CS-14

Environmental Science: Understanding the Earth's Ecosystems and Sustainability

UNIT- 2

Environmental Pollution

• Types of Pollution (air, water, soil, noise, etc.)
• Sources and impact of pollution
• Mitigation and control measures

- **What is Air Pollution?**

"Air Pollution is the release of pollutants such as gases, particles, biological molecules, etc. into the air that is harmful to human health and the environment."

Air pollution refers to any physical, chemical or biological change in the air. It is the contamination of air by harmful gases, dust and smoke which affects plants, animals and humans drastically.

There is a certain percentage of gases present in the atmosphere. An increase or decrease in the composition of these gases is harmful to survival. This imbalance in the gaseous composition has resulted in an increase in earth's temperature, which is known as global warming.

Types of Air Pollutants

There are two types of air pollutants:

Primary Pollutants

The pollutants that directly cause air pollution are known as primary pollutants. Sulphur-dioxide emitted from factories is a primary pollutant.

Secondary Pollutants

The pollutants formed by the intermingling and reaction of primary pollutants are known as secondary pollutants. Smog, formed by the intermingling of smoke and fog, is a secondary pollutant.

Causes of Air Pollution

Following are the important causes of air pollution:

Burning of Fossil Fuels

The combustion of fossil fuels emits a large amount of sulphur dioxide. Carbon monoxide released by incomplete combustion of fossil fuels also results in air pollution.

Automobiles

The gases emitted from vehicles such as jeeps, trucks, cars, buses, etc. pollute the environment. These are the major sources of greenhouse gases and also result in diseases among individuals.

Agricultural Activities

Ammonia is one of the most hazardous gases emitted during agricultural activities. The insecticides, pesticides and fertilisers emit harmful chemicals in the atmosphere and contaminate it.

Factories and Industries

Factories and industries are the main source of carbon monoxide, organic compounds, hydrocarbons and chemicals. These are released into the air, degrading its quality.

Mining Activities

In the mining process, the minerals below the earth are extracted using large pieces of equipment. The dust and chemicals released during the process not only pollute the air, but also deteriorate the health of the workers and people living in the nearby areas.

Domestic Sources

The household cleaning products and paints contain toxic chemicals that are released in the air. The smell from the newly painted walls is the smell of the chemicals present in the paints. It not only pollutes the air but also affects breathing.

Effects of Air Pollution

The hazardous effects of air pollution on the environment include:

Diseases

Air pollution has resulted in several respiratory disorders and heart diseases among humans. The cases of lung cancer have increased in the last few decades. Children living near polluted areas are more prone to pneumonia and asthma. Many people die every year due to the direct or indirect effects of air pollution.

Global Warming

Due to the emission of greenhouse gases, there is an imbalance in the gaseous composition of the air. This has led to an increase in the temperature of the earth. This increase in earth's temperature is known as global warming. This has resulted in the melting of glaciers and an increase in sea levels. Many areas are submerged underwater.

Acid Rain

The burning of fossil fuels releases harmful gases such as nitrogen oxides and sulphur oxides in the air. The water droplets combine with these pollutants, become acidic and fall as acid rain which damages human, animal and plant life.

Ozone Layer Depletion

The release of chlorofluorocarbons, halons, and hydrochlorofluorocarbons in the atmosphere is the major cause of depletion of the ozone layer. The depleting ozone layer does not prevent the harmful ultraviolet rays coming from the sun and causes skin diseases and eye problems among individuals.

Effect on Animals

The air pollutants suspend in the water bodies and affect aquatic life. Pollution also compels the animals to leave their habitat and shift to a new place. This renders them stray and has also led to the extinction of a large number of animal species.

Air Pollution Control

Following are the measures one should adopt, to control air pollution:

Avoid Using Vehicles

People should avoid using vehicles for shorter distances. Rather, they should prefer public modes of transport to travel from one place to another. This not only prevents pollution, but also conserves energy.

Energy Conservation

A large number of fossil fuels are burnt to generate electricity. Therefore, do not forget to switch off the electrical appliances when not in use. Thus, you can save the environment at the individual level. Use of energy-efficient devices such as CFLs also controls pollution to a greater level.

Use of Clean Energy Resources

The use of solar, wind and geothermal energies reduce air pollution at a larger level. Various countries, including India, have implemented the use of these resources as a step towards a cleaner environment.

- **What is Water Pollution?**

Water is one of the most vital natural resources on earth and has been around for a long time. In fact, the same water which we drink has been around in one form or the other since the time of the dinosaurs.

The earth has more than two-thirds of its surface covered with water. This translates to just over 1 octillion litres (1,260,000,000,000,000,000,000 litres) of water distributed in the oceans, rivers, lakes and streams.

That is a lot of water, however, less than 0.3% is accessible for human consumption. As commercialization and industrialization have progressed, that number continues to dwindle down. Furthermore, inefficient and

outdated practices, lack of awareness and a plethora of other circumstances have led to water pollution.

Water pollution can be defined as the contamination of water bodies. Water pollution is caused when water bodies such as rivers, lakes, oceans, groundwater and aquifers get contaminated with industrial and agricultural effluents.

When water gets polluted, it adversely affects all lifeforms that directly or indirectly depend on this source. The effects of water contamination can be felt for years to come.

Sources Of Water Pollution

The key causative of water pollution in India are:

- Urbanization.
- Deforestation.
- Industrial effluents.
- Social and Religious Practices.
- Use of Detergents and Fertilizers.
- Agricultural run-offs- Use of insecticides and pesticides.

Water Pollution – A Modern Epidemic

One of the primary **causes of water pollution** is the contamination of water bodies by toxic chemicals. As seen in the example mentioned above, the dumped plastic bottles, tins, water cans and other wastes pollute the water bodies. These result in water pollution, which harms not just humans, but the whole ecosystem. Toxins drained from these pollutants, travel up to the food chain and eventually affect humans. In most cases, the outcome is destructive to only the local population and species, but it can have an impact on a global scale too.

Nearly 6 billion kilograms of garbage is dumped every year in the oceans. Apart from industrial effluents and untreated sewage, other forms of unwanted materials are dumped into various water bodies. These can range from nuclear waste to oil spills – the latter of which can render vast areas uninhabitable.

Effects Of Water Pollution

The effect of water pollution depends upon the type of pollutants and their concentration. Also, the location of water bodies is an important factor to determine the levels of pollution.

- Water bodies in the vicinity of urban areas are extremely polluted. This is the result of dumping garbage and toxic chemicals by industrial and commercial establishments.
- Water pollution drastically affects aquatic life. It affects their metabolism, and behaviour, and causes illness and eventual death. Dioxin is a chemical that causes a lot of problems from reproduction to uncontrolled cell growth or cancer. This chemical is bioaccumulated in fish, chicken and meat. Chemicals such as this travel up the food chain before entering the human body.
- The effect of water pollution can have a huge impact on the food chain. It disrupts the food chain. Cadmium and lead are some toxic substances, these pollutants upon entering the food chain through animals (fish when consumed by animals, humans) can continue to disrupt at higher levels.
- Humans are affected by pollution and can contract diseases such as hepatitis through faecal matter in water sources. Poor drinking water treatment and unfit water can always cause an outbreak of **infectious diseases** such as cholera, etc.
- The ecosystem can be critically affected, modified and destructured because of water pollution.

Control Measures of Water Pollution

- Water pollution, to a larger extent, can be controlled by a variety of methods. Rather than releasing sewage waste into water bodies, it is better to treat them before discharge. Practising this can reduce the initial toxicity and the remaining substances can be degraded and rendered harmless by the water body itself. If the secondary treatment of water has been carried out, then this can be reused in sanitary systems and agricultural fields.
- A very special plant, the Water Hyacinth can absorb dissolved toxic chemicals such as cadmium and other such elements. Establishing these in regions prone to such kinds of pollutants will reduce the adverse effects to a large extent.

- Some chemical methods that help in the control of water pollution are precipitation, the ion exchange process, **reverse osmosis**, and coagulation. As an individual, reusing, reducing, and recycling wherever possible will advance a long way in overcoming the effects of water pollution.

- **What is Soil Pollution?**

Soil pollution refers to the contamination of soil with anomalous concentrations of toxic substances.
It is a serious environmental concern since it harbours many health hazards. For example, exposure to soil containing high concentrations of benzene increases the risk of contracting leukaemia. An image detailing the discolouration of soil due to soil pollution is provided below.

It is important to understand that all soils contain compounds that are harmful/toxic to human beings and other living organisms. However, the concentration of such substances in unpolluted soil is low enough that they do not pose any threat to the surrounding ecosystem. When the concentration of one or more such toxic substances is high enough to cause damage to living organisms, the soil is said to be contaminated.

The root cause of soil pollution is often one of the following:

- Agriculture (excessive/improper use of pesticides)
- Excessive industrial activity
- Poor management or inefficient disposal of waste

The challenges faced in soil remediation (decontamination of soil) are closely related to the extent of soil pollution. The greater the contamination, the greater the requirement for resources for remediation.

What are the Pollutants that Contaminate Soil?

Some of the most hazardous soil pollutants are xenobiotics – substances that are not naturally found in nature and are synthesized by human beings. The term ‘xenobiotic’ has Greek roots – ‘Xenos’ (foreigner), and ‘Bios’ (life). Several xenobiotics are known to be carcinogens. An illustration detailing major soil pollutants is provided below.

The different types of pollutants that are found in contaminated soil are listed in this subsection.

Heavy Metals

The presence of heavy metals (such as lead and mercury, in abnormally high concentrations) in soils can cause it to become highly toxic to human beings. Some metals that can be classified as soil pollutants are tabulated below.

These metals can originate from several sources such as mining activities, agricultural activities, and electronic waste (e-waste), and medical waste.

Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons (often abbreviated to PAHs) are organic compounds that

1. Contain only carbon and hydrogen atoms.
2. Contain more than one aromatic ring in their chemical structures.

Common examples of PAHs include naphthalene, anthracene, and phenalene. Exposure to polycyclic aromatic hydrocarbons has been linked to several forms of cancer. These organic compounds can also cause cardiovascular diseases in humans.

Soil pollution due to PAHs can be sourced to coke (coal) processing, vehicle emissions, cigarette smoke, and the extraction of shale oil.

Industrial Waste

The discharge of industrial waste into soils can result in soil pollution. Some common soil pollutants that can be sourced from industrial waste are listed below.

- Chlorinated industrial solvents
- Dioxins are produced from the manufacture of pesticides and the incineration of waste.
- Plasticizers/dispersants
- Polychlorinated biphenyls (PCBs)

The petroleum industry creates many petroleum hydrocarbon waste products. Some of these wastes, such as benzene and methylbenzene, are known to be carcinogenic in nature.

Pesticides

Pesticides are substances (or mixtures of substances) that are used to kill or inhibit the growth of pests. Common types of pesticides used in agriculture include

- Herbicides – used to kill/control weeds and other unwanted plants.
- Insecticides – used to kill insects.
- Fungicides – used to kill parasitic fungi or inhibit their growth.

However, the unintentional diffusion of pesticides into the environment (commonly known as ‘pesticide drift’) poses a variety of environmental concerns such as water pollution and soil pollution. Some important soil contaminants found in pesticides are listed below.

Herbicides

- Triazines
- Carbamates
- Amides
- Phenoxyalkyl acids
- Aliphatic acids

Insecticides

- Organophosphates
- Chlorinated hydrocarbons
- Arsenic-containing compounds
- Pyrethrum

Fungicides

- Mercury-containing compounds
- Thiocarbamates
- Copper sulfate

These chemicals pose several health risks to humans. Examples of health hazards related to pesticides include diseases of the central nervous system, immune system diseases, cancer, and birth defects.

What are the Processes that Cause Soil Pollution?

Soil pollution can be broadly classified into two categories –

- Naturally caused soil pollution
- Anthropogenic soil pollution (caused by human activity)

Natural Pollution of Soil

In some extremely rare processes, some pollutants are naturally accumulated in soils. This can occur due to the differential deposition of soil by the atmosphere. Another manner in which this type of soil pollution can occur is via the transportation of soil pollutants with precipitation water.

An example of natural soil pollution is the accumulation of compounds containing the perchlorate anion (ClO_4^-) in some dry, arid ecosystems. It is important to note that some contaminants can be naturally produced in the soil under the effect of certain environmental conditions. For example, perchlorates can be formed in soils containing chlorine and certain metals during a thunderstorm.

Anthropogenic Soil Pollution

Almost all cases of soil pollution are anthropogenic in nature. A variety of human activities can lead to the contamination of soil. Some such processes are listed below.

- The demolition of old buildings can involve the contamination of nearby soil with asbestos.
- Usage of lead-based paint during construction activities can also pollute the soil with hazardous concentrations of lead.
- Spillage of petrol and diesel during transportation can contaminate soils with the hydrocarbons found in petroleum.
- Activities associated with metal casting factories (foundries) often cause the dispersion of metallic contaminants into the nearby soils.
- Underground mining activities can cause the contamination of land with heavy metals.

- Improper disposal of highly toxic industrial/chemical waste can severely pollute the soil. For example, the storage of toxic wastes in landfills can result in the seepage of the waste into the soil. This waste can go on to pollute groundwater as well.
- Chemical pesticides contain several hazardous substances. Excessive and inefficient use of chemical pesticides can result in severe soil pollution.
- Sewage produced in urbanized areas can also contaminate soil (if not disposed of correctly). These wastes may also contain several carcinogenic substances.

Other forms of waste that can pollute soil include nuclear waste, e-waste, and coal ash.

What are the Negative Consequences of Soil Pollution?

Soil pollution harbours a broad spectrum of negative consequences that affect plants, animals, humans, and the ecosystem as a whole. Since children are more susceptible to diseases, polluted soil poses a greater threat to them. Some important effects of soil pollution are detailed in this subsection.

Effects on Human Beings

Soil contaminants can exist in all three phases (solid, liquid, and gaseous). Therefore, these contaminants can find their way into the human body via several channels such as direct contact with the skin or through the inhalation of contaminated soil dust.

The short term effects of human exposure to polluted soil include

- Headaches, nausea, and vomiting.
- Coughing, pain in the chest, and wheezing.
- Irritation of the skin and the eyes.
- Fatigue and weakness.

A variety of long-term ailments have been linked to soil pollution. Some such diseases are listed below.

- Exposure to high levels of lead can result in permanent damage to the nervous system. Children are particularly vulnerable to lead.
- Depression of the CNS (Central Nervous System).
- Damage to vital organs such as the kidney and the liver.

- Higher risk of developing cancer.

It can be noted that many soil pollutants such as petroleum hydrocarbons and industrial solvents have been linked to congenital disorders in humans. Thus, soil pollution can have several negative effects on human health.

Effects on Plants and Animals

Since soil pollution is often accompanied by a decrease in the availability of nutrients, plant life ceases to thrive in such soils. Soils contaminated with inorganic aluminium can prove toxic to plants. Also, this type of pollution often increases the salinity of the soil, making it inhospitable for the growth of plant life.

Plants that are grown in polluted soil may accumulate high concentrations of soil pollutants through a process known as bioaccumulation. When these plants are consumed by herbivores, all the accumulated pollutants are passed up the food chain. This can result in the loss/extinction of many desirable animal species. Also, these pollutants can eventually make their way to the top of the food chain and manifest as diseases in human beings.

Effects on the Ecosystem

- Since the volatile contaminants in the soil can be carried away into the atmosphere by winds or can seep into underground water reserves, soil pollution can be a direct contributor to air and water pollution.
- It can also contribute to acid rain (by releasing huge quantities of ammonia into the atmosphere).
- Acidic soils are inhospitable to several microorganisms that improve soil texture and help in the decomposition of organic matter. Thus, the negative effects of soil pollution also impact soil quality and texture.
- Crop yield is greatly affected by this form of pollution. In China, over 12 million tons of grain (worth approximately 2.6 billion USD) is found to be unfit for human consumption due to contamination with heavy metals (as per studies conducted by the China Dialogue).

How can Soil Pollution be Controlled?

Several technologies have been developed to tackle soil remediation. Some important strategies followed for the decontamination of polluted soil are listed below.

- Excavation and subsequent transportation of polluted soils to remote, uninhabited locations.
- Extraction of pollutants via thermal remediation – the temperature is raised in order to force the contaminants into the vapour phase, after which they can be collected through vapour extraction.
- Bioremediation or phytoremediation involves the use of microorganisms and plants for the decontamination of soil.
- Mycoremediation involves the use of fungi for the accumulation of heavy metal contaminants.

Noise Pollution

We know that a sound is a form of energy. Sometimes the sound can be soothing to listen to and, at times, loud to hear. Sound can travel in the air and is produced by the vibration of objects. Regular exposure to a higher sound level that impacts humans and other living organisms is known as sound pollution. This article will help us understand what noise pollution is, the types of noise and pollution, and its causes and examples.

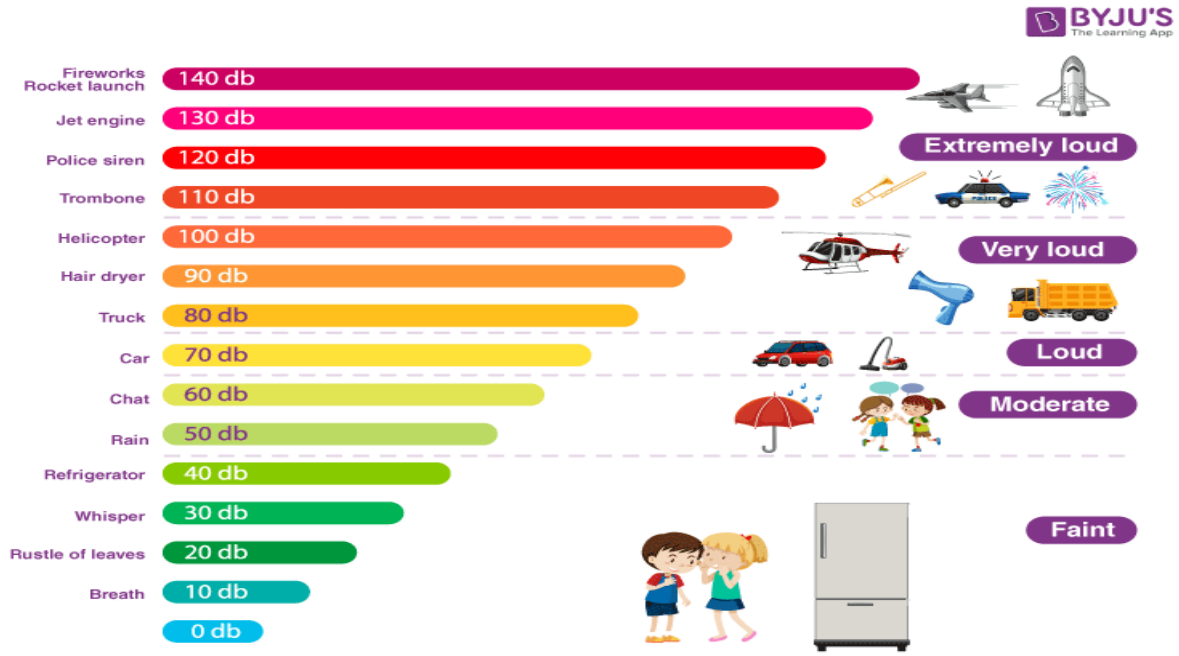
What is Noise Pollution?

The word noise is derived from the Latin word 'Nausea', which means sickness in which one feels the need to vomit. Noise is the unpleasant and undesirable sound which leads to discomfort in human beings. **The intensity of sound is measured in decibels (dB)**. The faintest sound that the human ear can hear is 1 Db. Due to increasing noise around the civilizations, noise pollution has become a matter of concern. Some of its major causes are vehicles, aircraft, industrial machines, loudspeakers, crackers, etc. When used at high volume, some other appliances also contribute to noise pollution, like television, transistor, radio, etc.

Types of Noise Pollution

Following are the three types of pollution:

- Transport Noise
- Neighbourhood Noise
- Industrial Noise



Transport Noise

It mainly consists of traffic noise which has increased in recent years with the increase in the number of vehicles. The increase in noise pollution leads to deafening of older people, headache, hypertension, etc.

Neighbourhood Noise

The noise from gadgets, household utensils etc. Some of the main sources are musical instruments, transistors, loudspeakers, etc.

Industrial Noise

It is the high-intensity sound which is caused by heavy industrial machines. According to many researches, industrial noise pollution damages the hearing ability to around 20%.

Causes and Sources of Noise Pollution

Following are the causes and sources of noise pollution:

- **Industrialisation:** Industrialisation has led to an increase in noise pollution as the use of heavy machinery such as generators, mills, huge exhaust fans are used, resulting in the production of unwanted noise.

- **Vehicles:** Increased number of vehicles on the roads are the second reason for noise pollution.
- **Events:** Weddings, public gatherings involve loudspeakers to play music resulting in the production of unwanted noise in the neighbourhood.
- **Construction sites:** Mining, construction of buildings, etc add to the noise pollution.

Noise Pollution Examples

Following are the examples of noise pollution:

- Unnecessary usage of horns
- Using loudspeakers either for religious functions or for political purposes
- Unnecessary usage of fireworks
- Industrial noise
- Construction noise
- Noise from transportation such as railway and aircraft

Effects of Noise Pollution on Human Health

Noise pollution can be hazardous to human health in the following ways:

- **Hypertension:** It is a direct result of noise pollution which is caused due to elevated blood levels for a longer duration.
- **Hearing loss:** Constant exposure of human ears to loud noise that are beyond the range of sound that human ears can withstand damages the eardrums, resulting in loss of hearing.
- **Sleeping disorders:** Lack of sleep might result in fatigue and low energy level throughout the day affecting everyday activities. Noise pollution hampers the sleep cycles leading to irritation and an uncomfortable state of mind.
- **Cardiovascular issues:** Heart-related problems such as blood pressure level, stress and cardiovascular diseases might come up in a normal person and a person suffering from any of these diseases might feel a sudden shoot up in the level.

Prevention of Noise Pollution

Some noise pollution preventive measures are provided in the points below.

- Honking in public places like teaching institutes, hospitals, etc. should be banned.
- In commercial, hospital, and industrial buildings, adequate soundproof systems should be installed.
- Musical instruments' sound should be controlled to desirable limits.
- Dense tree cover is useful in noise pollution prevention.
- Explosives should not be used in forest, mountainous and mining areas.

Sources and impact of pollution

The below explanation will be helpful in answering questions such as explain pollution and its types:

Air Pollution Causes

- Industrial Emissions: Combustion of fossil fuels in industries releases pollutants like particulate matter, sulfur dioxide (SO2), and nitrogen oxides (NOx).
- Vehicle Exhaust: Burning of gasoline and diesel fuels in automobiles produces pollutants such as carbon monoxide (CO) and nitrogen dioxide (NO2).
- Agricultural Practices: The use of fertilizers and pesticides can release harmful chemicals into the air.
- Burning of Solid Waste: Open burning of waste materials contributes to air pollution.

Read about Air-Pollution-Measurement.

Fig: Air Pollution

Water Pollution Causes

- Industrial Discharges: Factories often release untreated or inadequately treated wastewater into rivers and lakes.
- Agricultural Runoff: The use of fertilizers and pesticides in agriculture can lead to runoff, contaminating water bodies.
- Improper Waste Disposal: Dumping of solid waste and hazardous materials directly into water sources.
- Oil Spills: Accidental or deliberate discharge of oil into oceans and rivers.

Fig: Water Pollution

Soil Pollution Causes

- Industrial Activities: Improper disposal of industrial waste containing heavy metals and chemicals.
- Agricultural Practices: The use of pesticides, herbicides, and fertilizers can contaminate the soil.
- Landfills: Improperly managed landfills can release pollutants into the soil.
- Mining Operations: Extraction activities can introduce harmful substances into the soil.

Noise Pollution Causes

- Transportation: Traffic noise from vehicles, aircraft, and railways.
- Industrial Activities: Machinery and equipment used in industries.
- Urbanization: Construction activities and increased human activities in urban areas.
- Recreational Activities: Events with loud music, fireworks, and other noisy activities.

Read about Effects-of-noise,-pollution,-and-crowding.

Fig: Noise Pollution

Light Pollution Causes

- Artificial Lighting: Excessive or misdirected artificial light from streetlights, buildings, and outdoor advertising.
- Urbanization: Increased nighttime illumination in urban areas.
- Electronic Devices: Glare from electronic screens and displays.

Fig: Light Pollution

Thermal Pollution Causes

- Power Plants: Discharge of heated water from industrial processes and power generation.
- Industrial Activities: Heat released from manufacturing processes.

- Deforestation: Reduction of vegetation can lead to temperature changes in water bodies.

Fig: Thermal Pollution

Plastic Pollution Causes

- Improper Disposal: Discarding plastic waste in oceans, rivers, and landfills.
- Single-Use Plastics: Widespread use and improper disposal of items like plastic bags and bottles.
- Microplastics: Breakdown of larger plastic items into small particles.

Fig: Plastic Pollution

Radioactive Pollution Causes

- Nuclear Power Plants: Accidents, leaks, or improper disposal of radioactive waste.
- Nuclear Testing: Above-ground nuclear tests release radioactive substances into the atmosphere.

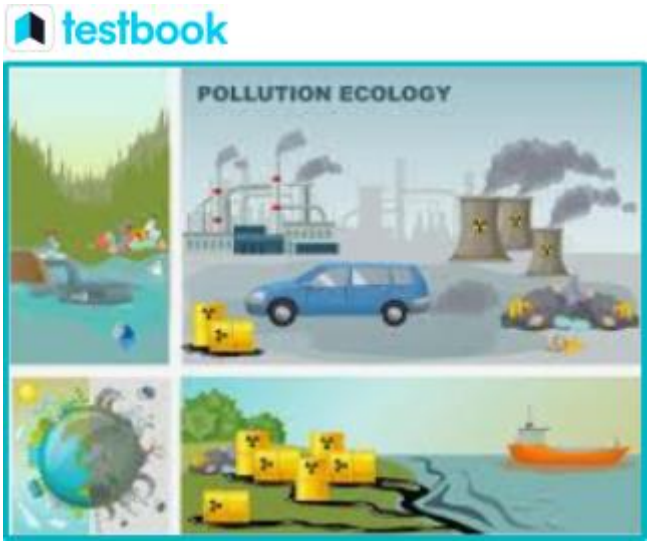


Fig: Radioactive Pollution

Environmental Pollution and Its Causes

Environmental pollution is the introduction of harmful contaminants into the environment, causing adverse effects on the ecosystem, human health, and well-being. The causes of environmental pollution are diverse and often result from human activities. Here are some common causes of environmental pollution:

- Industrial Activities:
  - Emissions: Factories and industrial facilities release pollutants into the air, water, and soil. Combustion processes, chemical production, and waste disposal contribute to air and water pollution. Many industrial wastes are disposed of in the nearby water bodies causing marine pollution.

Fig: Industrial Activities Causing Pollution

- Vehicle Emissions:
  - Air Pollution: Combustion of fossil fuels in vehicles releases pollutants like carbon monoxide, nitrogen oxides, particulate matter, and hydrocarbons, contributing to air pollution.
- Agricultural Practices:
  - Pesticides and Herbicides: The use of chemical pesticides and herbicides in agriculture can contaminate soil and water, affecting ecosystems and posing risks to human health.
  - Fertilizer Runoff: Excessive use of fertilizers leads to nutrient runoff into water bodies, causing eutrophication and harming aquatic ecosystems.
- Improper Waste Disposal:
  - Landfills: Improperly managed landfills can leach hazardous substances into the soil and groundwater, posing a threat to both the environment and human health.
  - Plastic Waste: Improper disposal and inadequate recycling of plastic waste contribute to pollution in oceans, rivers, and terrestrial environments.
- Deforestation:
  - Loss of Vegetation: Deforestation reduces the natural capacity of ecosystems to absorb pollutants, leading to soil erosion, degraded air quality, and disruption of local climate patterns.
- Mining Activities:
  - Water Contamination: Mining operations can release toxic substances into water bodies, causing water pollution. Tailings and runoff from mines may contain heavy metals and other harmful chemicals.

Fig: Mining Activities

- Oil Spills:
  - Marine Pollution: Accidental or intentional spills of oil from ships and offshore drilling operations can have severe impacts on marine ecosystems, causing harm to aquatic life and coastal environments.
- Airborne Pollutants:
  - Smoke and Particulate Matter: Burning of fossil fuels, wildfires, and certain industrial processes release airborne pollutants, contributing to air pollution and respiratory problems in humans.
- Nuclear Accidents and Radiation:
  - Radioactive Contamination: Accidents at nuclear power plants or improper disposal of radioactive waste can result in the release of harmful radioactive substances, leading to environmental contamination.
- Urbanization and Infrastructure Development:
  - Habitat Fragmentation: Urban expansion can lead to habitat loss and fragmentation, disrupting ecosystems and contributing to pollution through increased runoff and altered land use patterns.

Mitigation and Control Measures

Due to the increased human activities and pressure on natural resources becoming worse day by day, necessary precautions have to be taken to reduce it. If the same goes in a continual process at this rate, life on earth would become unsustainable. Many scientists and environmentalists are working to implement certain strategies to control environmental pollution. Due to some reasons, it is not happening. They made some plans on how to control environmental pollution, but eventually, the implementation had vanished. In contrast to the solid waste that we see in our household garbage bins, there

are also industrial, medical, mining, and agricultural wastes. The environment has mostly been polluted by improper disposal of waste. Therefore, it is needed to keep an eye over waste disposal regularly. When we look upon the effects of soil, air, and water pollution, the need to reduce environmental pollution comes into the picture. The required measures should be taken on an individual basis to reduce environmental pollution in the neighborhood as well, which should lead to a cleaner environment. Pollution occurs primarily because of the discharge of wastes and inefficient disposal. We should have a certain waste management strategy that should perform properly from its inception until the final disposal.

Waste Management

Every day, across thousands of cities in India, large quantities of waste materials are generated. Waste materials can be of many types, like domestic waste, chemical waste, and medical waste. Out of all this, domestic waste is one of the largest contributors to pollution in our cities as domestic waste is produced from every house, and hence, there should be a proper system to check the collection of domestic waste along with its proper treatment and disposal. All this comes under Waste Management.To ensure proper collection of wastes, Municipal Organizations of the various cities in India should take a cue and ensure that there is proper infrastructure in place by which the collection of garbage from homes can be done. Also, this waste needs to be classified as plastic and non-plastic waste because the disposal of waste becomes much easier. To ensure proper disposal of waste, governments need to come up with innovative techniques as just throwing the garbage in open sinks leads to a host of environmental concerns. The disposal methods of plastic and non-plastic waste need very different technologies.

Collection of Wastes

The domestic waste generated should be collected into the bins and transferred to the municipal workers who take them to disposable sites. And there, the waste is sorted out and separated as biodegradable and non-biodegradable. The plastic wastes, non-biodegradable, such as bottles, plastic bags, and more, are sent for recycling. On the other side, the biodegradable wastes are deposited on the land and converted as compost. If the waste is not collected properly for disposal, then it will be on its way into the sewers. And some amounts are eaten by the cattle - non-biodegradable wastes, including

plastic bags and metal scrap, choke the sewers and cause incontinence. The cattle swallow these polythene bags and choke their throat. It becomes difficult for them to breathe and may lead to death.

Disposal of Wastes

All of us should follow the practice of collecting waste and disposing of it properly. If certain waste management techniques are not implemented, then it may result in epidemics due to groundwater contamination leading to Water Pollution. It is especially hazardous to the people who work with the wastes. For example, the rag pickers and a few workers who were involved in waste disposal. They are largely affected because they don't follow any protective measures like wearing gloves and masks while handling the wastes. Improper disposal may also allow poisonous gases to escape into the atmosphere and cause Air Pollution. In addition, the vehicles and the industries pumping hazardous gases, either directly or indirectly, affect humans' lives and contribute to Air Pollution.As responsible citizens, we should participate in proper waste disposal management and cooperate with the government. Throwing wastes at inappropriate locations should be strictly avoided. Efforts are taken to reduce vehicular emissions by encouraging the use of public transport, carpooling, and finding greener alternatives to the existing fuel. Encouraging the use of renewable sources of energy will go a long way in making our planet safer and healthier to live in.

Strategies to Reduce Waste

1. Use a reusable bottle/cup for beverages on-the-go

You might already have a reusable water bottle, but do you use it all the time? You can put that reusable bottle to use, save money and reduce waste. By taking your own water with you, you'll also reduce your chances of purchasing more expensive beverages on-the-go. This will eliminate the one-time use containers they come in. While most cans and bottles can be recycled, they require a lot of energy to be produced, shipped to the bottling facility and then to the store for purchase.

2. Use reusable grocery bags, and not just for groceries

Just like a reusable water bottle, you may already have a reusable grocery bag, though it's often forgotten at home. Try writing BAGS on the top of your grocery list to help you remember, or keep them in the back seat where they

aren't as easy to forget. Many grocery stores will provide a 5 cent per bag refund so you'll save a few cents while reducing your usage of one-time-use plastic bags.

3. Purchase wisely and recycle

You can reduce the amount of waste you produce by purchasing products that come with less packaging and/or come in packaging that can be recycled. Not all plastics are recyclable in Delaware, so check labels before your buy. According to Delaware's Division of Waste and Hazardous Substances, "Containers labeled with a 1 or a 2 are almost always accepted because they are the highest value resins. Resins 4, 5 and 7 are now accepted in most programs in Delaware." Plastics labeled with a 3/PVC and 6/PS are generally not recyclable in Delaware. Learn more about recycling programs in your area for specifics.

4. Compost it!

Did you know as much as 25% of the items in your trash could potentially be removed from the waste stream and composted in your back yard? Your fruit and vegetable scraps, egg shells, coffee grounds, grass clippings and leaves can all be composted. While composting requires more effort than the previously mentioned lifestyle changes, it will provide you with a beneficial return on your investment of time and effort. Depending on the conditions, you may have compost in 3 to 12 months to use in your garden. You'll save on fertilizers and if you grow your own vegetables, you'll likely see improved yields. The organic matter will also act as a sponge to absorb more water, meaning you might not need to water your plants as much, saving you money and time.

5. Avoid single-use food and drink containers and utensils

Whenever possible, try to avoid single-use coffee cups, disposable utensils, straws and napkins. Some businesses will even give you a discount on your coffee for bringing your own mug. Keep a set of silverware at work along with a plate, bowl and cup that you can wash and reuse. Skip the plastic straw altogether or buy reusable metal ones instead. Remember, a lot of these items are made from plastic, had to be delivered by a truck and will end up in a landfill once we have used them one time. Anything we can do to reduce our use of these products adds up to make a big impact.

6. Buy secondhand items and donate used goods

Before you go buy something new, consider buying it used which can also save you lots of money. That can mean buying secondhand clothes at Goodwill, used furniture and repurposed construction materials at Habitat for Humanity's ReStore or searching Craigslist for a deal on a bicycle. By purchasing secondhand items you'll be supporting local charities in addition to saving items from ending up in the dump.

7. Shop local farmers markets and buy in bulk to reduce packaging

Shopping at your local farmers market is a win-win. First, you'll be supporting local farmers while also getting fresher ingredients than you might find in the big-box grocery store. Food produced locally doesn't have to be shipped as far or refrigerated in transit. Local farmers often rely on less packaging and many are happy to have you return last week's berry basket or egg carton for use next week. You can also majorly reduce packaging waste by shopping at stores that sell food in bulk, but you'll need to come prepared with your own containers.

8**. Curb your use of paper: mail, receipts, magazines**

In today's digital world, most companies offer bills by email, and some even offer incentives to do so. More stores are offering e-receipts, too, which are great because they're harder to lose if you need to make a return. Consider digital subscriptions for your favourite magazines that you can read on your tablet or computer. Digital subscriptions are often a little cheaper than the hard-copy version, as well.

Greenhouse effect and its implications

Greenhouse Effect Definition

"Greenhouse effect is the process by which radiations from the sun are absorbed by the greenhouse gases and not reflected back into space. This insulates the surface of the earth and prevents it from freezing."

What is the Greenhouse Effect?

A greenhouse is a house made of glass that can be used to grow plants. The sun's radiations warm the plants and the air inside the greenhouse. The heat trapped inside can't escape out and warms the greenhouse which is essential for the growth of the plants. Same is the case in the earth's atmosphere.

During the day the sun heats up the earth's atmosphere. At night, when the earth cools down the heat is radiated back into the atmosphere. During this

process, the heat is absorbed by the greenhouse gases in the earth's atmosphere. This is what makes the surface of the earth warmer, that makes the survival of living beings on earth possible.

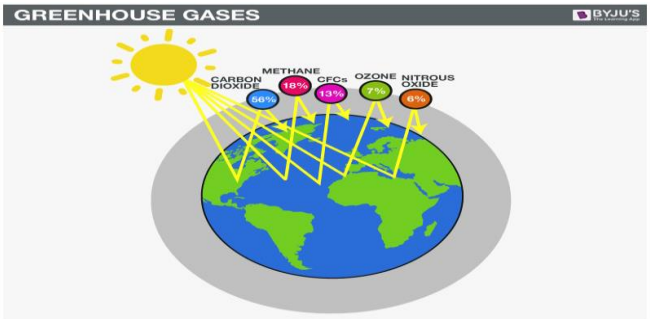
However, due to the increased levels of greenhouse gases, the temperature of the earth has increased considerably. This has led to several drastic effects.

Let us have a look at the greenhouse gases and understand the causes and consequences of greenhouse effects with the help of a diagram.

Greenhouse Gases

"Greenhouse gases are the gases that absorb the infrared radiations and create a greenhouse effect. For eg., carbondioxide and chlorofluorocarbons."

Greenhouse Effect Diagram



The Diagram shows Greenhouse Gases such as carbon dioxide are the primary cause of the Greenhouse Effect

The major contributors to greenhouse gases are factories, automobiles, deforestation, etc. The increased number of factories and automobiles increases the amount of these gases in the atmosphere. The greenhouse gases never let the radiation escape from the earth and increase the surface temperature of the earth. This then leads to global warming.

Causes of Greenhouse Effect

The major causes of the greenhouse effect are:

Burning of Fossil Fuels

Fossil fuels are an important part of our lives. They are widely used in transportation and to produce electricity. Burning of fossil fuels releases carbon dioxide. With the increase in population, the utilization of fossil fuels has increased. This has led to an increase in the release of greenhouse gases in the atmosphere.

Deforestation

Plants and trees take in carbon dioxide and release oxygen. Due to the cutting of trees, there is a considerable increase in the greenhouse gases which increases the earth's temperature.

Farming

Nitrous oxide used in fertilizers is one of the contributors to the greenhouse effect in the atmosphere.

Industrial Waste and Landfills

The industries and factories produce harmful gases which are released in the atmosphere. Landfills also release carbon dioxide and methane that adds to the greenhouse gases.

Effects of Greenhouse Effect

The main effects of increased greenhouse gases are:

Global Warming

It is the phenomenon of a gradual increase in the average temperature of the Earth's atmosphere. The main cause for this environmental issue is the increased volumes of greenhouse gases such as carbon dioxide and methane released by the burning of fossil fuels, emissions from the vehicles, industries and other human activities.

Depletion of Ozone Layer

Ozone Layer protects the earth from harmful ultraviolet rays from the sun. It is found in the upper regions of the stratosphere. The depletion of the ozone layer results in the entry of the harmful UV rays to the earth's surface that might lead to skin cancer and can also change the climate drastically.

The major cause of this phenomenon is the accumulation of natural greenhouse gases including chlorofluorocarbons, carbon dioxide, methane, etc.

Smog and Air Pollution

Smog is formed by the combination of smoke and fog. It can be caused both by natural means and man-made activities.

In general, smog is generally formed by the accumulation of more greenhouse gases including nitrogen and sulfur oxides. The major contributors to the formation of smog are automobile and industrial

emissions, agricultural fires, natural forest fires and the reaction of these chemicals among themselves.

Acidification of Water Bodies

Increase in the total amount of greenhouse gases in the air has turned most of the world's water bodies acidic. The greenhouse gases mix with the rainwater and fall as acid rain. This leads to the acidification of water bodies.

Also, the rainwater carries the contaminants along with it and falls into the river, streams and lakes thereby causing their acidification.

Runaway Greenhouse Effect

This phenomenon occurs when the planet absorbs more radiation than it can radiate back. Thus, the heat lost from the earth's surface is less and the temperature of the planet keeps rising. Scientists believe that this phenomenon took place on the surface of Venus billions of years ago.

This phenomenon is believed to have occurred in the following manner:

- A runaway greenhouse effect arises when the temperature of a planet rises to a level of the boiling point of water. As a result, all the water from the oceans converts into water vapour, which traps more heat coming from the sun and further increases the planet's temperature. This eventually accelerates the greenhouse effect. This is also called the "positive feedback loop".
- There is another scenario giving way to the runaway greenhouse effect. Suppose the temperature rise due to the above causes reaches such a high level that the chemical reactions begin to occur. These chemical reactions drive carbon dioxide from the rocks into the atmosphere. This would heat the surface of the planet which would further accelerate the transfer of carbon dioxide from the rocks to the atmosphere, giving rise to the runaway greenhouse effect.

In simple words, increasing the greenhouse effect gives rise to a runaway greenhouse effect which would increase the temperature of the earth to such an extent that no life will exist shortly.

Causes and consequences of climate change

Global warming is the phenomenon of a gradual increase in the temperature near the earth's surface. This phenomenon has been observed over the past

one or two centuries. This change has disturbed the climatic pattern of the earth. However, the concept of global warming is quite controversial but the scientists have provided relevant data in support of the fact that the temperature of the earth is rising constantly.

There are several causes of global warming, which have a negative effect on humans, plants and animals. These causes may be natural or might be the outcome of human activities. In order to curb the issues, it is very important to understand the negative impacts of global warming.

Let us have a detailed study of global warming, its causes and its effects.

Causes of Global Warming

Following are the major causes of global warming:

Man-made Causes of Global Warming

Deforestation

Plants are the main source of oxygen. They take in carbon dioxide and release oxygen thereby maintaining environmental balance. Forests are being depleted for many domestic and commercial purposes. This has led to an environmental imbalance, thereby giving rise to global warming.

Use of Vehicles

The use of vehicles, even for a very short distance results in various gaseous emissions. Vehicles burn fossil fuels which emit a large amount of carbon dioxide and other toxins into the atmosphere resulting in a temperature increase.

Chlorofluorocarbon

With the excessive use of air conditioners and refrigerators, humans have been adding CFCs into the environment which affects the atmospheric ozone layer. The ozone layer protects the earth surface from the harmful ultraviolet rays emitted by the sun. The CFCs have led to ozone layer depletion making way for the ultraviolet rays, thereby increasing the temperature of the earth.

Industrial Development

With the advent of industrialization, the temperature of the earth has been increasing rapidly. The harmful emissions from the factories add to the increasing temperature of the earth.

In 2013, the Intergovernmental Panel for Climate Change reported that the increase in the global temperature between 1880 and 2012 has been 0.9 degrees Celsius. The increase is 1.1 degrees Celsius when compared to the pre-industrial mean temperature.

Agriculture

Various farming activities produce carbon dioxide and methane gas. These add to the greenhouse gases in the atmosphere and increase the temperature of the earth.

Overpopulation

An increase in population means more people breathing. This leads to an increase in the level of carbon dioxide, the primary gas causing global warming, in the atmosphere.

Natural Causes of Global Warming

Volcanoes

Volcanoes are one of the largest natural contributors to global warming. The ash and smoke emitted during volcanic eruptions goes out into the atmosphere and affects the climate.

Water Vapour

Water vapour is a kind of greenhouse gas. Due to the increase in the earth's temperature, more water gets evaporated from the water bodies and stays in the atmosphere adding to global warming.

Melting Permafrost

Permafrost is frozen soil that has environmental gases trapped in it for several years and is present below Earth's surface. It is present in glaciers. As the permafrost melts, it releases the gases back into the atmosphere, increasing Earth's temperature.

Forest Blazes

Forest blazes or forest fires emit a large amount of carbon-containing smoke. These gases are released into the atmosphere and increase the earth's temperature resulting in global warming.

Effects of Global Warming

Following are the major effects of global warming:

Rise in Temperature

Global warming has led to an incredible increase in earth's temperature. Since 1880, the earth's temperature has increased by ~1 degrees. This has resulted in an increase in the melting of glaciers, which have led to an increase in the sea level. This could have devastating effects on coastal regions.

Threats to the Ecosystem

Global warming has affected the coral reefs that can lead to the loss of plant and animal lives. Increase in global temperatures has made the fragility of coral reefs even worse.

Climate Change

Global warming has led to a change in climatic conditions. There are droughts at some places and floods at some. This climatic imbalance is the result of global warming.

Spread of Diseases

Global warming leads to a change in the patterns of heat and humidity. This has led to the movement of mosquitoes that carry and spread diseases.

High Mortality Rates

Due to an increase in floods, tsunamis and other natural calamities, the average death toll usually increases. Also, such events can bring about the spread of diseases that can hamper human life.

Loss of Natural Habitat

A global shift in the climate leads to the loss of habitats of several plants and animals. In this case, the animals need to migrate from their natural habitat and many of them even become extinct. This is yet another major impact of global warming on biodiversity.

- ***Sustainable practices to combat global warming***

The Sustainable Development Goals spell out how we can protect our environment and slow climate change, from forests to oceans to everywhere in between. Think about your electricity use and your travel. Check your dinner table. Reuse whatever you can. The possibilities for action are many – and add up fast.

Greenhouse gas emissions per person vary greatly among countries. In the United States of America, per capita emissions are more than double the world average of 6.5 tons of CO2 equivalent, while in India they are less than half the world average. Globally, the 10 per cent of the population with the highest income account for nearly half of all emissions. **Here are some actions to reduce your impact on the environment**.

Change your home's source of energy

Ask your utility company if your home energy comes from oil, coal or gas. If possible, see if you can switch to renewable sources such as wind or solar. Or install solar panels on your roof to generate energy for your home. Switching your home from oil, gas or coal-powered energy to renewable sources of energy, such as wind or solar, can reduce your carbon footprint by up to 1.5 tons of CO2e per year. Learn more about why switching to renewable energy is key to tackling the climate crisis.

Walk, bike or take public transport

The world's roadways are clogged with vehicles, most of them burning diesel or gasoline. Walking or riding a bike instead of driving will reduce greenhouse gas emissions -- and help your health and fitness. For longer distances, consider taking a train or bus. And carpool whenever possible. Living car-free can reduce your carbon footprint by up to 2 tons of CO2e per year compared to a lifestyle using a car. Learn more about how to green your travel.

Switch to an electric vehicle

If you plan to buy a car, consider going electric, with more and cheaper models coming on the market. In many countries, electric cars help reduce air pollution and cause significantly fewer greenhouse gas emissions than gas or diesel-powered vehicles. But many electric cars still run on electricity produced from fossil fuels, and the batteries and engines require rare minerals which often come with high environmental and social costs. Switching from a gasoline or diesel-powered car to an electric vehicle can reduce your carbon footprint by up to 2 tons of CO2e per year. A hybrid vehicle can save you up to 700 kilograms of CO2e per year.

Consider your travel

Airplanes burn large amounts of fossil fuels, producing significant greenhouse gas emissions. That makes taking fewer flights one of the fastest ways to reduce your environmental impact. When you can, meet virtually,

take a train, or skip that long-distance trip altogether. Taking one less long-haul return flight can reduce your carbon footprint by up to almost 2 tons of CO2e. Learn more about how to green your travel.

Reduce, reuse, repair and recycle

Electronics, clothes, plastics and other items we buy cause carbon emissions at each point in production, from the extraction of raw materials to manufacturing and transporting goods to market. To protect the climate, buy fewer things, shop second-hand, and repair what you can. Plastics alone generated 1.8 billion metric tonnes of greenhouse gas emissions in 2019 – 3.4 per cent of the global total. Less than 10 per cent is recycled, and once plastic is discarded, it can linger for hundreds of years. Buying fewer new clothes – and other consumer goods – can also reduce your carbon footprint. Every kilogram of textiles produced generates about 17 kilograms of CO2e.

Eat more vegetables

Eating more vegetables, fruits, whole grains, legumes, nuts, and seeds, and less meat and dairy, can significantly lower your environmental impact. Producing plant-based foods generally results in fewer greenhouse gas emissions and requires less energy, land, and water. Shifting from a mixed to a vegetarian diet can reduce your carbon footprint by up to 500 kilograms of CO2e per year (or up to 900 kilograms for a vegan diet). Learn more about the connections between food and climate change.

Throw away less food

When you throw food away, you're also wasting the resources and energy that were used to grow, produce, package, and transport it. And when food rots in a landfill, it produces methane, a powerful greenhouse gas. So purchase only what you need, use what you buy and compost any leftovers. Cutting your food waste can reduce your carbon footprint by up to 300 kilograms of CO2e per year.

Plant native species

If you have a garden or even just a plant or two outside your home, check for native species. Use a plant identification app to help. And then think about replacing non-natives, especially any considered invasive. Plants, animals and insects depend on each other. Most insects will not eat non-native plants, which means birds and other species lose a food source. Biodiversity suffers. Even a single tree or shrub can offer a refuge – just remember to skip insecticides and other chemicals.

Clean up your environment

Humans, animals, and plants all suffer from land and water contaminated by improperly discarded garbage. Use what you need, and when you have to throw something out, dispose of it properly. Educate others to do the same, and participate in local clean-ups of parks, rivers, beaches and beyond. Every year, people throw out 2 billion tons of trash. About a third causes environment harms, from choking water supplies to poisoning soil.

Make your money count

Everything we spend money on affects the planet. You have the power to choose which goods and services you support. To reduce your environmental impact, choose products from companies who use resources responsibly and are committed to cutting their gas emissions and waste. If you have money that is being invested for you, through a pension fund for instance, it may be supporting fossil fuels or deforestation. Making sure your savings are invested in environmentally sustainable businesses can greatly reduce your carbon footprint.

Speak up

Speak up and get others to join in taking action. It's one of the quickest and most effective ways to make a difference. Talk to your neighbors, colleagues, friends, and family. Let business owners know you support bold changes – from plastics-free products and packaging to zero-emissions vehicles. Appeal to local and world leaders to act now. Climate action is a task for all of us. And it concerns all of us. No one can do it all alone – but we can do it together.