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STANDARD FIVE

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SCIENCE

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Term - III

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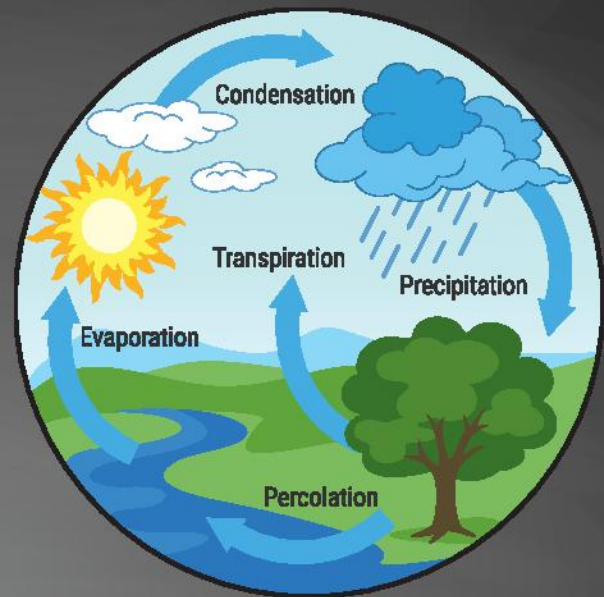
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Science

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E-Book



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1

OUR ENVIRONMENT



Learning Objectives

After the completion of this lesson, students will be able to:

- ❖ Know about different types of farms.
- ❖ List out the economic importance of dairy farms and poultry farms.
- ❖ Know about Apiculture and the uses of honey.
- ❖ Understand different types of manures and their uses.
- ❖ Know about vermiculture and vermicompost.



Introduction

Environment is everything that is around us. There are two types of environment. They are physical environment and biological environment. Physical environment includes all non-living things like land, water and air. Biological environment includes the living things such as plants and animals. Natural environment has a lot of economic values. Plants and animals in our environment are useful to us in a number of ways. Animals like cow, buffalo and goat give us milk. Some animals are used for transportation. These animals are raised in farms. In this lesson we will learn about dairy farms, poultry farms, apiculture, manures and vermicompost.



I. Farms

Farming is the activity of growing crops and raising livestock. It is a part of agriculture. Agriculture is the cultivation of land and breeding of animals and plants to provide food, fiber, woods and medicinal plants to sustain and enhance life. But, farming is more profitable than agriculture. So, it is done on a commercial scale. An area of land with fields and buildings that is devoted primarily to growing crops or raising domestic animals or both as a business is called farm. Large scale farms grow one or two major crops or animals. Middle sized and small sized farms grow different types of crops and animals.

1 Dairy Farm

Dairy farming is a type of agriculture that focuses on extraction of milk and preparation of various milk products like cheese, butter, curd etc. High milk producing cows along with bulls and oxen are raised in commercial dairy farms. Other animals raised in these farms include goats, sheep and camels.



Do you know?

'District Livestock Farm' in Hosur, Krishnagiri district of Tamil Nadu, is the biggest cattle farm in Asia. Total area of this farm is 1641 acres.



Activity 1

Visit an animal farm in your area and prepare a list of animals domesticated there. Also find out the products you can get from there.

❖ Cattle breeds

In India, there are 26 cattle breeds. They are domesticated for milk, agricultural work, transportation and many other needs. Gir, Sahiwal, Red Sindhi, Kangayam and Ongole are some of the cattle breeds found in India. Cattle breeds found in different states of India are given in the table.



Gir



Malvi



Nagari



Sahiwal



Red Sindhi



Ongole

Cattle Breed	States
Gir	Gujarat, Rajasthan
Sahiwal	Punjab, Haryana, Uttar Pradesh
Red Sindhi	Andhra Pradesh
Malvi	Rajasthan, Madhya Pradesh
Nagari	Haryana, Uttar Pradesh, Rajasthan
Kangayam	Tamil Nadu
Ongole	Andhra Pradesh



Do you know?

India has the largest number of livestock in the world, holding 281 million. In 2008, our country housed the second largest number of cattle in the world with 175 million. (One million = Ten lakh)



Activity 2

Some of the cattle breeds found in Tamil Nadu are given below. With the help of your teacher find out the districts where they are found.



Kangayam



Bargur



Umblachery



Pulikulam

Apart from these animals, buffaloes are also domesticated in India. There are 7 buffalo breeds in India. Buffaloes produce more amount of milk than cows. Also, buffalo's milk has more nutrients than cow's milk. Murrah, Jaffrabadi, Bhadawari and Surti are the buffalo breeds that are found in India. India is the biggest buffalo milk producer in the world. Some of the buffalo breeds found in our country are given in the table.



Jaffrabadi



Surti



Nagpuri



Murrah



Bhadawari



Mehsana

Buffalo Breeds	States
Murrah	Punjab, Haryana, Uttar Pradesh
Bhadawari	Uttar Pradesh, Madhya Pradesh
Jaffrabadi	Gujarat
Surti	Rajasthan, Gujarat
Mehsana	Gujarat
Nagpuri	Central and South India
Nili Ravi	Punjab, Haryana



Do you know?

White Revolution in India was launched in 1970s to make India self dependent in milk production. Dr. Verghese Kurien is called the Father of White Revolution.

❖ Feeding

Cattle need nutritious feed in order to be healthy and to produce high milk yield. The cattle feed includes roughage and concentrates. The roughage contains high amount of fiber and it includes fodder, hay, straw and silage. Concentrates include broken grams, cereals, millets, rice bran, cotton seeds and oil cakes. Apart from these feed, cattle need an adequate amount of fresh water.

❖ Diseases

Foot and mouth disease and anthrax are some of the common diseases found among cattle. Maintaining proper sanitation is necessary to stop the spread of these diseases. Timely vaccination can prevent most of the diseases. Veterinary medicine deals with the prevention, diagnosis and treatment of disease, disorder and injury among domestic and non-domestic animals.



Activity 3

Visit a veterinary hospital in your area and find out the common diseases found among the cattle in your area. Try to know how such diseases can be prevented.

❖ Uses

Cattle are useful to us in a number of ways. Some of them are listed below.

- We get milk from cows. Cow's milk contains essential minerals needed for us.
- Bullocks are used to plough land, harvest and thrash crops.
- Cattle are employed in transportation.
- Cattle dung is used as manure. It is also used as fuel and for generation of biogas.
- Panchagavya is an ayurvedic medicine used in agriculture to control pest and fungi. It is a mixer of dung and urine of cows, fresh milk, curd, jaggery and ghee.
- Leather goods are manufactured from cattle hides.



2 Poultry Farm

In poultry farms, avian species are reared and bred for the purpose of egg, meat or both. Fowls, ducks, geese, turkeys and some varieties of pigeon are the most commonly reared species. Chicken occupy 90% of the total poultry. Poultry birds grown for meat are called broilers. Layers are the female fowls grown for egg production. The poultry industry is important in providing a balanced diet for human population. Proper management of poultry includes methods of hatching, rearing, housing, sanitation, prevention of diseases and a sound marketing system. In Tamil Nadu, famous poultry farms are found in places like Namakkal, Palladam and Chennai.



❖ Breeds

There are more than hundred breeds of fowls. Fowls are classified on the basis of their utility to us. They are: meat type (broiler), egg type (egg layer) and dual type. Aseel, Chittagong, Ghagus, Busra, Brahma and Cochin are some of the breeds found in our country. Local and indigenous birds are reared in rural places traditionally. These birds have a poor meat production capacity compared to commercial broilers and layers. But, meat and egg from this type of poultry are better than other commercial poultry.



Do you know?

India ranks third in egg production in the world.

White leghorn is the most egg yielding breed in the world.



Ghagus



Cochin



Brahma



Broiler



Chittagong



Plymouth



Aseel



Kadaknath

❖ Feeding

Poultry birds need proteins, carbohydrates, fats, minerals and vitamins for egg and meat production. Bajra, barley, maize, wheat, rice bran, jowar, oil cake, fish meal, bread and green residues of vegetables are the feed given to the poultry birds.

❖ Poultry products

Poultry birds benefit us in many ways. Egg, meat and manure are the three main benefits we get from them.

- Poultry birds are good source of nutritive food.
- Eggs laid by them are rich source of protein. These are easily digestible. They contain minerals like calcium, potassium and iron, vitamins and moderate amount of fat.
- Their feathers are used for making pillows and quilts.
- Dropping of the poultry birds is used as manure. It is highly valuable for crops.



Do you know?

Egg contains minerals like calcium, phosphorus and sodium and vitamins like B₁, B₂ and D. Nutritious content of egg is: Water-66%, Protein-21%, Fat-9% and Minerals-3.5%.



❖ Poultry Diseases

If poultry animals are not cared or fed properly, they suffer from a number of diseases.

- Poultry birds affected by virus suffer from fever and diarrhea.
- Foul cholera is caused in them by bacteria.
- Over exposure to wet and cold conditions causes cramps in poultry birds.
- Poultry birds are affected by internal parasites like round worm and tap worm. They are also affected by external parasites like flies, lice, ticks etc.



Activity 4

Fill in the blanks using the words given below.

(Oilseeds, Egg, Honey, Food grains, Fish)

Green Revolution : _____

Blue Revolution : _____

Silver Revolution : _____

Gold Revolution : _____

Yellow Revolution : _____

❖ Poultry management

Poultry birds need a clean environment. The following measures should be taken in order to avoid diseases.

- Poultry houses should be clean and disinfected.
- It should have windows for ventilation.
- Light is essential for high egg production.
- Poultry birds need clean and fresh water.
- Timely vaccination is necessary to prevent diseases.



II. Apiculture

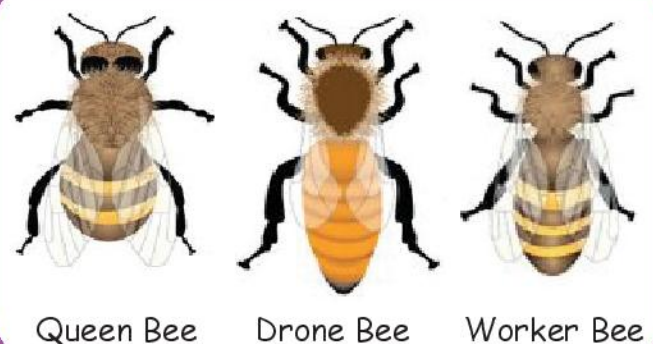
Rearing of honey bees for honey is known as apiculture. It is also called bee keeping. In this technique honey bees are reared in a specially designed wooden boxes. Honey bees have been very closely associated with humans since ancient times. Various products like honey and wax are obtained from honey bees. Earlier, honey was extracted from the hives in the forests. Nowadays they are domesticated by farmers to produce honey. Bee keeping is a profitable rural based industry. Honey bees are social insects. The nest of honey bee is known as the bee hive. They live in colonies and show division of labour.

1 Types of Honey Bee

Three types of honey bees are found in a colony. They are: Queen bee, the Drones and the Worker bees.

❖ Queen Bee

The queen bee is the largest member of the bee colony. There is only one queen and it is the fertile female of the colony. They are formed from fertile eggs. The queen is responsible for laying eggs in a colony. It lays about two thousand eggs per day. The life span of the queen bee is 3-4 years.



❖ Drones

Drones are the fertile males. They develop from unfertilized eggs. They are larger than the workers and smaller than the queen. Their main function is to fertilize the eggs produced by the queen. They also help in maintenance of hive temperature. The number of drones in a colony amounts to hundreds and sometimes to thousands. The normal life span of a drone is 57 days.

❖ Worker Bees

These are sterile female bees and the smallest members of the colony. These bees are very active. Their function is to collect honey, look after the young ones, clean the comb, defend the hive and maintain the temperature of the bee hive. Life span of worker bee is six weeks.



Do you know?

- ❖ One worker bee has to fly 90000 miles (three times around the globe) to make one pound of honey.
- ❖ Honey bee can fly up to six miles and as fast as 15 miles per hour.

2 Useful products from Honey Bees

Honey and bee wax are obtained from honey bees. Other products which are obtained from bees are bee venom, propolis and royal jelly.

❖ Honey

Honey is a sweet, viscous, edible natural food product. It contains proteins, free amino acids, vitamins and minerals like calcium, iron, phosphorus and manganese. The following are the uses of honey.

- ❖ Honey has an antiseptic and antibacterial property. It is an antibiotic also.
- ❖ It helps in building up haemoglobin content in the blood.
- ❖ It is used in Ayurvedic and Unani system of medicines.
- ❖ It prevents cough, cold, fever and relieves sore throat.
- ❖ It enhances digestion and appetite.
- ❖ It provides essential aminoacids required for the growth of the body.



Do you know?

Honey is the exciting source of natural sweet. It is also called as 'Liquid Gold'.



❖ Bee wax

Bee wax is secreted by the wax glands of worker bee to construct the combs of bee hive. Some of the uses of bee wax are given below.

- ❖ It is widely used in cosmetic industry.
- ❖ The wax is used in the preparation of shoe polish and manufacture of cold creams, lipsticks, candles and lubricants.
- ❖ It is also used in the preparation of ointments and in pharmaceutical industry.





III. Manure

Manure is an organic matter used as fertilizer. It is mostly derived from animal and plant residues. It increases the fertility of the soil by adding nutrients such as nitrogen, phosphorus and potassium. It is a natural form of fertilizer and it is cheaper.

1 Types of Manure

Animal manure, green manure and compost manure are the different types of manures.

❖ Animal manure

Common form of animal manure is the farmyard manure. It contains the feces and urine of different livestock like horse, cattle, pig, sheep, chicken, turkey and rabbit. It contains nutrients like nitrogen, phosphorus and potassium. It increases the capacity of the soil to hold more water and nutrients.

❖ Green manure

This manure is obtained by the decomposition of green leaves, twigs of trees, shrubs and herbs which are added into the farm land before starting cultivation. Leguminous plants like wild indigo (kolunchi) are used for this purpose. These plants are ploughed in the soil. They fix nitrogen in the root of the plants. They also help in suppression of weeds and prevention of soil erosion.

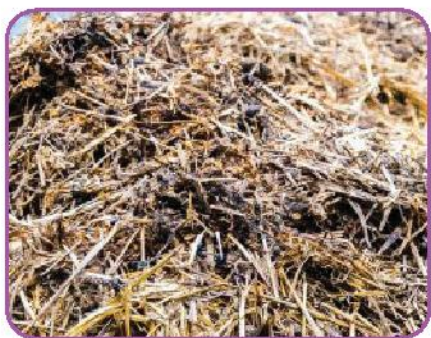
❖ Compost

Compost is obtained by the decomposition of organic matter like crop residues, animal wastes and food wastes by various microorganisms like bacteria and fungi under controlled conditions. These microorganisms break down organic matter into simpler substances.



Activity 5

With the guidance of your teacher set up a compost pit within your school campus. Put all the organic wastes like food waste and cover it with soil. Wait for three weeks and then you can use this as manure for the plants in your school.



Animal manure



Green manure



Compost



IV. Vermiculture



Vermiculture or Vermicomposting is a method of transforming organic wastes such as leaves, pieces of wood etc., into a nutrient rich fertilizer using earth worms. It is a healthy and clean way to eliminate wastes going into our landfills. It helps to keep the environment clean. Earthworms eat the organic wastes and excrete it in the form of castings. This is known as vermicompost. It is used as fertilizer for the soil and it improves the properties of the soil.

1 Materials used for Vermicomposting

Organic matters which are biologically degradable are used in vermicomposting. Some of them are given below.

- Crop residues like rice straw, rice husk, tea wastes and tobacco wastes.
- Fruit and vegetable wastes.
- Animal wastes like cattle dung, poultry droppings and droppings of goat and sheep.



2 Advantages of Vermicompost

- Vermicompost provides the essential nutrients such as nitrogen, potassium and phosphorus for the plant growth.
- It improves the water holding capacity of the soil and prevents soil erosion.
- It enhances plant growth, suppresses diseases in plants, increases porosity and improves water retention and aeration.
- It is used to clean sewage.
- It reduces the need for chemical fertilizers.

Do you know?



Common earth worms are not used for vermicomposting. Specialized breeds that multiple while living in colonies are used for this. The most common earth worms used are Red wigglers, European night crawlers, and African night crawlers.



Evaluation

I. Choose the correct answer.

1. Which of the following produces more milk?

- a) Cow b) Yak c) Buffalo d) Goat

2. Poultry farming is rearing and breeding of _____.

- a) chickens b) cows c) avian species d) animal





3. _____ is the best fertilizer.
a) Vermicompost b) Fruits c) Synthetic fertilizer d) Urea
4. _____ is more profitable than agriculture.
a) Dairy farm b) Farming c) Cultivation d) Poultry
5. Poultry farm is famous in _____ district of Tamil Nadu.
a) Ariyalur b) Salem c) Namakkal d) Thanjavur

II Fill in the blanks.

1. There are _____ breeds of cattle in India.
2. The milk of _____ has more nutrients than cow's milk.
3. _____ contains high amount of fiber.
4. Droppings of poultry birds are used as _____.
5. Vermicomposting transforms _____ into a nutrient rich fertilizer.

III. Match the following.

- | | | |
|---------------------|---|-------------------|
| 1. Surti | - | Egg |
| 2. White revolution | - | Transportation |
| 3. Layers | - | Leguminous plants |
| 4. Green manure | - | Buffalo |
| 5. Cattle | - | Milk |

IV. Say True or False. If false, correct the statement.

1. Farming is done on a commercial scale.
2. Vermicompost can be used to clean sewage.
3. Leguminous plants fix nitrogen in the leaves of the plants.
4. Namakkal district is famous for dairy farm.
5. Murrah is a buffalo breed.

V. Answer briefly.

1. What is farming?
2. Mention the types of farming.
3. Write a note on poultry farm.
4. What is farmyard manure?
5. Define Vermicompost.

VI. Answer in detail.

1. What are the uses of cattle?
2. How will you manage a poultry farm?



2

ANIMALS



Learning Objectives

After the completion of this lesson, students will be able to:

- ❖ Understand reproduction in animals.
- ❖ Differentiate oviparous and viviparous animals.
- ❖ Know about endangered animals and the importance to save them.
- ❖ List out the importance of wildlife sanctuaries and national parks.
- ❖ Understand the need for the prevention of cruelty to animals.



Introduction

Our planet earth has countless number of organisms including plants and animals. Among them, animals are the most advanced organisms. Animals are a gift of nature to human beings. They are very closely associated with us in our daily life and contribute a lot to us. Man is exploiting nature nowadays more than ever before. Hence animals are affected and many of the plant and animal species are disappearing from the earth. We are going to study about this in this lesson. This lesson will also deal with reproduction in animals, extinction of animals and the ways to preserve them.



I. Reproduction in Animals

Reproduction is the biological process by which an organism gives rise to a new organism. This process is seen in all living organisms - both plants and animals. Reproduction is essential for the continuation of similar kinds of species, generation after generation. In animals, two types of reproduction are seen. They are: sexual reproduction and asexual reproduction.



1 Sexual Reproduction

Sexual reproduction is a natural way of reproduction in humans, animals and also in most of the plants. This type of reproduction is more complex and lengthy as compared to asexual reproduction. Different and unique offspring are produced by sexual reproduction. Sexual reproduction consists of the following stages.

a. Pre-fertilization b. Fertilization c. Post-fertilization

a. Pre-fertilization

This is the first stage of sexual reproduction. In this stage, gamete (sex cells) formation and transfer of gametes take place. In animals, males and females have different reproductive organs. The male reproductive organ is called testes and the female reproductive organ is called ovary. The testes produce the male gametes known as sperms and the ovaries produce the female gametes known as ova or eggs. The male gamete reaches the female gamete during this stage.

b. Fertilization

When the male gamete reaches the female gamete they begin to fuse together. The fusion of gametes is known as fertilization. During fertilization, the nuclei of the sperm and the egg form a single nucleus together, resulting in the formation of a fertilized egg, known as zygote.



Fertilization in animals takes place in two ways. They are: External fertilization and Internal fertilization.

External fertilization takes place outside the animal's body. It usually takes place in aquatic environments where both eggs and sperm are released into the water. Fertilization in frogs and fish takes place by this method. When the fertilization takes place inside the animal's body, it is called internal fertilization. Internal fertilization takes place in animals like cat, dog, cow etc.



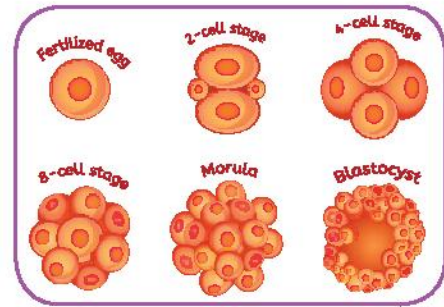
c. Post-fertilization

The zygote (fertilized egg) further divides repeatedly into group of cells. These cells develop into different tissues and organs constituting a full body. This structure is known as embryo.

The embryo continues to develop in the uterus and it is developed into body parts such as head, face, hands, legs, etc. Based on whether the embryo develops outside or inside the body, animals are classified into oviparous animals and viviparous animals respectively.

❖ Oviparous animals

Animals in which embryo develops outside the body are called oviparous animals. They produce their offspring by laying eggs. In the case of birds new ones are produced from the eggs. The egg shell protects the embryo from outer environment and the embryo receives its nutrients from the egg yolk. In some of these animals the new born one will have different developmental stages.



For example, in butterfly, there are different developmental stages like egg, larva, pupa and adult. Each stage is different. The process in which a butterfly becomes an adult is called metamorphosis. The life cycle process can take a month to year.

Stage 1 - Eggs

In the first stage a butterfly lays eggs on the leaf. These eggs are very small and round. About five days after the eggs are laid, a tiny worm-like creature will hatch from the egg.

Stage 2 - Caterpillar (Larva)

The second stage is the caterpillar. It is also called larva. The caterpillar starts to eat leaves and flowers once it has hatched. It grows very fast because it eats a lot. As it grows fast, it sheds its old skin and gets new skin. A caterpillar shedding its outgrown skin is called moulting.

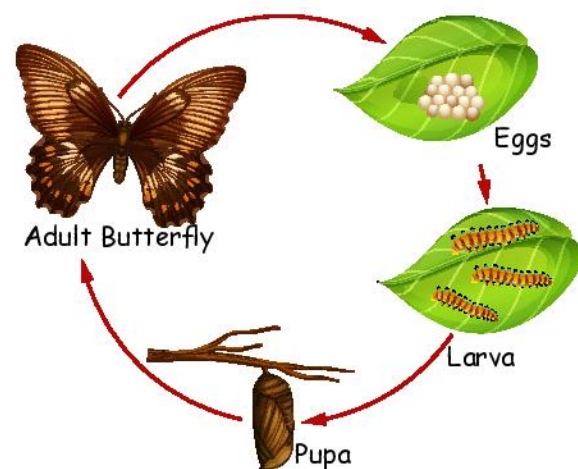
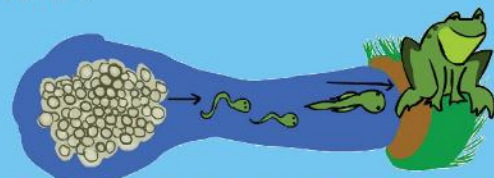
Stage 3 - Chrysalis (Pupa)

The third stage is the pupa. It is mostly brown or green. This is the resting stage as well as the changing stage. The caterpillar turns into a butterfly.



Do you know?

Amphibians are animals which have double life. The early part of an amphibian's life is spent in the water. As they get older, they spend time on land. Amphibians like frog lay thousands and sometimes millions of small, soft eggs in the water.



Stage 4 - Butterfly (Adult)

In the fourth stage, the pupa opens and a butterfly comes out. A butterfly is sometimes called an imago. It is also called as adult. Butterflies are very colourful. When the butterfly first comes out it is very tired and so it rests. Then the butterfly will lay eggs and the life cycle will start all over again.

❖ Viviparous animals

Animals in which the embryo develops inside the body are called viviparous animals. These animals give birth to the young ones. The developing embryo gets its nutrients from the mother. Human, cow, deer and dog are examples for viviparous animals.



Oviparous animals	Viviparous animals
The development of the embryo takes place outside the animal.	The development of the embryo takes place inside the animal.
They produce their young ones by laying eggs.	They directly give birth to the young ones.
The embryo receives the nutrients from the egg yolk.	The embryo receives the nutrients from the mother.
Examples for oviparous animals are insects, fish, reptiles, birds etc.	Examples for viviparous animals are cat, dog, lion, human etc.



Activity 1

Write down the names of any three oviparous and viviparous animals in the table given below.

Oviparous animals	Viviparous animals

2 Asexual Reproduction

The type of reproduction in which only a single parent gets divided into two or more new offspring is known as asexual reproduction. This type of reproduction takes place in micro organisms like hydra and amoeba. Asexual reproduction produces offspring that are identical to the parent. There are several ways by which animals reproduce asexually. Some of them are explained below.

❖ Fission

Fission occurs in some invertebrate (organisms without back bone), multi-celled organisms. In this method, an organism splits itself into two parts. For example, flatworms, sea anemones and sea cucumbers divide into two halves and regenerate the other half in each of the resulting individuals.

❖ Budding

Budding is a form of asexual reproduction that results from the outgrowth of a part of the body. Then, the bud is separated from the original organism forming two individuals. Budding occurs commonly in some invertebrate animals such as hydras and corals.

❖ Fragmentation

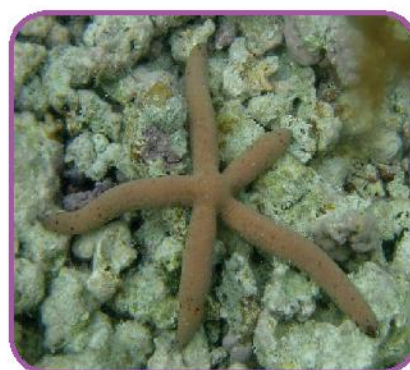
Fragmentation is the breaking of an individual into parts followed by regeneration. Reproduction through fragmentation is observed in sponges and sea stars. Fragmentation may occur through accidental damage, damage from predators, or as a natural form of reproduction.



Sea Anemone



Hydra



Star Fish

❖ Spores

Some protozoan, bacteria, plants and fungi reproduce via spores. Spores are the structures that naturally grow as part of an organism's life cycle. They are separated from the organism and dispersed through a medium such as air or water. In a suitable environment, the spores will develop into a fully grown organism.



Activity 2

Visit a nearby museum or a higher secondary school lab in your area. Find the specimens of starfish, cucumber and hydra there. Collect the pictures of these species and prepare an album.



II. Endangered Species

An endangered species is an animal or a plant that is at the risk of extinction. It means that they might extinct from the earth soon. It is reported that nearly 132 species of plants and animals are critically endangered in India. Snow leopard, Bengal tiger, Asiatic lion, Purple frog and Indian giant squirrel are some of the endangered animals in India. Similarly, plants like Umbrella tree, Glory lily, Rafflesia flower, Indian mallow and Musli plant are endangered.



Lion tailed Macaque



Asiatic Lion



The Nilgiri Tahr



Snow Leopard



Activity 3

Collect the pictures of different plants and animals. Prepare a poster showing the endangered animals and plants in India. Also find out where they are found.



Do you know?

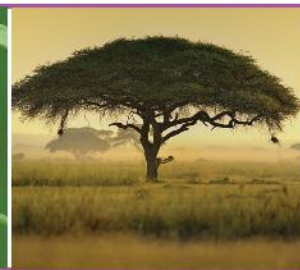
An animal species is said to be endangered if its population has declined between 50 and 70 percent over ten years.



Indian Mallow



Glory Lily



Umbrella Tree



Rafflesia Flower

1 Causes for Endangerment

- The following are the reasons why an animal or a plant is endangered or extinct.
- Forests which provide food and shelter to animals are destroyed for human needs.
 - Large number of animals are hunted for their horns, skin, teeth and many other valuable products.



Activity 4

Write few slogans for the conservation of forest and animals. Observe some important days related to nature like World Wildlife Day and organise a rally on those days.



Do you know?

In the recent years more number of animals are affected by wastes in the form of plastic. Animals mistake plastic as their food and eat them. Surgeons in Tamil Nadu Veterinary University, Chennai have removed 52kg of plastic wastes from a cow.

- Pollutions like air pollution and water pollution affect the animals.
- Sometimes animals are taken to new habitat by people. They cannot survive there.
- Pesticides and chemicals which are used to get rid of insects, pests or weeds, poison the plants and animals.
- Natural disasters like flood, cyclone and fire also destroy animals.



2 Saving Endangered Species

Nature is beautiful and it is filled with varieties of plants and animals. But they are endangered mainly due to human activities. We need to take some measures to protect them.

- Hunting and poaching of animals should be prohibited.
- We should not pollute the environment.
- Limiting the usage of plastic and recycling it can save the endangered animals.
- Pesticides and chemicals which pollute the environment should be avoided.
- Planting native trees will provide food to the animals.
- We should buy eco friendly products only.



Activity 5

Plant native trees like Banyan tree, Neem tree, Umbrella tree and Java plum tree in your school area. These trees can benefit birds.



Do you know?

Project Tiger was initiated in India in 1972 to protect the Bengal tiger. It was launched on 1st April, 1973. Due to this project the population of tiger has increased in India from 1400 in 2006 to 2967 in 2018.

3 Red Data Book

The Red Data Book is a book maintained for recording rare and endangered species of animals and plants. This book is created to identify and protect the species which are about to extinct.

Black	■	Confirmed to extinct species.
Red	■	Endangered species.
White	□	Rare species.
Green	■	Formerly endangered species but started to recover.

Red Data Book
A book, record of endangered species

It is maintained by the International Union for Conservation of Nature (IUCN), an international organization working in the field of nature conservation. The Red Data Book contains colour-coded information sheets.

❖ Advantages of Red Data Book

- It helps to evaluate the population of a particular species.
- The data given in this book can be used at the global level.
- The risk of a species becoming globally extinct can be estimated with the help of this book.
- It provides the necessary guidelines for implementing protective measures.



Do you know?

Red Data Book of India contains the conservation status of animals and plants which are found in the Indian subcontinent. Surveys conducted by Zoological Survey of India and Botanical Survey of India provide the data for this book.



III. Conservation of Animals

Biodiversity is the term used to describe different plants, animals, microorganisms, and insects etc., that are found on the earth. Conservation of biodiversity helps us to protect, maintain and recover the endangered animal and plant species. Conservation of biodiversity is the protection, preservation, management of wildlife and natural resources. Endangered species are maintained in certain protected areas such as national parks and wild life sanctuaries. In India, there are about 73 national parks and 416 wild life sanctuaries.

1 National Parks

A national park is an area which is strictly reserved for the betterment of wild life. In these areas, activities like forestry, grazing or cultivation are not permitted. Even private ownership rights are not allowed in these areas. The national parks cover an area of 100 - 500 square kilometers.



❖ Jim Corbett National Park

Jim Corbett National park is located close to Nainital, in Uttarakhand. Tigers are found in this park. Other animals found here include several species of deer, leopards, jackals, red foxes, black bear, sloth bear, and monkeys.

❖ Gir Forest National Park

It is located in Gujarat. Asiatic lions in their natural habitat can be seen here. Other animals that are found here include sambar, chinkara, chital, porcupine, wild boar and black buck.

❖ Kaziranga National Park

It is located in Assam. Wild animals such as rhinoceros, tiger, elephant, wild buffalo and swamp deer are seen here. This park also has bears, leopards, and several species of local and migratory birds. This park is famous for one horned rhino.



Do you know?

UNESCO (United Nations Educational, Scientific and Cultural Organisation) has declared Kaziranga National Park as a world heritage site.



❖ Sundarban National Park

Located in West Bengal, Sundarban National Park is a tiger and biosphere reserve on the Ganges delta. Bengal tiger, saltwater crocodile, wild boars, foxes, leopard cats, huge turtles, Ganges river dolphins and several other varieties of mammals and reptiles, along with a huge variety of local and migratory birds can be seen here.

❖ Kanha National Park

Kanha National Park, located in Madhya Pradesh was established as a part of Project Tiger. Apart from tiger, animals such as elephants, jackals, leopards, striped hyenas, monkeys, and several varieties of deer including black buck, swamp deer, chital and sambar are seen here.

❖ Periyar National Park

Periyar National Park is in Thekkady, Kerala. Various species including the majestic elephants, royal tigers, fishes, reptiles and birds can be seen here.

Name of the Park	District
Gulf of Mannar National Park	Ramanathapuram
Indira Gandhi National Park	Coimbatore
Mudumalai National Park	The Nilgiris
Mukurthi National Park	The Nilgiris

❖ Guindy National Park

This park is located at the heart of the Chennai city, the capital of Tamilnadu. It is a home to spotted deer, black bucks, white bucks, river otter, hyena, bonnet monkey, civet cat, jackals, pangolin, hedgehog and common mongoose etc.

2 Wildlife Sanctuaries

A sanctuary is a protected area which is reserved for the conservation of animals. Harvesting of timber, collection of forest products and private ownership rights are allowed here. Tourist visit is also allowed in these places.

❖ Kalakkad Wildlife Sanctuary

Kalakkad wildlife sanctuary is famous for tigers. Lion tailed macaque, Nilgiri langur, bonnet macaque, langur, Nilgiri tahr, sambar, sloth bear, gaur, elephant, flying squirrel, panther, wild dog and pangolin are some of the animals found here.

❖ Mudumalai Wildlife Sanctuary

It is located in Ooty. Bengal tiger, giant elephant and leopard are found here. Elephant safari is famous in this sanctuary.

❖ Mundanthurai Wildlife Sanctuary

It is located in Thirunelveli district. Major wild life animal found here is tiger.



Activity 6

List out the national parks and wild life sanctuaries in Tamil Nadu. Visit such places that are close to you and collect more information about the animals found there.



❖ Anaimalai Wildlife Sanctuary

It is also called as Indira Gandhi Wildlife Sanctuary. It is situated in Coimbatore district. Dhole, wild dog and giant squirrel are seen here.

❖ Vedanthangal Bird Sanctuary

It is a very old sanctuary in Tamil Nadu. It is located in Chengalpattu district. It has many migratory birds like spoon bills, open billed storks, pelicans etc.

Name of the Sanctuary	District
Meghamalai Wildlife Sanctuary	Theni
Vandalur Wildlife Sanctuary	Chengalpattu
Kalakkad Wildlife Sanctuary	Thirunelveli
Grizzled Squirrel Wildlife Sanctuary	Virudhunagar

3 Advantages of Conservation

- Species can be adapted to their habitat.
- Species can interact with each other.
- Natural habitat of the animals is maintained.
- It is less expensive and easy to manage.

Do you know?



Point Calimere Bird Sanctuary	- Nagapattinam
Karaivetti Bird Sanctuary	- Ariyalur
Vaduvur Bird Sanctuary	- Tiruvarur
Vallanadu Black Buck Sanctuary	- Tuticorin
Viralimalai Bird Sanctuary	- Trichy



IV. Prevention of Cruelty to Animals

Cruelty to animals includes capturing, trapping, poisoning of any wild animal collectively. There are many animal welfare organizations concerned with the health, safety and psychological wellness of animals. They include animal rescue groups which help animals in distress, and others which help animals suffering from some epidemic. Animal Welfare Board of India and National Institute of Animal Welfare are the government organizations which work for the welfare of animals. There are some private welfare organizations also.

1 Blue Cross

Blue Cross is a registered animal welfare charity in the United Kingdom. It was established in 1897 with the vision that every pet will enjoy a healthy life in a happy home. This charity provides support for pet owners who cannot afford private veterinary treatment, helps to find homes for unwanted animals, and educates the public in the responsibilities of animal ownership.

Blue Cross of India was established at Chennai in the year 1959. Now, Blue Cross of India is one of the largest animal welfare organizations in India. Its main office is located at Guindy, Chennai, with all amenities like hospitals, shelters, ambulance services and animal birth controls etc. Activities of the organization include, providing shelters, adoption, maintaining hospitals and mobile dispensary and providing ambulance services.



Activity 7

Make a visit to a veterinary clinic near your area. Find how animals are affected by people. Discuss how you can prevent cruelty to animals.



Do you know?

Blue Cross of India was founded by Captain V. Sundaram of Chennai. He was an Indian pilot and animal welfare activist.



Evaluation

I. Choose the correct answer.

- Fission is a way of _____ reproduction.
 - asexual
 - sexual
 - oviparous
 - viviparous
- _____ is an oviparous animal.
 - Cow
 - Deer
 - Goat
 - Duck
- Endangered animals are protected in _____.
 - museums
 - circus
 - farm
 - sanctuary
- Mundanthurai sanctuary is located in _____ district.
 - Thiruppur
 - Tiruvallur
 - Thirunelveli
 - Tiruvallur
- The vision of Blue Cross is _____ animals.
 - hunting
 - capturing
 - saving
 - neglecting





II Fill in the blanks.

1. Animals which give birth to young ones directly are named as _____.
2. _____ of animals leads to endangered condition.
3. Gir National Park is famous for _____.
4. Blue Cross is an _____ welfare organization.
5. Nilgiri Tahr is an _____ species.

III. Match the following.

- | | | |
|----------------------|---|----------------------|
| 1. Zycote | - | Asexual Reproduction |
| 2. Viviparous | - | Elephant |
| 3. Endangered animal | - | Cat |
| 4. Mudhumalai | - | Fertilized Egg |
| 5. Fragmentation | - | Rhinoceros |

IV. Answer in brief.

1. What is fertilization?
2. What are the different stages of sexual reproduction?
3. Mention the different types of asexual reproduction.
4. Differentiate between oviparous and viviparous animals.
5. Write a note on Blue Cross.

V. Answer in detail.

1. Explain the methods of asexual reproduction.
2. What are the causes for the extinction of animals?
3. Write an essay about national parks and wildlife sanctuaries.



3

AIR



Learning Objectives

After the completion of this lesson, students will be able to:

- ❖ Know about different layers of atmosphere.
- ❖ Understand the causes of air pollution.
- ❖ List out the ways of reducing air pollution.
- ❖ Know about the airborne diseases.
- ❖ Understand the importance of air in daily life.



Introduction

Air is present everywhere around us. Though we cannot see it, we can feel it. Air is a mixture of gases like oxygen, nitrogen, carbon dioxide and hydrogen. These gases act as an envelope around the earth and form the atmosphere. It is the presence of atmosphere that makes the earth a suitable place for living. In the recent years more number of industries have been established and they release excess of harmful gases like carbon dioxide into the atmosphere. Because of this, air is polluted more than ever before. In this lesson, we are going to study about different layers of atmosphere, air pollution, air borne diseases and the measures to control air pollution.



I. Atmosphere

The earth is surrounded by a layer of gases which is called atmosphere. It is composed mainly of nitrogen (78%) and oxygen (21%). Other gases like carbon dioxide and argon comprise 1% of the atmosphere by volume. The atmosphere is like a blanket that surrounds the earth. It protects the Earth from getting too cold or too hot.

Atmosphere is divided into five different layers. The layers from the bottom upwards are: Troposphere, Stratosphere, Mesosphere, Thermosphere and Exosphere.

❖ Troposphere

The troposphere is the lowest layer of the atmosphere. From the sea level it extends upto about 10 km. It is the densest layer and almost 75% of the air in the atmosphere is found in this layer. This layer also has water vapour. We live in the troposphere and most of the weather like clouds, rain, snow are found in this layer. All weather changes also occur in this layer.

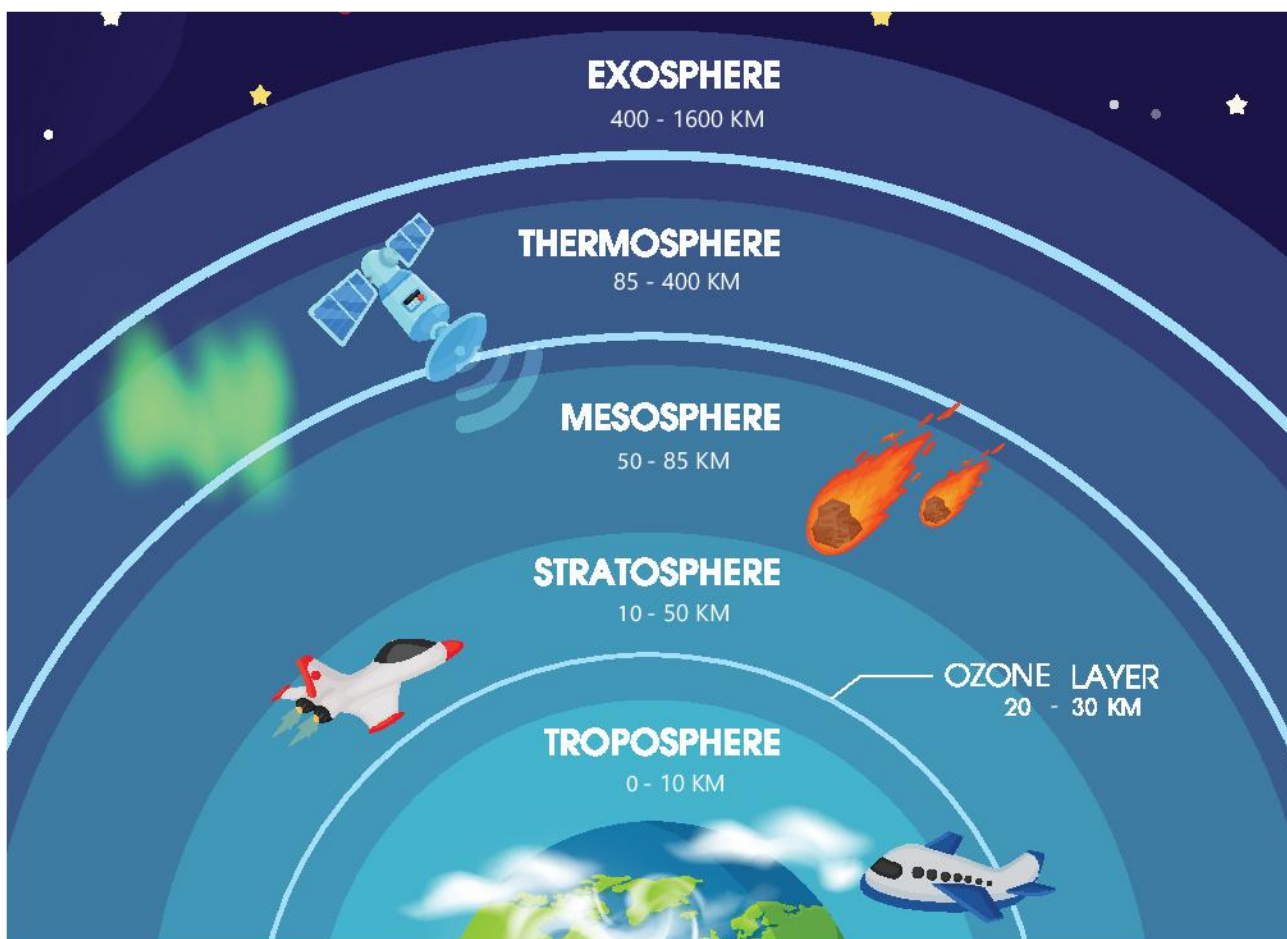


Activity 1

Read the weather news in a daily news paper and note down the changes in the weather over a week. In which layer these changes take place? Discuss in the classroom about these changes and record your points.

❖ Stratosphere

It extends from the top of the troposphere to about 50 km above the ground. Ozone layer found in this layer absorbs harmful ultraviolet rays which can cause damage to our skin and eyes. There is no water vapour in this layer. The temperature in this layer is around -55°C .



❖ Mesosphere

The region above the stratosphere is called mesosphere. It extends upward to a height of about 85km from the ground. The temperature in this layer decreases with height and it is -100°C . Most of the meteors found in the sky burn in this layer.

❖ Thermosphere

The layer of very rare air above the mesosphere is called thermosphere. It is the fourth layer of the atmosphere.

❖ Exosphere

The outermost layer of the atmosphere is called exosphere. It lies between 400 - 1600 km above the earth. The air here is extremely thin.



Do you know?

As the height increases, amount of air in the atmosphere decreases and so the oxygen level will decrease. That is why mountain climbers carry oxygen cylinders while climbing mountains.



II. Importance of Air

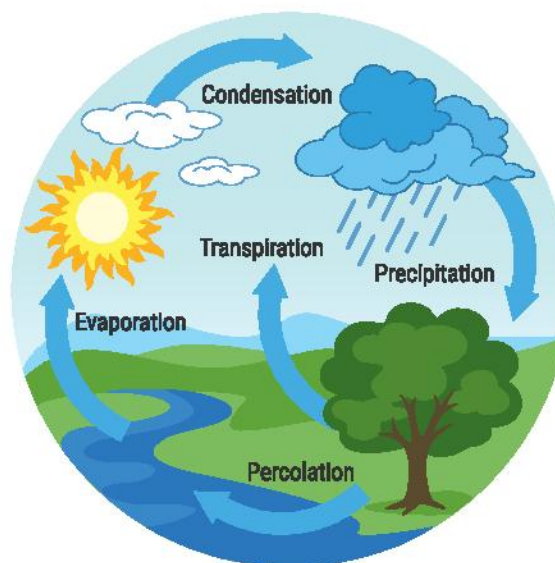
Air is important for all the living organisms. Without air no life can exist on the earth. We take in oxygen from the air and release carbon dioxide. Plants in turn use carbon dioxide present in the air to produce their food. The gases such as oxygen, nitrogen, carbon dioxide and hydrogen present in the air are important to us for many reasons. Let us study about the importance of air in this section.

❖ Water Cycle

Water vapour present in the air is important for the formation of water cycle. Water from the water bodies such as rivers and oceans evaporates and becomes water vapour. This water vapour then forms the clouds. These clouds move to the land and get cooled to give us the rain. This movement of clouds is possible due to air.

❖ Supplies Energy

We breathe oxygen present in the air and it is supplied to the cells in our body. Body cells burn the food molecules with the help of oxygen and produce energy. With this energy we do all kinds of works.



❖ Sound travels through air

We hear many things from the surrounding and people hear what we speak. This is possible due to air because sound needs a medium to travel. Sound travels from the point of generation to the listener through air.

❖ Useful for plants

Nitrogen present in the air is useful for plants. Nitrogen in the atmosphere is converted into easily absorbable nitrates by plants with the help of some microbes. It is known as nitrogen fixation. These nitrates are useful for the growth of plants. Also, air is helpful for the pollination of plants. Pollen grains travel from one plant to another plant through air. Thus, cross pollination is achieved with the help of air.

❖ Transport

Movement of air is called wind. This is helpful for the ships and boats to sail on the water. Airplanes and helicopters travel through air.

❖ Sports

Para-gliding is the recreational and competitive adventure sport of flying. In this sport, pilot sits in a harness suspended below a fabric wing. Hang gliding is also an air sport or recreational activity in which a pilot flies a light, non-motorized foot-launched air craft called a hang glider. Para-gliding and hang gliding are possible with the help of air. Other sports like wind surfing, kite surfing and sailing are also possible with the help of air.



Do you know?

Bir billing in Jogindernagar valley of Himachal Pradesh is known as para-gliding capital of India. In Tamil Nadu, Yelagiri is a good para-gliding spot.



Activity 2

Find out the places where wind energy is produced. Also discuss about the importance of wind energy in the classroom and make a report on your discussion.

❖ Parachutes and Hot air balloons

Parachutes and hot air balloons are used to land from above. In case of emergency, we can use parachutes and come down slowly and safely with the help of air.

❖ Wind energy

Air flows from high pressure region to low pressure region. This flow of air at high speed is called wind. This wind is used to generate electric power with the help of wind mills.



III. Air Pollution



The presence of harmful substances in the air which can have an adverse effect on living beings and the environment is called air pollution. When harmful substances including gases like carbon dioxide, carbon monoxide, sulphur dioxide etc., and particles like dust and aerosols are released into the earth's atmosphere, air pollution occurs. These substances are released into the atmosphere at a rate which exceeds the natural capacity of the environment to absorb them. Air pollution may cause diseases, allergies and even death to humans. It may also cause harm to other living organisms such as plants and animals. It may damage the natural environment also.

1 Causes of Air Pollution

Air pollution is caused by both natural and manmade activities. Air pollutants are released into the atmosphere through human activities like burning of fuels, releasing industrial wastes, mining etc. Natural events like volcanic eruption also cause air pollution. Let us see about some of the causes of air pollution in detail.

❖ Industries

Many industries have been established to manufacture things. Large amount of carbon monoxide, hydrocarbons, organic compounds, and chemicals are released into the air by these industries. Because of these pollutants quality of air is affected very much.



Do you know?

The word pollution is derived from the Latin word 'polluere' which means contamination or make dirty.



Activity 3

Organise a debate in your class about the advantages and disadvantages of industries. Discuss in what way industries are responsible for air pollution. Also discuss what measures can be taken to minimise air pollution caused by industries.

❖ Burning of fuels

Combustion of fossil fuels like coal and petroleum release sulphur dioxide which is an air pollutant. Major air pollutants are released by the vehicles including bus, cars, trains and airplanes. Improper or incomplete combustion of fuel releases carbon monoxide. Nitrogen oxides which are released by both natural and man-made processes, also cause air pollution.

❖ Agricultural activities

Use of insecticides, pesticides, and fertilizers in agricultural activities has increased in the modern days. They emit harmful chemicals such as ammonia into the air causing air pollution.

❖ Mining

Extraction of minerals from the earth is called mining. Mining processes release dust and chemicals into the air causing massive air pollution. This affects the health conditions of workers and people living in the surrounding areas.

❖ Household activities

Air is polluted through household activities also. While cleaning and painting, we use a lot of chemicals. These chemicals pollute the environment.



Do you know?

Taj Mahal in Agra is built entirely by white marbles. But, it has become yellow in colour in the recent years. It is because of air pollution. Industries located in these areas release lot of pollutants into the air. Every day 2000 metric tons of waste is being dumped into the city.



2 Effects of Air Pollution

Air pollution affects all living organisms including man. It causes serious health problems to human beings and affects both plants and animals. It brings about a lot of changes in the climate and environment also. In this section, let us learn about some of the effects of air pollution.

❖ Diseases

Air pollution causes several respiratory problems. Many people have died due to air pollution. Air pollutants cause pneumonia and asthma in children.

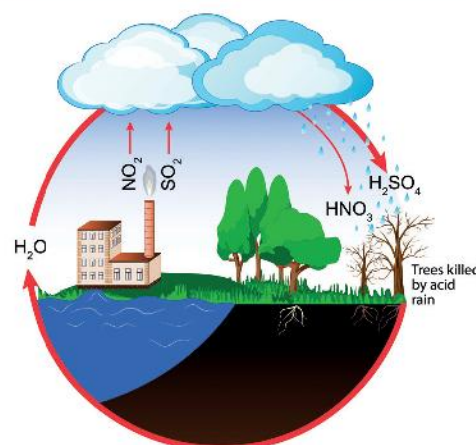
❖ Global warming

Air pollution results in the accumulation of carbon dioxide in the atmosphere. When gases like carbon dioxide are present in the atmosphere in large amount, they increase the atmospheric temperature. With increased temperature, melting of ice and icebergs in polar regions and increase in sea levels are taking place. It affects the organisms living there.



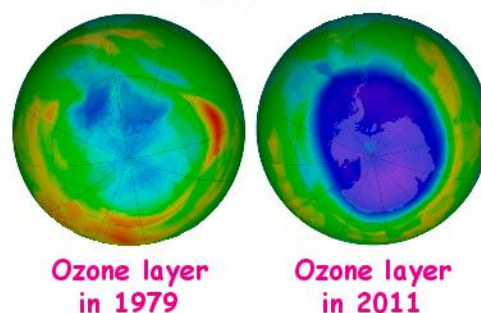
❖ Acid rain

As we saw earlier, harmful gases like nitrogen oxides and sulphur oxides are released into the atmosphere while burning fossil fuels. When it rains, the water droplets combine with these gases and fall on the ground in the form of acid rain. Acid rain affects human, animals, and crops.



❖ Depletion of ozone layer

Ozone molecules are present in the Earth's stratosphere and they protect humans from harmful ultraviolet (UV) rays. Chlorofluorocarbons, released into the atmosphere by human activities deplete the ozone layer. As the ozone layer is depleted, UV rays reach the earth and they cause skin and eye related problems to us.



❖ Marine life

Large amount of nitrogen present in some fertilizers is washed into the water bodies. They cause the growth of green algae in the water bodies. This is called Eutrophication. This adversely affects fish, plants and animal species.

❖ Effect on wildlife

Harmful substances present in the air affect wild animals. Wild animals move to a new place when the air is polluted. When their habitat is changed they face extinction.



Do you know?

Chemicals like chlorofluorocarbon (CFC) which are used in refrigerators, spray cans and fire extinguishers, have reduced the amount of ozone in the stratosphere. It has resulted in depletion of ozone layer in the Antarctic region.

3 Prevention of Air Pollution

If the air pollution increases at this rate, then there will be no life on the earth in the future. Future generation will be affected very badly. So, we need to take some measures to avoid air pollution. Some of them are discussed below.

- Major pollutants which cause air pollution come from automobiles. Using public modes of transport can reduce the rate of pollution. We should encourage others to use public transport.
- By reducing the usage of fossil fuels we can save the environment.
- Using non-renewable energy resources like solar energy and wind energy instead of conventional energy can reduce air pollution.
- We need to reduce our usage of things. We can reuse or recycle few items.
- Switch off fans and lights when you are not using them.
- CFL bulbs consume less electricity. By using these bulbs we can save energy.
- Planting more trees can reduce the amount of carbon dioxide in the atmosphere.



Activity 4

Find out the common air pollutants present in your area. Discuss about the effects of these pollutants. Record your observations in your note book.



IV. Airborne Diseases

Diseases which are caused by microorganisms and communicated through air are called airborne diseases. When we breathe in air, there are chances for the microorganisms present in the air to get into our body. Bacteria, virus and fungi are the microorganisms which cause airborne diseases. These microorganisms are transmitted through droplets caused by coughing or sneezing, breathing and talking. Let us study about some of the airborne diseases here.

1 Diseases caused by Bacteria

Diphtheria, Whooping Cough and Tuberculosis are some of the common airborne diseases caused by bacteria.

❖ Tuberculosis

Tuberculosis is caused by the bacteria, *Mycobacterium tuberculosis*. When we breathe, the bacteria present in the air get into the lungs and affect it. Infected person has to be treated with anti-tuberculosis drugs for a period of 6 months to 1 year.

❖ Whooping Cough

Whooping cough is caused by *Bordetella pertussis*. It also affects the respiratory tract and causes mild fever, severe cough ending in whoop.

❖ Diphtheria

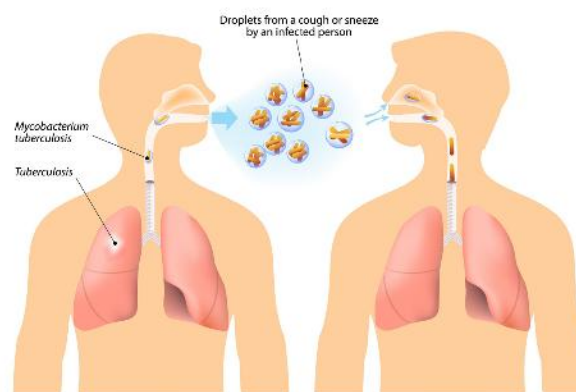
It is caused by the bacteria, *Corynebacterium diphtheriae*. It generally affects the upper respiratory tract (nose and throat) and causes fever, sore throat and choking of air passage.



Do you know?

National TB Control Programme was started in 1962.

World Tuberculosis Day is observed on 24th March.



Disease	Causative Organism	Mode of Transmission	Tissue/Organ affected	Symptoms
Tuberculosis	Mycobacterium tuberculosis	Droplet infection from sputum of infected persons	Lungs	Persistent cough, Chest pain, Loss of appetite, Loss of weight
Whooping Cough	Bordetella pertussis	Droplet infection from sputum of infected persons, Direct contact.	Respiratory tract	Mild fever, Severe cough ending in whoop
Diphtheria	Corynebacterium diphtheriae	Droplet infection from sputum of infected persons	Upper Respiratory tract	Fever, Sore throat, Choking of air passage

2 Diseases caused by Virus

Some diseases are caused by the virus present in the air. Common cold, influenza, measles, mumps and chicken pox are some of the diseases caused by virus.

❖ Common cold

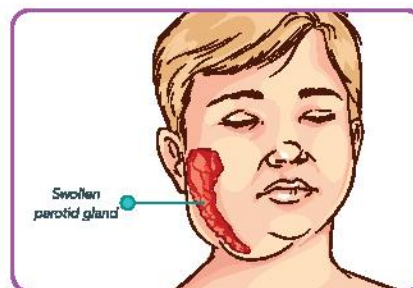
Common cold is an infectious disease which affects the upper respiratory system like nose and throat and it is easily spread. Symptoms of common cold include cough, painful throat, running nose and sometimes fever. Though many viruses can cause this, it is generally caused by Rhinovirus.

❖ Influenza

Influenza is commonly found during childhood. It is caused by the virus, Myxovirus and results in inflammation of nasal mucosa and pharynx. It is also known as flu.

❖ Mumps

It is caused by *Myxovirus parotitis* and it affects the upper respiratory tract. Some of the common symptoms of mumps include fever, headaches, sore throat and swelling of parotid glands which makes the jaw movement difficult.



❖ Chicken pox

It is common among children but adults also may get it. Affected people will have blisters or spots in the body and face along with fever. Those blisters with fluid will drain but sometimes they may leave scars.

❖ Measles

Measles is caused by *Rubeola virus* and it is easily caught by people from other infected people. Symptoms of measles include eruption of small rashes in skin, cough, sneezing, redness of eye, pneumonia and bronchitis. There is no cure for this disease. Yet people can recover from this by proper rest and diet.



Disease	Causative Organism	Mode of Transmission	Tissue/ Organ affected	Symptoms
Common Cold	Rhino virus	Droplet infection	Upper respiratory tract (Inflammation of nasal chamber)	Fever, Cough, Running nose, Sneezing and Headache
Influenza	Myxovirus	Droplet infection	Respiratory tract (Inflammation of nasal mucosa, pharynx)	Fever, Body pain, Cough, Sore throat, Nasal discharge, Respiratory congestion
Mumps	Myxovirus parotitis	Droplet infection, Contact with infected person	Upper respiratory tract	Enlargement of parotid gland, movement of jaw becomes difficult
Chicken Pox	Varicella Zoster virus	Droplet infection, Direct contact with infected person	Respiratory tract	Eruptions of the skin, Fever and Uneasiness
Measles	Rubeola virus	Droplet infection, Direct contact with infected person	Respiratory tract	Eruption of small red spots or rashes in skin, Cough, Sneezing, Redness of eye, Pneumonia, Bronchitis

3 Prevention

Prevention is better than cure. Airborne diseases can be prevented if we take certain measures.

- Avoid close contact with people who have active symptoms of disease.
- Maintain personal hygiene.
- Keep the patient in complete isolation.
- Cover nose and mouth while sneezing or coughing.
- Avoid touching the face with unwashed hands.
- Wash your hands thoroughly.
- Timely vaccination can prevent the diseases.



Activity 5

Divide the students in the class into different groups and discuss how airborne diseases can be prevented.



Avoid over-crowded places



Stay away from people with viral infection



Use disposable tissues



Cover mouth, nose while coughing or sneezing



Evaluation



I. Choose the correct answer.

1. Chlorofluoro carbon is used in
 - a) refrigerator
 - b) air conditioners
 - c) both
 - d) none
2. Which of the following gas is released by automobiles?
 - a) Carbon monoxide
 - b) Oxygen
 - c) Hydrogen
 - d) Nitrogen
3. A wind mill is used to produce
 - a) chemical energy
 - b) mechanical energy
 - c) electrical energy
 - d) all of these



4. Influenza is caused by

- a) fungus b) bacteria c) virus d) protozoa

5. Height of mesosphere which lies after troposphere is

- a) 70 to 75 km b) 75 to 80 km c) 50 to 85 km d) 85 to 90 km

II. Fill in the blanks.

1. Second layer of Earth's atmosphere is _____.
2. Releasing substances like chemical compounds into the atmosphere is known as _____.
3. Airborne diseases can be caused by _____.
4. The _____ layer protects us from the harmful UV rays coming from the sun.
5. _____ is used by plants as nitrates.

III. Match the following.

- | | | |
|-----------------|---|----------------|
| 1. Troposphere | - | Satellite |
| 2. Stratosphere | - | Space craft |
| 3. Exosphere | - | Ozone layer |
| 4. Thermosphere | - | Meteors |
| 5. Mesosphere | - | Weather change |

IV. Answer in brief.

1. What are the different layers of atmosphere?
2. What is air pollution?
3. Name some of the air borne diseases.
4. What is global warming?
5. Mention any two ways of controlling air pollution.

V. Answer in detail.

1. List the importance of air.
2. Explain any three airborne diseases.

VI. Higher Order Thinking Questions.

1. If there is no atmosphere, what will be the condition of earth ?
2. Give some suggestions to prevent air pollution.

