

# UNIT 9

## AIR POLLUTION

### Structure

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### 9.1 INTRODUCTION

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In the previous Unit, you have studied about the pollution and its types such as air pollution, water pollution, soil pollution, and noise pollution in general. Now in this Unit, we will explain you about air pollution in particular. We have explained the sources and types of air pollutants in Section 9.2. The industries are mainly responsible for adding a large amount of pollutants in the atmosphere. For the public health perspective and otherwise also, we essentially need to maintain the air quality. For which, the standards of air pollution suggested by the various organizations are discussed in Section 9.3. Air pollutants may cause severe or deadly health risks not only to the human beings but also animals and other forms of life. Section 9.4 gives you an idea with regard to the adverse effects of air pollution. There are some management issues related to air pollution which are explained in Section 9.5.

### Expected Learning Outcomes

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After completing the study of this unit, you should be able to:

- ❖ describe the sources and types of air pollutants;
- ❖ explain the standards of air pollution;
- ❖ elucidate effects of air pollution; and
- ❖ explain management strategies in controlling air pollution.

## 9.2 SOURCES AND TYPES OF AIR POLLUTANTS

You just recap about the air pollution which is briefly explained in the previous unit. **Air pollution** may be defined as “*the presence of one or more contaminants like dust, smoke, mist and odour in the atmosphere which are injurious to human beings, plants and animals*”. **Pollutants** harm the natural environment either by increasing the levels of contaminants or by introducing harmful toxic substances. Physical and chemical properties of pollutants are different in nature, explaining the discrepancy in their capacity for producing toxic effects. Central Pollution Control Board (CPCB) of India defined **air pollution** as “*the existence of more than one contaminant in the atmosphere, in such concentration, for such a period as it is harmful or tends to be harmful, to human beings, animals and plants life*”.

The pollutant air comes from both the natural and human-made sources. Rapid industrialization, haphazard growth of population, drastic increase of vehicles on the roads and other activities of human beings as well as natural processes like forest fire or volcanic eruption, etc. have been contributing pollutants in the air and are severely disturbing the balance of natural atmosphere. An air pollutant is a substance in the air that can cause harm to humans and the environment. Pollutants can be in the form of solid particles, liquid droplets, or gases. In addition, they may be natural or man-made.

### 9.2.1 Sources of Air Pollutants

**Pollutants** are released from both stationary sources and non-stationary sources. Stationary sources include commercial and industrial facilities, for example, thermal power plants, chemical plants, paper factories and the municipal waste areas whereas non-stationary or mobile sources comprise of ships, aero planes and automobiles. Air can be polluted through natural processes or by human-made activities. Some of the known natural sources of air pollution are:

- Volcanic eruptions
- Forest fires
- Biological decay
- Radioactive materials
- Pollen grains, etc.

You must understand that the natural factors plays a significant role in generating air pollution and some of them are not under human control. Smoke from burning forests and grasses, and also dust storms from desert areas work as pollutants and make the air pollution. Source may be of from a particular country but the effect of the pollution may be felt at global level or everywhere. Volcanic eruption is one of the natural sources of air pollution. The huge amount of volcanic ash and toxic materials from the active volcanoes mix into the atmosphere resulting into the deterioration of quality of air.

Human activities also called anthropogenic activities like burning of fossil fuel, burning of firewood and cow dung, manufacturing industries, mining and construction as well as blasting for construction materials etc. generate a lot

of pollutants like carbon monoxide, carbon dioxide, oxides of nitrogen, oxides of sulphur, hydrocarbons, ozone, dust particles and other particulate matters. On the other side, using generators or air conditioners (ACs), burning of wastes, dust from roadside and construction, vehicular movement also generates air pollutants in large amounts.

Following are some of the important sources which generate air pollutants:

- Industries
- Fossil Fuel
- Mining
- Power plants
- Automobiles
- Agro-chemicals

You will understand by studying these sources one by one.

#### **a) Pollutants from Industries**

The industrial units dealing with manufacture of explosives using concentrated nitric and sulphuric acids release thousands of tons of oxides of nitrogen and sulphur into the atmosphere. Industries also release thousands of tons of carbon dioxide into the atmosphere. Caustic soda manufacturing units are responsible for release of chlorine into the atmosphere. Various metallurgical processes are responsible for introducing carbon monoxide, carbon dioxide, hydrogen sulphide and metal particulate into the nature. Polymers and plastics, asbestos, and tobacco are some of the important industries with highly specialized products contributing to the air pollution.

#### **b) Pollutants from Fossil Fuel**

Fossil fuels include crude oil, coal, petroleum, natural gas, etc., occurring naturally in underground reservoirs as they formed from the fossilized, buried remains of plants and animals over the course of millions of years. Fossil fuels generally have rich carbon content. Crude oil can also be found embedded in shale and tar sands. Petrol, diesel, kerosene, gasoline, liquefied petroleum gas, and other non-fuel products such as pesticides, fertilizers, pharmaceuticals, plastics, etc. are produced through the processing of crude oil which is done in oil refineries. Oil particularly petroleum is recognized as a major source of greenhouse gas emissions. Coal is primarily used to generate electricity and the combustion of coal releases air pollutants like sulphur dioxide, nitrogen oxides and mercury. Natural gas burns cleaner than oil and coal, releases with less carbon dioxide but high methane which is however, more than 20 times as effective as carbon dioxide.

Pollution caused by these petrochemical industries at different stages, are as follows:

- ❖ During drilling some of the low boiling fractions escape into the atmosphere and spill on the land. In case of drilling from below the surface of oceans, crude oil may be spilled on the surface of water and may be swept by the ocean currents to distant places.
- ❖ During transportation of crude oil, there is spilling or leakage particularly occurring in oceans by the tankers.

- ❖ During fractional distillation in the refineries, a number of fractions find their way into the atmosphere due to leaks or poor recovery that can lead to serious health problems.

**c) Pollutants from Mining**

Mining is the process used to extract minerals from the Earth's surface. Processes associated with mining such as blasting, digging, loading and unloading including transportation contribute a lot of dust which pollute the air. The vegetation and top-soil gets destructed by the mining process ultimately causing severe environmental damage. You might observed in several mining places the contamination of surface waters, rivers and streams, and ground waters by mine wastes due to mining activities. Coal, mica and other mining ore industries contribute a lot of mining dust to the air causing severe air pollution.

**d) Pollutants from Power Plants**

Power plants are used for generating power or electricity. In most of the conventional power plants, the source of energy is coal. Burning of coal in the power plants contribute carbon dioxide, carbon monoxide and sulphur dioxide as pollutants to the atmosphere. With the advancement of knowledge, nuclear energy is now being used to produce electricity at a much cheaper rate. However, the maintenance and management is crucial in the establishment and generation of nuclear power plants.

**e) Pollutants from Automobiles**

Automobiles mostly run on petrol or diesel. The exhaust gases from automobiles inject a number of gaseous pollutants like carbon monoxide and carbon dioxide, etc. In fact, automobiles are major contributors of atmospheric pollutants.

**f) Pollutants from Agrochemicals**

The agrochemicals include variety of fertilizers and pesticides, insecticides and fungicides, etc. that causes severe air pollution. The consequences of an increased use of agricultural chemicals are noted either witnessed in short-term or long-term health effects including symptoms like headaches, skin rashes, eye irritations and some chronic effects e.g. cancer, endocrine disruption, birth defects, etc.

## **9.2.2 Types of Air Pollutants**

You now know the various sources of air pollutants. Now, you will study the toxic elements also called air pollutants which are of different types that affect the air quality.

The pollutants are classified into three types:

1. Natural Pollutants
2. Primary Pollutants
3. Secondary Pollutants

### **1. Natural Pollutants**

The pollutants that find their way into the atmosphere as a result of natural phenomena are referred to as **natural pollutants**. Some of the natural

pollutants including smoke from forest fires, dispersal of pollen from plants, dust particles from soils and volcanic eruptions, volatile organic compounds discharged from leaves and trees, organic matter from decomposition or putrefaction process, and nuclear residue from natural radioactivity. The natural pollutants have been known to cause atmospheric pollution since very early time; it is perhaps as old as the Earth itself. You may be aware of the process of nature which deals with such pollutants in its own way. These natural pollutants are believed to be less harmful to the environment.

## 2. Primary Pollutants

A **primary pollutant** is a pollutant that enters directly into the atmosphere as a result of natural and other activities. For example, sulphur and nitrogen compounds, carbon monoxide and carbon dioxide, volatile organic compounds and particulate matter, etc. Major primary pollutants produced by human activity includes:

### a) Sulphur oxides (SO<sub>x</sub>)

Sulphur dioxide is produced by volcanoes, bogs, swamps, springs naturally and also through various industrial processes. It is passed into the atmosphere when coal and oil burns. Flue-gas desulfurization (FGD) plants, furnace oil of coal power plant, paper mills, iron and steel industries, petroleum refineries, sewage treatment plants, vehicles engines, crackers smoke are some of the important sources of sulphur compounds.

Acid rains are another form of major pollution threat that is caused by sulphur dioxide and nitrogen oxides released into the air in high concentrations. Acid rain occurs when these substances mix and react with water, oxygen and other chemicals in the atmosphere forming more acidic pollutants and fall down as rain.

### b) Nitrogen oxides (NO<sub>x</sub>)

Especially, the nitrogen oxide is emitted from high temperature combustion. Nitrogen dioxide is responsible for photochemical smog, acid rain etc. Urea is one of the main source of nitrogen in fertilizers. Source of nitrogen compounds are jet engines, fertilizers using Ammonia, fossil fuel combustion, livestock, poultry farm waste, vegetation, biomass burning and energy production, etc.

### c) Carbon monoxide (CO)

It is a colourless, odourless, non-irritating but very poisonous gas. It is a product by incomplete combustion of fuel such as natural gas, coal or wood. Vehicular exhaust from cars, trucks and other vehicles is a major source of carbon monoxide. Kerosene and gas stoves, gas heaters, chimney and furnaces or boilers, generators, water heaters, and so on releases a significant amount of carbon monoxide.

### d) Carbon dioxide (CO<sub>2</sub>)

It is a greenhouse gas and pollutant which is emitted from combustion. But, it is also vital for living organisms. It is a natural gas in the atmosphere. Other sources are cement manufacturing industries, deforestation, coal, oil and natural gas burning, etc.



**e) Volatile Organic Compounds (VOC)**

VOCs include methane ( $\text{CH}_4$ ) and non-methane volatile organic compounds (NMVOCs). Methane is an extremely efficient greenhouse gas which contributes to enhance global warming. Other hydrocarbons and VOCs are also significant greenhouse gases which play a key role in creating ozone hole and in prolonging the life of methane in the atmosphere.

**f) Particulate Matter (PM)**

Particulate matter or fine particles are tiny particles of solid or liquid suspended in a gas or air. In contrast, aerosol refers to particles and the gas together. Some particulates occur naturally, originating from volcanoes, dust storms, forest and grassland fires, etc. The burning of fossil fuels in vehicles, power plants and various industrial processes contribute a large amount of aerosols in the atmosphere by human activities.

**g) Toxic metals**

Toxic metals such as lead, cadmium, iron, zinc, and copper in the environment also act as pollutants.

**h) Chlorofluorocarbons (CFCs)**

These are the pollutants that causes the depletion of ozone layer. This in turn helps in allowing more shortwave length energy coming from the Sun to enter into the atmosphere causing global warming.

**3. Secondary Pollutants**

A secondary pollutant is the one that is formed by the further reaction of primary air pollutants. For example, sulphur dioxide reacts with oxygen in the atmosphere to form sulphur trioxide, which can further react with water. Major secondary pollutants includes smog and ground level ozone. Smog results from large amounts of burning of coal and petroleum in an area caused by a mixture of smoke and sulphur dioxide. Particulate matter formed from the gaseous primary pollutants and compounds in photochemical smog are also considered as secondary pollutants. Ground level ozone ( $\text{O}_3$ ) is formed from both nitrogen oxides and volatile organic compounds. Ozone layer is found in stratosphere which is different from ground level ozone. Ozone at ground level is one of the major constituents of photochemical smog.

Photochemical and chemical reactions involved in it drives many of the chemical processes that occur in the atmosphere by day and night and contributes in the formation of ground level ozone. Abnormally, high concentrations of ground level ozone brought about by human activities (largely the combustion of fossil fuel, solvents and industry) is a pollutant, and a constituent of formation of smog.

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**SAQ I**

- a) What is a pollutant?
  - b) What are the sources of air pollutants?
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## 9.3 STANDARDS OF AIR POLLUTION

You have well understood about the sources and types of air pollutants. Air pollutants can be derived from both natural and human made sources. As we know that air pollution is a major environmental risk to health. Standards of air pollution is a system which is developed by several organizations like United State Environmental Protection Agency (USEPA) of USA, Central Pollution Control Board (CPCB) of India and also World Health Organization (WHO). Basically, the system measures the level of pollution of an air pollutant based on health impacts of various pollutants. It generally ranges between the values of zero (healthy) and five hundred (extremely unhealthy). You may have frequently read in the newspapers, the situation of ambient air which means outside air quality in various cities across the globe. The ambient air quality index shows six categories in different colours that are associated with various health impacts of people as given in Table 9.1.

**Table 9.1: Air quality index explaining the health impacts on humans.**

AQI	Associated Health Impacts
Good (0–50)	Minimal Impact
Satisfactory (51–100)	May cause minor breathing discomfort to sensitive people
Moderate (101–200)	May cause breathing discomfort to the people with lung disease such as asthma and discomfort to people with heart disease, children and older adults
Poor (201–300)	May cause breathing discomfort to people on prolonged exposure and discomfort to people with heart disease with short exposure
Very Poor (301–400)	May cause respiratory illness to the people on prolonged exposure. Effect may be more pronounced in people with lung and heart diseases
Severe (401–500)	May cause respiratory effects even on healthy people and serious health impacts on people with lung/heart diseases. The health impacts may be experienced even during light physical activity

(Source: Central Pollution Control Board ,CPCB, 2015).

In India, National Ambient Air Quality Standards are the standards for ambient air quality set by the CPCB which is applicable for the entire nation. The CPCB has been conferred this power by the Air (Prevention and Control of Pollution) Act, 1981. A new national air quality index (AQI) has been launched in October 2014 to disseminate information on air quality in an easily understandable form for the general public. The measurement of air quality is based on eight pollutants, namely, Particulate Matter (size less than 10  $\mu\text{m}$ -PM<sub>10</sub>), Particulate Matter (size less than 2.5  $\mu\text{m}$ -PM<sub>2.5</sub>), Nitrogen Dioxide (NO<sub>2</sub>), Sulphur Dioxide (SO<sub>2</sub>), Carbon Monoxide (CO), Ozone (O<sub>3</sub>), Ammonia (NH<sub>3</sub>), and Lead (Pb) for short-term (up to 24-hourly averaging period).

Refer to the Table 9.2 for understanding National Ambient Air Quality Standards of India.

**Table 9.2: National Ambient Air Quality Standards suggested by CPCB, Govt. of India.**

Pollutant	Time Weighted Average	Concentration in Ambient Air	
		Industrial, Residential, Rural and Other Areas	Ecologically Sensitive Areas
Sulphur Dioxide- SO <sub>2</sub> (µg/m <sup>3</sup> )	Annual	50	20
	24 hours	80	80
Nitrogen dioxide- NO <sub>2</sub> (µg/m <sup>3</sup> )	Annual	40	30
	24 hours	80	80
Particulate Matter size less than 10 µm- PM <sub>10</sub> (µg/m <sup>3</sup> )	Annual	60	60
	24 hours	100	100
Particulate Matter size less than 2.5 µm- PM <sub>2.5</sub> (µg/m <sup>3</sup> )	Annual	40	40
	24 hours	60	60
Ozone- O <sub>3</sub> (µg/m <sup>3</sup> )	8 hours	100	100
	1 hour	180	180
Lead- Pb (µg/m <sup>3</sup> )	Annual	0.5	0.5
	24 hours	1.0	1.0
Carbon-Monoxide CO (mg/m <sup>3</sup> )	8 hours	02	02
	1 hour	04	04
Ammonia- NH <sub>3</sub> (µg/m <sup>3</sup> )	Annual	100	100
	24 hours	400	400

(Source: CPCB, 2009; <https://www.transportpolicy.net/standard/india-air-quality-standards/>).

Ambient (outdoor) air pollution is a measure of the condition or quality of air surrounding us in the outdoors. As we know that the major components of PM are sulfate, nitrates, ammonia, sodium chloride, black carbon, mineral dust and water. PM<sub>10</sub> and PM<sub>2.5</sub> explains the particles with a diameter of 10 microns and 2.5 microns, respectively. PM<sub>10</sub> can penetrate into the lungs while PM<sub>2.5</sub> is fine particles, thus, they are able to enter into the blood system. Air quality measurements are typically reported in terms of daily or annual mean concentrations of PM<sub>10</sub> particles per cubic meter of air volume (m<sup>3</sup>). Routine



air quality measurements typically describe such PM concentrations in terms of micrograms per cubic meter ( $\mu\text{g}/\text{m}^3$ ).

Nitrogen oxide ( $\text{NO}_2$ ) is the main source of nitrate aerosols, which forms an important fraction of  $\text{PM}_{2.5}$  and ozone ( $\text{O}_3$ ). Sulphur dioxide ( $\text{SO}_2$ ) is a colourless gas with a sharp odour. You might be knowing that  $\text{NO}_2$  and  $\text{SO}_2$  are mostly produced from the burning of fossil fuels and combustion processes (heating, power generation, and engines in vehicles and ships).

Ozone at ground level is formed by the reaction with sunlight (photochemical reaction) of pollutants such as nitrogen oxides ( $\text{NO}_x$ ) and volatile organic compounds (VOCs). As a result, the highest levels of ozone pollution occurs during the periods of sunny weather.

$\text{NH}_3$  (Ammonia) either directly or indirectly, is a building block for the synthesis of many pharmaceuticals. Pb (lead) content generates in the air mainly through ore and metals processing, waste incinerators and from lead-acid battery manufacturing industries.

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## SAQ 2

- What are eight basic pollutants used to measure the air quality standard?
  - Name of the organization that regulates the standards for air quality in India.
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## 9.4 EFFECTS OF AIR POLLUTION

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You have understood now the air quality standards. You now know the effects of air pollution in all forms of life from human to plants, animals and also materials related to human welfare. Some of the important effects of air pollution under three broad categories namely effects of human health, effects on wildlife and effects on environment are discussed below.

### 9.4.1 Effects on Human Health

As we all know that air is very essential for life. If the air is polluted then it will be worsened all the life forms. We could find several alerts in newspapers or television channels with regard to the levels of air pollution in the environment particularly for cities. Polluted air severely affects the children and aged population directly into the eyes, nose, throat and lungs. Toxic air inhalation causes problem not only to the respiratory system but also to our total body system.

The polluted air affects the human health. These are discussed as follows:

- Sulphur dioxide can harm human respiratory system and makes breathing difficult. It irritates the skin and mucous membranes of the eyes, nose, throat, and lungs.
- Nitrogen oxide at higher concentrations cause the breathing problems, headaches, allergies, and impairs the functioning of lungs by causing

accumulation of water in the air pores. Nitrogen compounds also contribute in the formation of fine particles and ozone at ground level, both of which are associated with adverse health effects. Longer exposures to NO<sub>2</sub> can lead to the development of asthma and it carries a potential risk to children and the elderly people as well.

- Over exposure to carbon monoxide leads to symptoms like fatigue, nausea, dizziness, disturbances of psychomotor function, vision problems, brain damage, serious effects on cardio-vascular systems, muscle weakness, and may lead to even death. Sulphur and nitrogen oxides combined with carbon monoxide diffuses into the blood, combine with haemoglobin leading to obstruction of oxygen transport.
- Radio-active elements in air cause severe skin diseases, reduction in white blood cells, damage of small blood vessels, heart failure, and deformities which are inherited in succeeding generations.
- The particulate pollutants such as silicon particles, lead, carbon, fibres of asbestos and those of cotton cause diseases like silicosis, fibrosis, etc.
- Air borne spores, pollen grains, bacteria, fungi, fur, hair, etc., cause various allergic reactions like bronchial asthma, fever and dangerous diseases like tuberculosis, dermatitis, etc. Chronic exposure to particles contributes to the risk of developing cardio vascular and respiratory diseases, as well as lung cancer.

#### **9.4.2 Effects on Wildlife**

Toxic pollutants in the air affects the animals similar to that of humans. Studies show that air toxicants are significantly contributing to birth defects, reproductive failure, and disease in animals. The toxic air pollutants also affect the aquatic ecosystems. The pollutants accumulated in sediments may bio-magnify in tissues of animals at the top of the food chain to concentrations many times higher than in the water or air. We could find a number of livestock poisoned by fluorides and arsenic toxicants/pollutants across the world.

#### **9.4.3 Effects on Environment**

Along with harming humans, animals, plants health, air pollution can also cause a variety of environmental effects. Nitrogen and sulphur oxides interact with water, oxygen and other chemicals in the atmosphere to form acid rain which can harm sensitive ecosystems such as lakes and forests. Acid rain not only damages vegetation but also soils and waterbodies. Waterbodies including ponds and lakes have become acid, making the water unsuitable for some fish and other wildlife. The result of acid rain is leading to the quick decay of buildings, monuments and statues. High concentrations of nitrogen oxides affects the vegetation through damaging leaves and its growth. It also reacts with other pollutants in the presence of sunlight to form ozone which can adversely damage vegetation.

Haze is also an important effect of air pollution. It is caused by tiny pollutant particles in the air that leads to the loss of visibility, clarity, colour, texture, and

form of what we see. The sources of air pollutants causing to haze may be from power plants, industries, trucks and automobiles, and construction activities. The highest air concentrations of lead are usually found near lead smelters. High levels of ammonia is both caustic and hazardous.

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### SAQ 3

Write any two effects of air pollution on human health.

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## 9.5 MANAGEMENT OF AIR POLLUTION

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Several countries have put up their concerted efforts to control the air pollution by developing certain measures through technological advancements. However, the progress of innovation in controlling the air pollution has not reached greater heights, so far. To control air pollution, the following measures are suggested:

- a) The establishment of regulatory authority at national level to suggest air quality standards for protecting health of human beings. Proper management studies related to emissions inventories, air monitoring and air quality modeling shall be conducted periodically to understand the levels of air pollution and health and environment related problems.
- b) Strict regulations and stringent punishments on one hand and incentive programs for emitting lower emissions at industrial and other sources on the other hand may be implemented cautiously.
- c) Use of purified good quality of petrol may minimize the level of sulphur and lead oxides in automobile exhausts. The modified efficient engines in automobiles can help to release the low level of carbon monoxides and hydrocarbons into the atmosphere.
- d) The industrial machines and vehicle engines should be made energy efficient to use fuels at the maximum level to reduce the release of pollutants.
- e) Installing treatment plants for purification of air pollutants is also one of the vital solution. It is now very important to pay attention to the usage of alternative and cleaner energy sources. The common alternative sources of energy are wind, water and sunlight. The solar and battery energy operated vehicles needs to be manufactured to reduce the use of fossil fuels.
- f) The aerosol emissions should be controlled by efficient arresters like filters and precipitators, and scrubbers. The emissions from factories and industries should be treated by various techniques like settling chambers, wet and gas scrubbers, cyclone separator, etc., before being released into the atmosphere. Use of fuelwood and coal for cooking and other purposes must be controlled by introducing smoke free furnaces.
- g) Alternatively, deforestation activities needs to be strictly monitored and encourage the adoption of afforestation practices. Every nation should

participate in planting trees and follow the slogan “*save and plant trees, save the homes of living organisms and whole of the planet Earth*”. You must know the fact that the plants and trees absorb carbon dioxide for photosynthesis and thus reduce pollution from the air. Besides, broad leaved trees are particularly able to trap large amount of gases and dust on their leaves and twigs. Trees act as dust or particulate filters and substantially reduces CO<sub>2</sub> emissions, hence, it is the need of the hour to take initiation for restricting tree felling.

- h) The most important and fundamental programme for dealing with environmental problems can be done by the introduction of environmental education at all levels. Every citizen of the nation from her/his very childhood should be sensitized and made aware of the problems of air pollution in particular and environmental pollution as a whole.

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### SAQ 4

What are the important measures of minimizing air pollution?

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## 9.6 SUMMARY

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In this unit, you have studied:

- The contaminants in high concentrations that exists in the air is harmful to the all living organisms through air pollution.
- Sources of air pollutants are different in form. It may be from industries, burning of fossil fuel, mining and power plants, agro-chemicals and so on.
- Pollutants are mainly of three types namely natural, primary and secondary pollutants.
- Some of significant pollutants recognized are sulphur and nitrogen oxides, carbon monoxide and carbon dioxide, volatile organic compounds, particulate matter, etc. Ozone at ground level is also one of the prominent source of secondary pollutant.
- The major air pollutants namely PM<sub>10</sub>, PM<sub>2.5</sub>, NO<sub>2</sub>, SO<sub>2</sub>, CO, O<sub>3</sub>, NH<sub>3</sub>, and Pb are generally considered for measuring the quality of air. Central Pollution Control Board of India has developed a national air quality index by fixing standards for different parameters to qualify the air quality.
- Air pollution affects human health, animals and plants life, and also whole environment.
- You have also studied several possible measures to control the air pollution.

## 9.7 TERMINAL QUESTIONS

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1. Discuss various sources of air pollutants.
2. Write a note on effects of air pollution on human and environmental health.
3. Discuss various management strategies to reduce the air pollution.

## 9.8 ANSWERS

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### Self Assessment Questions

1. a) An air pollutant is a substance in the air that can cause harm to humans and the environment.  
b) There are two sources of air pollution i.e. natural and human made.
2. a) The eight pollutants are PM<sub>10</sub>, PM<sub>2.5</sub>, NO<sub>2</sub>, SO<sub>2</sub>, CO, O<sub>3</sub>, NH<sub>3</sub>, and Pb.  
b) Central Pollution Control Board (CPCB)
3. Effect of air pollution on human health are respiratory problems, loss of vision, clarity, skin diseases, and so on.
4. Use of good quality of petrol, modernization of industries, use of alternative and cleaner energy sources, etc.

### Terminal Questions

1. Sources of air pollutants are stationary sources and non-stationary sources. Refer to Sub-section 9.2.1.
2. Refer to Section 9.4.
3. Refer to Section 9.5.

## 9.9 REFERENCES AND FURTHER READING

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