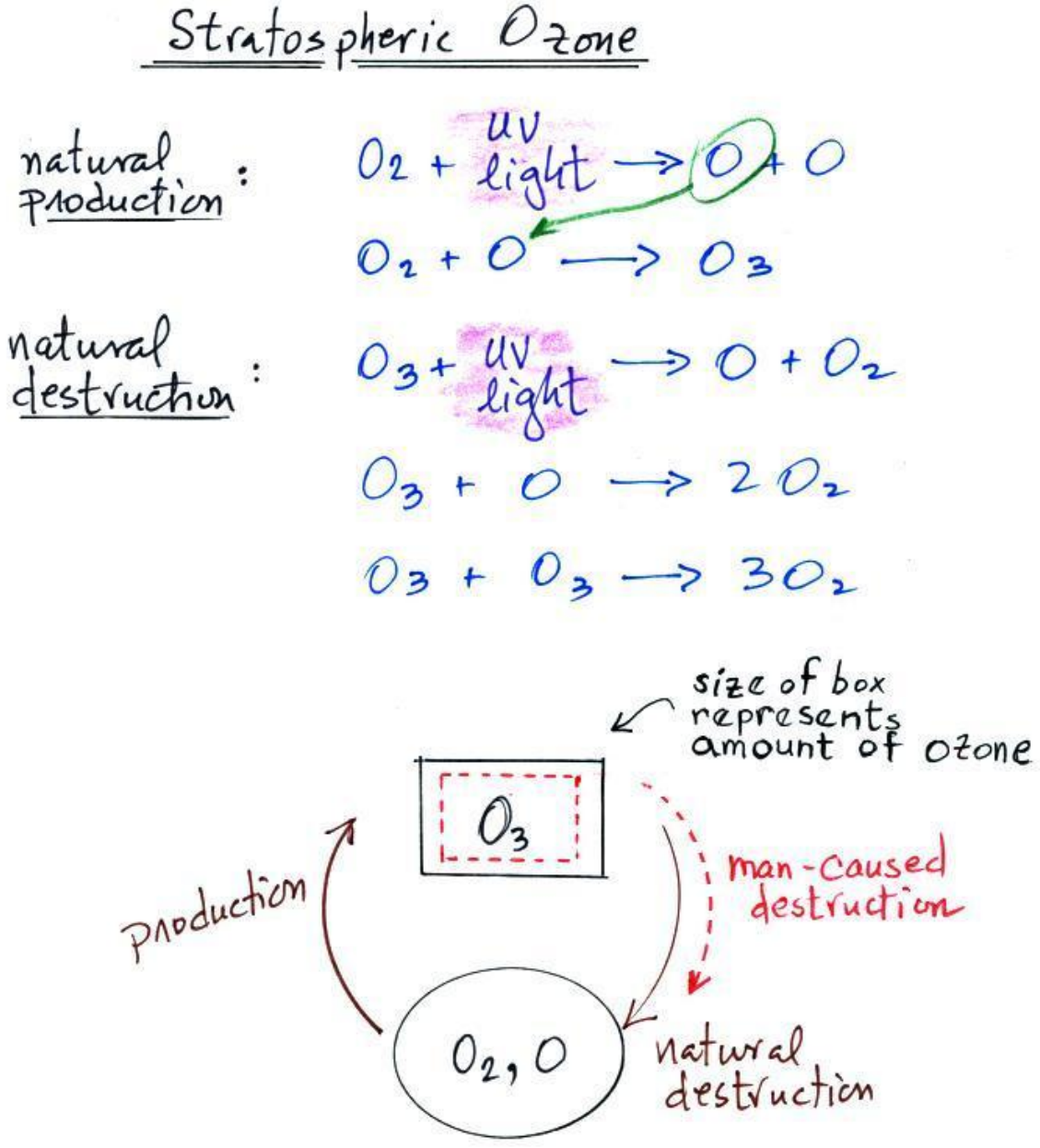
2. The wind flows almost entirely over either ocean or land, without encountering land-sea temperature differences that create kinks, or waves, in the flow. This leads to a stable vortex that isolates the air over Antarctica from that of lower latitudes, and the resulting colder temperatures allow for the formation of PSC over the entire polar region.

3. In the northern hemisphere, the flows encounter repeated land-sea temperature differences that result in waves that can disrupt the polar vortex. Thus, there are frequent intrusions of low latitude air into the northern polar region that prevent the formation of PSC.

Formation of photochemical smog:



Formation and breakdown of ozone:



Ultraviolet radiation & Skin damage

Ultraviolet (UV) radiation is a form of energy that the sun produces. You can't see UV radiation because its wavelengths are shorter than visible light.

The UV energy that the sun produces reaches the Earth and provides vitamin D for your body to help you survive. You can also find UV radiation in human-made sources like tanning beds. Exposure to too much ultraviolet radiation greatly increases your risk of developing skin cancer.

What are the three types of ultraviolet radiation?

There are three different types of ultraviolet radiation based on the size of the wavelength:

- **UVA** causes your skin to wrinkle, tan and/or burn. Too much exposure leads to skin cancer.
- **UVB** can damage the outermost layers of your skin. It can cause sun spots, tanning, sunburns and blistering, which can lead to skin cancer.
- **UVC** is absorbed by the Earth's atmosphere and the UV light you experience on Earth is either UVA or UVB, not UVC.

Changes in your skin related to sun exposure include:

- Precancerous (actinic keratosis) and cancerous skin lesions caused by loss of your skin's immune function.
- Tumors.
- Skin discoloration, mottled pigmentation or a yellow tone.
- Dilated small blood vessels.
- Damaged elastic tissues that cause wrinkles (elastosis).
- Damage to your eyes, like cataracts or macular degeneration.

How does ultraviolet radiation lead to cancer?

Too much ultraviolet radiation causes skin cancer. Your body needs some UV light for vitamin D, which is a vitamin you need to survive. When your skin has too much exposure to UV radiation, it damages your cells. Within your cells, you have DNA. DNA tells your cells how to form and function within your body. Too much UV radiation targets the DNA in your cells, which causes them to misunderstand their function. As a result, your cells divide and replicate too frequently. Your cells then clump together to form tumors, which can be cancerous.

Ultraviolet radiation from the sun is the primary cause of skin cancer. Exposure to sunlight during the winter months puts you at the same risk of exposure during the summer time.

What is skin cancer?

Skin cancer is the uncontrolled growth of skin cells. While healthy cells grow and divide in an orderly way, cancer cells grow and divide in a rapid, haphazard manner. This abnormal growth causes tumors that are either benign (noncancerous) or malignant (cancerous). There are three main types of skin cancer:

- Basal cell carcinoma.
- Squamous cell carcinoma.
- Melanoma

Basal cell and squamous cell cancers are less serious types and make up 95% of all skin cancers. These cancers are nonmelanoma skin cancers. This means that they're highly curable when treated early.

Melanoma, made up of abnormal skin pigment cells called melanocytes, is the most serious form of skin cancer and causes 75% of all skin cancer deaths. If left untreated, melanoma can spread to other organs and is difficult to control.

Who is at risk for skin cancer caused by ultraviolet radiation?

Anyone can get skin cancer from ultraviolet radiation. The risk is greatest in people who have:

- Fair skin.
- Freckled skin.
- Skin that burns easily.
- Light eyes.
- Blond or red hair.

People who have a darker skin tone can get skin cancer, but their risk is lower than people who have a lighter skin tone.