

# **SUBJECT BASIC SCIENCE**

## **TOPIC ENVIRONMENTAL POLLUTION**



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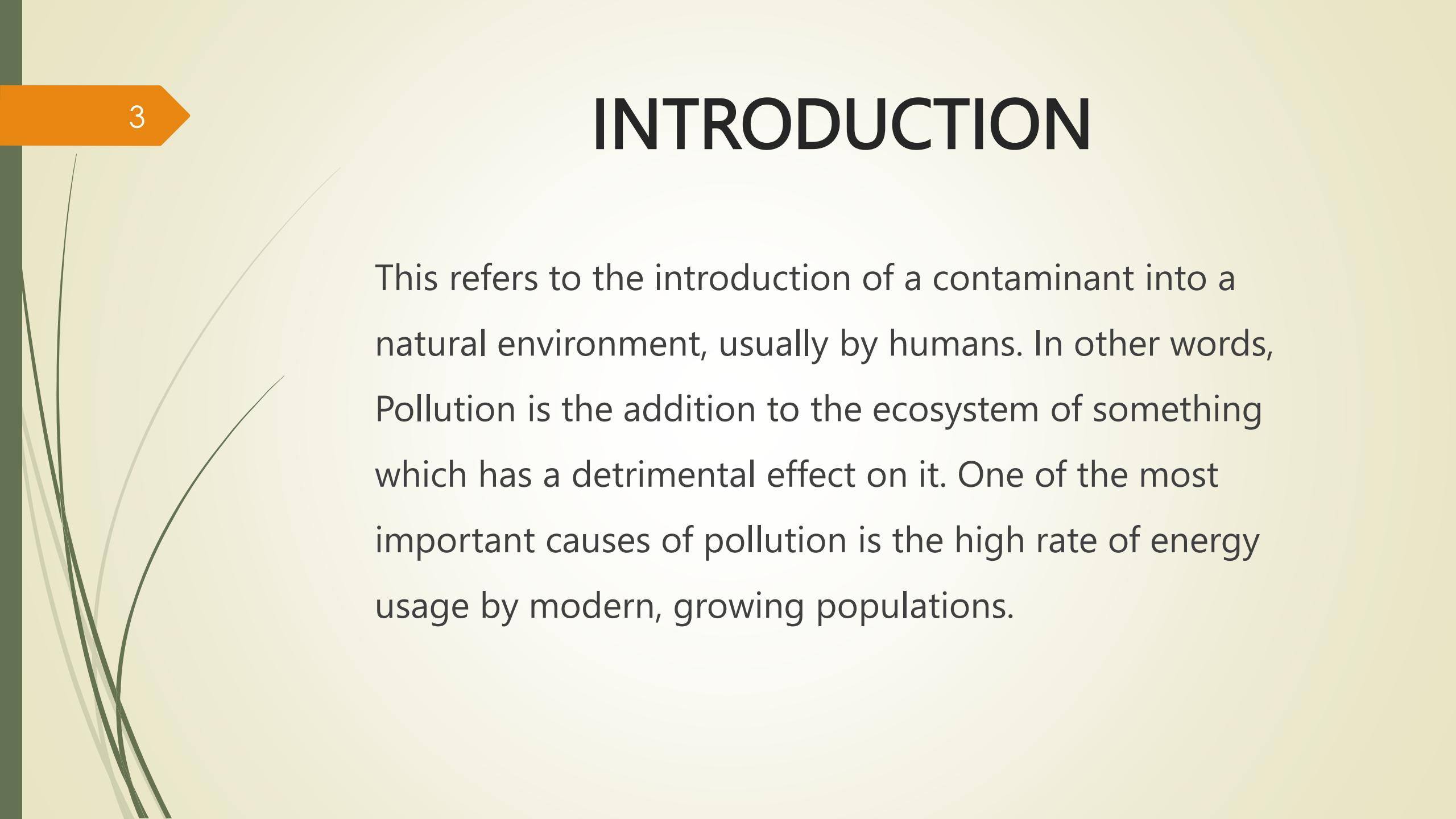
### **CLASS JSS 1**

# BEHAVIOURAL OBJECTIVES

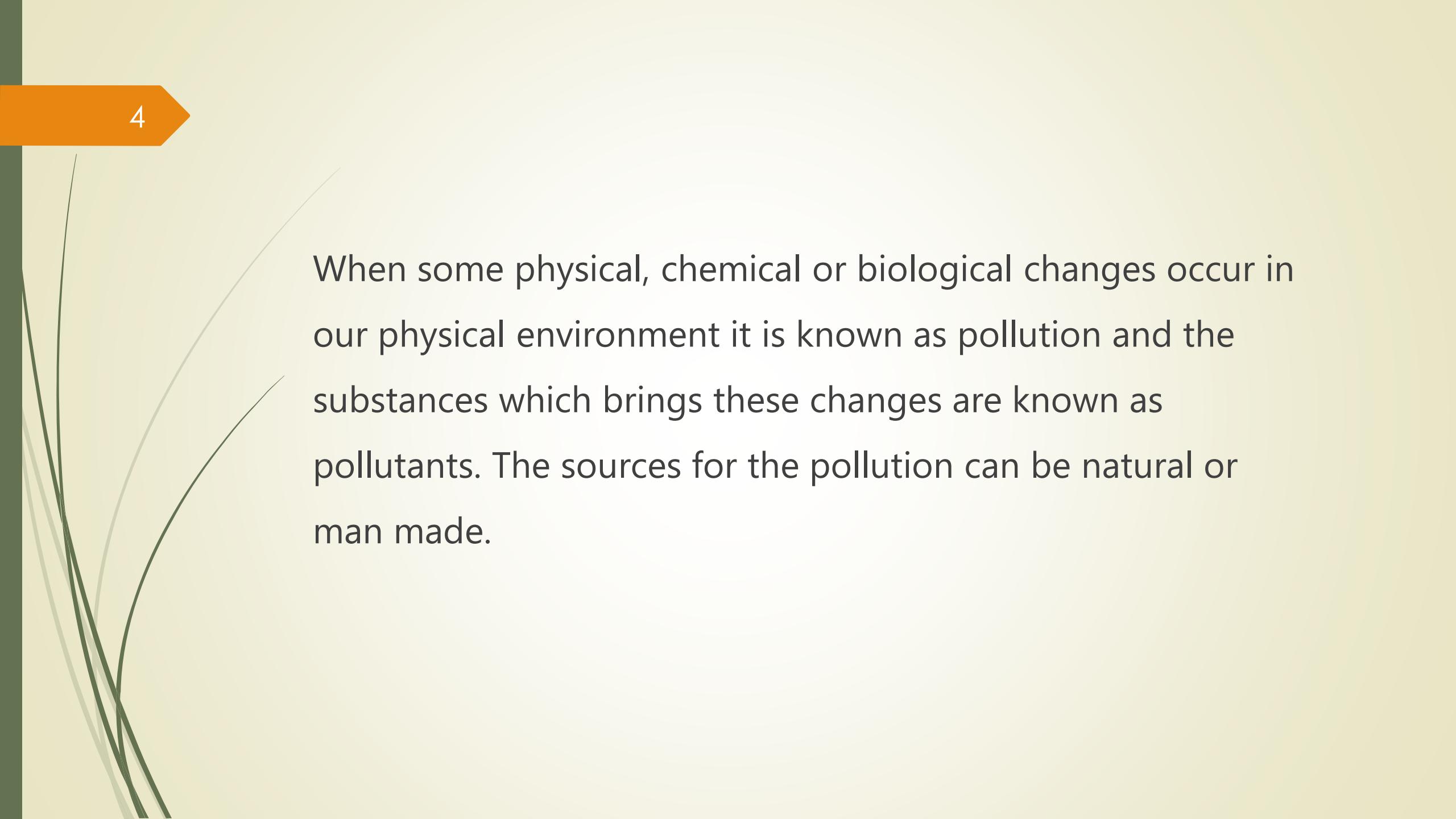
By the end of this lesson, students should be able to;

1. List and describe the major types of pollution.
2. Give examples of their pollutants.
3. List and explain ways to control them.
4. Discuss the effects of Ozone layer depletion on living organisms and the natural environment.

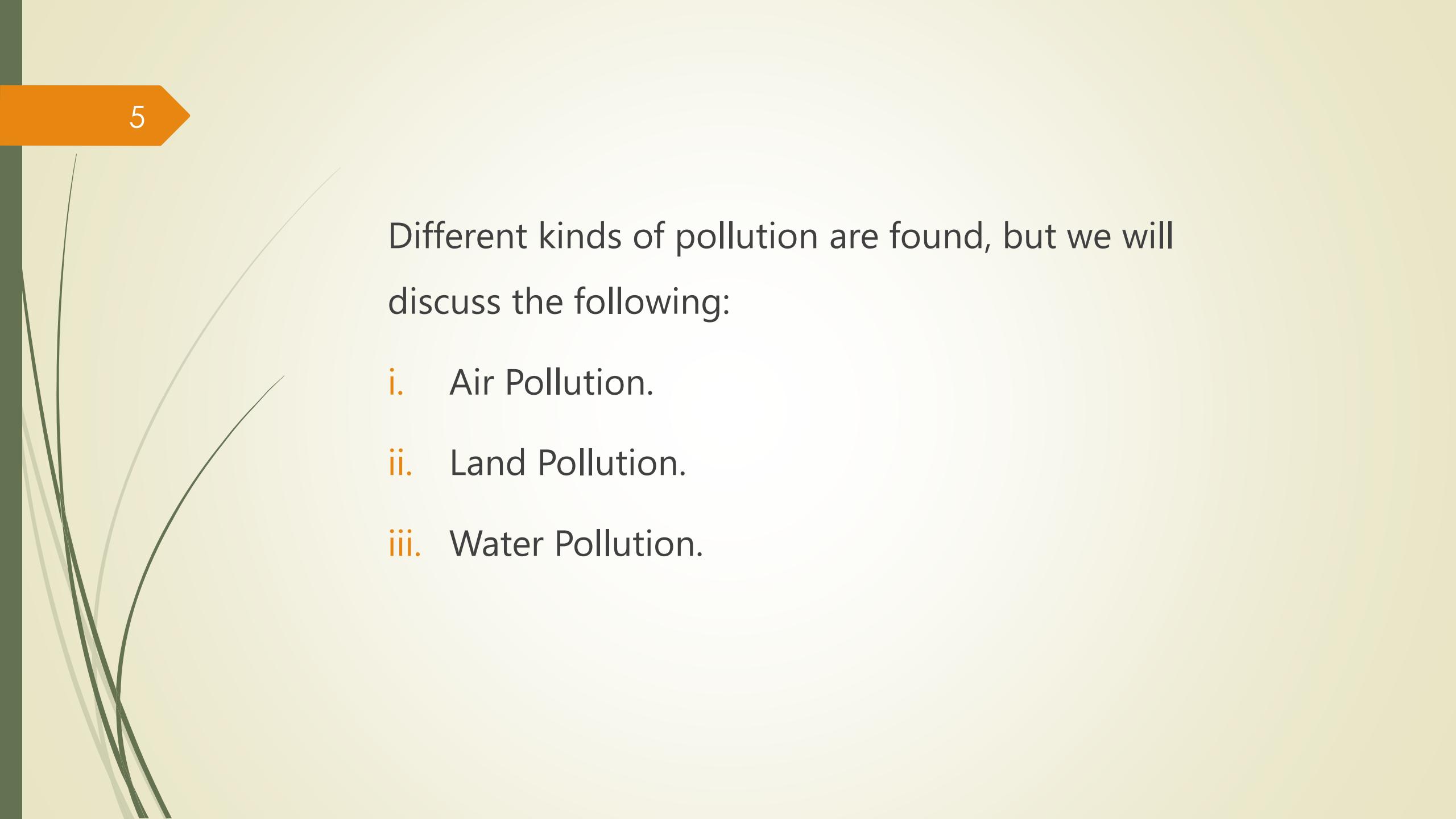
# INTRODUCTION



This refers to the introduction of a contaminant into a natural environment, usually by humans. In other words, Pollution is the addition to the ecosystem of something which has a detrimental effect on it. One of the most important causes of pollution is the high rate of energy usage by modern, growing populations.



When some physical, chemical or biological changes occur in our physical environment it is known as pollution and the substances which brings these changes are known as pollutants. The sources for the pollution can be natural or man made.



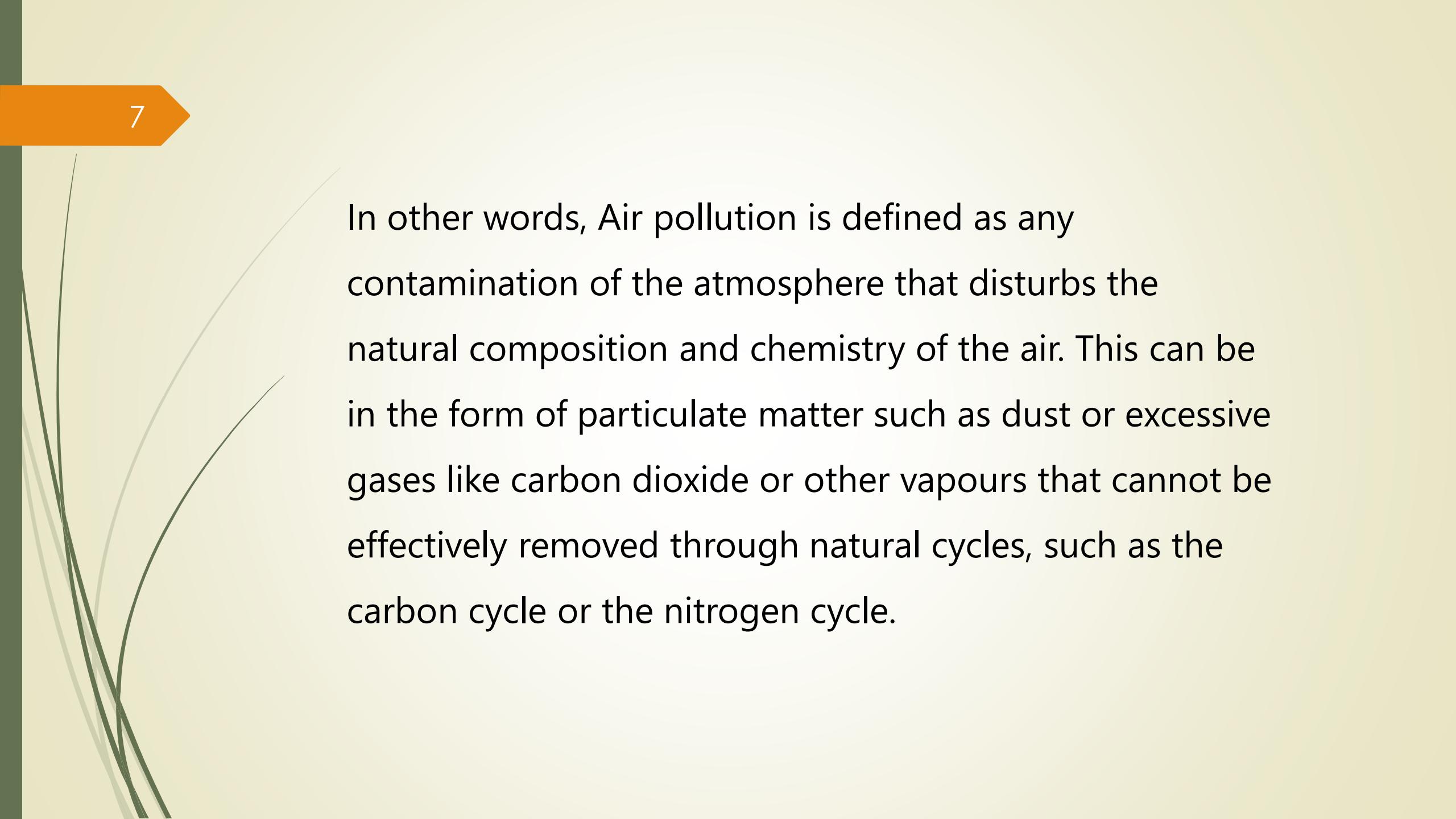
Different kinds of pollution are found, but we will discuss the following:

- i. Air Pollution.
- ii. Land Pollution.
- iii. Water Pollution.

# AIR POLLUTION

Air pollution is the accumulation in the atmosphere of substances that, in sufficient concentrations, endanger human health or produce other measured effects on living matter and other materials.





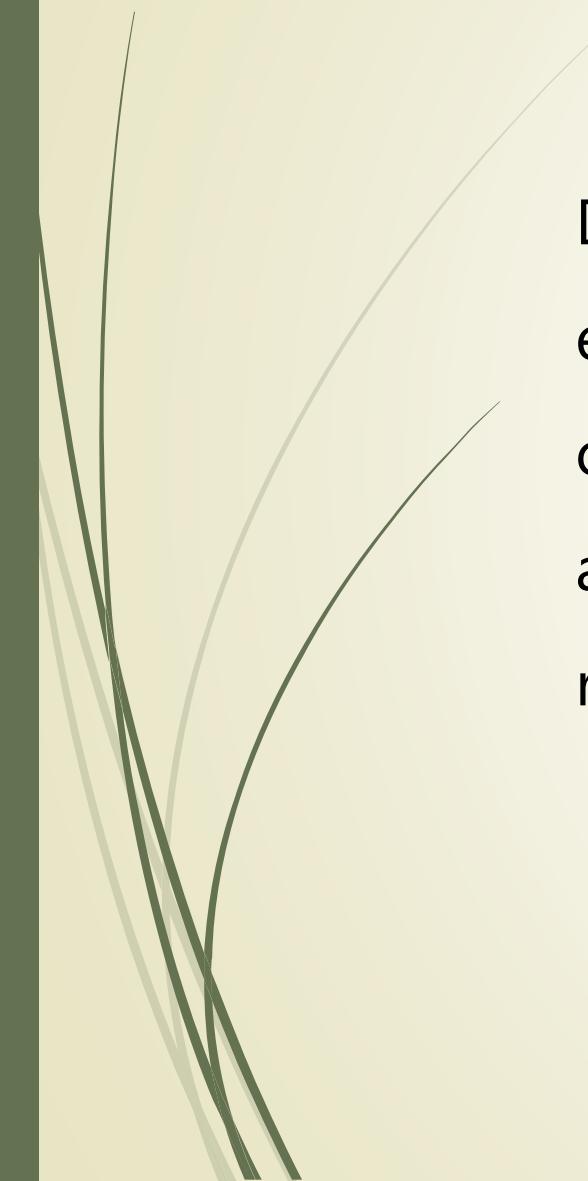
In other words, Air pollution is defined as any contamination of the atmosphere that disturbs the natural composition and chemistry of the air. This can be in the form of particulate matter such as dust or excessive gases like carbon dioxide or other vapours that cannot be effectively removed through natural cycles, such as the carbon cycle or the nitrogen cycle.



Among the major sources of pollution are power and heat generation, the burning of solid wastes, industrial processes, and, especially, transportation. The six major types of pollutants are carbon monoxide, hydrocarbons, nitrogen oxides, particulates, sulphur dioxide, and photochemical oxidants.

Air pollution comes from a wide variety of sources, these sources are referred to as pollutants. Some of the most excessive sources include:

- Vehicle or manufacturing exhaust
- Forest fires, volcanic eruptions, dry soil erosion, and other natural sources
- Building construction or demolition



Depending on the concentration of air pollutants, several effects can be noticed. Smog increases, higher rain acidity, crop depletion from inadequate oxygen, and higher rates of asthma. Many scientists believe that global warming is also related to increased air pollution.

# EXAMPLES OF AIR POLLUTION



- **Noise Pollution**

Noise pollution or unwanted sounds that are carried by the air, have an irritating and detrimental effect on humans and other animals. Careful planning of streets and buildings in towns and better control over noisy vehicles may add to the control of noise pollution.

- **Tobacco Smoke**

Tobacco smoke is one of the major forms of pollution in buildings. It is not only the smoker who is infected, but everyone who inhales the polluted air. There is a very strong connection between smoking and lung cancer. Bronchitis is common among smokers and unborn babies of mothers who smoke also suffer from the harmful effects of smoking.





## ■ Exhaust Gases of Vehicles

Pollution from exhaust gases of vehicles is responsible for 60% of all air pollution and in cities up to 80%. There is a large variety of harmful chemicals present in these gases, with lead being one of the most dangerous.

- **Combustion of Coal**

The combustion of coal without special precautions can have serious consequences. If winds do not blow away the poisonous gases, they can have fatal effects and may lead to death.





- **Acid rain**

Acid rain is the term for pollution caused when sulfur and nitrogen dioxides combine with atmospheric moisture to produce highly acidic rain, snow, hail, or fog. The acid eats into the stone, brick and metal articles and pollutes water sources. Coal in South Africa is rich in sulphur and the power stations in the Mpumalanga Province could be responsible for acid rain over other areas of our country.

# CONTROL MEASURES



Although individual people can help to combat air pollution in their own immediate environment, efficient control can be best achieved by legislation. Some commonly enforced control measures include

- The establishment of more smokeless zones;
- Control over the kinds of fuel used in cars, aeroplanes, power stations, etc.
- Separating Industries and Factories from areas where people live.
- Creation of awareness on the need for recycling and reducing burning of waste to the lowest level.

# LAND POLLUTION



Land pollution is the degradation of the Earth's land surface through misuse of the soil by poor agricultural practices, mineral exploitation, industrial waste dumping, and indiscriminate disposal of urban wastes. It includes visible waste and litter as well as pollution of the soil itself.

# EXAMPLES OF LAND POLLUTION

## ► Soil Pollution

Soil pollution is mainly due to chemicals in herbicides (weed killers) and pesticides (poisons which kill insects and other invertebrate pests). Litter is waste material dumped in public places such as streets, parks, picnic areas, at bus stops and near shops.

# EXAMPLES OF LAND POLLUTION

## ► Waste Disposal

The accumulation of waste threatens the health of people in residential areas. Waste decays, encourages household pests and turns urban areas into unsightly, dirty and unhealthy places to live in.

# CONTROL MEASURES

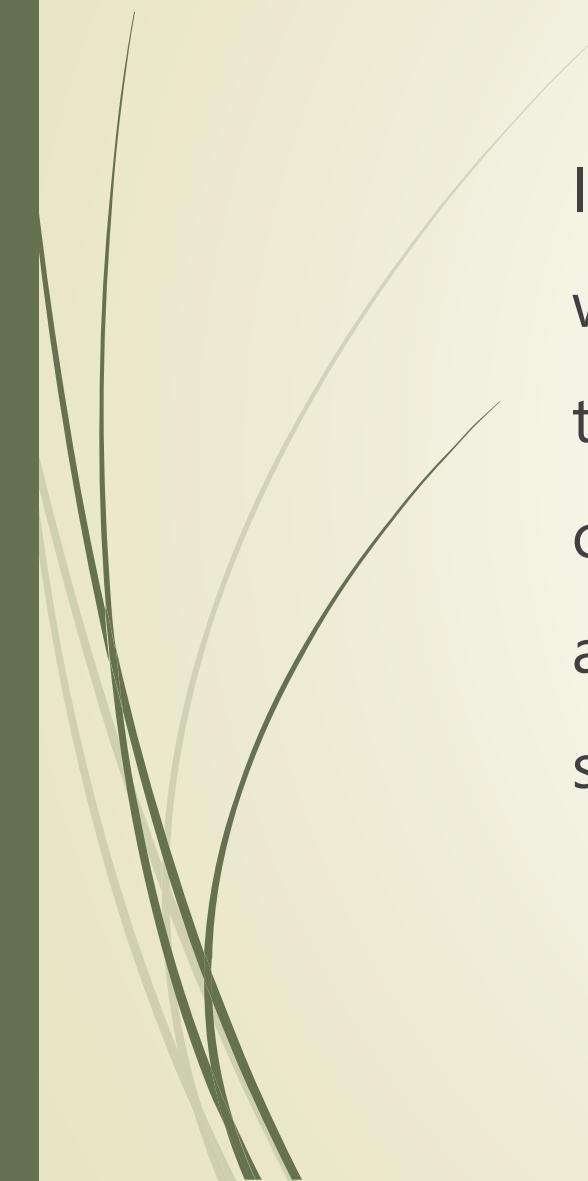
The following measures can be used to control land pollution:

- i. anti-litter campaigns can educate people against littering;
- ii. organic waste can be dumped in places far from residential areas;
- iii. inorganic materials such as metals, glass and plastic, but also paper, can be reclaimed and recycled.

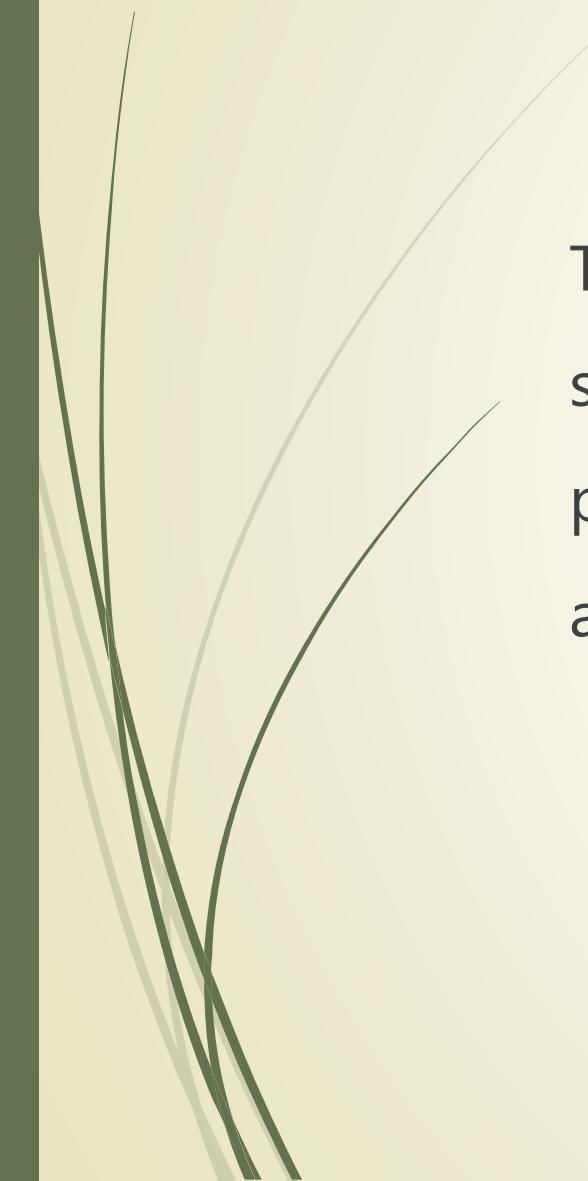
# WATER POLLUTION

Water pollution is the introduction into fresh or ocean waters of chemical, physical, or biological material that degrades the quality of the water and affects the organisms living in it.





In other words, Water pollution involves any contaminated water, whether from chemical, particulate, or bacterial matter that degrades the water's quality and purity. Water pollution can occur in oceans, rivers, lakes, and underground reservoirs, and as different water sources flow together the pollution can spread.



This process ranges from simple addition of dissolved or suspended solids to discharge of the most insidious and persistent toxic pollutants (such as pesticides, heavy metals, and non-degradable, chemical compounds).

# CAUSES OF WATER POLLUTION

- Increased sediment from soil erosion
- Improper waste disposal and littering
- Leaching of soil pollution into water supplies
- Organic material decay in water supplies



The effects of water pollution include decreasing the quantity of drinkable water available, lowering water supplies for crop irrigation, and impacting fish and wildlife populations that require water of a certain purity for survival.

# EXAMPLES OF WATER POLLUTION

- **Industrial Affluents**

Water is discharged from after having been used in production processes. This waste water may contain acids, alkalis, salts, poisons, oils and in some cases harmful bacteria.

- **Mining and Agricultural Wastes**

Mines, especially gold and coal mines, are responsible for large quantities of acid water. Agricultural pesticides, fertilizers and herbicides may wash into rivers and stagnant water bodies.

- **Sewage Disposal and Domestic Wastes**

Sewage as well as domestic and farm wastes were often allowed to pollute rivers and dams.



# CONTROL MEASURES

The following measures can be used to stop water pollution:

- The public should be educated enough about the risks of polluting the water.

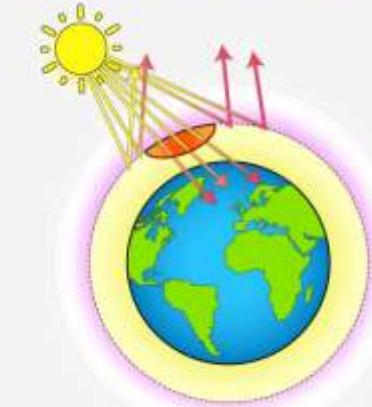
- By research and legislation, the pollution of water bodies, even though not entirely prevented, can be effectively controlled.
- By constructing surface drainage systems.
- By monitoring what is brought into the country through the sea.
- By making sewers available to the public.

# OZONE LAYER DEPLETION

The ozone layer is responsible for absorbing harmful ultraviolet rays, and preventing them from entering the Earth's atmosphere. However, various factors have led to the depletion and damage of this protective layer.

## OZONE LAYER DEPLETION

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The Learning App





Ozone is a colourless gas found in the upper atmosphere of the Earth. It is formed when oxygen molecules absorb ultraviolet photons, and undergo a chemical reaction known as photo dissociation or photolysis. In this process, a single molecule of oxygen breaks down into two oxygen atoms.



The free oxygen atom (O), then combines with an oxygen molecule ( $O_2$ ), and forms a molecule of ozone ( $O_3$ ). The ozone molecules, in turn absorb ultraviolet rays between 310 to 200 nm (nanometers) wavelength, and thereby prevent these harmful radiations from entering the Earth's atmosphere.

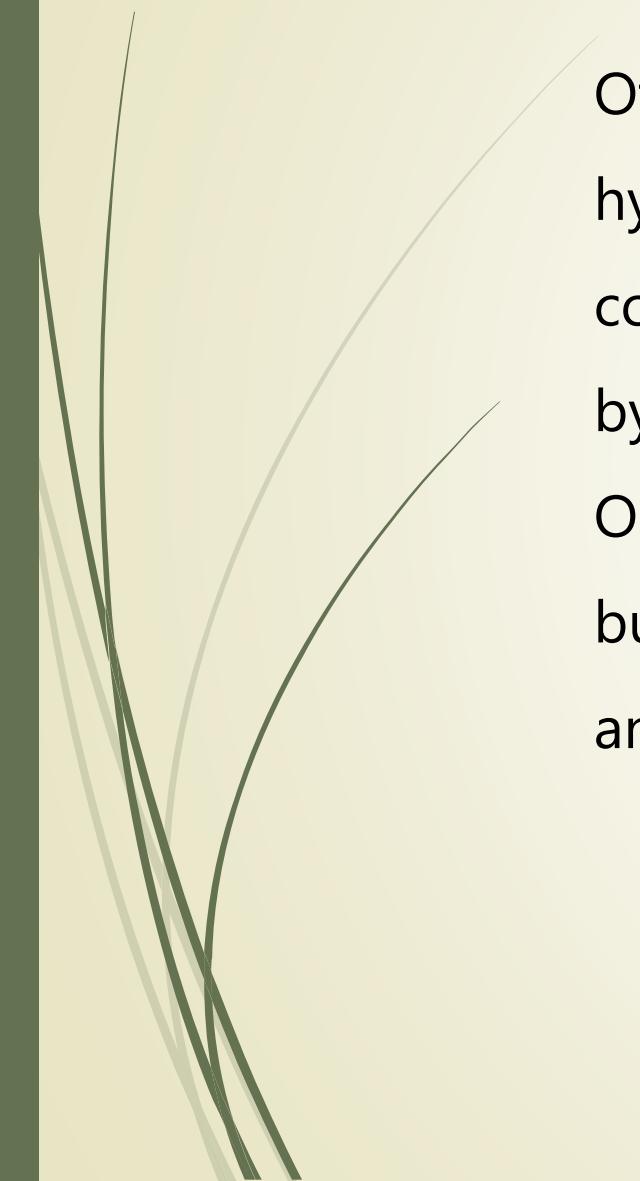


The process of absorption of harmful radiation occurs when ozone molecules split up into a molecule of oxygen, and an oxygen atom. The oxygen atom (O), again combines with the oxygen molecule ( $O_2$ ) to regenerate an ozone ( $O_3$ ) molecule. Thus, the total amount of ozone is maintained by this continuous process of destruction, and regeneration.

# CAUSES OF OZONE DEPLETION



Ozone is a triatomic form of oxygen ( $O_3$ ), found in the Earth's atmosphere. A combination of low temperatures, elevated chlorine and bromine concentrations in the upper stratosphere are responsible for the destruction of ozone. The production and emission of chlorofluorocarbons (CFCs), is the leading cause of ozone layer depletion. CFC's accounts for almost 80% of the total depletion of ozone.



Other ozone-depleting substances (ODS), include hydrochlorofluorocarbons (HCFCs), and volatile organic compounds (VOCs). These are often found in vehicle emissions, byproducts of industrial processes, refrigerants, and aerosols. ODS are relatively stable in the lower atmosphere of the Earth, but in the stratosphere, they are exposed to ultraviolet radiation and thus, they break down to release a free chlorine atom.



This free chlorine atom reacts with an ozone molecule ( $O_3$ ), and forms chlorine monoxide (ClO), and a molecule of oxygen. Now, ClO reacts with an ozone molecule to form a chlorine atom, and two molecules of oxygen. The free chlorine molecule again reacts with ozone to form chlorine monoxide. The process continues, and this results in the depletion of the ozone layer.

## POSSIBLE EFFECTS OF OZONE DEPLETION



As ozone depletes in the stratosphere, it forms a 'hole' in the layer. This hole enables harmful ultraviolet rays to enter the Earth's atmosphere. Ultraviolet rays of the Sun are associated with a number of health-related, and environmental issues.

# IMPACT ON HUMANS

- **Skin cancer:** Exposure to ultraviolet rays poses an increased risk of developing several types of skin cancers, including malignant melanoma, basal and squamous cell carcinoma.
- **Eye damage:** Direct exposure to UV radiations can result in photokeratitis (snow blindness), and cataracts.

- **Immune system damage:** Effects of UV rays include impairment of the immune system. Increased exposure to UV rays weakens the response of the immune system.
- **Accelerated aging of skin:** Constant exposure to UV radiation can cause photo allergy, which results in the outbreak of rash in fair-skinned people.
- **Other effects:** Ozone chemicals can cause difficulty in breathing, chest pain, throat irritation, and hamper lung functioning.

# EFFECTS ON AMPHIBIANS

Ozone depletion is listed as one of the causes for the declining numbers of amphibian species. Ozone depletion affects many species of amphibians at every stage of their life cycle.

Some of the effects are mentioned below:

1. Hampers growth and development in larvae
2. Changes behaviour and habits
3. Causes deformities in some species
4. Decreases immunity. Some species have become more vulnerable to diseases and death
5. Retinal damage and blindness in some species

# EFFECTS ON MARINE ECOSYSTEMS



In particular, plankton (phytoplankton and bacterioplankton) are threatened by increased UV radiation. Marine phytoplankton play a fundamental role in both the food chain as well as the oceanic carbon cycle. Plankton play an important role in converting atmospheric carbon dioxide into oxygen. Ultraviolet rays can influence the survival rates of these microscopic organisms, by affecting their orientation and mobility. This eventually disturbs and affects the entire ecosystem.

# IMPACT ON PLANTS

In some species of plants, UV radiation can alter the time of flowering, as well as the number of flowers.

Plant growth can be directly affected by UV-B radiation. Despite mechanisms to reduce or repair these effects, physiological and developmental processes of plants are affected.

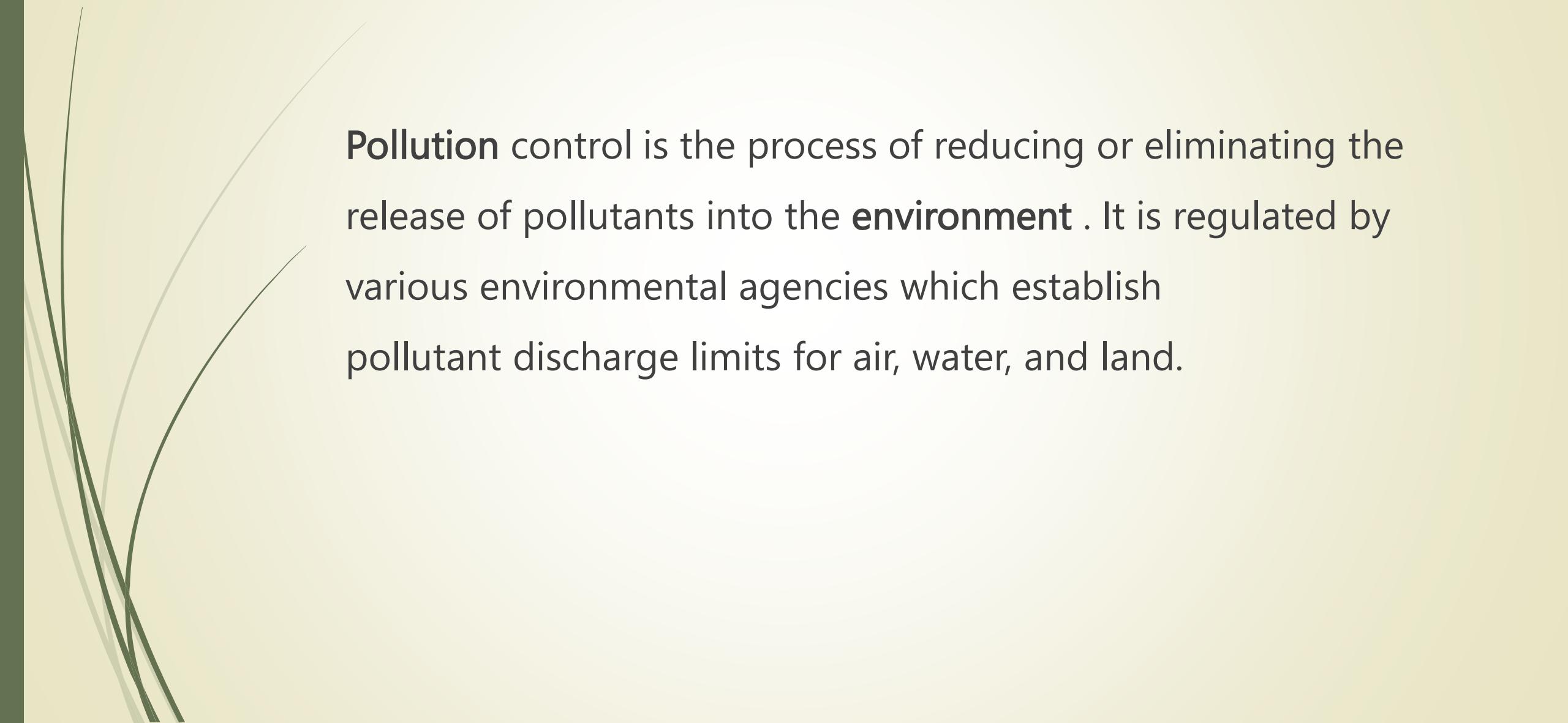


Another observation is an increase in the ozone present in the lower atmosphere due to the decrease in the ozone in the stratosphere. Ozone present in the lower atmosphere is mainly regarded as a pollutant and a greenhouse gas, that can contribute to global warming and climate change.



However, studies have pointed out that the lifespan of lower atmospheric ozone is quite less, compared to stratospheric ozone. At the same time, increase in the level of ozone in the lower atmosphere can enhance the ability of sunlight to synthesize vitamin D, which can be regarded as an important beneficial effect of ozone layer depletion.

# POLLUTION CONTROL



**Pollution** control is the process of reducing or eliminating the release of pollutants into the **environment**. It is regulated by various environmental agencies which establish pollutant discharge limits for air, water, and land.

# EVALUATION

1. Define Environmental Pollution.
2. Mention five pollutants you know.
3. Give three ways of controlling water pollution.
4. What is ozone layer depletion?



► Thank you for  
watching