ENVIRONMENT EDUCATION

STANDARD ELEVEN

The Coordination Committee formed by GR No. Abhyas - 2116/(Pra.Kra.43/16) SD - 4
Dated 25.4.2016 has given approval to prescribe this textbook in its meeting held on 20.06.2019 and it has been decided to implement it from academic year 2019-20.

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The Constitution of India

Preamble

WE, THE PEOPLE OF INDIA, having solemnly resolved to constitute India into a SOVEREIGN SOCIALIST SECULAR DEMOCRATIC REPUBLIC and to secure to all its citizens:

JUSTICE, social, economic and political;

LIBERTY of thought, expression, belief, faith and worship;

EQUALITY of status and of opportunity; and to promote among them all

FRATERNITY assuring the dignity of the individual and the unity and integrity of the Nation;

IN OUR CONSTITUENT ASSEMBLY this twenty-sixth day of November, 1949, do HEREBY ADOPT, ENACT AND GIVE TO OURSELVES THIS CONSTITUTION.

NATIONAL ANTHEM

Jana-gana-mana-adhināyaka jaya hē
Bhārata-bhāgya-vidhātā,

Panjāba-Sindhu-Gujarāta-Marāthā
Drāvida-Utkala-Banga

Vindhya-Himāchala-Yamunā-Gangā
uchchala-jaladhi-taranga

Tava subha nāmē jāgē, tava subha āsisa māgē,
gāhē tava jaya-gāthā,

Jana-gana-mangala-dāyaka jaya hē
Bhārata-bhāgya-vidhātā,

Jaya hē, Jaya hē, Jaya hē,
Jaya jaya jaya, jaya hē.

PLEDGE

India is my country. All Indians are my brothers and sisters.

I love my country, and I am proud of its rich and varied heritage. I shall always strive to be worthy of it.

I shall give my parents, teachers and all elders respect, and treat everyone with courtesy.

To my country and my people, I pledge my devotion. In their well-being and prosperity alone lies my happiness.

Preface

Dear Students/Readers,

The Maharashtra State Curriculum Framework 2010 (SCF 2010) has been prepared in accordance to the National Curriculum Framework 2005. The present book is organised according to teaching and learning approaches and materials based on SCF 2010. The Hon'ble Supreme Court (SC) has directed that Environment Education (EE) to be compulsory at all levels of education. Following the directives given by the SC, EE has been decided to be a separate and compulsory subject at 11th and 12th standard.

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Maharashtra State has prepared the book which includes major concepts of environment which shall encourage collaborative learning and group activities to facilitate peer learning. The book has been prepared for constructivist approach and activity based teaching-learning. The contents have been presented in a graded manner to facilitate knowledge building with the illustrations relevant to the content of the syllabus. The textbook highlights the measures for protection and care of the environment, conservation of Biodiversity, Natural resources and management of disasters. The topics are included to facilitate understanding of the sustainable development. The interactive processes of social, environmental and economic problems and the ways and means to solve them are presented.

This textbook also considers appropriate environmental case studies related to various topics in the book. The teachers are encouraged to emphasize this view and try to apply it during transaction of the syllabus. The curriculum, emphasises student activities as the main vehicle of learning. At the higher secondary stage, to ensure the continuation of proactive action towards the environment, the core course is considered compulsory course in a project and theory exam-based evaluation mode.

Such approach would help in understanding of practical environmental issues and will also enhance student's motivation and contribution towards solving current problems. Different examplar activities and project work suggested (but not restricted to) in the textbooks provide exposures to the practical environmental issues. The project-based learning would ensure learning to bring forth good, sensitive, rational citizens. A careful planning and preparation can lead to successful implementation of this approach. Expert views and suggestions are included in this book. Hope that the content of this book will help students and teachers understand and act upon responsibly towards environment.

The Maharashtra State Bureau of Textbook Production and Curriculum Research, Pune, looks forward for feedback and suggestions from teachers, parents and other readers.

(Dr. Sunil Magar)
Director
Maharashtra State Bureau of
Textbook Production and
Curriculum Research, Pune

Pune
Date : 20 June 2019
Bharatiya Saur Dinank : 30 Jyeshtha 1941

CLASS 11 ENVIRONMENT EDUCATION

COMPANTORY STATEMENT

- Develop skills of observation and explore the natural and social environment, gradually moving from immediate to the wider environment.
- Develop a concrete understanding of integrated perspective of environment.
- Explore, understand, appreciate and value his/her opinion on local and regional environmental issues.
- Share the details of the observed objects/events/ phenomenon orally/ written/ drawings/any other ways of choice with reference to the explained/observed scope and importance of environment.
- This produces a deeper understanding of issues related to sustainability at national, state and local levels.
- Gain knowledge, discuss and appreciate the efforts of different organizations.
- Describe and document the efforts involved in supporting actions that shall positively affect the attitudes to subscribe to the vision and adopt global environmental welfare and eventually develop sensitivity towards concerned environmental issues.
- Accepts and takes responsibility in a more refined manner, poses questions and finds answers through reflection, discussion, designing and performing appropriate activities.
- Generate awareness, explore, share, narrate the natural and social environment from lived experiences.
- Understand the relationships between natural and social environment within and beyond classroom through the opportunity providing concrete learning experiences.
- Develop various processes/skills through the interaction with the natural and social environment.
- Generate an understanding of the classified structure and related function of ecosystems.
- Identify surrroundings based on observable features, similarities and differences in ecosystems, sorts/groups features based on observations.
- Observe, relate, share and explain experiences about the dynamics of ecosystem, processes and phenomenon with causes.
- Finds an opportunity to apply learnt scientific concepts in day-to-day life.
- Relate to the real situations in their surroundings.
- Understand the term biodiversity and the levels of biodiversity.

CLASS 11 ENVIRONMENT EDUCATION

COMPANTORY STATEMENT

- Understand, get sensitized and be able to explain the values of biodiversity with the help of examples.
- Appreciate the variations/ diversity in natural and social environment and develop a scientific understanding of the variations and the need to respect them.
- Obtain information regarding 'India a megadiversity nation'.
- Explain the threats of biodiversity and its effects.
- Understand the conservation of biodiversity as a social responsibility.
- Explore different types of natural resources, appreciate the interdependence and interrelatedness of all living things and life support systems.
- Comprehend various environmental problems and develop necessary insights and attitudes towards solving them methodically.
- Collect the informationn of conservation of natural resources.
- Develop a concrete understanding of the risk of disasters and appreciate types and effects of natural and man-made disasters.
- Develop skills for preparedness before potential disasters and be able to prepare a disaster emergency kit and management strategie.
- Be equipped to avoid or to minimize damage during disasters following precautionary measures and systematic preparedness.
- Prove to be an immense aid for community welfare in managing the event.

- For Teachers -

To begin with, get familiar with the textbook yourself.

- ✓ Please refer to the related textbooks of earlier classes before teaching the topics of this textbook.
- ✓ Please plan carefully and independently for the activities of each chapter.
- ✓ The teaching-learning interactions, processes and participation of all students is necessary through your active guidance.
- ✓ Please use proper teaching aids in the class room for appropriate understanding of the subject such as audio-visual aids, apps etc.
- ✓ You are expected to use the given number of periods fully. Do not finish the chapter in short. This will help the students to assimilate the content without feeling the 'burden of learning'.
- ✓ Major concepts of environment have a scientific base and they also deal with social aspects. Encourage group activities, learning through each other's help etc. Facilitate peer learning as much as possible by recognizing the class structure frequently.
- ✓ Do not ask questions on statistical information. Instead, ask questions on their trends or patterns.
- ✓ The present book has been prepared for constructivist and activity-based teaching-learning.
- ✓ Follow the order of the chapters as given because the concepts have been introduced in a graded manner to facilitate knowledge building.
- ✓ Use QR code given in the textbook. Some websites have been given for reference. A list of references used is provided. You as well as the students are expected to use these references. These references will surely help you to go beyond the textbook. Please bear in mind that extra reading is always helpful for understanding any subject in depth.
- ✓ The thought-provoking, activity-oriented, open ended, multiple choice-questions, short and long questions are considered for evaluation. Some examples are given at the end of the chapters in the 'exercise'.

Contents

Contents

Front Page : The componenets of earth and positive actions for envioronment and sustainability.

Back Page : In day to day life what do's and don'ts regarding recyclable product.

1. Environment and Sustainable Development

1.1 Interdisciplinary nature of Environment.

"Environmental studies deal with every issue that affects living organisms. It is essentially a multidisciplinary approach that brings about an appreciation of our natural world and human impact on its integrity."

The word environment is derived from the French word "***Environ***" meaning "Surroundings" i.e. everything around us is environment.

Do you know?

World Environment Day is celebrated on 5th June every year.

The Stockholm Conference:

United Nations International Conference on Human Environment, was held at Stockholm, Sweden, from 5th June to 14th June 1972. It was attended by representatives of 114 nations. For the first time respective governments at the highest level came together to take note of how mankind had misused our environment of which we are an integral part. 150 Action plans and 20 principles were approved to protect the delicate balance of ecosystems and to preserve them for the coming generation. The conference adopted the motto "Only one earth" for the entire humanity. The conference declared 5th June as World Environment Day.

Environment provides us with a basic life support system through air, water and food. We can not continue to survive without protecting the earth's environmental resources.

Basic terms related to the environment:

1. **Environment :** It includes all aspects of the world around us in which humans, animals and plants live.
2. **Ecology :** The science that studies the relationships between living and non-living things. It studies the structure and function of nature.
3. **Environmental Science :** It is the systematic and scientific study of our environment. It integrates knowledge from the pure sciences, ecology, engineering, management, social sciences and other aspects.
4. **Environment Education :** A subject concerned with learning on all environmental issues. It has a wider coverage than environmental science or ecology. It also includes the social aspects of the environment.
5. **Environmental Degradation :** It is the damage caused to the environment due to various human activities which harm our surrounding. For example: Deforestation, pollution of water, air, soil etc.
6. **Environmental Conservation:** It includes ways in which to protect nature and control the damage caused to our natural environment. For example when we prevent the killing of wildlife, or we turn a barren land into a forest, we are conserving the environment.

The environment consist of four segments. These are 1. Atmosphere 2. Hydrosphere 3. Lithosphere 4. Biosphere

1. Atmosphere

About 99% of the total earths atmospheric mass is concentrated in the first 30 km above Earth's surface. Based on characteristics such as temperature and composition, the earth's atmosphere can be divisible into following layers –Troposphere, Stratosphere, Ionosphere, Exosphere.

Layers of Atmosphere;

1) Troposphere : Troposphere is at about 12 km from Earth's surface. The lowest layer from the surface of the earth is known as " Troposphere ". The temperature decreases according to the height at this level. The drop of temperature rate at every 160 m height is about 10^0C. The temperature differs at different heights and at different layers. Although this layer is smaller than the other layers, it is important as regards the weight of the air and it covers 80% of the atmospheric air. Other elements of the air are vapour, water molecules, dust and microscopic organisms are found in this layer. This layer is very important and useful for the life of living beings. in which rain, wind, storm, hail, snow, clouds etc. exist.

Tropopause the layer that separates troposphere and stratosphere layers is called as tropopause which is at 2 to 3 km above the troposphere. It is umbrella like coat of air which has stable air. Rain, wind, lightning, clouds, storm, etc., do not exist in this layer. The tropopause has a width of 1.5 km, and temperature of this layer is about - 53° C. It also contains high amount dry ozone.

2) Stratosphere : Stratosphere is a layer between tropopause and stratopause. The height of this layer keeps changing according to seasons. Temperatures remain constant for certain height of the layer. But beyond 32 Km of height, the temperature increases. This layer is called 'Isothermal Zone'. The heat from the sun is absorbed in this layer hence temperature is retained. The extension of this layer is much higher in the summer than in the winter. The air in this part of the atmosphere is sparse. Humidity, dust, clouds, etc. are not exactly the same.

Ozonosphere is a layer of Ozone which cover at a height of about 20 to 35 km from the surface of the earth. When the ultraviolet radiation from sunlight come in contact with oxygen, they are processed and ozone (O_3) gas is produced. Ozone layer absorbs the harmful ultraviolet rays radiated from Sun, hence the temperature of Ozone layer increases. This layer protects life on Earth. Hence ozone layer is called "Protective umbrella of earth ". Today, due to increasing pollution, the layer of ozone is becoming weak, that results in increase in global temperature, (Global Warming). This has become a serious matter in terms of survival of living organisms.

3) Ionosphere: Ionosphere is a layer found beyond the stratosphere, around 360 to 400 km from the surface of the earth, which is until the end of atmosphere. It extends from 104 to 112 km from the surface of the earth. The radio waves travel from this layer to the Earth, because of which we can listen to

the radio. Only 1% of the air is present in this layer of the total atmospheric air.

The mesosphere extends upto 85 km from stratosphere. The top of the mesosphere, called mesopause, is the coldest part of Earth's atmosphere with temperatures avaranging about -130^0 F (-90^{0}C). Jets and ballons don't go high enough in this layer.

4) Exosphere :

Exosphere extends from 500 to 750 km from the surface of the earth. At a height of about 490 km radio waves of a temperature of 1700^0 C has been detected through rocket and radio waves. This layer predominantly contains neutral atoms of Oxygen, Helium and Hydrogen. At a height of about 2000 km, the Neutral atoms have an effect called a magnetic circle.

Role of atmosphere in climate :

Earth is able to support a wide variety of living beings because of its diverse regional climate, that ranges from extreme cold at the poles to tropical heat at the Equator. A region's climate is often described, for example, as sunny, windy, dry or humid, but while the weather can change in just a few hours, climate changes over a longer span of time.

Earth's global climate is an average of regional climates. Today, we are experiencing unusually rapid warming. The scientific consensus is that, the greenhouse gases are increasing because of human activities and trapped heat in the atmosphere.

2. **Hydrosphere:** Hydrosphere covers more than 71% of the earth's surface either as oceans (salt water) or as fresh water. Hydrosphere includes (both surface and underground water) sea, rivers, oceans, lakes, ponds, streams and wetlands.

3. **Lithosphere:** It includes the Earth's crust and upper mantle. It contains the fossil fuels and minerals and the soil chemicals (nutrients) needed to support plant life.

4. **Biosphere :** The portion of earth where living (biotic) organisms are found and interact with one another and with their non-living (abiotic) environment. This zone of life includes, plants, animals, and their habitat.

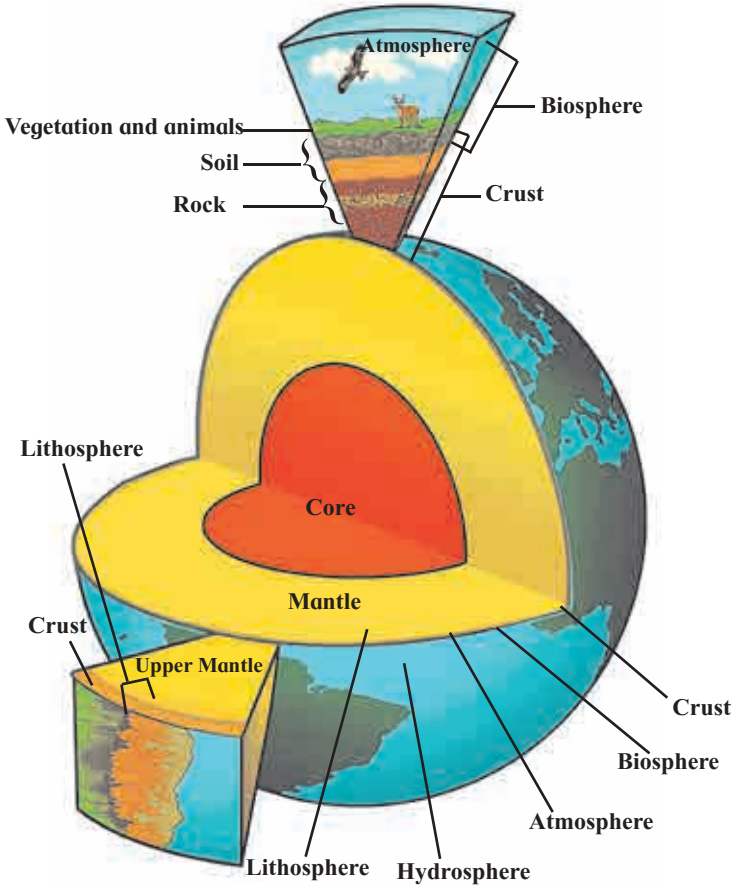


Figure 1.1 : Our life support system: The general structure of the earth

1.2 Scope and Importance

Environment is not a single subject; it is an integration of several subjects that includes both science as well as social science. To understand all the aspects of our environment, we need to know about life sciences, chemistry, physics, geography, resource management, economics, and engineering and social science, population, issues of poverty, resource use and allied issues. Thus the scope of environment education is extremely wide and covers some aspects of nearly every major discipline.

If we study the natural history of the areas in which we live, we would see that our surroundings were originally a natural landscape such as forest, river, mountain, desert, marine environment or a combination of these elements. Most of us live on landscapes that have been profoundly modified by human beings into villages towns or cities. We get our food supply from surrounding villages which in turn, are dependent on natural landscapes such as forests, grasslands and rivers for resources.

The industrial development and intensive agricultural practices that provide the goods for our increasing consumer oriented society uses up a large amount of natural resources. Consequently, these will get exhausted in the near future. If we continue to extract them. There will be nothing left for the next generations. Rapid economic growth and unplanned development has inevitably led to environmental degradation.

The environment affects us in many ways due to weather changes and quality of air and water. We in turn affect the natural environment often negatively. We cut trees or throw away our garbage, which has an adverse effect on the environment.

In the industrialized era that we live in today, every component of our environment such as air, water or food are impacted by industrial activities, infrastructure development, population explosion and pollution.

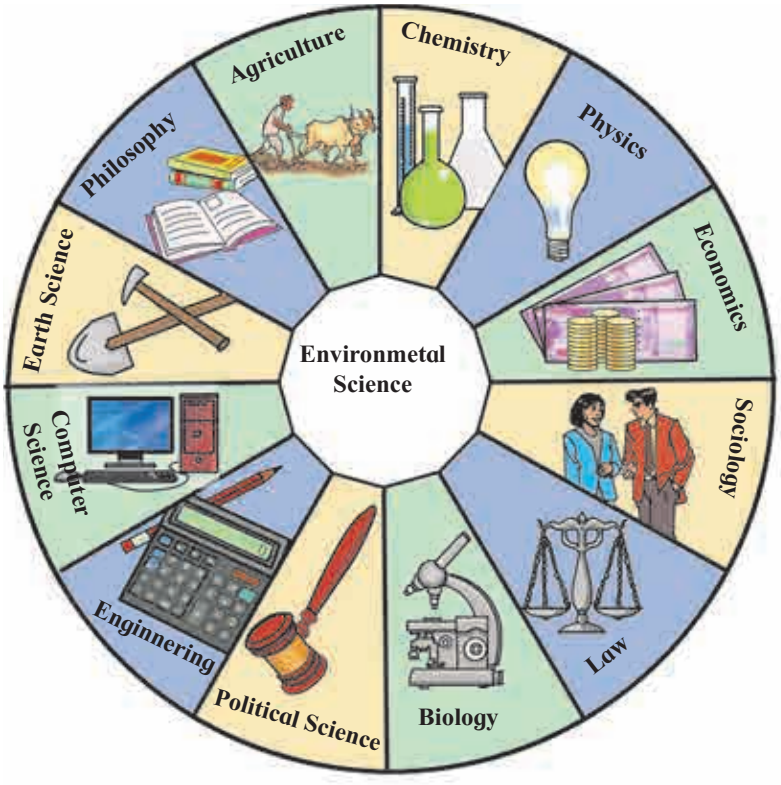


Figure 1.2: Interdisciplinary nature of Environment

How can you contribute to our Environment

1. Gain knowledge about various types of environmental problems and different environmental hazards.
2. By creating a concern and respect for the environment.
3. Begin to appreciate and adopt the ideas of development without destruction of the environment.
4. Play an effective role in protecting the environment by understanding and following environmental laws.

Learning by doing can be achieved in the environment by doing experiments at micro and macro levels with air, water, soil, plants, animals and their interactions with each other.

Environment Education and Awareness:

Since 1970, many National and International Conferences have been held, to enhance environmental awareness. However, most people recognize the urgent need for more information and action through environmental education. India is one of the major countries having large number of NGO's working on environmental awareness campaigns.

The role of mass media and various public institutions that furthered environment awareness is a key to better environmental management. This will need to integrate economic long term growth with the needs of environmental conservation.

Increasing population, urbanization and poverty have generated pressure on natural resources and led to environmental degradation. To prevent the environment from further degradation, Hon'ble Supreme Court of India has ordered and initiated environmental protection awareness programs through government and non government agencies who must take part in protecting our environment .

Environmental pollution cannot be prevented by laws alone. Public participation is equally important for environmental protection.

Environment education is a process of learning by giving an overall perspective of knowledge and awareness of the environment. It sensitizes the society about environmental issues and challenges. Individuals must develop relevent skills, expertise and must be able to provide appropriate solutions.

Activity: 1

With the help of your teacher and internet, find out the details of any two international conferences on environment. Write the information related to this and prepare an informative poster for the class.

Steps of Environment Education:

1. **Knowledge:** Provide individuals with information to acquire basic understanding of environment, its associated problems and their solutions.
2. **Awareness:** Help communities to create awareness of their own environmental issues and sensitize them towards environmental problems and solutions.
3. **Attitudes:** Help individuals acquire a set of values and feelings of concern for the environment and motivation for active participation in environmental improvement and protection activities.
4. **Skill :** Develop skills for identification of problems and provide solutions for environmental management.
5. **Values :** Imbibe and inculcate values and the need for conservation of natural resources.

1.3 National and International Organizations

There are several government and non-government organizations (NGOs) that are working towards environmental protection and for conservation of natural resources.

A) Botanical Survey of India (BSI)

BSI was established in 1890 with the objectives of exploring the plant resources of the country and identifying plant species with economic values. Its headquarter is located in Kolkata.

The objectives of BSI are undertaking intensive floristic surveys and collecting accurate and detailed information on the occurrence, distribution, ecology and economic utility of plants in the country.

B) Forest Research Institute (FRI)

FRI was established in 1906at Dehradun to conduct training research and management of protection of forest.

The institute provides training for forest officers and forest rangers of our country.

C) Zoological Survey of India (ZSI)

ZSI was established on 1st July, 1916 to promote survey, exploration and research leading to the advancement of our knowledge in various aspects of animal life. Its headquarter is located in Kolkata.

The main objectives of ZSI are exploration, survey, inventorying and monitoring of faunal diversity in various states, ecosystems and protected areas of India.

D) The International Union for Conservation of Nature (IUCN)

IUCN, was established on 5th October 1948. As the first global environmental union, it brought together governments and civil society organizations with a shared goal to protect nature. Its aim is to encourage international cooperation and provide scientific knowledge and tools to guide conservation action. Its headquarter is located in Switzerland.

IUCN played a fundamental role in the creation of key international conventions, including the Ramsar Convention on Wetlands (1971), the World Heritage Convention (1972), the Convention on International Trade in Endangered Species (CITES),(1974) and the Convention on Biological Diversity (CBD), (1992).

In 1980, IUCN in partnership with the United Nations Environment Programme (UNEP) and the World Wildlife Fund (WWF) published the World Conservation Strategy : a ground-breaking document which helped define the concept of 'sustainable development' and shaped the global conservation and sustainable development agenda.

E) National Environmental Engineering Research Institute (NEERI):

NEERI, in Nagpur is a constituent of Council of Scientific & Industrial Research

(CSIR), New Delhi and has a nation-wide presence with its five zonal laboratories at Chennai, Delhi, Hyderabad, Kolkata and Mumbai. The mandate of NEERI is to conduct research and developmental studies in environmental science and engineering, to render assistance to the industries of the region and local bodies in solving the problems of environmental pollution.

It's vision is to create Leadership in Environmental Science and Engineering for Sustainable Development.

F) World Wildlife Fund for Nature (WWF)

WWF was established in April, 1961 at Switzerland. The Giant Panda became the logo for WWF. WWF's wildlife trade arm, TRAFFIC (Trade Record Analysis of Flora and Fauna In Commerce), launched an extensive publicity campaign to combat illegal wildlife trade in 1986.

WWF aims to stop the degradation of the planet's natural environment and build a future in which humans live in harmony with nature.It aims in conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, promoting the reduction of pollution and wasteful consumption.

Activity :2

1. Collect Information about wild animals, birds which are reared in your locality.
2. Educate people that it is illlegal activity and it is against law to keep wild animals and birds in their houses.

G) United Nations Environment Programme (UNEP)

UNEP was established in 1972, with headquarter at Nairobi, Kenya. It is the leading global environmental authority that sets the global environmental agenda. It also promotes the implementation of environmental dimensions of sustainable development within the United Nations system.

UNEP's mission is "to provide leadership and encourage partnership in caring for the environment by inspiring, informing and enabling nations and people to improve their quality of life without compromising that of future generations."

H) Central Pollution Control Board (CPCB)

CPCB is a statutory organisation, constituted in 1974 under the Water (Prevention and Control of Pollution) Act, 1974. Further, CPCB was entrusted with the powers and functions under the Air (Prevention and Control of Pollution) Act, 1981.

The functions of the Central Pollution Control Board at the National Level is to advise the Central Government on any matter concerning prevention and control of water and air pollution and improvement of the quality of air.

I) Maharashtra Pollution Control Board (MPCB)

MPCB was established in 1970.

The functions of MPCB includes.

- To collect, plan and

disseminate comprehensive information program for the prevention, control or abatement of pollution.

- To inspect sewage or effluent treatment and disposal facilities, and air pollution control systems.
- Supporting and encouraging the developments in the fields of pollution control, waste recycle-reuse, eco-friendly practices etc.
- Creation of public awareness about the clean and healthy environment.

J) Bombay Natural History Society (BNHS)

BNHS, was the pioneer orgnisation started for conservation in India. A pan-India wildlife research organization, was initiated in 1883. It is one of the largest non-governmental organizations in India engaged in conservation and biodiversity research. It supports many research efforts through grants and publishes the Journal of the Bombay Natural History Society.

It's mission is conservation of nature, primarily biological diversity through action based research, education and public awareness.

It's vision is to excel in the conservation of threatened species and habitats.

Main activities of BNHS include natural history collection, research on various species and habitat, conservation of landscapes and seascapes, environmental information system, outreach (camps, exhibitions, lectures, and other events), conservation education centres, communications and advocacy, university studies, library, wildlife publications and souvenirs.

Activity : 3

Try to identify the organizations that work for the conservation of forest, birds, wild life, rare plants and animals species.

K) Wildlife Institute of India (WII)

Established in 1982, Wildlife Institute of India (WII) is an internationally acclaimed Institution, which offers training program, academic courses and advisory in wildlife research and management. The Institute is actively engaged in research across the breadth of the country on biodiversity related issues. Its headquarter is located at Deharadun.

The aims and objectives of WII are :

- To build up scientific knowledge on wildlife.
- To train personnel for conservation and management of wildlife and carry out research.
- To collaborate with international organizations and develop as a regional center of international importance.

L) Environmental Information System in India (ENVIS)

In 1982, the Government of India established an Environmental Information System (ENVIS) .that provides environmental information to decision makers, policy planners, scientist, engineers, researchers etc. across the country.

Activity:4

Visit a scientific organization / NGO working in the field of environment and find out the work it does in nearby your locality.

1.4 Contribution of people for environment protection

Dr. Salim Ali was an Indian ornithologist and naturalist, often referred to as the "Birdman of India." He was the first person to introduce systematic ornithology when nobody was aware of distribution of birds in India. Keoladeo National Park (Bharatpur Bird Sanctuary) was established after Dr. Salim Ali's continuous interventions. He fought to save the Silent Valley National Park in Kerala, where the government planned to construct a hydroelectric power project. His research on the habitat of weaver birds was appreciated by ornithologists all over the world. In 1967 he received the J. Paul Wildlife Conservation award, a prestigeous award in conservation.

M. C. Mehta undoubtedly India's most famous environmental lawyer since 1984, has filed several Public Interest Litigations (PILs) for supporting the cause of environmental conservation. His most famous and long – drawn battles includes protecting the Taj Mahal, cleaning up the Ganga river, banning intensive shrimp farming on the coast, initiating government to implement environmental education in the schools and colleges and variety of other conservation issues.

Through his work, Mehta has the national agenda in the field of water and air pollution, vehicular pollution control, coastal zone conservation and the translocation of heavy industries from urban areas. He has obtained more than forty landmark judgments and numerous orders from the Honb'le Supreme Court against the polluters.

What do we learn?

It shows that there are adequate environmental laws in India, to further conservation of natural resources and prevent pollution. We can use them, when we wish to take action against the environmental destruction caused by unsustainble development. More importantly, Mehta's work has shown what a single determined individual could do to protect the environment. His story is an inspiration to all of us.

Activity 5 :

1. Find out more about the air pollution on Taj Mahal.
2. Ganga Action Plan.

Sundarlal Bahuguna initiated Chipko movement which became an internationally well-known example of highly successful conservation action programs through the efforts of local people for guarding their forest resources.

His fight to prevent the construction of the Tehri dam in a fragile earthquake – prone setting is a battle that he continued to wage.

Dr. M. S. Swaminathan is called as the Father of Green Revolution of India. He was one of India's foremost agricultural scientist and has showed concern about various aspects of biodiversity conservation of both traditional crops and wild species. He has founded the Dr. M. S . Swaminathan Research Foundation in Chennai, which works for the conservation of biological diversity.

Activity 6:

Make a list of people who have worked in Maharashtra for environment conservation and document the work done by them.

Do you know?

Story of Bishnois:

The Bishnois of Rajasthan have been known for their concern for trees, birds, and animals. In 1730, Abhaysingh, the king of Jodhpur, wanted large quantities of wood for burning bricks to build his new palace. He sent his minister Giridhardas, with wood cutters to cut the trees in the Bishnois in the Khejarli village.

Amritadevi a local resident of the village wanted to save the tree. She rushed in and hugged the tree to protect them. She told Giridhardas and cutters to stop operations. Her daughters too followed her example. Giridhardas ordered his men to proceed and they cut down the trees and the women. The news spread and more villagers came to the rescue of the trees. But the cutting continued and by nightfall, 363 people had given their lives for the cause of forest protection. When the king heard the news, with remorse, he banned felling of trees in the Bishnoi forest forever.

The Bishnois have religiously followed these ecofriendly rules. Since Khejarli, there have been many incidences of nature protection by this community.

The Government of India has instituted the Amritadevi Wildlife Protection Award to be given to village community that show valour and courage for the forest and wildlife protection.

What we learn from the story?

The Bishnois are an inspiring example of how human society can make environmental conservation a part of its tradition.

1.5 Sustainable Development

India is an emerging economy with diverse communities, cultures and religions.It covers a vast geographical area and long coastline. Topographically the Indian subcontinent is diverse.It has 10 distinctive biogeographic zones. India has been experiencing rapid growth in population which has led to socio-economic inequity and rampant uncontrolled growth patterns which has led to environmental degradation. All this would obviously have long term negative impacts on the environment and its consequences would be felt particularly by the socio-economically challenged groups and our future genrations.

To combat the problems of unsustainable growth patterns, post Stockholm Conference of 1972, India adopted the concept of Sustainable Development (SD). In 1992, during the United Nations Conference on Environment and Development (UNCED); India became a part of the 187 countries pledging their commitment towards achieving Sustainable Development by signing the Rio Declaration.

In 1992 during the Earth Summit of the UNCED, the role of education in achieving Sustainable Development was a major concern (Agenda 21). Education has been considered as one of the basic requirement and tool towards achieving Sustainable Development. Educating people from all walks of life would serve the dual purpose of creating awareness about environment conservation and protection.Thus safeguarding the environment would help to combat and reduce the socio-economic inequity by empowering people through education.

The Government of India later recommended the Ministry of Human Resource Development to integrate environmental concerns, issues and awareness in education at all levels.

In its 57th meeting in December 2002 (UNESCO, 2002), the UN General Assembly proclaimed the UN Decade of Education for Sustainable Development (DESD), 2005-2015, emphasized that 'education is an indispensable element for achieving sustainable development.

Education is often considered to be done in classrooms. According to UNESCO (2004), Education for Sustainable Development (ESD) is formal education, but it extends to daily social and professional life. ESD can make education 'participatory'. This enhances the problem solving capacities of young people through processes which enable collaboration and dialogue.

Concept of sustainable development

Sustainable Development refers to development which can meet the needs of the present generation without compromising on the ability of the future generations to meet their own needs (Brundtland Report, 1987).

There are three aims of sustainable development

1. **Economic -** to attain balanced growth
2. **Environmental -** to preserve the environment
3. **Social-** to include all human communities to access all resources.

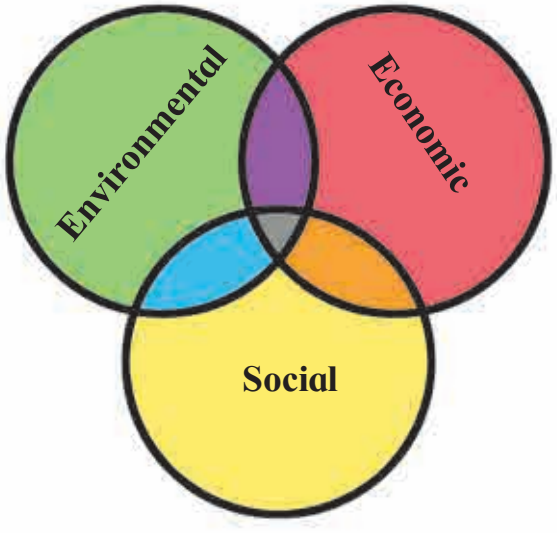


Figure 1.3 : Three aims of sustainable development

The concept of "needs" refers to essential needs of human beings. Millions of people today do not have adequate food, proper house, clean drinking water or basic education. The definition suggest that such essential needs of all people must be met with. But at the same time the pattern of development has to be such that future generations would also be able to meet their own needs from the resources without destroying or degrading nature. This may include water resource, productivity of various ecosystems, quality of air etc.

Development conventionally means enhancing economic well-being and wealth. Well-being of an individual or family and community depends on several factors apart from income levels. Development is more than economic growth. The development achieved in the short term may not continue over time and is unsustainable in the longer term.

Think and Act….

The past and present generations used energy from fossil fuels for domestic and industrial processes. This use in energy has led to the global climate change. How do conserve energy in daily life.

1. Switch off lights and fans in the classroom when it is not necessaary.
2. ----------.

Concept of sustainable consumption

Development is largely based on the use of resources. Therefore a change in the pattern of development requires a change in the pattern of resource use. The pattern of sustainable consumption relates to use of both renewable and non-renewable resources. For renewable resources the use of a resource should not exceed the capacity of the environment to replenishing the resources. Non-renewable resources should be used with care as they can be totally used up. The natural available resources are shrinking because consumption levels are so high. Current consumption patterns are responsible for increasing pollution which damages our environment.

There is sufficiency in the world for man's need but not for man's greed.

- Mahatma Gandhi

In the recent past consumerism has become a part of our daily life. There is also inequality in the way, rich and underpreviledged groups in the society use resources. Our excessive resource use creates unsurmountable amounts of waste. All this requires changes to be made in our lifestyles to prevent the further degradation of our environment. Each one of us is creating a large environment foot print in our resource base. We all need to reduce our environmental foot print and create positive impacts to conserve our environmental resources for the future. This is now refered to as environmental handprint.

Inspite of India's rapid population growth, industrialzation and consumerism our country still includes a wealth of Natural Resources which requires urgent conservation measures.

Activity 7:

How you will reduce your environment footprint and increase your environmental handprint. Give some actions of your daily life.

Activity 8:

Find out which activities will make water resource unsustainable. What should be done to make it sustainable? List down all activities in school to make sustainable use of water resource. What can you do at home?

Activity 9:

Observe one day in a week as "No Vehicle Day" and eduacate others to follow this.

Do you know?

- If 50 persons in an office use both sides of just 10 per cent of the paper they use, the company can save ten trees a year.
- The energy saved from recycling one glass bottle will light a 100-watt bulb for four hours.
- Plastic bags and other plastic garbage thrown into the sea kills a million sea creatures every year.

What can you do?

Be a wise consumer. Buy things only when you need it. Do not waste. Develop a habit of using and reusing things and also educate others.

Think on it :

What will you do for sustainble development? What and Why today environment education is necessary?

Exercise

Q.1. Fill in the blank with the help of correct option.

1) ..... is celebrated as World Environment Day.
   a) 5th May b) 5th June
   c) 16th September d) 21st April
2) Environmental science is a:
   a) Multidisciplinary science
   b) Chemical science
   c) Medical science
   d) None of these
3) FRI was established in 1906 at ..... .
   a) Dehradun b) Delhi
   c) Calcutta d) Mumbai
4) ..... led by Chipko movement.
   a) Dr.Salim Ali b) M.S.Swaminathan c) Sundarlal bahuguna d) Medha Patkar
5) ENVIS is established in .....
   a) 1945 b) 1961
   c) 1982 d) 1973
6) The headquarter of NEERI is located at- .....
   a) Pune b) Nagpur
   c) Mumbai d) Kolkata
7) The United Nation set up the world commission on Environment and development in .....
   a) 1983 b) 1984
   c) 1985 d) 1986

Q.2 Write short answer of the following questions.

1) Define the term Environment.
2) Explain environmental scope and its significance
3) What is the need of environmental education?
4) Why is environment awareness necessary?
5) What is sustainable consumption?

Q.3. Write the long answer of the following questions.

1) Describe briefly the work of the following organization with regard to development and environment issues
   a) UNEP b) NEERI
2) Give two example of people's movement, and explain it.
3) What is your contribution for environmental conservation?
4) Describe concept and aims of sustainable development .

2: Ecosystems

Do you know?

Earth is perhaps the only planet in the solar system that supports life. The portion of the earth which sustains life is called biosphere. Biosphere is very huge and cannot be studied as a single entity. It is divided into many distinct functional units called ecosystems.

To understand the proper structure and functions of various kinds of ecosystem, it is very essential to understand the scope of ecology.

The word ecology is derived from two Greek words i.e. "Oikos" meaning house and "ology" means to study. Thus, ecology is the study of organisms in their natural home i.e. habitat. It is generally defined as the study of plants and animals in reciprocal relationship with their environment.

2.1 Scope of ecology:

Ecology deals with the interrelationship between the organisms and its environment. Therefore the scope of ecology becomes wide due to variable environmental conditions as well as abundance of plants and animals. The main function of ecology is to show the general principle under which the natural community and its various components operate. These may be applied for the interpretation of various activities of particular plants or the animals in a given region. The biota (plants and animals) of an area can be easily identified and counted. An understanding of ecology is useful for conservation of air, water, soil, wildlife etc. Ecology has practical applications in the field of agriculture, biological survey, forestry and fisheries.

In this lesson, you will study about the structure, types and functions of ecosystems.

2.2 Structure and function of Ecosystems:

In nature several communities of organisms live together and interact with each other as well as with their physical environment as an ecological unit. An ecosystem is a functional unit of nature encompassing complex interaction between its biotic (living) and abiotic (non-living) components. For example- aquatic systems such as a pond, lake, river, estuary, ocean. The terrestrial ecosystems includes forest, grassland, agricultural field, desert etc.

The structure of ecosystem is includes two kinds of components.

(a) Abiotic components

(b) Biotic components

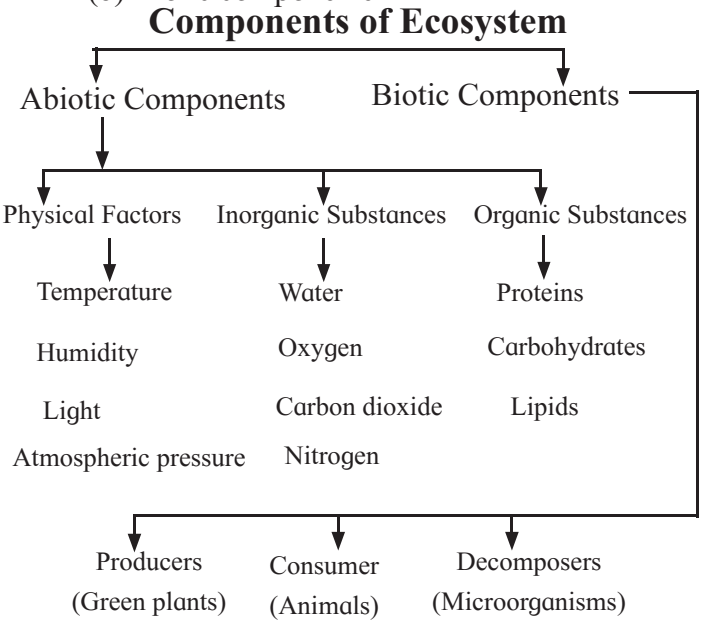


Figure 2.1 : Components of Ecosystems

(a) Abiotic components (Nonliving):

The abiotic component can be grouped into following three categories:-

(i) Physical factors: Sun light, temperature, rainfall, humidity and pressure. They sustain and limit the growth of organisms in an ecosystem.

(ii) Inorganic substances: Carbon dioxide, nitrogen, oxygen, phosphorus, sulphur, water, rock, soil and other minerals.

(iii) Organic compounds: Carbohydrates, proteins, lipids. They are the building blocks of living systems and therefore, make a link between the biotic and abiotic components.

(b) Biotic components (Living)

(i) Producers: The green plants manufacture food for the entire ecosystem through the process of photosynthesis. Green plants are called autotrophs, as they absorb water and nutrients from the soil, carbon dioxide from the air, and capture solar energy for this process.

(ii) Consumers: They are called heterotrophs and they consume food synthesized by the autotrophs. Based on food preferences they can be grouped into three broad categories.

a) Herbivores feed directly on plants (e.g. cow, deer and rabbit etc.)

b) Carnivores are animals which eat other animals. (eg. lion, cat, dog etc.)

c) Omnivores organisms feed upon both plants and animals (e.g. human beings, pigs and crows).

(iii) Decomposers: Also called saprotrophs. These are mostly bacteria and fungi that feed on dead organic matter of plants and animals by secreting enzymes outside their body on the decaying matter. They play a very important role in recycling of nutrients. They are also called detritivoours or detritus feeders.

Functions of ecosystems :

Ecosystems are complex dynamic entities which include abiotic and biotic components. They perform various functions. These are:-

(i) Energy flow through food chain

(ii) Nutrient cycling (biogeochemical cycles)

(iii) Ecological succession or ecosystem development

Ponds, lakes, marshlands, grasslands, deserts and forests are examples of natural ecosystems. Many of you have seen a grassland, a garden and an agricultural field in your neighborhood. These are examples of man made ecosystems.

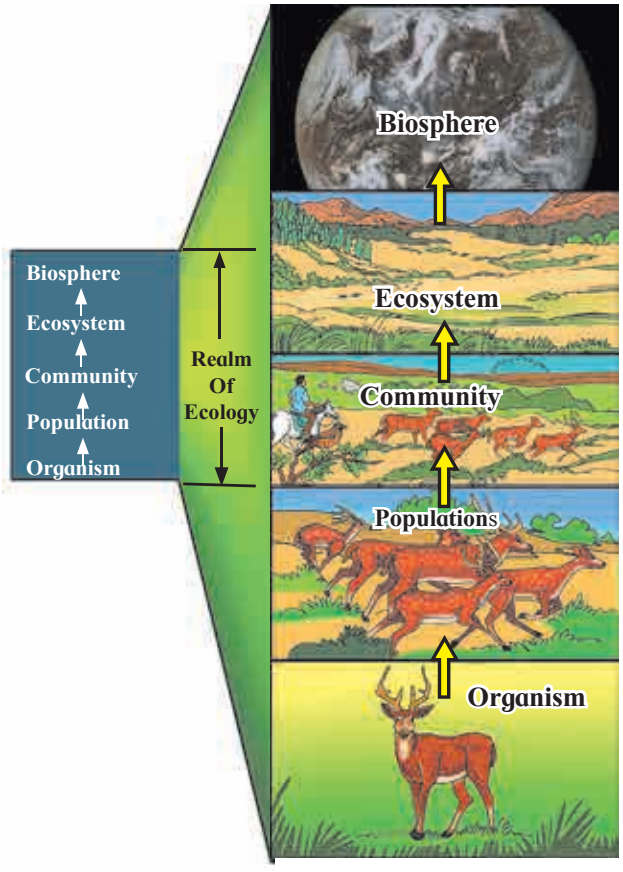


Figure 2.2 : Realms of Ecology

2.3 Types of ecosystems

Ecosystems are broadly classified as follows:

(I) Natural ecosystems

(II) Man made ecosystems

(I) Natural ecosystems

Natural ecosystem are totally dependent on solar radiation e.g. forests, grasslands, oceans,

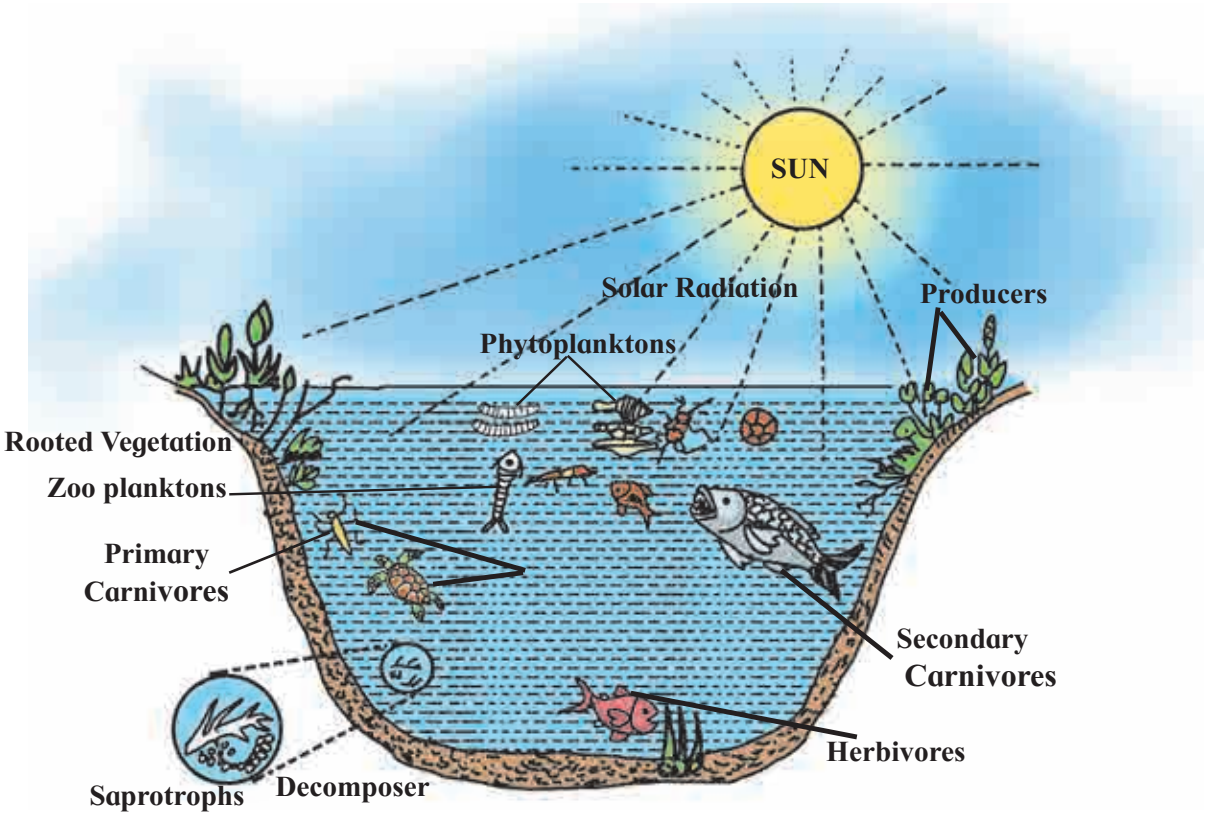


Figure 2.3 : Pond ecosystem

lakes, rivers and deserts. They provide food, fuel, fodder and medicines.

Pond Ecosystem:

A pond is an example of natural ecosystem. It is convenient to study its basic structure and functions. It works on solar energy and maintains its biotic community depending on the seasons. If you collect a glass full of pond water or a scoop full of mud from bottom of the pond, it consists of a mixture of plants, animals, microorganisms, inorganic and organic materials.

The Following components are found in a pond ecosystem.

(a) Abiotic (Non living) components of pond ecosystem:

(i) Sunlight: Solar radiation provides energy that controls the entire system. Penetration of light depends on transparency of water, amount of dissolved or suspended particles in water and the number of plankton. On the basis of extent of penetration of light a pond can be divided into euphotic(eu=true, photic = light), mesophotic and aphotic zones.Plenty of light is available to plants and animals in euphotic zone. No light is available in the aphotic zone.

(ii) Inorganic substances: These are water, carbon, nitrogen, phosphorus, calcium and a few other elements like sulphur depending on the location of the pond. O_2 and CO_2 are in dissolved state in water. All plants and animals depend on food and exchange of gases in the water. Other inorganic salts are held in reserve in bottom sediment and inside the living organisms.

(iii)Organic compounds: The commonly found organic matter in the pond area are amino acids, humic acids and the breakdown products of dead animals and plants. They are partly dissolved in water and partly suspended in water.

(b) Biotic (Living) components of pond ecosysytem

(1) Producers or autotrophs :

Synthesize food for all the heterotrophs of the pond. They can be categorized into two groups:-

(a) Floating microorganisms and plants
(b) Rooted plants

(a) Floating microorganisms: Small green plants (algae) and blue green algae are called phytoplanktons ("phyto"- plants, "plankton"– floating). They are microscopic organisms. Sometimes they are so abundant in pond that they impart green colour to pond water. Such a condition is called algal bloom or water bloom e.g. *Spirogyra, Ulothrix, Cladophora, Diatoms, Volvox*.

(b) Rooted plants: These are arranged in concentric zones from periphery to the deeper layers. Three distinct zones of aquatic plants can be seen with increasing depth of water in the following order:

i) **Zone of emergent vegetation:** e.g. *Typha* and *Sagittaria*

ii) **Zone of rooted vegetation with floating leaves** .eg. *Nymphaea*

iii) **Zone of submergent vegetation:** eg. All under water vegetation like *Hydrilla, Vallisnaria* etc.

(2) Consumers (Heterotrophs) : These are the animals which feed directly or indirectly on autotrophs eg. Tadpole, snails, some variety of fish.

Pond animals can be classified into the following groups

(a) *Zooplanktons are floating animals. Cyclops, Cypris, Daphnia* etc.

(b) Nektons are the animals that can swim and navigate eg. fishes

(c) Benthic animals are the bottom dwellers e.g. beetle, mites, molluscs and some crustaceans.

(3) Decomposers: They are distributed throughout the pond, but are most abundant in the sediment. There are bacteria and fungi. (*Rhizopus, Penicillium, Cladosporium*) found at the bottom of the pond.

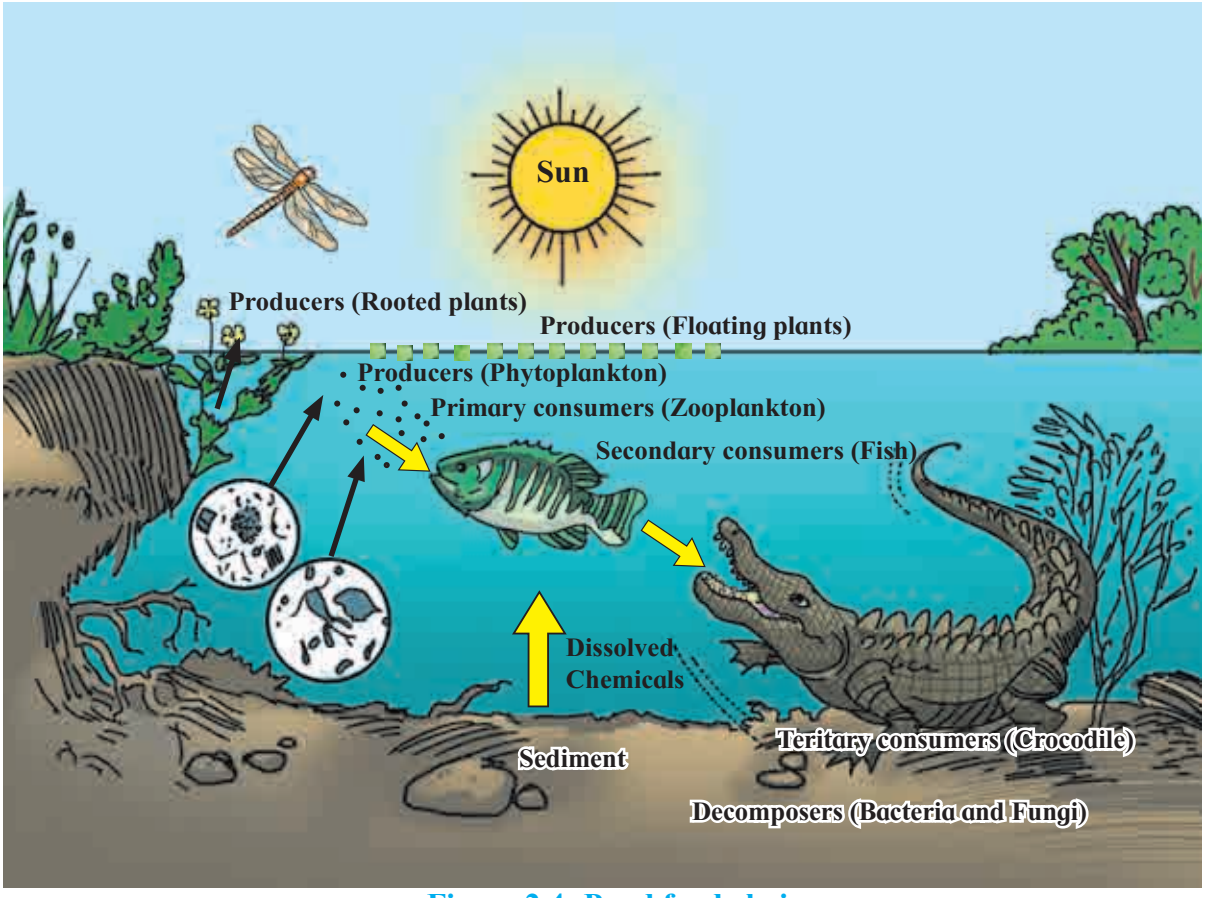


Figure 2.4: Pond food chain

(II) Man made ecosystems:

1) It is a system which is influenced by significant human interactions between living and non living components.

2) They do not possess self regulating mechanisms.

3) The cycling of nutrients is negligible.

4) The inputs are provided by human efforts.

Examples are crop fields and orchards.

Activity 1:
Visit a local pond near your locality and make the list of following:

(1) Note down the colour of pond water.

(2) Check pH value of pond water with pH paper.

(3) Make list of number of different types of plants and animals observed in the water.

Activity 2 :
Observe a park of your locality before and after the rains for one month and record your observations (count the number of different birds, plants and insects).

2.4 Dynamics of ecosystems

In the ecosystems, the flow of energy and matter from one component to the other component is called its dynamics. It is also called as functions of the ecosystems. The nutrients and minerals work through cycles between the biotic and abiotic components of the ecosystem. The energy transfer in the ecosystem is unidirectional and it never returns back to the source (i.e. sun).

The dynamics of ecosystem can be explained under the following heads-

1) Food chain
2) Food web
3) Trophic levels
4) Energy flow
5) Ecological pyramids
6) Bio-geochemical cycles.

1. Food chain : The transfer of food energy from the source (Producers / green plants) to consumers forms a food chain. Green plants in the food chain occupy the first trophic level (i.e. producer).The herbivores that eat the plants occupy second trophic level (i.e. primary consumers). The carnivores that eat the herbivores occupy third trophic level (i.e. secondary consumers) and occasionally even a fourth trophic level (i.e. tertiary consumer).

In nature three types of food chains have been distinguished namely grazing food chain, parasitic food chain and detritus food chain.

I) Grazing food chain: This food chain starts from green plants, goes through herbivores and terminates in carnivores.

The photosynthetic organisms, synthesise their food from inorganic elements in the presence of sunlight, hence they are called producers.The producers are eaten by herbivorous animals, thus herbivorous animals are called primary consumers. Primary consumers or herbivores are eaten by secondary consumers called carnivores. Thus this type of food chain depends on autotrophs as primary producer.

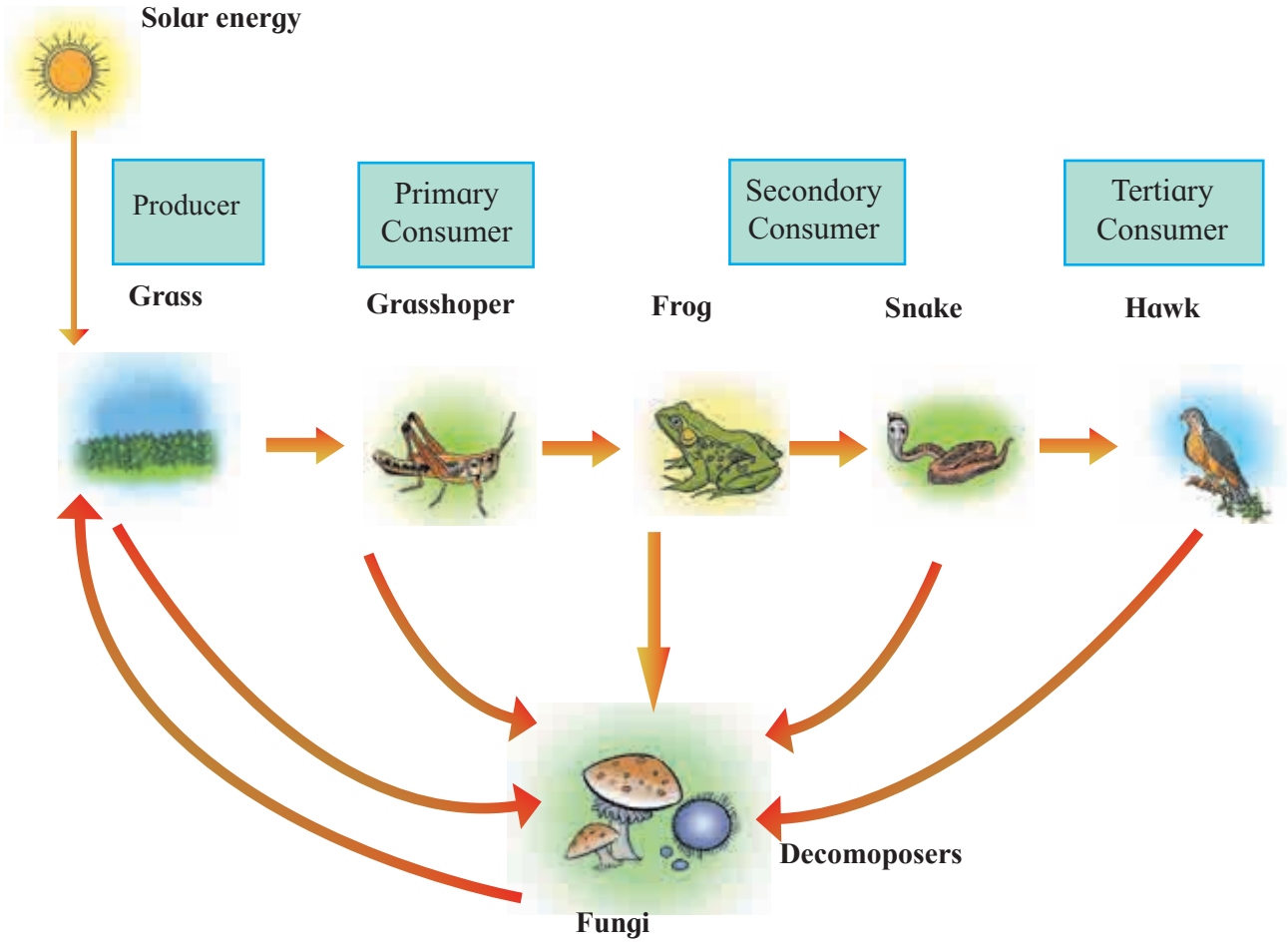


Figure 2.5 : Food Chain

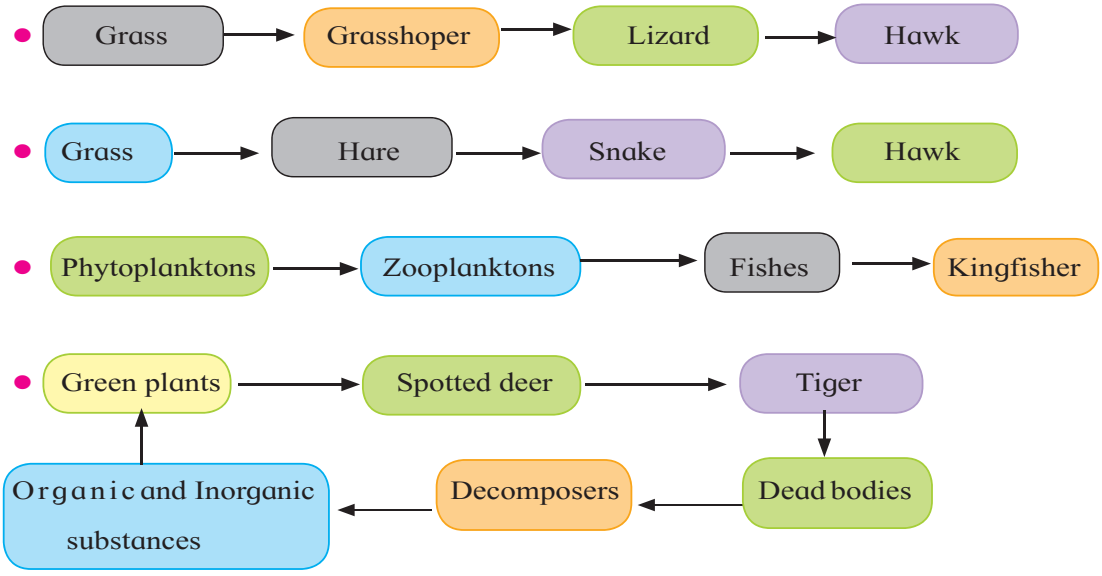


Figure 2.6: Food chains in different ecosystems

II) Parasitic food chain: This food chain goes from large organisms to smaller ones without killing the host organism. For e.g. large number of lice live on herbivore as ectoparasites.

III)Detritus food chain: The food chain starts from dead organic matter of decaying plants and/or animals bodies, microorganisms and then to detritus feeding organisms (detritivores or saprovores) and their predators which is known as detritus food chain. e.g. Dead and drying leaves in forest are broken into smaller pieces by soil animals such as beetles, ants, earth warms on which fungi and bacteria act to produce soil nutrients. some of these soil animals are used food by secondary consumers like birds, frogs and lizards.

This type of interrelationship interlinks the individuals of the whole community. In this way multiple food chains become interlinked forming a food web. The food web maintains the stability of the ecosystem.

Energy flow in ecosystem :

Energy can be defined as the capacity to perform work. The solar radiation is the primary source of energy for all organisms which passes through the different trophic levels. Organisms that can fix energy from inorganic sources into organic molecules are called autotrophs. Organisms that cannot obtain energy from abiotic sources but depend on energy-rich organic molecules which is synthesized by autotrophs are called heterotrophs. Those organisms that obtain energy from living organisms are called consumer and those that obtain energy from dead organisms are called decomposers.

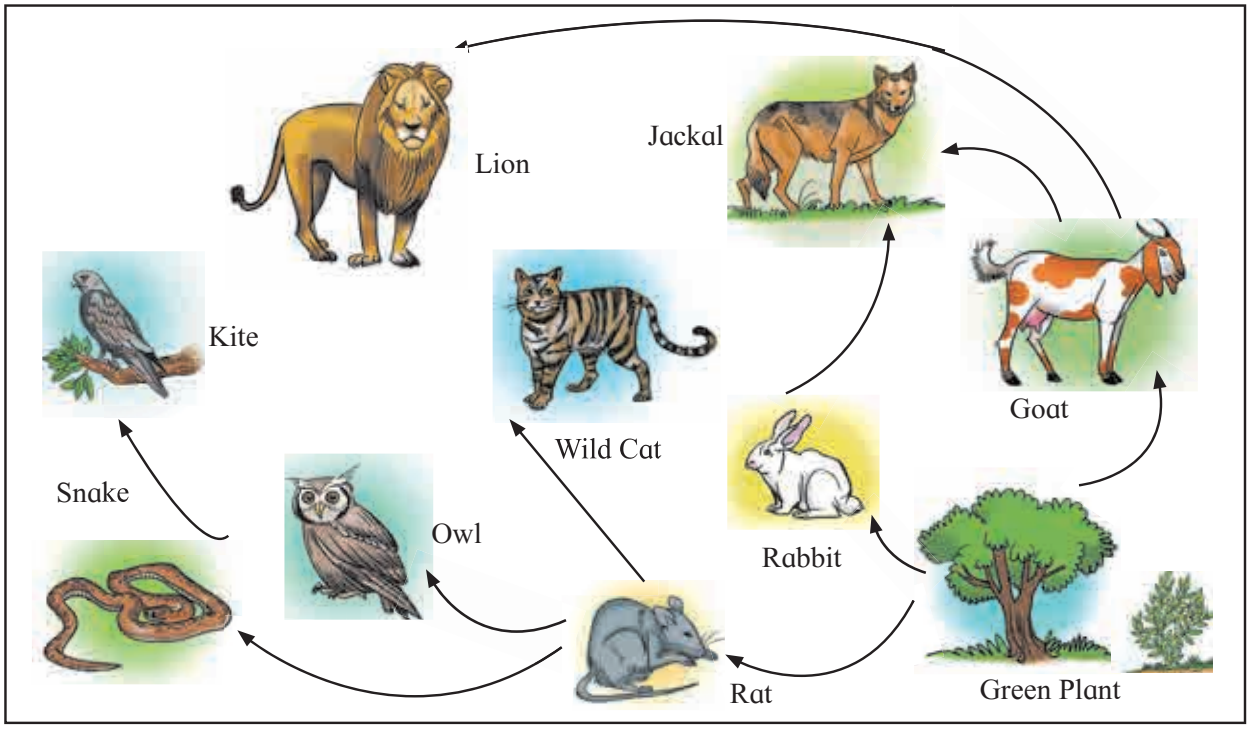


Figure 2.7 : Food Web

2. Food Web: Many food chains exist in an ecosystem, but these food chains are not independent of each other. The producers are eaten by variety of insects, birds, mammals and fishes. These first order consumers are eaten by predators. In grassland ecosystem, grass is eaten by herbivores such as hare which will be eaten by snake, which will be eaten by an eagle.

The movement of energy in an ecosystem is termed as the energy flow in nature.

i) The producers absorb and convert solar energy into plant material.

ii) The energy converted into biomass is used by consumers.

iii) The total input of energy in form of food is used for day to day activities and biomass.
iv) The loss of energy occur through respiration, heat, excretion.
v) The gross net production.

About 23% of incoming solar energy is absorbed in the atmosphere by water vapours, dust and ozone, and 48% passes through the atmosphere and is absorbed by the surface. Thus about 71 % of the total incoming solar energy is absorbed by the earth system. However plants do not absorbs all incoming sunlight and do not convert all harvested energy into biomass, which results in an overall photosynthetic efficiency of 3 to 6 % of total solar radiation. It means very small amount of sunlight reaching the earth's atmosphere is used in photosynthesis. The plant synthesize food in the form of carbohydrates i.e. is a form of chemical energy. This chemical energy of carbohydrates is used as a food for herbivores. In the food chain or food web, there is transfer of both the matter and energy in the living world.

The transfer of energy is never 100 %. The green plants trap solar energy and convert it into chemical energy, they are the producers. They use some amount of energy for their own life processes. Therefore, only a small portion of the energy trapped by the producers is available to primary consumers. Animals move from place to place, so they require more energy. Therefore they transfer less amount of energy to the next trophic level.

At every trophic level, a considerable amount of energy is lost to the surroundings in the form of heat. The amount of energy available to the next higher level is only 10%.

Even decomposition of organic matter carried out by microbes is responsible for release of heat energy. Thus most of the solar energy trapped by the green plants goes to the atmosphere in the form of heat. But, this heat energy never returns to the sun. Energy transfer is therefore never in the reverse direction.

Ecological pyramids

Ecological pyramids are the graphic representations of trophic levels in an ecosystem. The producers make the base of the pyramid and the subsequent tiers of the pyramid represent herbivore, carnivore and top carnivore. The pyramids are of three types.

(1) Pyramid of number:

This represents the number of organisms at each trophic level.

For example in a grassland the number of grasses is more than the number of herbivores that feed on them and the number of herbivores is more than the number of carnivores.

In some instances the pyramid of number may be inverted, i.e herbivores are more than primary producers as you may observe that many caterpillars and insects feed on a single tree.

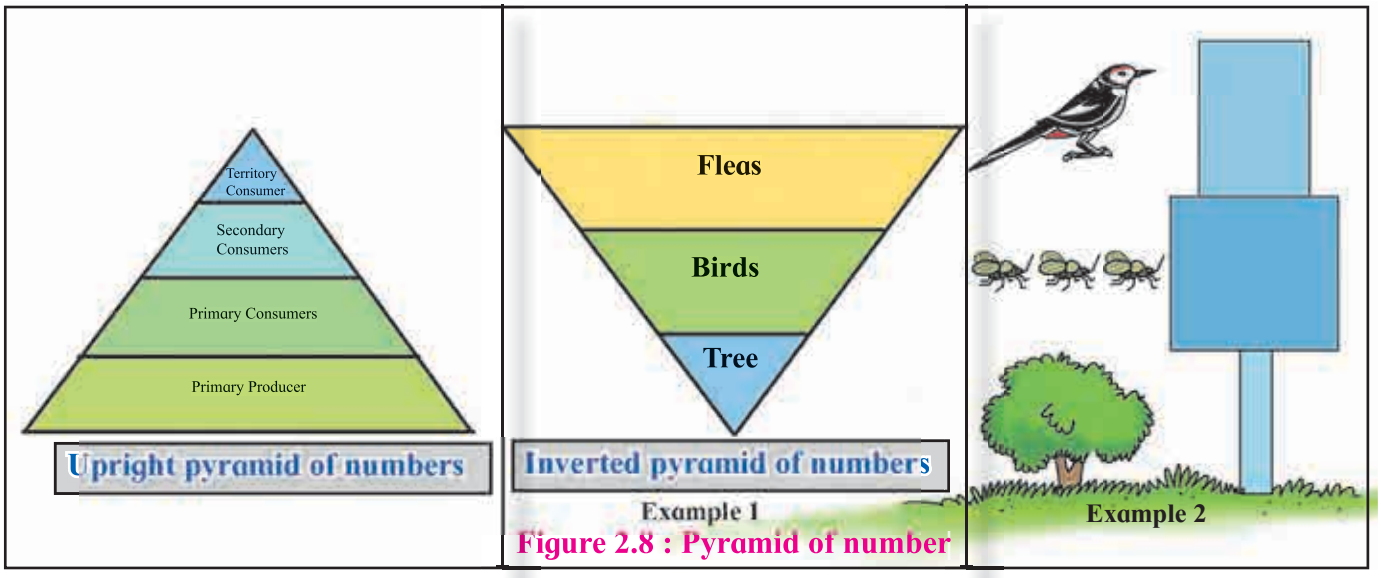


Figure 2.8 : Pyramid of number

(2) Pyramid of biomass:

This represents the biomass at each trophic level. Standing biomass is the amount of the living matter at any given time. It is expressed as gm/unit area or kilo cal/unit area. In most of the terrestrial ecosystems the pyramid of biomass is upright. However, in case of aquatic ecosystems the pyramid of biomass may be inverted e.g. in a pond, phytoplankton are the main producers, they have very short life cycles and a rapid turn over rate (i.e. they are rapidly replaced by new plants). Therefore, their total biomass at any given time is less than the biomass of herbivores supported by them.

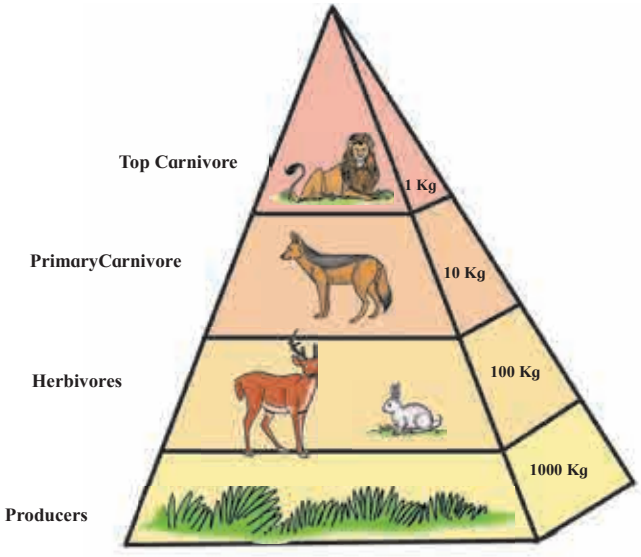


Figure 2.9 : Upright Pyramid of biomass in Terristrial Ecosystem

(3) Pyramid of energy :

This pyramid represents the total amount of energy at each trophic level. Energy is expressed in terms of kcal/unit area /unit time. Energy pyramids is never inverted.

All the living organisms of an ecosystem are interdependent through food chains and food webs. Removal of any single species of the community causes ecological change.

In the food chain the producers can be eaten by several primary consumers (herbivoves). These multiple herbivoves are eaten by only a fewer species of carnivares. In every ecosystem the quantum of producers is the largest followed by primary consumers and only a few second order consumers. This is because at every step in the trophic chain energy is lost in day to day activities.

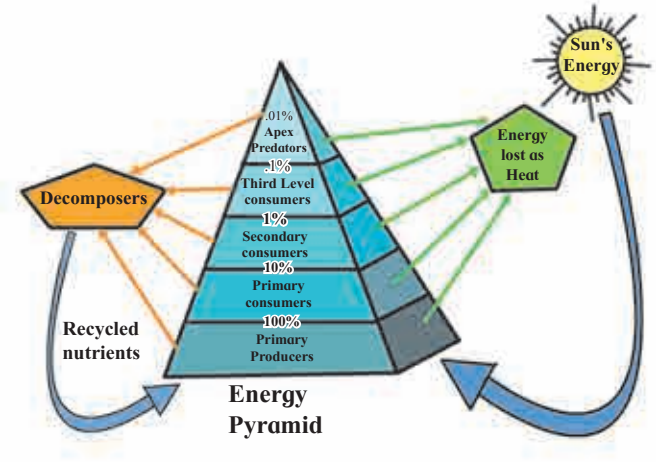


Figure 2.10 : Pyramid of Energy

Biogeochemical cycle

The nutrients move from the nonliving to the living and back to the nonliving component of the ecosystem in a more or less circular manner is known as biogeochemical cycle.

After the death of organisms, the dead remains are decomposed and the nutrients are released back into the soil by detrivores. These are absorbed again by the root of green plants and are passed on to herbivores and then to the carnivores. Micro organisms and fungi play a role in the recycling of nutrients. This recycling of the nutrients is called biogeochemical or nutrient cycle. There are more than 40 elements required for the various life processes by plants and animals. The entire earth or biosphere is a closed system i.e. nutrients are neither imported nor exported from the biosphere.

The common biogeochemical cycles are.

1. Nitrogen cycle
2. Carbon cycle
3. Oxygen cycle
4. Sulphur cycle
5. Phosphorous cycle
6. Hydrological cycle (Water cycle)

2.5 Ecosystem services

Ecosystem services can be devided into resources used by people or services of nature. examples

Direct uses of forest ecosystem resources

- Timber
- Fruits
- Tubers
- Medicine
- Fuel woods

Indirect values of forest ecosystem :

1. Regulating Ecological balance
2. Conservation of water and soil
3. Maintain temperature
4. Increase rainfall rate
5. Habitat for wild animals
6. Increase asthetic value of nature

Ecosystem services are processes in natural ecosystems which sustain biodiversity and human needs. Nature provides these services to us free of cost. Ecosystem services have both ecological and economic values. But in recent decades, however, they have been seriously affected by human activities.

Ecosystem services provide us in many ways:

a) **Provisioning services:** It includes all products that are collected by people which include food items like fruits, tubers, herbs, and medicinal plants. People depend on forest ecosystem for fuel wood, fodder, building material for housing etc. The forest products are of great economic value as they are collected and marketed.

Various industrial products are being produced from the wild plants of the forest. Many of our medicines come from wild plants from different ecosystem.

b) **Supporting services:** The other supporting services provided by ecosystem are biomass production, production of atmospheric oxygen, soil formation etc. Forest indirect services include the control of flow of water in streams and rivers. Forest cover reduces the surface run-off of rain water and allows the recharge of ground water. Forest also prevents the erosion of soil which takes thousands of years to form.

c) **Regulating services:** The regulation of ecosystem process, includes, the flood control, regulation of climate, water purification, control of human diseases etc. Forest regulates the local temperature by absorbing carbon dioxide and release the oxygen that we breathe. And also it helps to maintain temperature and moisture. It also maintains the ecological balance, habitat for wild animals and increase rate of rainfall.

d) **Cultural services:** There are various non-material benefits which people obtain from ecosystems like education, recreation and various cultural practices.

2.6 Species interdependence and interactions

Different species in an ecosystem have common activities or resource needs. They may interact with one another of the same species or with the individuals of the other species. Such interactions may benefit a species or may cause harm to it or may not affect it in any way.

There are some basic types of interdependence and interaction between species

1) Competition
2) Predation
3) Parasitism
4) Mutualism
5) Commensalism

1) Competition : Competition between individuals occurs when resources such as food and space are shared. Individuals may compete with members of their own species (Intraspecific competition) or with members of other species who use the same resources (Interspecific competition).

For example - a) Plants compete with one another for access to light and water.

b) Various animals compete for food and space.

Figure 2.11 : Competition

2) Predation: Predation is an interaction between species in which one species (the predator) kills and eats another species (prey).

Example : in the following figure Lion is predator and Deer is the prey.

Figure 2. 12 : Predation

3) Parasitism: Parasitism is a relationship in which one organism (the parasite) benefits at the cost of another organism (the host).

Example:

a) Ticks on the skin of a dog.

b) *Cuscuta* plant as a parasite on a host plant

Figure 2.13 a : Ticks on the skin of a dog

Figure 2. 13 b : Cuscuta plant as a parasite on a host plant

4) Mutualism: Two organisms interact in such a way that both benefits from the relationship from each other.

Example: Lichens which are formed as a result of a association between fungus and algae. The fungi provide home for the algae and the algae provides food.

Figure 2.14 : Mutualism (Lichen)

5) **Commensalism:** Commensalism is an interaction between two species in which one is benefited, but the other is neither benefited nor harmed.

Example: Epiphytic plants like Orchids (Vanda) attaching themselves on trees just for support but not for nutrition.

Figure 2.15 : Epiphytic plant *Vanda*

2.7 Ecological Succession

Vegetation occupying a given habitat under natural condition is called as a plant community. The gradual replacement of one type of plant community by others is called as plant succession.

Succession is a complex process which begins, develops and finally stabilizes at the climax stage. The climax stage is the final, self maintaining, mature and self reproducing stage of vegetational development in a climatic unit.

Kinds of Succession

On the basis of different aspects, succession can be classified into several categories. They are discussed as follows.

On the basis of presence or absence of vegetation in the area where succession takes place, it is divided into two kinds. They are primary succession and secondary succession.

a) **Primary succession:** If the succession starts on the extreme bare area on which there was no previous existence of vegetation such as newly exposed rocks, surface of lava flow etc. are known as primary succession. The first group of organisms that establish themselves on bare areas are known as pioneers or primary colonizers.

b) **Secondary succession:** If succession starts on a place which was once occupied by plant communities that has changed by natural or manmade alteration the process is secondary. Destructive agencies like fire, cultivation, strong wind, soil erosion, draught, rain are responsible for denudation process. The bare area formed after denudation process is known as secondary bare area. Secondary succession is more rapid than the primary succession.

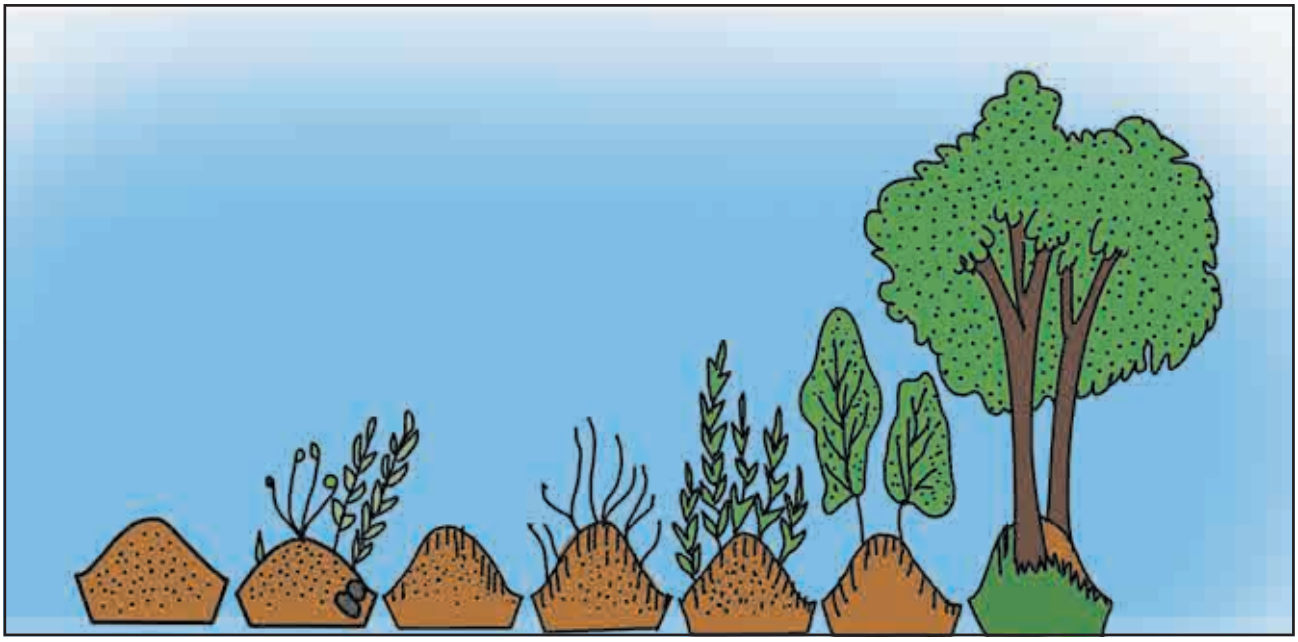


Figure 2.16 : Ecological Succession from virgin land to climax

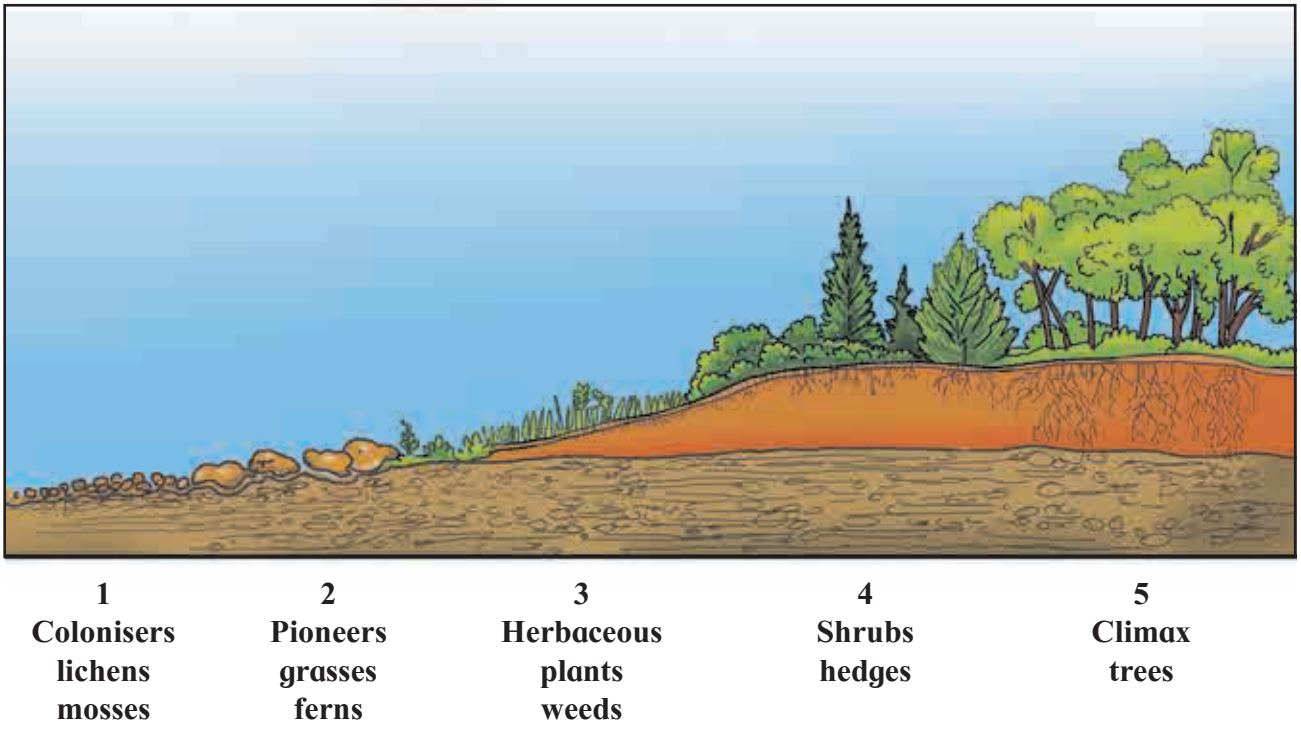


Figure 2.17 : Ecological Succession

Exercise

Q.1. Multiple choice questions.

1. The word Ecology is derived from the ..... word.
   a. American c. Greek
   b. Latin d. None of above

2. Sunlight is ..... type of component
   a. Abiotic c. Biotic
   b. Both a & b d. None of these

3. ..... is not a member of aquatic ecosystem
   a. Tiger c. Fish
   b. Algae d. Aquatic plants

4. Source of energy for green plants is .....
   a. Earth c. Moon
   b. Sun d. Air

5. ..... is not an example of indirect use of ecosystem services
   a. Regulation of ecological balance
   b. Conservation of water and soil
   c. Habitat for wild animal
   d. Fuel wood

6. Organisms that can fix energy from inorganic sources into organic molecule are called .....
   a. Autotrophs c. Hetrotrophs
   b. Decomposersd. d. Consumers

7. Lichen is an example of ..... .
   a. Predation b. Parasitism
   c. Mutualism d. Commensalism

8. ..... is not an example of carnivore
   a. Rabbit b. Lion
   c. Fox d. Vulture

Q.2. Write the answers in short of the following.

1) What is ecosystem?
2) What are the indirect uses of ecosystem?
3) Define food web and Explain it.
4) What is standing crop biomass?
5) Name different biogeochemical cycles.
6) Give two ecosystem services provided by forest.
7) What is parasitism?
8) What is predation?
9) What is primary succession?

Q.3. Long answer questions.

1) Explain structure of ecosystem.
2) Explain pond ecosystem.
3) What is ecological pyramid? Explain pyramid of number.
4) Explain energy flow in ecosystem.
5) Explain in detail ecosystem services.
6) What is succession? Explain kinds of succession.

3. Biodiversity

Figure 3.1 : Biodiversity (a)

Do you know?

It is interesting to know that there are more than 20,000 species of ants, 3,00,000 species of beetles, 28,000 species of fishes and nearly 20,000 species of orchids. Ecologists and evolutionary biologists have been trying to understand the significance of diversity.

- There are about 1.8 Million species known and described.
- Scientist are still identifying species that were not known in the past.

3.1 What is biodiversity?

The variety and range of life forms on the earth is termed as "Biological diversity" or "Biodiversity". In other words, biodiversity is made up of all living species, their genetic properties and the ecosystems of a region. Biodiversity is the outcome of 3000 million years of evolution.

The biosphere constitutes a vital life supports for man. Its existence in a healthy and functional state is essential for existence of human race. This diversity of living creatures form a support-system which has been utilized by each civilization for its growth and development. The variability in nature helped in utilization of the earth's biological wealth for the benefit of humanity and has been integral to the process of development.

Those that used this "bounty of nature" carefully survived. Those that over used or misused it disintegrated. At present we are losing accumulated heritage of millions of years at a very rapid rate. The very basis of our existence is being undermined. The onset of reduction in diversity of life forms is bound to have grave consequences for the entire living-world.

"Variation is the law of Nature."

Observe and discuss:

Different living beings have different structures, shapes, defense mechanism, feeding habits and life cycle. Such variety is found in all forms of flora and fauna in your surroundings. Make a list.

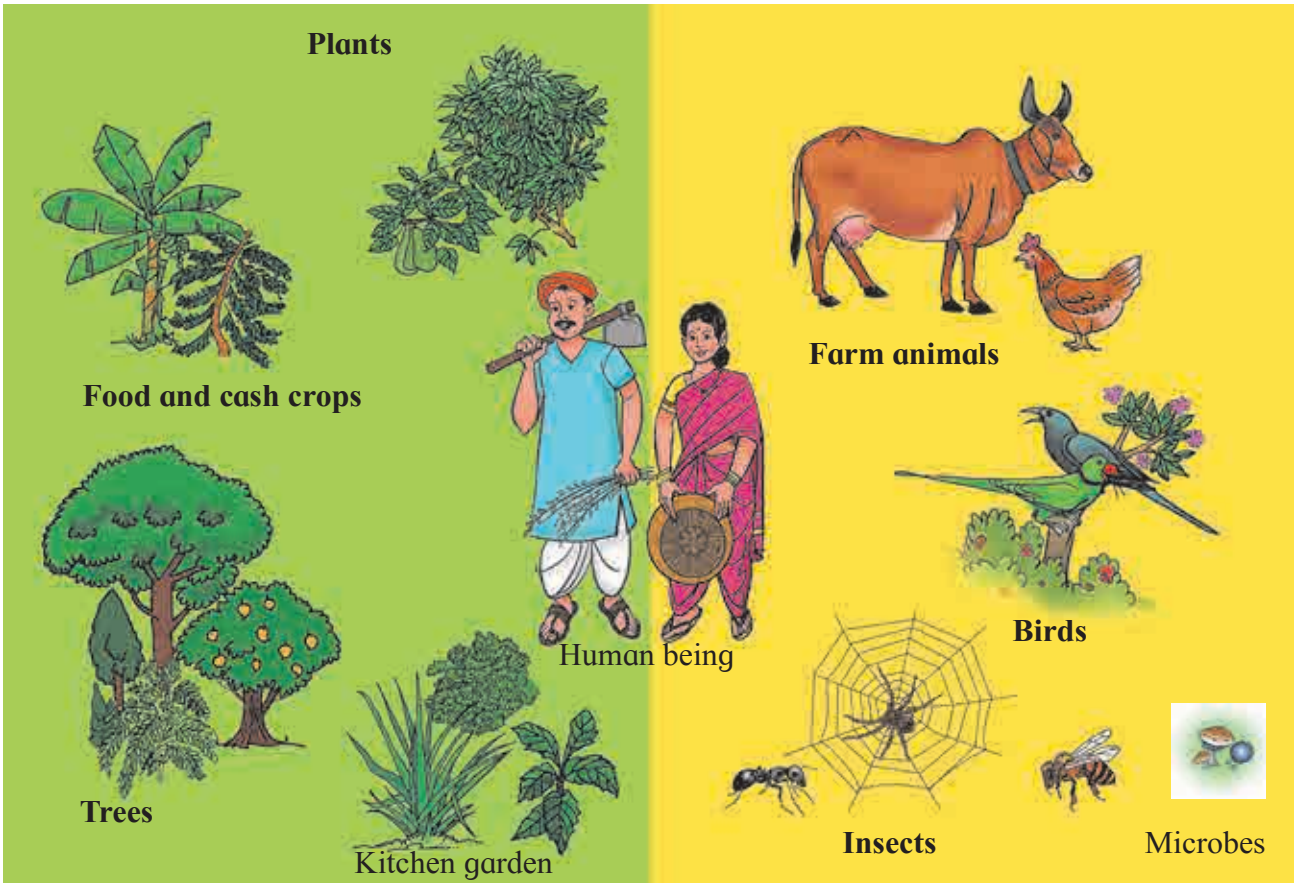


Figure 3.1 : Biodiversity (b)

3.2. Levels of Biodiversity

There are three hierarchical levels.

(a) Genetic diversity: This is the variability that is present in the individuals of a species due to differences in individuals genetic makeup.

It refers to variation of genes within species. Differences could be in entire genes or in structure of chromosomes. Genetic diversity enables a population to adapt to the environment. It is also responsible for speciation. Some variations are easy to see, such as; size, colours, taste and flavor. For example varieties of rice and wheat. Deliberate manipulation of genes by humans within a species produces new varieties of crops and new breeds of domestic animals.

(b) Species diversity:

It is the variability in the species richness within a specified area (habitat).

It refers to the variety of species in a given region.

It is largely the result of natural evolutionary process.

(c) Ecosystem diversity :

It is the variety of ecosystems that are present on the earth. some of them include forest, grassland, pond, river, marine ecosystems etc.

This variety in ecosystems is formed because of different climatic conditions and topographical features which are present on the earth.

Do you know?

The Warlis, an Adivasi community of Maharashtra, cultivate about 15 varieties of rice. They have developed their farming systems over several generations. The different varieties of paddy they cultivate have different requirements of water and soil texture. These varieties have different resistances to insects and possess varied flavors. If the monsoon proceeds normally, their main varieties give a good yield. If it does not the other hardier varieties which though having a low yield can survive in less rainfall conditions and give adequate production. The availability of varieties for different soil, water and weather conditions helps to get some production in adverse conditions as well.

Do you know?

- **Number of Species on the earth**

GROUP	Number of Species **(approx)**
Mammals	5,513
Birds	10,425
Reptiles	10,038
Fish	32,900
Amphibians	7,302
Insects	10,00,000
plants	30,7,674
Lichens	17,000

Source : IUCN-2014

ACTIVITY: 1

Using the school /college and the local environment students should identify the three different categories of biodiversity. e.g.

- Birds, insects, trees, animals, living in the local area
- Survey the different varieties of any crop e.g. rice, jowar etc. and document names of variety.
- Identify and name the different ecosystem within a local area.

Sample oberservation Table on species

S.N.	Species	Number	Found where
1			
2			

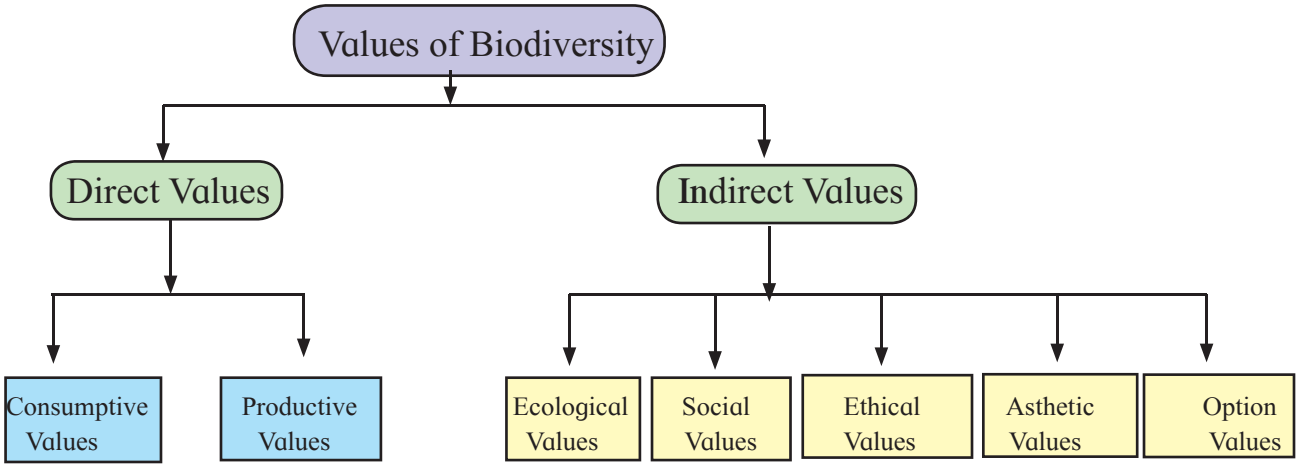
3.3. Values of Biodiversity:

The world is inhabited by myriads of life forms, animals and plants. These life forms are of great diversity, living in diverse habitat and possessing diverse qualities which in themselves make very interesting studies. Moreover, these life forms are vital to human survival as they provide food and materials for shelter, clothing, tools and medicine.

Now a days, we possess modern technologies which can utilize the different genetic qualities in a variety of ways. Wild diversity can also be incorporated into crops and contribute to world agricultural development.

Why is Biodiversity important?

All species are interconnected. They depend on one another. With less biodiversity, these connections weaken and sometimes break, harming all the species in the ecosystem. Biodiversity is important to people in many ways As biodiversity decreases, these systems break down.



A. Direct Values

1. Consumptive Values:

This is related to natural products which are consumed directly for food, fodder, timber, fuel wood etc. Human use thousands of species of plants and animals in their day to day lives. The tribal people generally depend on the forest for their daily needs.

2. Productive use values:

This is assigned to products that are commercially harvested and marketed like resins,gum, honey etc. Present agricultural crops have originated from wild varieties.

1. Honey comb

2. Commercial product; Honey

3. Gum exudation from the tree bark

Figure 3.2 : Productive use values

Economics of biological diversity

People are dependent on biodiversity for meeting their basic needs of food and energy. A range of industries including pharmaceutical, agricultural, timber etc. are dependent on biodiversity for raw materials. Some of the economic uses of biodiversity are described below:

i) **Food Value:** Approximately 80,000 edible plant species have been used at one time or another in human history, of which about 3,000 are currently used. About 150 species have been cultivated on a large scale. Of these; about 10 to 20 species provide 80-90% of the world's calorie intakes.

Apart from the above major edible plants, hundreds of other uncultivated plants are used as food.

ii) **Medicines, Drugs, Cosmetics:** Biodiversity provides health security to humans, livestock and plants (bio-pesticides and bio-fertilizer). In the Western Ghats, about 2000 plants are being used for medicinal purposes. Across the country, some 8,000 plants and a few hundred animals are being used for their medicinal value by local communities.

A large proportion of allopathic medicines have a plant origin. Nearly 25% of all prescription drugs used in the developed world are based on plants, including various indispensable mainstream

drugs, e.g. Aspirin. Ayurvedic medicines and medicinal plants after primary processing have been exported from India for centuries. The volume of this trade has become much bigger in recent years. Medical tourism is emerging as a high value economic sector, where therapies based on indigenous Ayurveda and other oriental medical systems are provided.

iii) **Fibre:** Cotton, jute, flax, sisal, hemp, rattan, coconut coir, bamboo and other grasses are sources of natural fibre. These are used in both local economies and for industrial use, for making twines, ropes, cords, fabric, as building and packaging material in sacks and gunny bags, as carpet-backing etc.

iv) **Biofuels:** Most of the rural population of India depends on fire wood for fuel. Fuels like biogas, biodiesel and ethanol are also becoming economically important. All these fuels come from bio resources. Jatropha and Karanj are two plant species used to make biofuels. In India, scientists are screening different varieties of Jatropha and Karanj to identify naturally high-yielding varieties. Recently scientists are working on algae as potential source of biofuel.

v) **Building Materials:** Housing and building materials such as bamboo, grasses, hardy plants, palm leaves and timber come from the local ecosystem. Large scale cultivation of bamboo and timber species is done in several countries. Most of the world's timber production still comes from forests.

vi) **Tourism:** Nature-based tourism is increasing day by day the world over. It has become a major industry supporting lakhs of people across the world. example - case of Sanjay Gandhi National Park on the outskirts of Mumbai receives more than 15 lakh tourists every year. Nature-based tourism is growing as an economic sector. Tadoba Andhari Tiger Reserve (TATR) receives more than 30 lakh tourists every year generating lakhs of rupees of revenue for the Government.

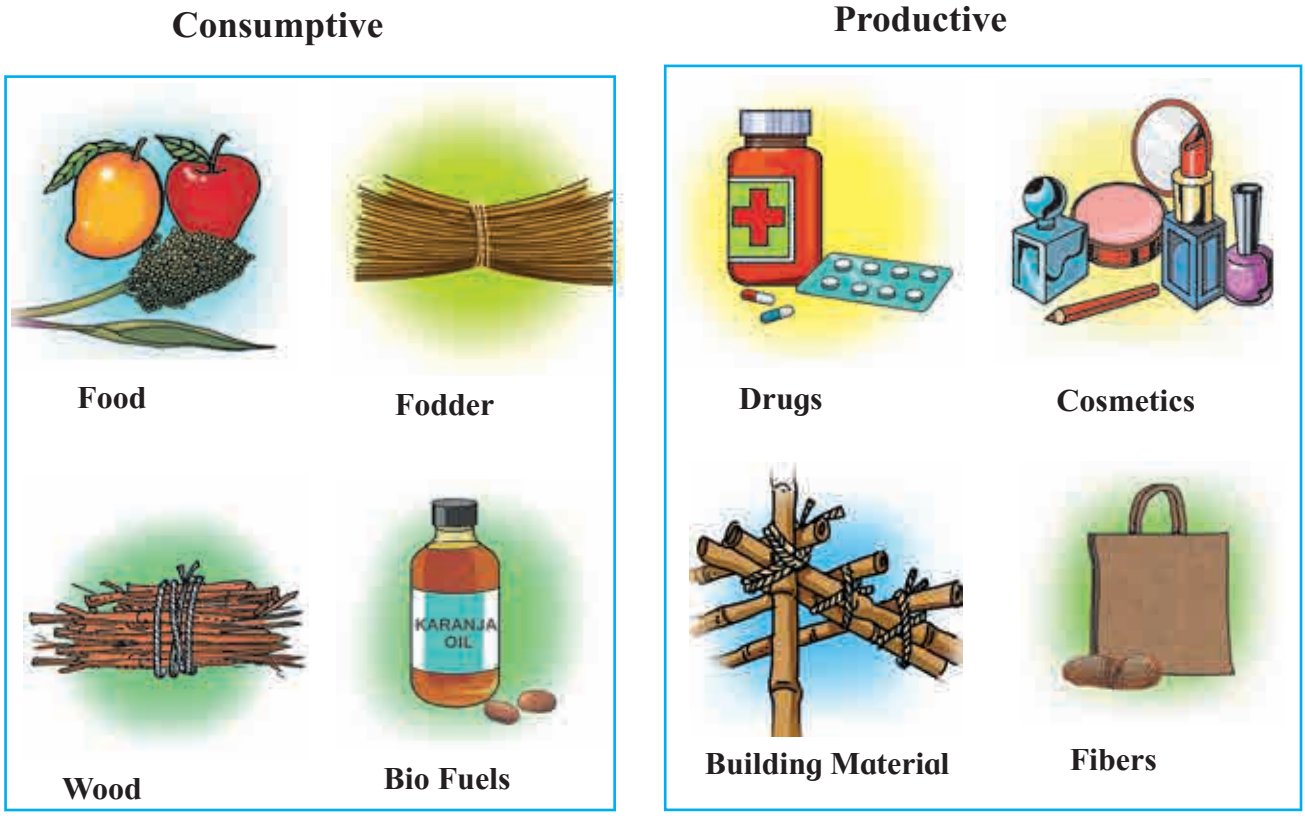


Figure 3.3 : Direct Values

Indirect values of Biodiversity

Biodiversity as a part of natural cycles:

Biodiversity provides essential ecosystem benefits. These are the methods by which biodiversity creates condition of the earth that support human survival. These include hydrological and geo-chemical cycles and climatic condition. For example- microbes convert dead organic material made up of complex compound of carbon, hydrogen, oxygen, nitrogen etc. into the constituent simpler organic compounds. In this way, biodiversity influences soil formation, reduction of soil salinity, decomposition of dead organisms and modification of minerals, nutrient cycling etc. Vegetation cover helps in air purification by absorbing atmospheric carbon dioxide. Biosphere maintains the balance of atmospheric gases and helps to stabilize the climate.

Forest and grassland help to maintain the flow of stream and river. They help to recharge ground water and reduce soil erosion. Rain water percolates into the soil when the surface is covered with vegetation. The roots help to bind the soil and prevent erosion.

A change in the balance of ecosystems or degradation of ecosystems can affect the above functions of the natural world around us. Examples of such changes are loss of soil productivity, soil, erosion, reduced water holding and recharge capacity. Toxins may build up in the environment due to reduced capacity to absorb or disperse pollutants.

Figure 3.4 : Forest helps to maintain flow of water

figure 3.5 : Roots help to bind soil and prevent erosion

1. Ecological Value of Biodiversity

Interdependence of species: Species have evolved to fill particular niches (role in ecosystem) or habitats. Many species depend on each other in intricate ways for survival, such as food chain and food webs. Besides, there are other ecological roles, such as pollination and seed dispersal. Living organisms and relationships of symbiosis, predation, food chain and food webs are aspects of biodiversity. These are important to maintain and evolve biodiversity itself.

Figure 3.6 : Natural Habitat

ACTIVITY 2:

Help students to make a note on how local biodiversity is responsible to meet our daily needs

Group: 5 to 6 students per group

Work plan:

1. Ask each group to enlist daily requirement of a household by keeping a record for 6-7 days.
2. Make different lists of things which are collected from nearby areas. e.g. Gobar, fire wood, plants, vegetables, fruits, honey, flowers etc.

   In cities students can observe and note down the use of plants in their own or neighbor's gardens, collection of firewood from road side trees, use of hills for walking etc.
3. Discuss with friends and elders about what would happen if these items were not available from the surroundings in our villages or cities.
4. Note down these discussions and share within the group. Make a comprehensive report of the discussions.
5. Ask each group to present their findings in the class.

2. Social Values

The biodiversity in different parts of the world has been largely preserved by the traditional societies. The indigenous people have protected the forests for their own use. In ancient times, especially in India flora and fauna were held in high esteem.

Trees like Peepal, Banyan and Tulsi are still worshiped.

Human activities are dependent on the relationship between biological diversity and ecological processes. Loss in diversity has many unfavorable implications related to ecosystem functions such as; energy flow and biogeochemical cycles.

Banyan Tulsi

Figure 3.7 : Social Values

3. Ethical Values

The ethics of biodiversity loss is now a major consideration for saving biodiversity, because such loss is forever and there is no way to recreate lost biodiversity. Morality and ethics teach us to preserve all forms of life and not to harm any organism unnecessarily. Some people take pleasure in the hunting of animals and sometimes degrade and pollute the environment by their unethical actions.

4. Aesthetic Values

A world without melodious birds, graceful beats and thick forest would be poorer place for humans to live in. People feel pleasure and happiness in the presence of wild life. Aesthetic value of biodiversity is described in the number of folk arts and folk songs, stories and other literature which shows its impact on the minds of the people.

5. Option Values

The potential of species to provide economic benefit to human beings in the future is called Option Value. The biotechnologists working towards generating new species to fight and cure deadly disease such as Cancer and AIDS are examples of option value.

Figure 3.8 : Techniques in Biotechnology

3.4 India as a Mega Diversity Nation

India has been recognized as one of the world's top 17 Mega Diversity Nations. In India, about 1,15,000 species of plants and animals have been identified and described.

The country boast of 45,000 species which account for 15% of the known world plants. The North Eastern is known for a being unique treasure house of orchids in the country.

India is very rich in faunal wealth and has nearly 92,037 animal species. About 61,375 of which are insects. In animals, the rate of endemism in reptiles is 33% and in amphibians 62%. Further there is wide diversity in domestic animals. There are no clear estimates about the richness of marine biota. There is an abundance of sea weeds, fish, crustaceans, molluscs, corals, reptiles and mammals associated with marine and coastal ecosystem.

Do you know?

17 Mega Diversity Nations

1) Mexico	2) Colombia
3) Ecuador	4) Peru
5) Brazil	6) Papua New Guinea
7) Madagascar	8) China
9) India	10) Malaysia
11) Indonesia	12) Australia
13) South Africa	14) USA
15) Philippines	16) Venezuela
17) Democratic Republic of Congo	

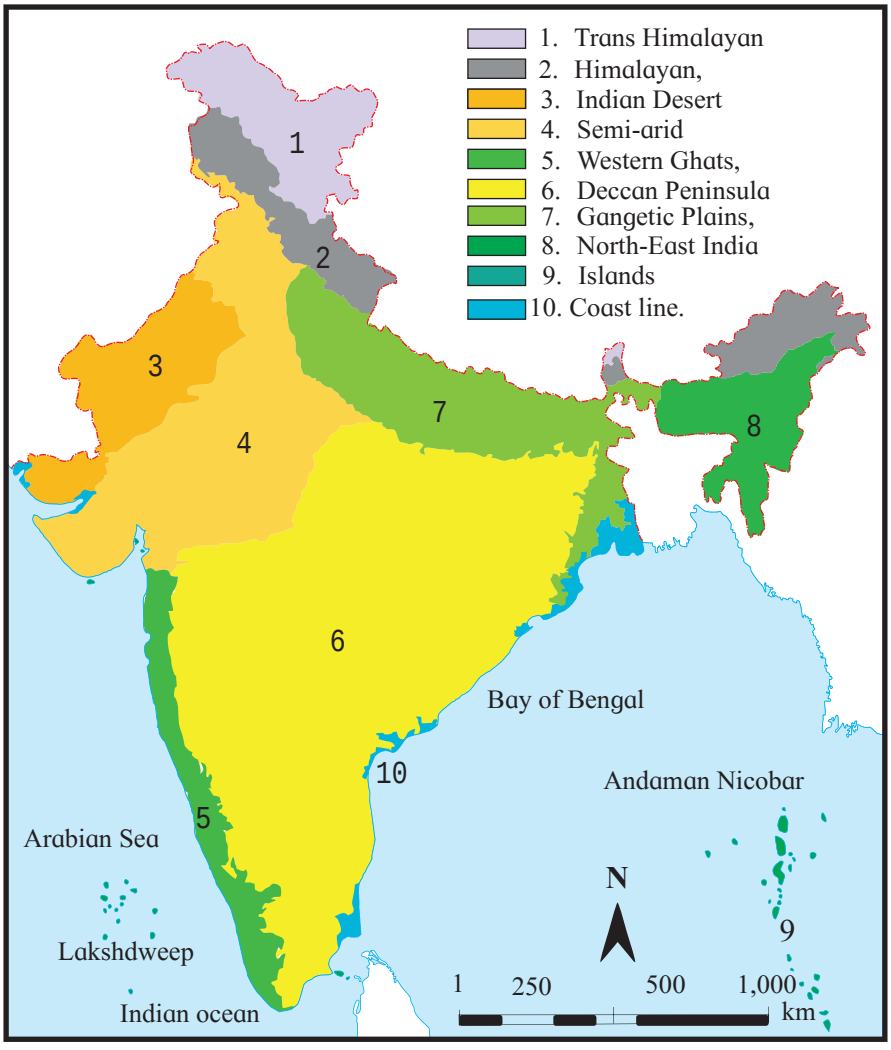
Biodiversity Hotspots

Hotspots are areas which are extremely rich in species, having high endemism and face a constant threat. There are 35 hotspots in the world. In India there exist 2 hotspots, the Western Ghats and the Eastern Himalayan.

The Indian Gene Centre is among the 17 mega diversity region of the world. More than 20 crop species were domesticated here. It is known to have more than 49,000 species of plants, 18,000 species of higher plants including major and minor crops (166) and their wild relatives (326). Around thousands of wild edible plant species are widely used by Indian local tribal communities. These include 145 species of roots and tubers, 521 of leafy vegetables/ greens, 101 of buds and flowers, 647 of fruits and 118 of seeds and nuts. In addition, nearly 9,500 plant species of ethnobotinical uses have been reported from the country of which 7,500 are the ethno medicinal importance and 3,900 are multipurpose, edible species.

Bigeograophic zones of India :

India is divided into 10 major Biogeographical Zones. This is is based on geography which is



Map 3.1 : Bigeographic zones of India

related to climate (rainfall and temperature), soil characteristics, nature of vegetation and the diversity of its faunal species. This thus considers both abiotic and biotic aspects of nature. Human societies in India have used these biogeographic zones for agriculture, pastoralism and urbanization in ways that are specific to the biogeographic zones. This biogeography is closely linked to cultural (human) geography.

India has high Himalayan Mountains, river plains of our major rivers, semiarid lands, hilly regions and coastel areas. When viewed in a biogeographical context the plant and animal diversity of wild and cultivar species is region specific. This provides 10 distinctive biogeographical zones which given India its Megadiversity status.

1. Trans Himalayan
2. Himalayan
3. Indian Desert
4. Semi-arid
5. Western Ghats
6. Deccan Peninsula
7. Gangetic Plains
8. North-East India
9. Islands
10. Coastal line

Do you know about Western Ghats?

The Western Ghats are 1600 km long mountain range running all along the West Coast of India. Covering approximately 1, 40,000 sq. km, these mountains are home to number of endemic plants and animal species. It is one of the hotspots of the world from biodiversity point of view. Western Ghats start from the Gujarat, Maharashtra, Goa, Karnataka, Tamil-Nadu and ends in Kerala. In Maharashtra Western Ghats are locally called as Sahyadris.

3.5 Threats to Biodiversity

The wild variety of species on the earth are vital to keep the world's many ecosystems healthy, balanced and thriving. There are several major causes of biodiversity loss.

1. Fragmentation and Habitat loss

Habitat degradation overexploitation of resources, agricultural conversion and urbanization are the factors contributing to loss of biodiversity. The consequent fragmentation of habitat results in small isolated patches of land which cannot maintain populations of species in the long term.

When large habitats are broken up into small fragments due to various human activities, those mammals and birds which require large territories are decline and may become extinct. Certain animals which migrate long distances are badly affected, leading to a population decline.

2. Over exploitation

Over- hunting, over-fishing and over-harvesting contribute greatly to the loss of biodiversity.

3. Invasive species

The introduction of non-native species into an ecosystem can threaten endemic wildlife. When alien species are introduced unintentionally or deliberately for whatever purpose, some of them become invasive and cause a decline in the population or extinction of indigenous species. Threats posed to our native species by invasive weed species include *Partheniun, Lantana* and water Hyacinth. *Tilapia* fish introduced from South America has reduced the population of local fish species.

4. Pollution

Air pollution and acid rain destroy forests. Water pollution kills fish and other aquatic plants and animals. Toxic and

hazardous substances that are drained into water sources kill aquatic life. Oil spills kill coastal birds and aquatic plant life and other marine animals. Plastic trash affects wildlife. Pollution is a big threat to biodiversity.

5. Climate Change

Climate change is already having an impact on biodiversity, and is projected to become a progressively more significant threat in the coming decades. Loss of Arctic sea ice threatens biodiversity across an entire biome and beyond. The related pressure of ocean acidification, resulting from higher concentration of carbon dioxide in the atmosphere, is already threaten our ecosystem. In addition to warming temperatures, increased frequency of extreme weather events, storms and changing patterns of rainfall and repeated drought well have a significant impact on biodiversity.

Deforestation

Urabanization

Industrilization

Pollution

Figure 3.9 :Threats to Biodiversity

3.6 Man and wildlife conflict

When wild animals leave their natural habitat in search of food and water, it gives rise to a conflict between man and wildlife.

In Maharashtra, at times leopards attack people in both urban and rural areas. Destruction of crops by wild boar and blackbuck are conflicts reported in the newspaper from time to time. In Central India, Sloth bear attacks are common during the season of Mahua collection.

Activity 3 :

Based on the news in newspaper articles from local newspaper write a note analyzing man –animal conflict in Maharashtra.

3.7 Conservation of Biodiversity

Conservation is the planned management of natural resources, to retain the balance in nature and retain species and habitat diversity.

Figure 3.10: Leopard entering urban areas

The main reason for this conflict is the growing human pressure on wildlife habitat which results in:

1. Fragmentation and honeycombing of animal habitat.
2. Loss of corridors and migratory routes for long-range animals such as elephants is a serious conflict issue.
3. Loss of food and water in wildlife habitats due to the shrinking of forest cover leads to crop damaged outside protected areas.

It also includes wise use of natural resources in such a way that the needs of present generation are met and at the same time leaving enough for the future generations. Conservation of biodiversity is important to:

- prevent the loss of genetic diversity of a species.
- save a species from becoming extinct.
- Prevent ecosystems damage and degradation.

Methods of biodiversity conservation

Conservation efforts can be grouped into the following two categories:

1. In-situ (on-site) conservation includes the

protection of plants and animals within their natural habitats. Protected Areas on land or in the sea which is dedicated to protect and maintain biodiversity is done through our national parks and sancturies.

2. Ex-situ (off-site) conservation of plants and animals is done outside their natural habitats. These include botanical gardens, zoos, gene banks, seed bank, tissue culture and cryopreservation.

1. In-situ Conservation

i) Protection of habitat: The main strategy for conservation of species is the protection of habitats in representative ecosystems. Currently, India has 104 National Parks, 551 Wildlife Sanctuaries, 18 Biosphere Reserves, 50 Tiger Reserves and 32 Elephant Reserves. 27 wetlands, 30 mangrove areas and four coral reef areas have been identified for intensive conservation and management purposes by the Ministry of Environment, Forests and climate change, Govt. of India.

• National Parks and Wildlife Sanctuaries:

Many National Parks and Wildlife Sanctuaries have been established to preserve wildlife in their natural environment. The Jim Corbett Tiger Reserve- Uttaranchal, Kanha National Park, Madhya Pradesh, Bandhavgarh National Park- Madhya Pradesh, Ranthambhor National Park- Rajashtan, Gir National Park- Gujarat etc. Some of the main protective areas in India are;

- Kaziranga National Park (Assam) – One-horned rhinoceros
- Manas National Park (Assam) – Wild buffaloes
- Gir National Park (Gujarat) – Lions, chital, sambar, wild bears
- Kolleru National Park (Andhra Pradesh) – Pelicans and marine birds
- Dachigam National Park (Jammu and Kashmir) – Kashmir stag, wild goats, and sheep.
- Bandipur National Park (Karnataka) – Indian bison, elephants, langurs, Tiger
- Periyar National Park (Kerala) – Elephants, barking deer, sambar
- Kanha National Park (Madhya Pradesh) – Tiger, leopards, wild dogs, barasingha.
- Keoledeo National Park (Rajasthan) – ducks, herons, flemingo, pelicans.
- Jim Corbett National Park (Uttaranchal) – Tigers, barking deer, sambar, bear, rhesus monkey.
- Jaldapara National Park (West Bengal) – Rhinoceros

Do You Know?

TIGER RESERVES IN MAHARASHTRA

Tiger Reserves were started by the former Prime Minister Indira Gandhi's flagship program **"Project Tiger"**. It envisioned creating a safe heaven for tigers to flourish and receive legal protection against poachers. Melghat is the first tiger reserve to be declared in 1973-74 with Gugamal National Park as its core zone along with adjoining Melghat Wildlife Sanctuary. Subsequently, over the years, 5 additional Tiger Reserves were created.

List of Tiger Reserves in Maharashtra

Tiger Reserve	Location	Year de-clared	Core area (sq. km)	Buffer area (sq.km)
Melghat	Amravati	1974	1,500	1,268
Tadoba-Adhari	Chandra-pur	1993	626	1,102
Pench	Nagpur	1999	257	484
Sahyadri	Western Ghats	2007	600	565
Nawegaon –Nagzira	Gondia	2013	654	1,241
Bor	Wardha	2014	138	678

Source : National wildlife database, WII

UNESCO

• Biosphere Reserves

The concept of Biosphere Reserves (BR) was launched in 1975 as a part of UNESCO's Man and Biosphere Programme (MAB), dealing with the conservation of ecosystems and the genetic material they contain. A Biosphere Reserve consists of core, buffer and transition zones.

(a) The core zone is the fully protected natural area of the Biosphere Reserve which is least disturbed by human activities. It is a legally protected ecosystem in which entry is not allowed except with permission for some special purpose. Destructive sampling for scientific investigations is prohibited.

(b) The buffer zone surrounds the core zone and is managed so that some resources can be used by local people and promotes research and educational activities.

(c) The transition zone is the outermost part of the Biosphere Reserve. It is an area where active co-operation between the reserve management and the local people. Such as settlements, agiculture, forestry, recreation and other economic activities are in harmony with the conservation goals. There are 553 Biosphere Reserves located in 107 countries in the world.

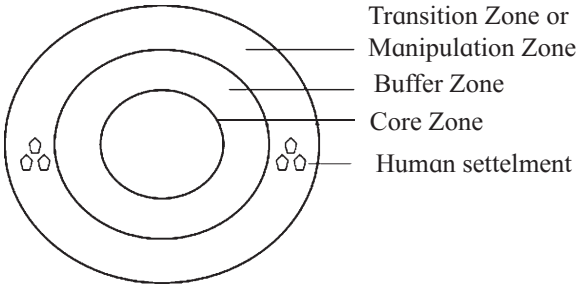


Figure 3.11 : Diagrammatic representation of Biosphere reserve

The main functions of the biosphere reserves are:

- **Conservation :** Long term conservation of representative landscapes and different types of ecosystems along with all their species and genetic resources.
- **Development :** Encourage traditional resource use and promote economic development which is culturally, socially and ecologically sustainable.
- **Scientific research, monitoring and education :** Support conservation research, monitoring, education and information exchange related to local, national and global environmental and conservation issues.

ii) Species-Oriented Projects:

Several species have been identified that need a concentrated and specifically directed effort to prevent extinction.

1. Project Tiger –

This has been success in conservation of the tiger its prey and its habitat.

Tigers which were once abundant in Indian forests declined drastically from an estimate of 40,000 at the turn of nineteenth century to 1200 by 1970. This led to initiating Project Tiger in 1973, with the objective of conserving and rescuing this species from extinction. A total ban was imposed on hunting of tigers and trading in tiger products at the national and international levels. Elaborate management plans are made for each of the tiger reserves for tiger habitat improvement and anti -poaching measures to safeguard our national animal.

2. Project Elephant

Project Elephant was launched in February, 1992 to assist states having free ranging populations of wild elephants to ensure long-term survival of identified

viable populations of elephants in their natural habitats. The project is being implemented in several states. Some of them are; Andhra Pradesh, Arunachal Pradesh, Assam, Jharkhand, Kerala, Karnataka, Odisha, Tamil Naidu, West Bengal etc. Recently elephants have started migrating into Maharashtra in the Kokan region (Sawantwadi) creating man-elephant conflict in the area.

3. Crocodile breeding and management project :

The project surveyed the crocodile habitats and facilitated their protection through declaration of Sanctuaries and National Parks. Captive breeding and reintroduction programs involved careful collection of eggs from the wild. Eleven Sanctuaries have been declared specially for crocodile protection including the National Chambal Sanctuary in Madhya Pradesh.

iii) Sacred forests and sacred lakes:

These are small forest patches protected by tribal communities due to their religious sanctity. These have been free from all disturbances. Sacred forests are located in several parts of India i.e. Karnataka, Maharashtra, Kerala, Meghalaya. Several water bodies for example, Khecheopalri lake in Sikkim have been declared sacred by local people, leading to the protection of their aquatic flora and fauna. Sacred groves or Devrais in the Western Ghat of Maharashtra are examples of sacred forest that have been preserved over several generation.

2. Ex-situ Conservation

i) Botanical Gardens, Zoos : To complement in-situ conservation efforts, ex-situ conservation is being undertaken through setting up botanical gardens, zoos, medicinal plant parks, etc. by various agencies. The Indian Botanical Garden in Howrah (West Bengal) is over 200 years old. Other important botanical gardens are in Ooty, Bangalore and Lucknow.

Number of zoos have been developed in the country. They have played an important role in the conservation of endangered animal species such as the Manipur Thamin deer (*Cerus eldi eldi*) and Red panda (*Ailurus fulgens*) of Assam. Notable successful examples of captive breeding is that of Gangetic gharial (*Gavialis gangeticus*).

The main objectives of botanical gardens are –

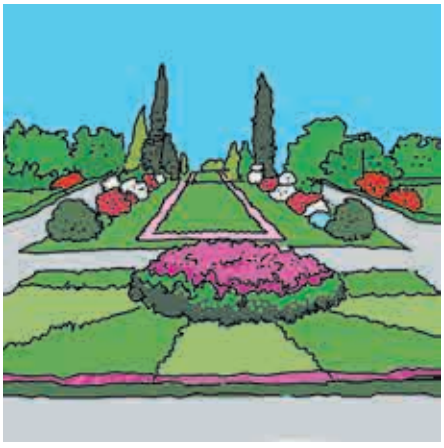
- Ex-situ conservation and propagation of important threatened plant species.
- Serve as a Centre for Conservation, Research and training,
- Build public awareness through education on plant diversity and need for their conservation.

ii) Gene Banks : Ex-situ collection and preservation of genetic resources is done through gene banks and seed banks. The National Bureau of Plant Genetic Resources (NBPGR), New Delhi preserves seeds of wild relatives of crop plants as well as cultivated varieties; the National Bureau of Animal Genetic Resources (NBAGR) at Karnal, Haryana maintains the genetic material for domesticated animals and the National Bureau of Fish Genetic Resources (NBFGR), Lucknow for fishes.

iii) Cryopreservation: This method is particularly useful for conserving crops through vegetative propagation. Cryopreservation is the storage of material at ultra-low temperature in liquid nitrogen (-196^{0}C). It essentially involves suspension of all metabolic processes and activities.

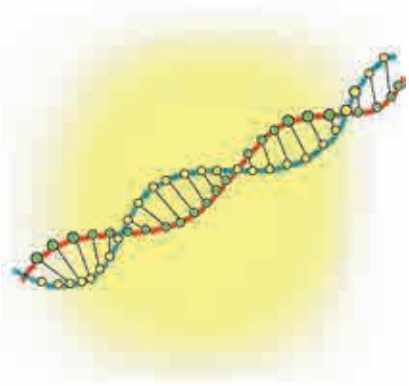
iv) **Conservation at Molecular Level (DNA level):** Germplasm conservation at molecular level is now feasible and is attracting attention. Cloned DNA and material having DNA in its native state can all be used for genetic conservation. Non-viable material representing valuable genotypes stored in gene banks can all be used as sources of DNA libraries from where a relevant gene or a combination of genes can be recovered.

v) **Legal measures:** Market demand for some animal body parts like bones of tiger, rhino horns, furs, ivory, skins, musk, peacock feathers, etc. results in killing of a large number of wild animals. The Wildlife Protection Act (1972) contain provisions for penalties or punishment for offender. Thus prevents poaching and illegal trade.

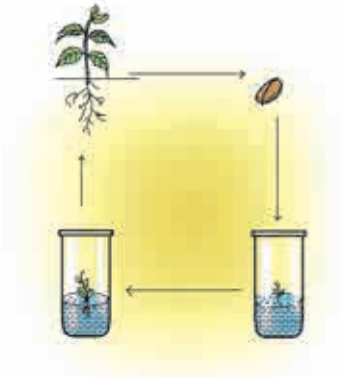


Botanical Garden

Zoo



Genetic Conservation



Tissue Culture

Figure 3.12: Ex-situ Conservation

Think on it:
How can we conserve biodiversity and why?

Exercise

Q. 1. Fill in the blank with the help of correct option.

1) ..... is one of the biodiversity Hotspots in India.
   a) Assam b) North-East India
   c) western Ghats d) Kerala

2) ..... is the indirect value of biodiversity.
   a) Consumptive use value
   b) Productive use value
   c) Option value
   d) None of these.

3) India has been recognized as one of the world's top ..... mega diversity nations.
   a) 10 b) 12
   c) 17 d) 20

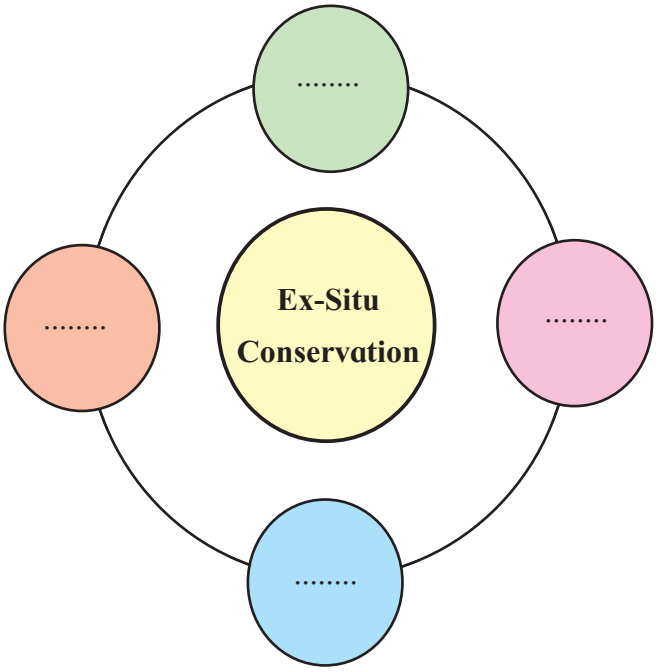
4) ..... are the causes of Biological reduction
   a) Pollution
   b) Over-exploitation
   c) Climate Change
   d) All of these

5) Dachigam National park is located at .....
   a) Jammu and Kashmir
   b) Assam
   c) Kerala
   d) Karnataka.

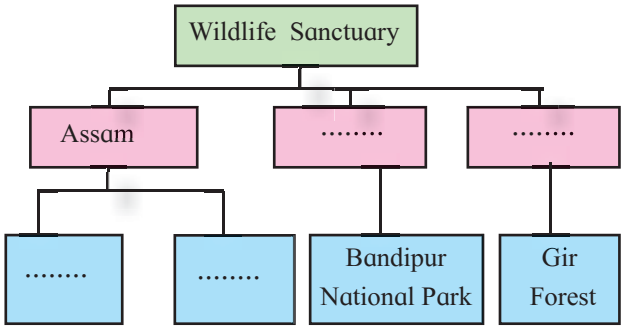
Q.2. Correlate the following pairs.

1) Peepal and Tulsi : Social Value Of Biodiversity :: Folk arts and songs.....
2) Variation of Genes: genetic biodiversity:: Variety of species : .....
3) In-situ: natural habitat :: Ex-situ : .....
4) Simplipal National Park: Mangroves:: Kanha National Park : .....
5) Project Tiger: 1973 :: Project Elephant : .....

Q.3. Complete the Web Diagram.



Q.4. Complete the tree diagram.



Q.5) Write the short answer of the following questions.

1) What is biodiversity?
2) Roots help to bind the soil and prevent erosion. give reasons.
3) What are the two conservation strategies of Biodiversity?
4) Write the importance of Biodiversity.
5) Explain your role in biodiversity conservation.
6) What is the hotspot of biodiversity?

Q.6) Write the long answer of the following questions.

1) What are the values of Biodiversity? Describe each value.
2) Explain Ex-situ conservation in detail.
3) What are threats to Biodiversity? Write any four.
4) Describe any two species-oriented projects under In-situ conservation.
5) Write about Biosphere reserve in detail.

■ ■ ■

4. Natural Resources

Man depends upon a large number of goods and services provided by nature. The water, air, soil, minerals, coal are abiotic resources. Forest resources , crops, wildlife and marine flora and fauna are all examples of biotic resources. Any material which is required or used to sustain life or livelihood is termed as a resource. Natural resources are defined as a form of energy and/or matter which is essential for the functioning of organisms, populations and ecosystems.

Natural resources can be classified into two categories: (i) Renewable resources (ii) Non-renewable resources.

i. **Renewable resources:** These are the resources that are replenished by the environment over relatively short period of time. These floral and faunal resources are able to increase through reproduction and utilization of simple substances. Example: Plants regenerate through biogeochemical cycles and photosynthesis.

ii. **Non-renewable resources:** These are the resources that are not easily replenished by the environment. These are available in limited amounts, which cannot be increased. Example: Coal, petroleum, minerals, natural gas.

- Solar energy, geothermal energy are considered perpetual resources.

Non-renewable resources can be further divided into two categories:

i. **Recyclable:** These are non-renewable resources, which can be collected after they are used and can be reused and recycled. These are mainly the mineral resources, which occur in the earth's crust and deposits. Eg. Iron metal items which can be recycled after use.

ii. **Non- recyclable:** These are non renewable resources, which cannot be recycled in any way. Example: Fossil fuels and uranium, which provide 90% of our energy requirement.

4.1 Water as a natural resource

Without water there would be no life on the earth. Fresh water is the main resource on earth without it there would be no plants or animals. Human beings require water not only to drink but also to grow crop, operate industries and to provide hydro electric energy. Water is an indispensable natural resource on this earth on which all life depends. About 97% of the earth's surface is covered by water and most of the animals and plants have 60-65% water in their bodies.

Distribution of water resources on Earth's water:

Sources of water	% of Total
Ocean	97.3
Ice	2.22
Ground water	0.5
Inland water	0.2
Soil moisture	0.005
Rivers	0.001
Atmospheric water vapour	0.001

Freshwater makes up a very small fraction of all water on the planet. Nearly 71% of the earth is covered by water only 2.5% of it is fresh water. The rest is saline water in the oceans. Only 1% of freshwater is available as much of it is trapped in glaciers and the Artic and Antartic circles.

Due to these unique properties water has of multiple use for all living organisms. Water is absolutely essential for life. Most of the life processes takes place in the tissue fluids in flora and fauna. Uptake of nutrients, their distribution in the body, regulation of temperature and removal of wastes are all maintained through water.

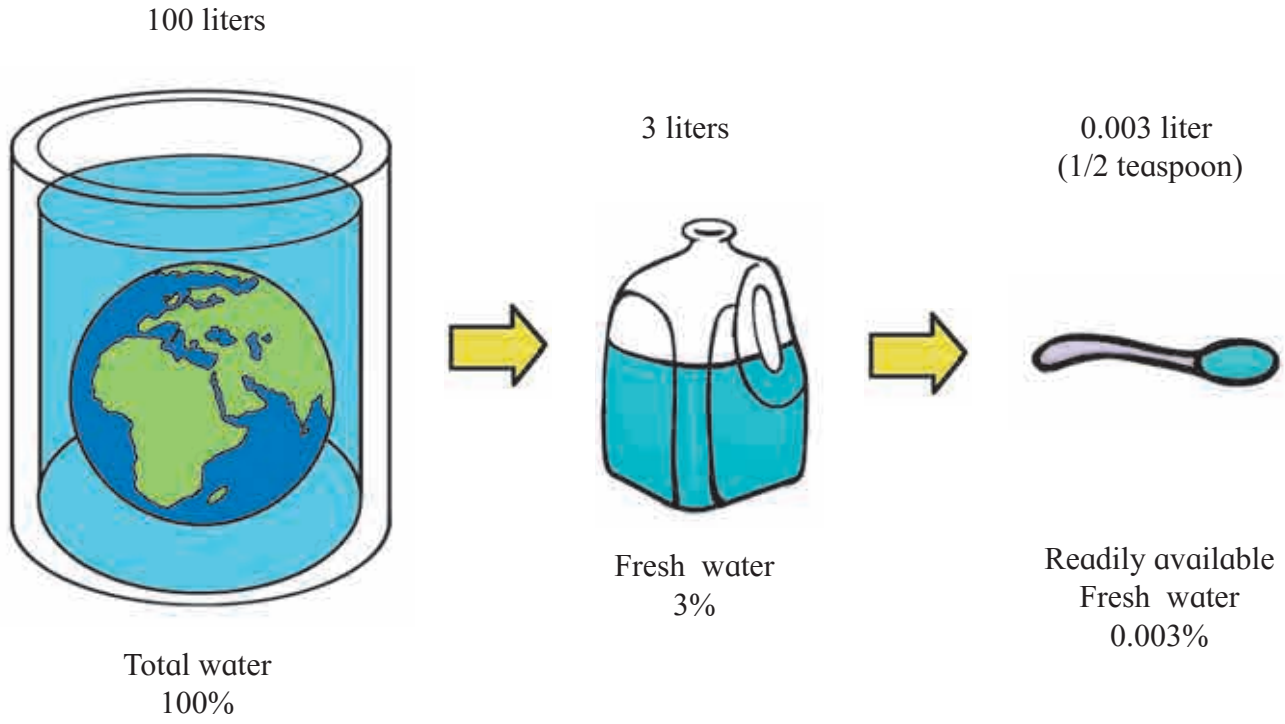


Figure 4.1 : Only a tiny fraction of the world's water supply is available as a fresh water for human use

Classification of Water Resources

Surface water resources:

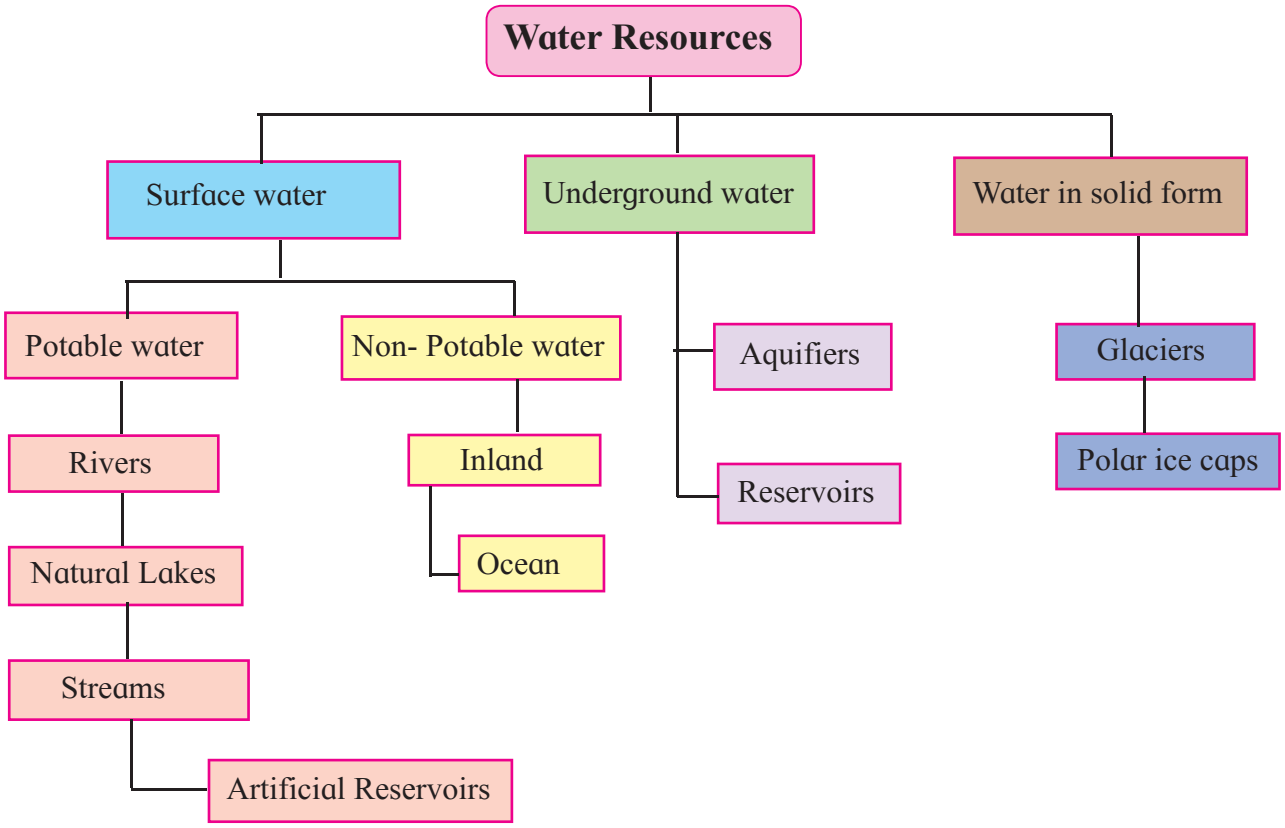
The surface water generally originates from the following:

- Precipitation in the form of snowfall and rainfall.

Underground water resources

It is the natural storage of water due to percolation of rain water through the soil. The quality of ground water is usually clean, clear and fresh as it gets filtered naturally. This water is mostly used for the agricultural purposes and domestic use.

About 9.86% of the total fresh water resources is in the form of groundwater. Overuse of groundwater for drinking, irrigation and domestic purposes has resulted in rapid depletion of groundwater levels in various regions leading to lowering of water table and drying of wells. Pollution of many groundwater aquifers has made the well water unfit for consumption. Rivers and streams are used for discharging urban , industrial and agriculture waste. Most of the civilizations have flourished on the banks of rivers, but, in turn they became sources of pollution for the rivers.



Distribution of Water Resources

Degradation of water resources:

Degradation of water is decrease in quality and quantity of water on the earth surface with increase in population and industrial growth. Water is being degraded day by day.

Reasons for degradation:-

1. To fulfill the need of increasing population surface water and ground water are overused.
2. Sewage i.e. waste water generated from domestic and municipal use, when mixed with fresh water; becomes unfit for use by human beings and animals.
3. Untreated waste water from industries percolates into ground water which is polluted.
4. Agricultural wastes containing manures, fertilizers and pesticides enter water bodies and degrade the quality of water.
5. Continuous decrease in the level of ground water occurs due over use. The movement of saline sea water into fresh water wells, causes salinity of fresh water.

Activity 1 : Water budget
How much water does your family require per day?

Purpose	Approximate requirements Lit. per day
Drinking	
Cooking	
House cleaning	
Utensils washing	
Cloths washing	
Bathing	
Sanitation	
Miscellaneous (livestock, fire)	

Approximately calculate the yearly use of water.

Do You Know?

The data of ground water levels in Maharashtra shows that around 50% area of the state ground water level has fallen in the last ten years. In districts like Yavatmal, Chandrapur, Amravati, Akola, Beed and others the fall in ground water level has been more than 4 meters.

Conservation of water: -

Conservation and management of water are essential for the survival of biosphere.

This can be done by adopting following methods:-

1. Growing vegetation in the catchment area which holds water in the soil and allows it to percolate in deeper layers and contributes to the formation of ground water.
2. Constructing small dams and reservoir to regulate supply of water to the fields.
3. Sewage should be treated and only the clean water should be released into the rivers.
4. Industrial wastes should be treated to prevent chemical and thermal pollution of fresh water.
5. Judicious use of water in our day to day life.
6. Rainwater harvesting should be done by storing rain water and recharging ground water.
7. Use drip irrigation and sprinklers.

Think about it!

What you can do for water conservation?

Activity 2 : Study the water supply in your area under following headings

1. Drinking water supply.
2. Are there water purification plants?
3. Where the waste water goes from your houses?
4. Do you pay water tax?

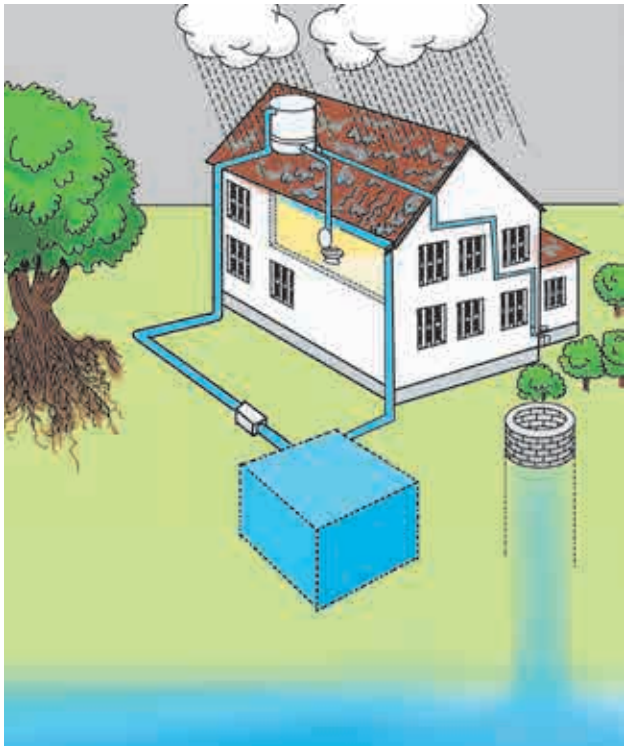


Figure 4.2 :Rain Water Harvesting

Activity 3 : Water management

Visit a watershed development programme/Rainwater harvesting unit and collect following information.

1. Process of watershed Management.
2. Economic benefits to the local people.
3. Perceptions of local people towards the project.

Case Study

Miracle of Water

Hiware Bazar a village located in the Ahmadnagar district, Maharashtra falls in rain shadow area with less than 400 mm of rainfall per annum created miracle with people's support and by using various government schemes.

In 1994, the Maharashtra government brought Hiware Bazar under the Adarsh Gaon Yojana (AGY). The first work it took up was planting trees on forest land; people were persuaded to stop grazing in forested areas.

The village invested all its funds on water conservation, recharging ground water and creating surface storage systems to collect rainwater. The 70-ha regenerated forest helped in recharging the wells. 414 ha of contour bunding stopped surface runoff; and around 660 water-harvesting structures collected the rainwater. The state government spent Rs. 42 lakh under Employment Guarantee Scheme (EGS) in the village to treat 1,000 ha of land.

Hiware Bazar is now reaping the benefits of its investments. "The little rainfall it receives is trapped and stored into the soil," says a villager, who worked on its watershed programme. The number of wells has increased from 97 to 217. Irrigated land has gone up from 120 ha in 1999 to 260 ha in 2006. Grass production went up from 100 tonnes in 2000 to 6,000 tonnes in 2004. Nearly 80 people go to the forest to collect grass. Residents of neighbouring village come here to collect grass. With more grass available, livestock numbers have gone up from 20 in 1998 to 340 in 2003 according to a government livestock census. Milk production rose from 150 litres per day in the mid-1990s to 4,000 litres in 2006. In 2005-06, income from agriculture was nearly Rs. 2.48 crore.

"There has been a 73 per cent reduction in poverty, due to profits from dairy and cash crops," says Sarpanch Popatrao Pawar. According to Pawar, those who earn Rs. 10,000 a year are considered below the poverty line in Hiware Bazar. This is around 3 times higher than the official poverty line of country.

Discuss and act:

Collect the information about contribution of people or orgnisation for water conservation in Maharashtra and discuss it in class.

4.2 Forest resources:

Forest is a dense growth of trees, together with other plants, covering a large area of land. Forests are important natural resources on earth. Covering the earth like a green blanket the forests not only produce innumerable material goods, but also provide several environmental services which are essential for life.

Uses of forest

1. Commercial use:

Forest provide a large number of commercial goods which include timber, firewood, pulpwood, food items, gums, resins, non-edible oils, rubber, fibers, lac, bamboo, cane, fodder, medicines, drugs and many more items. Half of the timber cut each year is used as fuel for heating and cooking. Wood is used for building material for , plywood and hardwood, particle board and chipboard and some portions are converted into pulp and used for paper industry. Many forest lands are used for mining, agriculture, grazing, tourism and recreation and for development of dams.

2. Ecological uses:

a. **Production of oxygen:** Trees produce oxygen by photosynthesis which is vital for life on this earth. They are called lungs of the earth.

b. **Reducing global warming:** The main greenhouse gas, carbon dioxide (CO_2) is absorbed by the forest as a raw material for photosynthesis. Thus, forest can act as a sink for CO_2 thereby reducing the problem of global warming caused by the greenhouse gas.

c. **Wildlife habitat:** Forests are the homes of millions of wild animals and plants. About 7 million species are found in the tropical forests alone.

d. **Regulation of hydrological cycle:** Forested watershed act like giant sponges, absorbing the rainfall, slowing down surface runoff, percolation into ground water and slowly releasing the water for recharge of springs. About 50-80% of the moisture in the air above tropical forests come from their transpiration.

e. **Soil conservation:** Forests bind the soil particles tightly in their roots and prevent soil erosion. They also act as windbreakers.

f. **Pollution control:** Forest can absorb carbon dioxide and release oxygen. This helps in keeping the air pure and clean. They have also been reported to absorb noise and thus help in preventing air and noise pollution.

Threats to forest

- **Over exploitation of forests:**

Humans depend on forest for food, medicine, shelter, wood and fuel. With growing civilization, the demands of raw material like timber, pulp, minerals, fuel wood etc. has increased. Large scale logging, mining, road-building and clearing of forests are major threats. Our forests contribute substantially to the local economy. Excessive use of fuel wood and charcoal has lead to forest degradation. The expansion of urban, agricultural, industrial areas leads to severe landuse and landcover changes. Overgrazing and repeated fires has lead to over exploitation of our forests.

- **Deforestation:**

The total forest area of the world in 1990 was estimated to be 7000 million hectares which was reduced to 2890 million hectors in 1995 and reduced to only 2300 million hectares by 2000. Deforestation rate is relatively less in temperate countries, but is alarming in tropical countries. In developing countries it can be as high as 40-50% and at the present rate it is

estimated that in the next 60 years we would lose more than 90% of our tropical forest. The forested area in India seems to have stabilized since 1982 with about 0.04% decline annually between 1982-90. The current Forest report of Govt. of India has shown that the forest and tree cover has increased by 1 % from 2017 to 2018. The total forest and tree cover is now 24.39% of the geographical area of the country.

Major causes of deforestation are:

i. **Shifting cultivation:** It is estimated that there are 300 million people living as shifting cultivators who practice slash and burn agriculture and clear more than 5 lakh hectares of forest for shifting cultivation annually. In India this practice is found in the North-East regions and to some extent in Andhra Pradesh, Bihar , Madhya Pradesh and Western Ghats which contribute to nearly half of the forest clearing annually.

ii. **Fuelwood requirements:** There is an increase in the fuel wood demand by our growing poverty stricken population.

iii. **Raw material for industrial use:** Wood for making boxes, furniture, plywood, match boxes, pulp for paper industry, etc. add tremendous pressure on forests.

iv. **Development projects:** The forests are destroyed for various developmental projects like hydroelectric projects, dams, road construction, mining, urbanization industry etc.

v. **Growing food needs:** To meet the demands of rapidly growing population, agricultural lands and settlements are created by clearing forests, irrigated and highly intensive agriculture.

vi. **Overgrazing:** Loss of tree cover and the cleared lands are turned into grazing lands. Overgrazing by the cattle lead to further degradation of these forests.

Major consequences of deforestation:

1. It threatens the existence of many wildlife species due to destruction of their natural habitat.
2. Biodiversity is lost and genetic diversity is eroded.
3. Hydrological cycle gets affected, thereby influencing rainfall.
4. Problems of soil erosion and loss of soil fertility increases.
5. In hilly areas it often leads to landslides.
6. It contributes to global warming as concentration of CO_2 increases.

4.3 Food Resources

There are thousands of edible plants and animals over the world out of which only few constitute major food for humans. The main food resources include wheat, rice, maize, potato, barley, oats, etc. About twenty common fruits and vegetables, milk, meat, fish and seafood.

Since 1950 food production from agricultural lands has increased drastically. The growth occurred because of technological advances such as use of tractors, farm machinery, inorganic chemical fertilizers, irrigation, pesticides, high yielding varieties of wheat, rice, etc. Animal products increased due to increasing poultry and dairy industry besides piggery. Fisheries and aquaculture ponds increased quantity of fish. This increase in food resource has happened because of green revolution by Dr. M.S. Swaminathan.

Today our food comes entirely from agriculture, animal husbandry and fishing activities. India is self-sufficient in food production. This is only because of modern methods of agriculture which however pollutes our environment with excessive use of fertilizers and pesticides.

Impact of modern agriculture includes

- The changes due to high yielding varieties of crops leads to loss of traditional cultivable diversity.
- Fertilizers related problems include micronutrient imbalance, nitrate pollution, eutrophication.
- Pesticide related problems include creating resistance in pests and producing new pests. It also leads to death of non-target useful organisms in nature. Biomagnification leads to loss of species at the apex of food pyramid.
- Water logging affects a number of biological and chemical processes in plants and soil and can affect crop growth in the long and short term.
- Salinity problems reduce productivity in both irrigated and non-irrigated agricultural lands throughout the world. As the water evaporates, salt accumulates at the soil surface making the land unproductive.

Food Scarcity: -

In many developing countries the production of food is unable to keep pace with rapidly expanding population. A developing country does not produce enough food or does not have the financial ability to import it. The technologies we have used to achieve high yield cause major problems such as:

1) Decrease in fertility of the soil
2) Conversion of forest, grass land, wetland into agricultural use which has led to degradation of ecosystems.
3) Reduction of fish catch.
4) Some communities such as tribals still face serious food problem leading to malnutrition.

In India, there is a shortage of cultivable productive land. Farm sizes are too small to support the family. Farmlands are being sub-divided. Poor environmental condition and agricultural practices reduce food production. Due to the over use of agricultural chemicals land degradation occurs along with decrease in nutrients. Water scarcity, salinization and water logging affects large amount of agricultural land. The loss of genetic diversity in crop plants is another issue that is reducing agricultural produce.

In India, some traditional communities in urban and semi urban areas used to grow their own vegetables in backyard using waste water from their own homes. This is not commanly done now.

Food Security:

It is estimated that 18 million people worldwide die each year due to starvation or malnutrition and many others suffer a variety of dietary deficiency. To overcome this problem we have to conserve and supply nutritious food.

Food security is only possible if food is equally distributed to all. It is important not to waste food. Another major concern is the support needed for different farmers, so that they do not migrate to urban centers as unskilled industrial workers.

Alternate food resources should be used and food production can also be increased by following intercropping patterns. Using unfamiliar crops such as **Nagali** which are grown on poor soil on hill slopes of Western Ghat. Several crops can be grown in urban settings including vegetables which can be grown on house hold waste water and fertilizers from vermicomposting.

Do you Know?

Israel's drip irrigation system: The small and arid state of Israel began using drip irrigation system, as they sufer from acute shortage of water. With this technique farmers have been able to improve the efficiency of irrigation by 95 % over a 20 year period. Israel's food production has doubled without increase in the use of water for agriculture. Israel is one of the major suppliers of food and vegetables in the world.

Case Study:

Using the purification capacity of wetlands, the Indian city Kolkata has pioneered a system of sewage disposal. 8000 hectar of East Kolkata wetlands are declared as Ramsar Site. A patchwork of tree fringed canals, vegetable plots, rice paddies and fish ponds is used by the 20 thousand people that work there daily and transform 1/3rd of the city's sewage and most of its domestic refuse in to a rich harvest of fish and fresh vegetables.

4.4 Land as a Resource:

Land is a very valuable resource that provides food, fiber, medicine, wood and other biological materials needed for mankind. Land is a resource generating area on which people depend. If land is utilized carefully, it can be considered a renewable resource.

Land is a finite and valuable resource upon which we depend for our food, fiber and fuel wood.

Land degradation:-

Because of increasing of population growth the demands for arable land for producing food and fuel wood is increasing. Hence there is more and more pressure on the limited land resources which are getting degraded due to over-exploitation. Soil erosion, water logging, salinization and contamination of the soil with industrial waste like fly-ash, press mud or heavy metals which cause degradation of land.

Main causes of land degradation Deforestation, excessive use of fertilizers and pesticides , overgrazing, salinization, water logging, desertification, soil erosion, wastelands and landslides.

1. **Soil erosion -** The removal of top fertile layer of soil by wind and water is called soil erosion. Characteristics of different natural ecosystems depend on the type of the soil. The misuse of various ecosystem leads to the loss of valuable soil.
2. **Causes of Soil Erosion -** Poor farming methods, over grazing and deforestation, are responsible for soil erosion.

Mining and soil erosion

Mining exploration is detrimental to the environment and causes soil erosion. The main types of soil erosion in the mining areas is due to water erosion and wind erosion. Water causes soil erosion in the rainy season which extends from June to September. Most soil loss in these areas is associated with water erosion. Wind erosion, accompanied by sand storms takes place in the dry season that normally extends from January to April.

Topography and soil cover change is due to digging of open cast mines and dumping of rock mass in the form of large heaps. Due to mass deforestation in mining areas soil gets exposed to further erosion.

Even the soil which is removed and dumped elsewhere is exposed to further erosion and weathering.

In order to prevent soil erosion and conserve the soil the following conservation practices are carried out:

1. Contour farming
2. Terracing
3. Strip cropping
4. Wind breaks or shear belts

The causes of land degradation are as follows

1) If forests are depleted, the land becomes unproductive.
2) Intensive irrigation leads to water logged and salinized soil, on which crops cannot grow.
3) Land can be converted into a non-renewable resource when highly toxic industrial and nuclear wastes are dumped on it.
4) Farm land is under threat due to more and more intense utilization.
5) When soil is used more intensively for farming it gets eroded which is accelerated by wind and rain.
6) The use of more chemical fertilizers, poisons the soil and eventually the land becomes unproductive.
7) Due to urbanization and industrialization degradation of agricultural land and forest land takes place. This is a serious loss and will have unfavorable long term effects on human civilization.
8) Various anthropogenic activities like large dams, construction of roads and railway lines, unplanned urbanization, mining, etc. are responsible for landslides.
9) Desertification is a process by which the productive potential of arid or semi-arid lands fall by ten percent or more. Desertification is characterized by loss of vegetal over, depletion of groundwater, and severe soil erosion.

Case Study

Landslides and disaster

On 26 October 2013, in the state of Uttarakhand and adjoining areas received heavy rainfall, which was about 375% more than the benchmark rainfall during a normal monsoon. This caused the melting of Chorabari Glacier at the height of 3800 metres, and eruption of the Mandakini River which led to heavy floods near Kedarnath temple, Uttarakhand.

The upper Himalayan region of Himachal Pradesh and Uttarakhand are full of forests and snow-covered mountains and thus remain relatively inaccessible. Heavy rainfall for four consecutive days as well as melting snow aggravated the floods and land slides causing thousands of people to be caught unaware, resulting in huge loss of life and property.

The heavy rains resulted in large flashfloods and massive landslides. Landslides, due to the floods, damaged several houses and structures, killing those who were trapped. Entire villages and settlements such as Gaurikund were affected. The market town of Sonprayag suffered heavy damage and loss of lives. Pilgrimage centres in the region, are usually visited by thousands of devotees, who were affected by land slides. Over 70,000 people were stuck in various regions because of damaged or blocked roads .

Conservation of land resources:

Conservation of land is the process of protecting natural ecosystems and converting developed land to its natural state. As some land has only suffered minor disturbances and other area have been completely destroyed, a variety of techniques are needed to carry out eco restoration. Some of the most common techniques include preservation, restoration, remediation, and mitigation.

1. **Preservation –** Preservation of land as a natural resource by humans can be maintained in its pristine form. Under this form of land conservation, humans would no longer be able to use certain land for human use, but would be able to enjoy it for its natural beauty, which would help protect the land for many years to come.
2. **Restoration -** Another technique used in land conservation is restoration, which is the process of returning ecosystems and communities to their original natural conditions. In order to restore an ecosystem, scientists must first examine the current environmental status and do research to determine the historical background of the ecosystem. Restoration often includes planting native plants, introducing native animals, restoring streams to their natural flow and removing human infrastructure.
3. **Remediation** is the cleaning of a contaminated area using relatively mild or nondestructive methods. We can use a variety of methods for remediation, including chemical, physical, and biological methods to remove contamination. Bioremediation is a more effective method than chemical, physical remediation. Bioremediation is the use of naturally occurring or purposefully introduced organisms to break down pollutants.

Activity 4 :

Visit an agricultural farm in your area and try to find out following information.

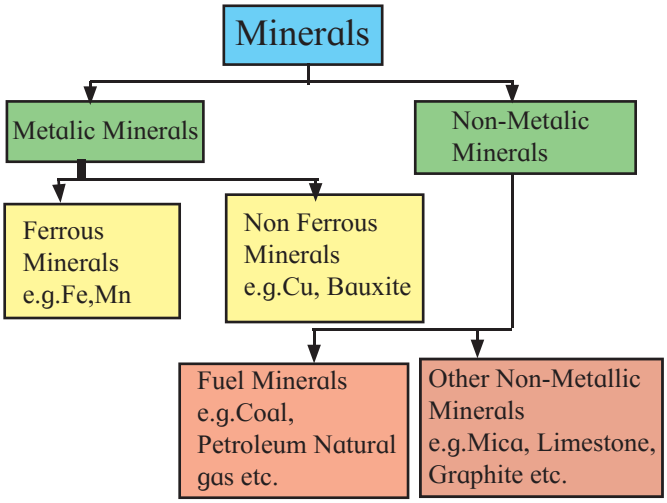
1. What are types of crops grown?
2. Which were the crops grown ten years back?
3. Has the production increased or decreased?
4. What are the problems related to agriculture in last five years?

4.5 Minerals as a natural resource

A mineral is a natural substance of organic and inorganic origin with definite chemical and physical properties. The mineral resources provide the country with necessary base for industrial development. India is endowed with a rich variety of mineral resources due to its varied geological structure.

Types of mineral Resources

On the basis of chemical and physical properties, minerals are grouped into two main categories such as metallic and non – metallic which may be further classified as follows:



A) Metallic minerals: Metallic minerals are the sources of metals such as iron ore, copper, gold. These are ferrous and non-

ferrous metallic minerals. All these minerals which have iron content are ferrous and which do not have iron content are non-ferrous.

B) Non-metallic minerals: Non-metallic minerals are organic in origin such as fossil fuel which are derived from buried animals and plant life such as coal and petroleum. Other types of Non-metallic minerals are inorganic in origin like mica, limestone, graphite, etc.

Minerals are exhaustible over time. Minerals take a longer period to develop geologically and they can not be replenished. There is a need to conserve and not to misuse minerals.

Both metals and non-metals mineral are used in number of industries.

Do you know:

India is a rich country of mineral resources. Reserve of some minerals are inadequate, while some minerals are available in excess amount e.g. as mica and bauxite is present in excess amount those are exported while Titanium and petroleum are in scarcity, are imported.

Availability of Minerals:

Most of the metallic minerals in India occur in Peninsular plateau region in the old crystalline rocks.

1. **Coal -** Coal is one of the important minerals used in generation of thermal power and smelting of iron ore. The deposits of coal are found in Jharkhand and Bengal belt. 97% coal is found in the valley of Damodar, Shone, Mahanadi and Godavari.
2. **Petroleum -** Crude petroleum consists of hydrocarbon in liquid and gaseous states varying in chemical composition, color, and specific gravity. It is used in internal combustion engines in automobiles. It's reserves located in sedimentary basins of Assam, Gujarat and Mumbai high and Krishna-Cauveri basins.

Degradation of Minerals:

Environmental impacts of mining activity: -

As mineral resources are essential for industrialization and the development the rate of consumption is increased and according to correct rate it will deplete in next 50 – 100 years.

Mining and processing minerals are among the most environmentally damaging of all human activities, the mineral industry accounts for 5-10% of world energy use making it a major contribute to air and water pollution also increases greenhouse effect. Mining wastes often contain hazardous substances. The overall impacts of mining observed are summarized as follows.

1) Forest are destroyed.
2) Mined land becomes unproductive.
3) Local people loose their lands.
4) Peoples are forced to migrates and are economically impoverished.
5) Rivers are polluted.
6) Air and water pollution occurs after mining.

Energy Resource:-

Mineral fuels are essential for generation of power required by urban areas, agriculture industry, transport and other sectors of the economy. Mineral fuels like coal, petroleum, natural gas and nuclear energy minerals are the conventional energy sources of energy and are non renewable resources. They will completely used up in the future.

Energy consumption of a nation is usually considered as an index of its development. This is because almost all development activities are

directly or indirectly dependent upon available energy. There are wide disparities in per capita energy use between developed and the developing nation. The very original form of energy technology was fire, which produced heat and the early man used it for cooking and heating purposes. Wind and hydropower have also been used. Invention of steam engineers replaced the burning of wood by coal was further replaced by oil. The oil producing countries put the terms for developed as well as developing countries by dictating the prices of oil and other petroleum products.

Energy resources are primarily divided into two categories namely, renewable and non-renewable sources. Renewable energy resources must be preferred over the non-renewable resources. This will seek to end energy crisis which the world is facing. It is inevitable truth that now there is an urgent need of thinking in terms of alternative source of energy, which are also termed as non-conventional energy sources which include:

1. **Solar energy:** Using solar cells, solar cooker, water heater, furnace, power plants are must.
2. **Wind energy:** It is the use of air flow through wind turbines to provide the mechanical power to turn electric generators. Wind power is an alternative to burning fossil fuels.
3. **Hydropower:** It refers to the conversion of energy from flowing water into electricity.
4. **Tidal energy:** Tidal stream generators are same as wind turbines except they are below water. The turbine and generator convert the movement of water coming from change in tide into the kinetic energy to electricity.
5. **Ocean thermal energy:** It is a process that can produce electricity by using the temperature difference between deep cold ocean water and warm tropical surface waters.
6. **Geothermal energy:** It works by tapping into steam or hot water reservoirs underground, then heat is used to drive an electrical generator.
7. **Biomass:** It can either be used directly via combustion to produce heat or indirectly after converting it to various forms of biofuel like burning .
8. **Biogas:** It is a type of biofuel that is naturally produced form the decomposition of organic waste.

Conservation of Minerals

The Mineral resources are being rapidly consumed. Recycling of metals scrap like iron, copper, aluminum, zinc, lead etc. should be encouraged and facilitated.

4.6 Sustainable use of Natural Resources:-

We should rethink our energy strategies to satisfy our needs with minimum use of energy with a environmental impacts.

There are a number of practical steps that all of us can take to help protect and improve the sustainable use of resources. Some are very small steps like putting off the lights when you go out of the room. Implementing energy audit for households or in your college/school.

We can contribute in conservation by not throwing unncessary household articles. Instead they can be reused or recycled. Walking, cycling or using public transportation, avoiding environment damaging goods or wasteful packaging are activities which are environment friendly.

Good business practice-

Businesses and large retailers are now instructed to develop environment friendly practices due to consumer pressure. We should

all become wise consumers. Lifestyle change, consumer pressure and acceptance of personal responsibility will bring out transformation of our industrial society. But without this pressure there cannot be sustainable solutions. Each one of us is responsible to bring about the change in society.

Role of an individual in conservation of Natural Resources

Different natural resources like forest, water, soil, food, mineral and energy resources play an important role in the development of a nation. With small individual efforts we can help in conserving our natural resources to a large extent. The following ways can be adopted in order to conserve resources:

Conserve water:

i. Do not keep the water taps running while brushing, shaving, washing or bathing.
ii. In washing machines, fill the machine only to the level required for your clothes.
iii. Install water saving toilets, that use no more than 6 liters per flush.
iv. Check for water leaks in pipes and toilets and repair them properly.
v. Reuse the soap water from washing of clothes for gardening, etc.
vi. Water the plants and the lawns in the morning or evening when the evaporation losses are minimum.
vii. Install a system to capture rain water.

Conserve energy:

i. Turn off the lights, fans and other appliances when not in use.
ii. Use light as much as possible from natural sources like sunlight.
iii. Dry clothes in sun instead of drier.
iv. Use solar cooker for cooking which will be more nutritious and will save the LPG expenses.
v. Build houses with provision for sun light which will keep the house warmer and will provide more light.
vi. Use bicycle or walk down instead if using vehicles
vii. Use public transportation whenever possible.
viii. Control the use of air conditioners.
ix. Recycle and reuse glass, metal and papers.

Protect the soil:

i. Grow different types of ornamental plants, herbs and trees in your garden.
ii. Grow grass in the open areas which will bind the soil and prevent erosion.
iii. Make compost from kitchen waste and use it for the garden.
iv. Do not irrigate plants using a strong flow of water as it would wash off the soil.
v. Use drip irrigation, if possible.

Promote good practices:

i. Do not waste food.
ii. Reduce the use of pesticides.
iii. Use organic fertilizers.
iv. Use drip irrigation.
v. Eat local and seasonal vegetables.
vi. Control pests by using biopesticides.

Equitable use of resources for sustainable life style:

The division in the world with more developed countries and less developed countries should be reduced. It is observed that more developed countries have only 22% of the world's population but they use 88% of the natural resources, 73% of the energy and command 85% of income, in turn they contribute to pollution. On the other hand, low developed countries have very low or moderate industrial growth and have 78% of the world's population. They use only 12% of the natural resources,

27% of energy and have only 15% of global income. The rich become more rich and the poor become poorer. The gap between these two worlds should be reduced as this is not sustainable growth. The solution to this problem is to have more equitable distribution of resources and wealth. A global consensus has to be reached for balanced distribution. There are two major causes of unsustainability:

1. Over population in poor countries.
2. Over consumption of resources by rich countries.

The rich countries will have to lower down their consumption levels. Need of the hour is fair sharing of resources between rich and poor which will bring out sustainable development for all.

Think on it!

What is your individual role in conservation of natural resource.

Exercise

Q. 1. Fill in the blank with the help of correct option.

1. Total forest cover is ..... % of the geographical area of India.

   a) 24.39% b) 27%

   c) 50% d) 75%

2. ..... is a naturally occurring or purposefully introduced organisms to break down pollutants.

   a) Bioremediation

   b) Chemicoremadation

   c) Physicalremadation

   d) None of this.

3. .....is a naturally occurring substance of organic and inorganic origin with definite physical and chemical properties.

   a) Mineral b) Matter

   c) Material d) None of this.

4. The removal of top soil by wind and water is .....

   a) Soil fertility b) Soil salinity

   c) Soil erosion d) Soil alkalinity.

5. Renewable resources are known as .....

   a) Inexhaustible b) Both a and b

   c) Exhaustible d) None of this

Q.2. Write answer in short answer for the following question.

1. What are the ecological uses of forest?
2. What are the causes behind less food production and increase in food production?
3. What do you mean by ferrous and nonferrous mineral?
4. Discuss the industrial uses of minerals
5. Write a short note on food resources.
6. Explain in brief soil salinity.

Q.3. Write the answer in Long for the followinh questions.

1. Explain Renewable and Nonrenewable resources in detail.
2. Explain the causes of water degradation and suggest the control measures to overcome water scarcity problem
3. Explain the land degradation and suggest conservation practices for mineral resources.
4. What are the environmental impacts of mining activity? Suggest the conservation practices for mineral resources.

■ ■ ■

5 . Disasters

5.1 Understanding Disasters

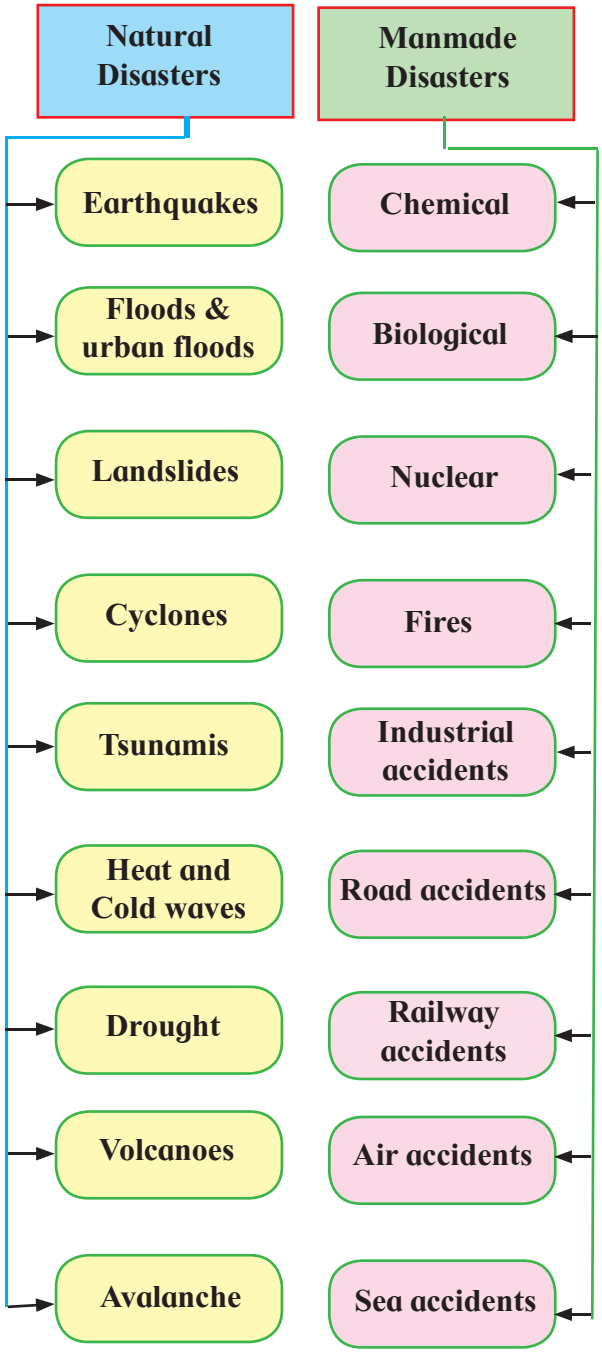
A disaster is "a sudden accident or a natural catastrophe that causes great damage or loss of life". A disaster is an event or series of events, which gives rise to casualties and damage or loss of property, infrastructure, essential envoronmental services, or means of livelihood.

Disasters threaten sustainable economic development worldwide. In the past twenty years, earthquakes, floods, tropical storms, droughts and other calamities have killed around three million people, inflicted injury, disease, homelessness, and misery on one billion pepole, and caused damage worth millions of rupees. Disasters destroy decades of human effort and investments, thereby placing new demands on society for reconstruction and rehabilitation.

Figure 5.1 : Examples of Natural disasters

Source : http://nidm.gov.in/PDF/dosaster_about.pdf

5.2 Types of disasters



Source : http://nidm.gov.in/en/#) & IGNOU New Delhi

Features of disasters-

- It disrupts the normal functioning of society.
- It affects large number of people.
- It causes large scale loss to life and property.
- It affects a community which requires external aid to cope with the losses.

We shall discuss some of the disasters as follows;

I. Natural Disasters	II. Man made Disasters
A) Earthquakes B) Floods & Urban floods C) Cyclones D) Tsunamis E) Drought	1) Biological 2) Nuclear 3) Fire 4) Industrial accidents

5.3 I. Natural Disasters

A) Earthquakes

Earthquakes cause the shaking, rolling or movement of the earth's surface. Earthquakes happen along cracks (called fault lines) in the earth's surface. Earthquakes can be felt over large areas, although they usually last less than one minute. Earthquake is a sudden geological event below the surface of the earth which results in generation of shock waves that travel far and wide and cause vertical and horizontal vibrations. These consequential motions cause destructions of infrastructure. The severity of the impact depends on the magnitude of the earthquake, which in turn depends on the amount of energy released at the spot where the geological event takes place below the surface of the earth. Scientific study of earthquakes is called seismology. Therefore, earthquake activity is also referred to as seismic activity.

Earthquakes are considered to be one of the most dangerous and destructive natural hazards. The impact of this phenomenon is sudden with very little warning or without any warning. Large number of earthquakes occur every year all-round the earth but only a limited number of them are centered near populated areas or are having sufficient strength to cause damage to

the environment. It can destroy buildings and infrastructure in seconds, killing or injuring the inhabitants. Earthquakes not only destroy the entire habitation but may destabilize economy and social structure of the region.

Earthquakes - seismicity in Maharashtra

The state of Maharashtra occupies the central-western portion of peninsular India, technically an intraplate continental area. A disastrous earthquake occured, at Koyna on December 11, 1967, with magnitude of 6.5 on the Richter Scale. Latur earthquake of September 30, 1993, with magnitude 6.4 these were caused by serious damage by adjustments of crustal blocks along such pre-existing weak zones.

Maharashtra and adjoining regions are prone to earthquakes of moderate magnitude as can be seen from the experience of several years. Koyna regions of Satara district have experienced the maximum number of tremors in Maharashtra.

Earthquakes in Maharashtra show major alignment along the west coast and Western Ghats region. Seismic activity can be seen near Ratnagiri, along the western coast, Koyna Nagar and Thane district.

Figure 5.2 :The Bhuj earthquake 26th January,2001
Source : http://.rsf.org.in?img/csr/05/jpg

Earthquakes; Dos &Don'ts-

a) If Indoor:

- DROP to the ground; take COVER by getting under a sturdy table or other piece of furniture; and HOLD ON until the shaking stops. If there isn't a table or desk near you, cover your face and head with your arms and crouch in an inside corner of the building.
- Stay away from glass, windows, outside doors and walls, and anything that could fall, such as lighting fixtures or furniture.
- Stay in bed if you are there when the earthquake strikes. Hold on and protect your head with a pillow, unless you are under a heavy loose fixture that could fall. In that case, move to the nearest safe place.
- Use a doorway for shelter only if it is in close proximity to you and if you know it is a strongly supported, loadbearing doorway.
- Stay inside until the shaking stops and it is safe to go outside.
- Be aware that the electricity may go out or the sprinkler systems or fire alarms may turn on.
- DO NOT use the elevators.

b) If Outdoors:

- Stay there.
- Move away from buildings, trees, streetlights, and utility wires.
- Once in the open, stay there until the shaking stops. The greatest danger exists directly outside buildings, at exits, and alongside exterior walls. Most earthquake-related casualties result from collapsing walls, flying glass and falling objects.
- Do not forget to carry the disaster emergency kit!

c) If in a moving vehicle:

- Stop as quickly as safety permits and stay in the vehicle. Avoid stopping near or under buildings, trees, overpasses, and utility wires.
- Proceed cautiously once the earthquake has stopped. Avoid roads, bridges, or ramps that might have been damaged by the earthquake.

Figure 5.3 : 'DROP', 'COVER', 'HOLD ON'activity during earthquake
(Source : http://nidm.gov.in/en/#)

Do you know?

Latur earthquake was one of the deadliest earthquakes Maharashtra has seen till date. The earthquake (Richter scale 6.4) struck at about 3.56 am on September 30, 1993. About 52 villages were destroyed, over 30,000 were injured and approximately 10,000 pepole were killed. The earthquake left a huge hollow at Killari, which was also the epicenter.

- The area of Latur was densely populated so, the toll of those who were killed and injured was very high.
- Since the earthquake's focus was 12-kilometre-deep, the shock waves caused more damage
- The National Disaster Management Authority (NDMA) monitoring center was set up after the Latur earthquake.

Figure 5.4 : What to do during an earthquake **(Source : http://nidm.gov.in/en/#)**

B) Floods -

Floods have been a recurrent phenomena in India from time immemorial. Almost every year floods of varying magnitude affect some parts of the country. Different regions of the country have varied climate and rainfall patterns. Therefore, while some parts face devastating floods, other parts may, experience drought conditions.

The monsoon regime is a regular phenomenon. Year-to-year variations occur with regard to the onset of the monsoon. The Indian subcontinent receives maximum rainfall during the south- west (SW) monsoon for a period of about 100 days, starting from the first week of June to the end September.

Flood denotes inundation or accumulation of water i.e. it results from an imbalance between inflow and outflow of water in a river. Floods can occur through heavy rains, dam failures, rapid snow melts, river or even bursting of water pipelines. Floods result in damage, deaths and injuries, and create problems in drinking water supply and food shortages. In India, 40 million hectares of land is vulnerable to floods and about 8-million-hectare is affected by floods annually. Thus, India is highly prone to floods especially in the monsoon and cyclone seasons. A major flood disaster in mumbai on 26 th July 2005 paralysed the whole city.

There are three types of floods i.e. flash floods, river floods, and coastal floods.

1. **Flash floods-** are generally events in hilly areas where sudden very heavy rain over a limited area can cause strong flow of water. Flash floods also occur when a temporary blockage in hilly areas impounds water, which when released suddenly creates havoc.
2. **River floods** - occur due to heavy inflow of water from heavy rainfall, snowmelt, and short intense storms. Flooding in rivers is also caused by inadequate capacity within the banks of the river to contain high flows, River bank erosion and silting of riverbeds, synchronization of flood in the main and tributary rivers, and flow retardation due to tidal and backwater effects the intensity of the flood.
3. **Coastal floods-** are caused due to tsunami or heavy rainfall from cyclones and the storm surge associated with a cyclone. The situation could be aggravated due to high tide. Tidal flooding is saline from the backflow of sea-water into coastal rivers at high tides. Flood due to storm surge is also saline and therefore, more destructive.

Floods affect Maharashtra quite frequently. Floods are not just restricted to one particular region, but are spread all over the state. Maharashtra, therefore, exhibits a high proneness to floods. Most floods occur during monsoon and hence, the accompanying damage such as deaths due to lightning, landslides, house crashes and drowning have been commonly reported from most districts. Floods destroys houses, crops and food stocks. They strip farm lands, wash away irrigation systems and erode large areas of land or make them unusable. Floods are more threatening for an agricultural economy such as that of Maharashtra, especially because of the heavy damage they cause, thereby disrupting the economy. Analyzing the floods in Maharashtra, one observes that most floods in Maharashtra are flash floods due to nallah-overflows and poor drainage systems.

Urban floods -

Urban areas are densely populated and people living in vulnerable areas suffer due to flooding, sometimes resulting in loss of life. It is not only the event of flooding but the secondary

effect of exposure to infection also has its toll in terms of human suffering, loss of livelihood and, loss of life.

Major cities in India have witnessed loss of life and property, disruption in transport and power and incidence of epidemics. Therefore, management of urban flooding has to be accorded top priority. Increasing trend of urban flooding is a universal phenomenon and poses a great challenge to urban planners the world over. Problems associated with urban floods range from relatively localized incidents to major incidents, resulting in cities being inundated from hours to several days.

Figure 5.5 : July 26, 2005, Mumbai flood
(Source : http://www.downoearth.org.in)

*** Do's and Dont's during floods -**

- DO keep your emergency kit with you, safe and dry
- DO watch out for your children at all times AND DO NOT allow them to swim or play in flood water
- DO take care of elderly people
- DO take particular care of people with special needs.
- DO take note of the health of your family and community members.
- DO evacuate to higher ground where possible
- DO listen to local announcements over loud-speaker/ public broadcast, radio or TV where possible – and carefully follow all advice and warnings
- Do not forget to carry the disaster emergency kit!

*** Floods; Don'ts -**

- DO NOT wade through flood water
- DO NOT eat food which has been in contact with flood water
- DO NOT drink water from wells; ONLY drink water which has been boiled, or supplied in bottles
- DO NOT use gas, electricity or electrical appliances which have come into contact with flood water – until they have been checked by safety officials.
- DO NOT walk near river banks, sand bag mounds or canal edge as these may collapse.

During Floods - Do's

Turn of power and gas connection be alert for gas leaks.

Evacuate low line areas and move to safer places.

Bring boiled/clorinated water.

Stay away from sewage lines, gutters, drains etc.

Stay away from electric ports and fallen power lines to avoid electrocutions.

Watch out for broken electric poles and wires, sharp objects and debris.

If you must prepare to evacuate, you should:

- Secure your home. If you have time, bring in outdoor furniture. Move essential items to an upper floor.
- Disconnect electrical appliances. Do not touch electrical equipment if you are wet or standing in water.
- Do not forget to carry the disaster emergency kit!

C) Cyclones

Cyclones are violent rotating windstorms. They are Tropical storms which occur in nearly every major ocean across the world. Cyclones occur in the Indian Ocean; the Bay of Bengal. The cyclones move around an area of low atmospheric pressure. Tropical cyclones are characterized by destructive winds and copious rainfall, which causes flooding. In such storms, winds can exceed speeds of over 120 kmph. Due to such strong winds, sea-water accumulates ahead of the cyclone as it moves towards the coast. When a cyclone hits the coast, the accumulated enormous mass of sea- water strikes the coast as a giant sea wave called storm surge. Cyclones pose a major threat to life and property. Cyclones have different nomenclatures, like hurricanes in America and typhoons in Japan.

History of Cyclones in Maharashtra

In the Arabian sea, during the period 1890-1995, these were 207 depressions/cyclonic storms/severe cyclonic storms that have been recorded. Most of them have moved away from Maharashtra. Thus, the coastal region of Maharashtra is climatologically an area where frequency of cyclonic disturbances is very low. Out of 207 disturbances, only 19 have affected Maharashtra - Goa coast. Of these six were major ones causing 70 deaths, with 150 boats and 160 crew missing and extensive damage to trees and ships. The wind and cyclone hazard map for Maharashtra has also been produced indicating the risk zones according to possible impact.

Mumbai which is the economic capital of India, is also a coastal city which has faced many threats of cyclones in recent times. It has faced peripheral impact in 1982, 1988 and 1996, and has been hit on two occasions (June, 1948 and 1996). It indicates that the city is prone to cyclones. Considering these problems, the Indian economy may have to face a serious problems if Mumbai is hit by a cyclone. It becomes far more important to implement preventive and preparedness measures.

Before the Cyclone season-

- Check the house; secure loose tiles, carry out repair works for doors and windows
- Remove dead woods or dying trees close to the house
- Keep some wooden boards ready so that glass windows can be boarded if needed
- Keep a hurricane lantern filled with kerosene, battery operated torches and enough dry cells
- Demolish condemned buildings
- Keep some dry non-perishable food always ready for emergency use
- Keep the disaster emergency kit with you ready!

D) Tsunamis

A tsunami is a series of waves with a long wavelength and period. Tsunamis are often incorrectly called tidal waves; they have no relation to the daily ocean tides. Tsunami (soo-NAH-mee) is a Japanese word meaning 'harbour wave', the sea waves generated by undersea earthquakes. These waves may originate from undersea or coastal seismic activity, or volcanic eruption. Whatever may be the cause, seawater is displaced into a violent and sudden motion ultimately breaking over land even at very long distances with great destructive power.

Tsunami events or those less than 30 minutes from the source cause the majority of damage. The force of the water can destroy everything in its path. It is normally the flooding effects of the tsunami that causes major destruction to the human settlements, roads and infrastructure and damage to ports/airports thereby disrupting the normal functioning of the society. Withdrawal of the tsunami causes major damage. As the waves withdraw towards the

ocean, they sweep out the foundations of the buildings, the beaches get destroyed and the houses carried out to sea. Apart from the physical damage, there is a huge impact on the public health system. Deaths mainly occur because of drowning as water floods homes. Many people get washed away or crushed by the giant waves and some are crushed by the debris.

It can be highly destructive to coastal areas as was witnessed during the catastrophic tsunami event in December 2004. On the 26th December 2004, tsunami considerably affected the coastal regions of southern peninsular India. Nearly 8,835 human lives were lost with 86 persons reported missing. Extensive damage was recorded in terms of housing stock along the coast, as well as bridges and roads. Structures were damaged by direct pressure from tsunami waves, and scouring damage was induced by the receding waves.

Tsunamis; Dos and Don'ts

- You should first protect yourself.
- Gather members of your household and move quickly to higher ground away from the coast.
- Avoid downed power lines and stay away from damaged buildings and bridges from which heavy objects might fall.
- Do not forget to carry the disaster emergency kit!

Figure 5.6 : Japan Tsunami Fukushima Daichi Nuclear disaster , 14 th March,2011
(Source : http://sites.suffolk.edu)

Figure 5.7 : A general view of the scene of Marina beach in Chennai, India, On December 26, 2004, after tsunami wave hit the region. Waves devastated the southern Indian coasttime killing an estimated 18,000 People. (Source : http://www.theatlantic.com)

Do you know?

• The tsunami that occurred during 2004 Sumatra-Andaman earthquake of Mw 9.3 was primarily caused by vertical displacement of the seafloor, in response to slip on the inter-plate thrust fault. The earthquake and resulting tsunami in the Indian Ocean affected many countries in Southeast Asia and beyond, including Indonesia, Sri Lanka, India, Thailand, the Maldives, Somalia, Myanmar, Malaysia, Seychelles and others.

• Many other countries, especially Australia and those in Europe incurred casualties due to the tsunami, because they had large numbers of citizens traveling in the region on holiday. This tsunami-genic earthquake was one of the ten worst earthquakes in recorded history, as well as the single worst tsunami in history. Indonesia was the worst affected country. Beyond the heavy toll on human lives, the Indian Ocean earthquake has caused an enormous environmental impact that will affect the region for many years to come. The disaster also caused a substantial geo-physical impact in Indian Ocean. The disaster invited attention of affected countries for setting up effective tsunami early warning system and institutional mechanism for handling disasters.

• The Government of India has put in place an Early Warning System for mitigation of such oceanogenic disasters under the control of Indian National Center for Ocean Information Services (INCOIS), Hyderabad.

E) Drought-

Variations of rainfall in monsoon leading to water shortage causes drought. In India, almost three-fourths of annual rainfall is received during South West Monsoon Period (June-September) and erratic nature of monsoon (South West Monsoon), with long dry spells and high temperature. This is mainly responsible for drought. Drought is declared by the respective State Governments considering rainfall situation, crop growth etc. The Deccan plateau constitutes 50 percent of the drought-prone areas of the state. 12 percent of the population lives in drought-prone areas. Once in 5 years, deficient rainfall is reported. Severe drought conditions occur once every 8-9 years. The 1996 drought affected 7 districts and 266.75 lakh people. The 1997 drought affected 17 districts.

Types of droughts:

1. **Meteorological Drought –** referring to lack of precipitation.
2. **Agricultural drought –** referring to lack of moisture in the soil where crops grow.
3. **Hydrological drought –** referring to low levels of water in reservoirs.
4. **Socio-economic drought –** referring to water shortages affecting people in society, which impacts availability of food grains, fodder, etc.

Drought;

Do's and Don'ts-

1. Monitoring of rainfall situation during South West Monsoon period, on regular basis.
2. Issue of advisories to farmers for taking up drought resistant crops & crops requiring less water.
3. Judicious use of available water.
4. Ensure availability of agricultural inputs.
5. Optimum utilization of funds available under various schemes/programmes implemented by Central and State Govts. towards mitigating adverse effects of drought.

6. Do not waste water, especially drinking water, as it is precious.
7. Do not waste food, as it could be useful for those in need.

Do you know?

Jalyukta Shivar Abhiyaan: Under the theme of 'a drought-free state by 2019', is being implemented across the State of Maharashtra since December, 2014 with a view to permanently overcome the water scarcity situation. The main aim of this abhiyaan is to increase ground water level by way of percolation of rain water in the ground along with creation of sustainable irrigation facilities.

It is targeted to make 5,000 villages every year and 25,000 villages in five years free of water scarcity. During 2017-18 as on 12th January, number of villages selected are 5,018 in which 7,683 works are completed and 6,440 works are in progress.

5.4 II Manmade Disasters

Difference of Man made Disasters from Natural Disasters:

In most cases of natural disasters, the hazard is directly attributable, however the main causes of man-made disasters are complex and inter-related. Man-made disasters could also result from natural disasters as, for example- earthquake may render large number of people homeless and without livelihood, which could lead to unforeseen consequences. To a certain extent, natural disasters may sometimes be considered as human induced disasters. Areas with severe deforestation, erosion, over cultivation and over grazing tend to be hardest hit by disasters.

Causes of Man-made Disasters

Human induced disasters occur due to many and varied causes. They could arise from the indiscriminate industrialization, over population, increased consumerism, use of hazardous substances or processes or simply accidents of various types. Negligence on the part of professionals as well as the public along with ignorance increases the possibility of man-made disasters.

Man made disaster could also be caused due to unintentional activity, poor maintenance, low quality work or human error. On the other hand, they could also result from willful, deliberate and intentional activity, such as sabotage, mischief, revenge, riots, mob fury or enemy attack. Sometimes, man-made disasters, especially those related to industrial and technological causes, are the results of system or process malfunctioning as in the case of nuclear radiation, gas leak, explosion and fire etc.

1) Biological Disasters

Biological disasters are natural scenarios involving disease, disability or death on a large scale among humans, animals and plants due to micro-organisms like bacteria, or virus or toxins.

Biological disasters may be in the form of: -

- Epidemic affecting a disproportionately large number of individuals within a population, community, or region at the same time, examples being Cholera, Plague.
- Pandemic is an epidemic that spreads across a large region, that is, a continent, or even worldwide of existing, emerging or reemerging diseases, example- Influenza H_1N_1 (Swine Flu).

Examples :

A) Mosquito Borne Diseases Like Malaria, Dengue, Filaria, Chikungunya, Swine Flu (H_1N_1)

Do's

1. Follow "sun-down sleeves-down" approach. Wear clothes that cover arms and legs.
2. Prevent water collections on ground and other places to prevent malaria breeding.
3. Empty water containers at least once a week.
4. Remove water from coolers from time to time.
5. Cover and seal any septic tanks.
6. Use Mosquito Nets Preferably Insecticide Treated Bed Nets (ITBN)
7. Apply insect repellants while sleeping to keep away mosquitoes.

Don'ts

1. Do not encourage children to wear shorts and half sleeved clothing.
2. Do not allow water to stagnate.
3. Do not allow discarded items to accumulate such as tires, tubes, empty coconut shells, household items and objects where water may collect.
4. Do not bathe in village ponds and allow cattle to take bath in the same pond.

B) Diarrhoeal Group Of Diseases Including Cholera:

Do's -

1. Hand Hygiene
2. Encourage drinking of water from a safe source or water that has been disinfected (chlorinated). Add bleaching powder in all community wells at regular intervals.
3. Drink boiled potable water in an emergency that has been boiled for at least 15 minutes and consumed it on the same day.
4. Promote storage of water in narrow mouthed container.
5. Cook food thoroughly especially meat, poultry, eggs and seafood until it is steaming and eat it while it is still hot.
6. Ensure cooked meat and poultry is safe and no part of the meat discoloured or foul smelling & keep food items covered.
7. Increase fluid intake as soon as diarrhoea starts by drinking ORS solution or lemon juice.
8. Encourage banana eating, which provides potassium.
9. Continue feeding children when they are sick and to continue breastfeeding if the child is being breast fed.
10. Refer the diarrhoea case to a health facility in case of the following: Child is irritable, restless or lethargic or unconscious: eating or drinking poorly; child has marked thirst; child has fever or blood in stool.

Don'ts -

1. Do not drink water from unsafe sources.
2. Do not eat uncooked food unless it is peeled or shelled.
3. Do not leave cooked food at room temperature longer than 2 hours.

4. Do not consume cut fruits from vendors.
5. Do not defecate in open area.
6. Do not give access to rats and houseflies in your premises.

C) Respiratory Group Of Diseases Like Tuberculosis, Influenza, Chickenpox, Meningitis;

Do's & Don'ts :

1. Avoid close contact with people who are having respiratory illness.
2. The sick person should stay at home, and avoid going into the community, school/ office, public places for at least 24 hours after symptoms have resolved.
3. Sick persons at home should keep distance from others.
4. Respiratory Hygiene/Cough Etiquette: -

a) Cover the nose/mouth with a handkerchief/ tissue paper when coughing or sneezing which should be disposed-off in dustbins;

b) Perform hand hygiene (e.g., frequent hand washing with soap and water, alcohol-based hand rub, or antiseptic hand wash) and thoroughly dried.

5. Triple layer surgical Mask of standard and certified make should be worn by Suspected/ probable/confirmed cases of influenza.
6. Get plenty of sleep, be physically active, manage your stress, drink plenty of fluids, and eat nutritious food.
7. Avoid smoking.
8. Persons who have difficulty in breathing or shortness of breath should seek immediate medical attention and report to the nearby hospital.
9. Immunization status should be up to date as per National Universal Immunization Programme.

2) Nuclear disasters -

The growth in the application of nuclear science and technology in the fields of power generation, medicine, industry, agriculture, research and defence has led to an increase in the risk of occurrence of Nuclear emergencies.

Nuclear emergency can arise in a nuclear facility at plant level leading to plant/ site or offsite emergency depending upon the extent of its impact on the surroundings. It can also take place while using radiation sources, either at hospitals, industries and agriculture or research institutions due to misplacement or because of faulty handling. The other events that can lead to nuclear emergencies in the public domain include, accident of a vehicle carrying radioactive material. The memories of the use of nuclear weapons dropped on Hiroshima and Nagasaki and the wide publicity given to the reactor accidents at Chernobyl in erstwhile USSR, have strongly influenced the public perception of any nuclear or radiological emergency. It may be noted that better infrastructure can be helpful during such incidences in terms of enhanced communication, transport and medical support. Nuclear emergencies can still arise due to factors beyond the control of the operating agencies however, proper emergency preparedness plans must be in place so that there is minimum avoidable loss of life, livelihood, property and impact on the environment.

Do You Know?

In 1986, on April 26, the world worst nuclear power plant accident occurs at the Chemobyl nuclear power station on the Soviet Union. Thirty-two people died and dozens more sufficient radiation burns in the opening days of the crisis.

A a Part of their poorly designed experiment, the engineers disconnected the reactor's emergency safety systems and it's power regulationg system. Next, they compounded this irresponsibility with a series of mistakes. They ran the reactor at a power level so low that the reactions became unstable, and then removed too many of the reactor's control rods in an attempt to power it up again. The reactor's output rose to more than 200 megawatts proving increasingly difficult to control. At 1:23 a.m. on April 26, the engineers continued with their experiment and shut down the turbine engine to see if it's inertial spinning would power the reactor's water pumps. In fact, it did not adequately power the water pumps, and without cooling water the power level in the reactor surged.

In the beginning days of the crisis, 32 people died at Chenobyl and several more suffered radiation on burns. The radiation that escaped into the atmosphere, which was several times that was produced by the atomic bombs dropped on Hiroshima and Nagasaki, was spread by the wind over Northern and Eastern Europe, containing millions of acres of forest and farmland. An estimated 5,000 Soviet citizens eventually died from cancer and other radiation induced illness caused by their exposure to the Chenobyl radiation and millions more had their health adversely affected. In 2000, the last working reactors at Chenobyl were shut down and the plant was officialy closed.

3) Fire

Fires can spread rapidally and have a very serious effect on our lives, homes, and families. It is very important that everyone in your family is aware of proper fire protection.

Figure 5.8 : Fire Incident
(Source : http://google.com)

Fire-

Do's

1. Stay Calm, don't panic and don't run.
2. Raise alarm and alert everyone in your premises.
3. Escape first and then call for help.
4. Use nearest available exit routes.
5. While leaving the premises, close all doors & windows behind you if possible but must ensure that nobody is left behind and you are safe.
6. Use only escapes routes because they are built for the purpose.
7. Use staircase "Don't use Lifts".
8. If you are trapped in your room, close the door and block any gaps which might let smoke or fumes through. Shout from the window to attract attention of rescue team as well as others.
9. Do not forget to carry the disaster emergency kit before you evacuate!

Fire-

Don'ts

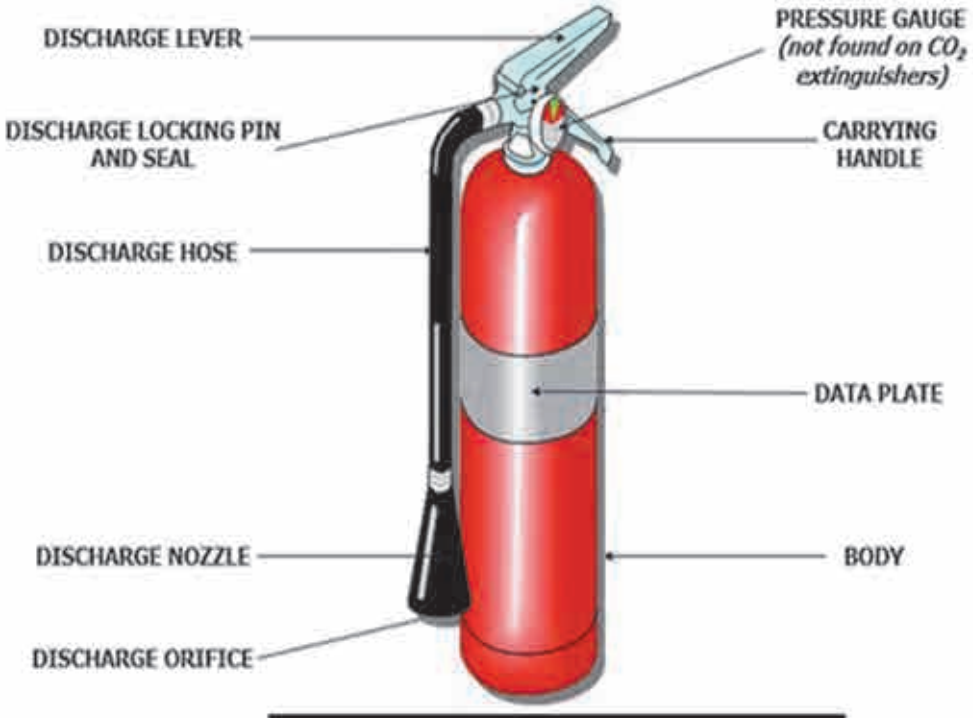
1. Never stand up in a fire always crawl low under the smoke and try to keep your mouth covered.

2. Never go back into a burning building for any reason.
3. Teach children not to hide from fireman, if someone is missing, tell the fireman. They are equipped to perform rescues safely.
4. Don't secure open fire and smoke check doors as they limit the spread of fire and smoke when in closed position.
5. Don't be tempted to clutter the stairs, corridors and lobbies as they are your escape routes.
6. Never use lifts in case of fire. Always use staircase.
7. Do not stop to collect belongings.
8. Don't shout or run. This tends to cause panic to others
9. Discourage use of fire crackers.

How to use fire extinguisher-

The PASS Method for Using a Fire Extinguisher-

1. PASS Step 1: PULL the pin. Many fire extinguishers have a pin near the handle at the top.
2. PASS Step 2: AIM the nozzle, horse, or hose. ...
3. PASS Step 3: SQUEEZE the handle. ...
4. PASS Step 4: SWEEP from side to side at the base of the fire.



Fig; Know the fire extinguisher

Figure 5.9: Know the fire extinguisher

(Source : http://dgfscdhg.gov.in/mass-awarenwss-in-english)

Do you Know?

Among cities, Mumbai leads in fire mishap deaths; 3,781 people died during 2006-2015. India reported 2.16 lakh deaths in fire accidents between 2006 and 2015, with nearly 64 per cent of the victims being women. The National Crime Records Bureau Data indicates that a total of 113961 people lost their lives due to Fire Accidents from 2010 to 2014. This is an average of 62 deaths a day. Maharashtra alone accounted for 24293 deaths or 21.3% of all the deaths due to fire accidents.

Maharashtra's capital Mumbai has recently witnessed five deadly fire accidents with the latest one occurred in South Mumbai's Fort area, the other four incidents have resulted in deaths of more than 30 people. The incidents have taken place at Kamala Mills compound (Dec 29, 2017), Mamoon Manzil building at Marol (January 4, 2018), Sessions Court in Fort (January 8, 2018), Cinevista studio in East Mumbai (January 6, 2018), and a snack shop in Saki Naka area (December 18, 2017).

4) Industrial disasters -

In highly industrialized cities, accidents can caused serious impacts on citizen. Industrial development has led to concentration and localization of industries in certain areas where attempts at regulating them are essential. These require strong legal framework with adequate institutional prevention and implementation management. Industrial disasters are caused due to malfunctions, failures or unanticipated side effects of technological processes. This usually occurs in the form of explosions, fires, spills, leaks or wastes. All technological innovations have benefits but also carry risks. A technological disaster is a manmade disaster because of failure of proper management.

Do you know?

An example of hazardous material disaster is Bhopal Gas Tragedy that occurred in December 1984. Approximately 2500 people died in this tragedy and thousands of people were directly or indirectly affected by this accident. This is witnessed as the world's worst chemical (industrial) disaster "Bhopal Gas Tragedy" in the year 1984. It was most devastating chemical accident in history, where over thousands of people died due to accidental release of toxic gas Methyl Isocyanate (MIC). Such accidents are significant in terms of injuries, pain, suffering, loss of lives, damage to property and environment. India continued to witness a series of chemical accidents even after Bhopal had demonstrated the vulnerability of the country.

Another threat really being faced by disaster management is the threat from atomic and nuclear sources, and this threat is really in the form of radiation. Problems like nuclear leaks are likely because of development programmes in this field. The possibility of global war may have receded over recent years but the possibility of nuclear weapons being used in some lesser form of conflict cannot be disregarded altogether. Even though a country is not directly involved in use of such nuclear activities or terrorism, it could well suffer severely from the radioactive side effects.

5.5 Effects of disasters-

It is common knowledge that natural disasters have catastrophic effects on the place and people. The adverse impacts are much more in the developing countries with a large population and high vulnerability in terms of weak infrastructure and poor support systems. Disasters not only do enormous damage, cause deaths, destroy food sources, spread disease and

epidemics. They create unemployment and they unsettle the entire rhythm of life of the affected community for a long time. It requires enormous physical, financial and motivational resources to bring the impoverished and demoralized community back to normal. As most of the natural disasters occur suddenly or with short notice, direct effects include damage to houses, equipments, crops, infrastructure (bridges and roads) and loss of life. Malnutrition, envioronment related disease and migration are the indirect effects. Economic impact can be seen in the form of emergency relief costs.

Do you know?

As a part of overall preparedness of the State, the GoM (Government of Maharashtra) has a State Disaster Management Plan to support and strengthen the efforts of district administration. The Centre for Disaster Management (CDM) of the GoM was set up in August 1996 with support from the Natural Disaster Management Division, Department of Agriculture and Cooperation, Ministry of Agriculture, Govt. of India. Its infrastructure consists of Documentation Centre and a stand-by Control Room (with 30 seconds connectivity for Video Conferencing, VSAT, Email and Fax Communication (www.yashada.org). Under 1996 Disaster Management Council's mandate, the Government of Maharashtra prepared a plan, which involves:

- Scrutinizing disasters like earthquakes, floods, cyclones, epidemics, road accidents, industrial and chemical accidents, and fires,
- Estimating their footprint and reach,
- Listing down the monitoring facilities and regulatory regimes,
- Tracing the counter measures available to handle the disasters.

Disasters disrupt social life and economic activities. The damage and rehabilitation work after the disasters generally halts developmental activities. Because of the circumstances in the aftermath of disasters, the human and financial resources earmarked for development have to be shifted to relief and rehabilitation at least partly if not fully.

The District Disaster Management Plan

To support and strengthen the efforts of district administration, every district has its own District Disaster Management Plan (DDMP) that addresses the districts' response to the disasters.

The objectives of DDMP are

1. To improve preparedness at the district level, through risk and vulnerability analysis of disasters and to minimize their impact in terms of human, physical and material loss.
2. To ascertain the status of existing resources and facilities available with the various agencies involved in the district and make it an exercise in capacity building of district administration.
3. To utilize different aspects of the disaster for development planning as a tool for location and area specific planning for development of district.

As a part of this plan the control rooms are established at the Collectorate and at each Tehsil office in the district, which should be kept functioning 24 hours a day. The phone numbers are informed to all departments. The Superintendent of Police office and public hospitals are directed to develop preparations in case of emergency situations and contact is maintained with the police control room. The District Control room has facilities of wireless communication, hot line, fax, e-mail and video conferencing.

5.6 The Disaster Emergency Kit

Have a disaster emergency kit ready as follows;

1. **Battery operated torch, radio, extra batteries, candles, lighter,**
2. **First aid kit and manual.**
3. **Important documents, passport, insurance details, house deeds, bank details, medical prescriptions, certificates**
4. **Emergency food (dry items) and water (packed and sealed).**
5. **Candles and matches in a waterproof container, knife, can opener, chlorine tablets or powdered water purifiers.**
6. **Essential medicines, cash and credit cards.**
7. **Thick ropes and cords, sturdy shoes.**

Figure 5.10: The Disaster Emergency Kit (Source : http://ndma.gov.in/en/#)

5.7 Activity

1. List the natural disaster phenomena likely in the Indian subcontinent. Describe the regional and seasonal profile of any two disasters.
2. Prepare a list of natural disasters, which are affecting your area and explain their impacts and identify your role to reduce it.
3. Draw a chart of do's and don'ts of the common disaster experienced in your region and display the same in your classroom/school board and also during festivals/public meetings.
4. Design the disaster emergency kit on a chart and display it in your classroom/school notice board.
5. Make an evacuation plan for your school during emergency. Display it in your classroom/ school board, and in each stairway. Explain during the assembly and National Day assembly too.

Exercise

Q.1. Select the most appropriate alternative from the given questions below.

1) The sequence of operating a fire-extinguisher is;

a) SWEEP » AIM » PULL » SQUEEZE

b) AIM » SWEEP » SQUEEZE » PULL

c) PULL » AIM » SQUEEZE » SWEEP

d) SQUEEZE » PULL » AIM » SWEEP

2) Man made disaster could also be cause due to .....

a) uninntentional activity

b) carelessness

c) low quality work

d) All of the above

3) 'Tsunami'is a disaster that occurs due to ..... .

a) Volcanic eruption

b) High tides

c) Undersea seismic activities

d) Heavy rainfall

4) 'Drop to Ground', 'Take cover', 'Hold on' are the actions related to ..... disaster.

a) flood

b) fire

c) drought

d) earthquake

5) ..... are the features of disaster.

i) It affects a large number of people

ii) Causes large scale loss of life and property

iii) Disrupts normal functioning of society

iv) Needs external aid to cope with the loss

Q.2. Answer the questions given below.

1. Enlist some Do's during earthquakes
2. Enlist some Do's during floods
3. Enlist some Do's during fires
4. Enlist some Do's during mosquito borne diseases
5. Enlist some Do's during respiratory group of diseases.

Q.3. Answer the following questions in brief.

1) What is an earthquake? Why is it called as seismic activity?

2) What do you mean by manmade disaster? Enlist some causes of manmade disasters.

3) Explain the 'PASS' method for using a fire extinguisher.

4) Write a short note on effects of disasters.

5) What precautions should we take in case of a diarrhoeal disaster?

6) Enlist some precautionary measures before the cyclones.

7) Write a note on the contents of a 'Disaster emergency kit'

Glossary

- **Aphotic -** The deep zone of an ocean or lake receiving too little light to permit photosynthesis.
- **Aquifer -** A layer of earth material that can transmit water sufficient for water supply purpose.
- **Aspirin-** A synthetic compound used medicinally to relieve mild or chronic pain and to reduce fever and inflammation, usually taken in tablet form.
- **Autotrophs-** An organism that is able to form nutritional organic substances from simple inorganic substances such as carbon dioxide.
- **Benthic-** Describe organisms that live on the bottom of marine and fresh water ecosystem.
- **Biogeochemical cycles-** Cycling of substance or substances through a pathway by which a chemical substance moves through biotic (biosphere) and abiotic (lithosphere, atmosphere, and hydrosphere) compartments of Earth.
- **Biological disasters -** Devastating effects caused by spread of a certain kind of living organism that may spread a disease or an epidemic.
- **Biomass -** Total dry weight of all living organisms that can be supported at each tropic level in food chain.
- **Biome -** A kind of plant and animal community that cover major geographic areas.
- **Biosphere -** Zone of earth where life is found.
- **Community-** Population of all species living and interacting in an area at a particular time.
- **Conservation-** To use in the best possible way so that greatest long-term benefit is realized by society.
- **Consumer -** Organisms that rely on other organisms for food.
- **Corridors -** a long passage or gallery.
- **Cyclones -** Cyclones are violent rotating windstorms.
- **Debris-** scattered pieces of rubbish or remains.
- **Decomposers-** Small organisms, like bacteria and fungi, that cause the decay of dead organic matter and nutrients.
- **Deforestation -** The action of clearing a wide area of trees.
- **Demolish-** To completely destroy any structure example- a building, especially in order to use the land for something else
- **Denudation-** The processes that cause the wearing away of the Earth's surface by moving water, by ice, by wind and by waves, leading to a reduction in elevation and in relief of landforms and of landscapes.
- **Desertification-** The conversion of arid and semi –arid land into deserts by in appropriate farming practices or overgrazing.
- **Detritus-** Organic material that result from fecal waste material or decomposition of plants and animals.
- **Endangered species -** Those species that are present in such small numbers that they are in immediate becoming extinct.
- **Endemic -** Native and restricted to a certain place.
- **Energy Flow -** the flow of energy in ecosystems through the food chain.
- **Epidemic -** a widespread occurrence of an infectious disease in a community at a particular time.
- **Erosion-** The action of surface processes that removes soil, rock, or dissolved

material from one location on the Earth's crust, and then transports it to another location.

- **Ethics-** What we believe to be right or wrong behavior.
- **Ethnobotanical-** The study of a region's plants and their practical uses through the traditional knowledge of a local culture and people, investigating plants used by societies in various parts of the world.
- **Etiquette -** The customary code of polite behaviour in society or among members of a particular profession or group.
- **Euphotic zone-** The upper layer in ocean where the sun's rays penetrate.
- **Evacuate-** Leave or remove (someone) from a place of danger to a safer place.
- **Extinction-** The elimination of all the individuals in a particular species is called extinction.
- **Fault lines -** A line on a rock surface or the ground that traces a geological fault.
- **Fauna -** Animal life in general, a classification of animal of the region.
- **Flash floods-** Generally, the events of hill areas where sudden very heavy rain over a limited area can cause strong flow. Flash floods also occur when a temporary blockage in hilly areas impounds water, which when released suddenly creates the havoc.
- **Flora-** Plant life in general, a classification of animal of the region.
- **Habitat-** Place or type of place where an organism or a population of organisms live.
- **Herbivores-** Primary consumer, animal that eat plants.
- **Heterotrophs-** an organism deriving its nutritional requirements from complex organic substances.
- **Hotspots-** a biogeographic region with significant levels of biodiversity that is threatened with humans.
- **Host-** Plant or animal upon which a parasite feeds.
- **Indigenous-** originating or occurring naturally in a particular place or a native of that place.
- **Inhabitants-** A person or animal that lives in or occupies a place.
- **Invasive species-** species that is not native to a specific location (an introduced species), and that has a tendency to spread to a degree believed to cause damage to the environment, human economy or human health.
- **Landscapes-** all the visible features of an area of land, often considered in terms of their aesthetic appeal.
- **Lichen-** A plant like organism containing characteristics of algae and fungi.it is most sensitive to pollution.
- **Mangrove-** a tree or shrub which grows in tidal, chiefly tropical, coastal swamps, having numerous tangled roots that grow above ground and form dense thickets.
- **Mitigation-** the action of reducing the severity, seriousness, or painfulness of something.
- **Natural hazards-** Natural hazards are naturally occurring physical phenomena caused either by rapid or slow onset events which can be geophysical (earthquakes, landslides, tsunamis and volcanic activity), hydrological (avalanches and floods), climatological (extreme temperatures, drought and wildfires), meteorological (cyclones and storms/wave surges) or biological (disease epidemics and insect/ animal plagues).
- **Niche-** The role or position of an organism plays in a habitat.
- **Omnivores-** Organisms that eat both plants and animals.
- **Parasitic-** Nutrition mode of an animal or plant that lives on or in another animal or plant of a different type and feeds from it:

- **Pastoralism-** Pastoralism is the branch of agriculture concerned with the raising of livestock.
- **Percolation-** It is the process of a liquid slowly passing through a filter.
- **pH-** The negative logarithm of the hydrogen ions concentration, measure of the number of hydrogen ion present.
- **Phytoplankton-** These are the first link in the food chain. They are known as primary producers because they produce the first forms of food. Zooplankton and other small animals that graze on the phytoplankton are known as primary consumers.
- **Power lines-** A cable carrying electrical power, especially one supported by pylons or poles.
- **Predator-** An organism that kills and eats another organism.
- **Preparedness-** activities designed to minimize loss of life and damage, to organize the temporary removal for people and property from a threatened location and to facilitate timely and effective rescue, relief and rehabilitation.
- **Prey-** an organism that is killed and eaten by predator.
- **Receding waves-** The waves that hit the shore and then move back.
- **Red data book-** These books published by of world conservation union, contain the list of endangered species of birds and mammals etc.
- **Remediation-** the action of remedying something, in particular of reversing or stopping environmental damage.
- **Restoration-** the action of returning something to a former owner, place, or condition.
- **Rio-declaration-** The united nation conference on environment and development was held in Rio- de- Janeiro in 1992 and known as earth summit.
- **Salinity-** the quality or degree of being saline/salty.
- **Sea caps-** A basket-shaped sponge which sometimes attains great size,
- **Seismic activity-** It is is the type, frequency and size of earthquakes that happen over a period of time in a certain area.
- **Seismology-** The branch of science concerned with earthquakes and related phenomena.
- **Sewerage lines-** a large pipe, usually underground, that is used for carrying wastewater safely disposed to a place.
- **Succession-** regular and predictable changes in the structure of community ultimately leading to a climax community.
- **Threatened species-** Those species that could become extinct if a critical factor in their environment were changed.
- **Trophic levels-** a stage in the energy flow through ecosystems.
- **Unforeseen consequences-** The outcomes/ situations that are not foreseen and intended by a purposeful action.
- **Vibrations-** Vibration is a periodic motion of the particles of an elastic body or medium in alternately opposite directions from the position of equilibrium when that equilibrium has been disturbed
- **Volcanic eruption-** Outbreak of a volcano which is a rupture in the crust of, Earth (or a planetary-mass object), through which hot lava, ash and gases escape from a magma chamber below the surface.
- **Wetland-** A area that include swamps, tidal marsh, coastal wetlands and estuaries.
- **Zooplankton-** Animal plankton small floating herbivores that fled on plant plankton (Phytoplankton)

■ ■ ■

Environmental Education subject is mandatory for the standard 11th and 12th - Arts, Commerce, Science. Students of class 11th and 12th are required to prepare project report in writing during each academic year.

Guidelines for writing project report

- It is mandatory for the students to write project reports according to the following guidelines.
- A reference list of project topics is provided in the textbook.
- Evaluation of Project work should be according to the guidelines.

1. Selection of the project topic (Introduction):

Student is expected to write briefly about the subject and the reasons for selecting the particular topic. Brief history, new updated information, current status of the topic should be included in introduction.

2. Importance of topic:

Student has to write the precise importance of project work by identifying the present environmental, scientific and social value of the project topic.

3. Objectives of the project work:

This should have the wrie an what you will do in the project work and must write the appropriate objectives. The objectives of the project work should be in proper manner.

4. Project work methodology:

A short description of how the information will be obtained under the practical approach. It is necessary to use a variety of data collection methods which includes survey, questionnaire, interviews, experiments, field observations, site visits, etc. The students should generally consider their local environmental issues for the project work (but not limited to). So that they can identify and formulate solutions to the problems surrounding them.

Students should be encouraged to illustrate the problems of the selected environmental issue. Encourage use of the newspapers / self-drawn pictures/ photographs of the issues taken by the students themselves.

5. Observations:

The data / information obtained from the selected topic should be depicted in the form of observation tables, graphs and brief points. The next part - conclusion is based on the observations recorded.

6. Analysis of data:

It is an important step to analyze/evaluate the observations based on a various numerical or statistical methods, e.g. Mean, mode, median, correlation, average, percentage etc. Based on this analysis it becomes more accurate and effective. By this method, you can effectively indicate the numerical values through graphs, histograms, and images.

7. Results and Conclusions:

The results should have interpretation and inference of the data / information obtained.

Project List

01: Visit/ study a watershed development programme and prepare a project report explaining how it is sustainable development Example achieving environmental, social and economic development of the area.

02: Study the role of any one national / International organization mentioned in the book and write about the work done by that organization in environment protection.

03: List the various NGOs in your area working for environment protection and document various activities they have conducted.

04: Arrange an interview with a person in your area working for environment and write down about his work.

05: Visit website of any one of the organisations in Maharashtra which is working for environment protection or conservation of biodiversity and prepare a short write up on the work carried out in last five years.

06: Collect the information regarding any one of the nationally recognized movement related to environment and prepare a short report on it.

O7: Start a ' Nature-club/Eco-club in your school/college. Carry out any two activities like keeping premises clean , preparing a garden and taking care of plants and write report on it.

08 : Collect the information about " Nobel Peace Prize" winner Environmentalists (at least two) and write about the work done by him/her and what message you get from this information.

09: Study any pond, lake, river ecosystem in your area and make a report on what biodiversity you have seen at the place and also if there are any threats like pollution, solid waste and what you can do to.

10: Study any natural area in your surrounding and document flora and fauna of the area and write information on the species observed (any ten species).

11: Study any natural area in your village/ town / city (ex. hill, grassland , forest, river bank, lake) and prepare a report on biodiversity observed and food-chain and food-web in the area.

12: Document the biodiversity related news that are reported in local newspaper. Categorize them as positive and negative news. Write down any three actions that you can do to improve the situation.

13: Study the trees (any ten) in your surrounding and write down changes over time on these trees like flowering, fruiting time, leaf fall, birds/ insects seen or any nesting of birds etc.

14: Study the different flora in your locality with respect to their social/ religious values.

15: Collect the information about different invasive species in your area , where it is seen , how it has affected local biodiversity and what you can do to control them.

16: Collect the information on (any five) National Parks of Maharashtra and make tabular record of form name of the NP, area, location, district, common flora, fauna and any special feature mentioned .

17: Collect information on endangered species of plants (any five)/ animals (any five) in our country. Make tabulor record including name of the species, scientific name, location where it is found, threats to the species and any special feature mentioned .

18: Prepare a list of medicinal plants (any five) found in your area after interviewing an expert. (vaidu, any local tribal, grandparents in your/ friends house). Find out the current status of the species. Write what you can do to conserve.

19: Conduct a survey of biodiversity in your village/ town/ city (can be a group activity). Document heritage trees (old ,big trees), write their information, what you can see on them like birds. (nesting, roosting), insects, monkeys, squirrels etc.

20: Prepare photo-gallery/album related to biodiversity (birds, insects, butterflies in the local area/school area and make a report on it.

21: Observe the different types of birds-nests, make sketches and identify the birds.

22 : Visit any wetland in your area and write a report on the species of plants and birds seen on the wetland. Visit the site in winter month of October and document the changes in water level, bird seen (species and number). Write about any local migration/winter long distance migration of birds.

23: Make a disaster evaluation plan for your school during emergency. Explain during the National Day.

24: Study water conservation methods through various water harvesting techniques/ recharge system in your locality which is in practice. Make documentation of it with diagrams.

25: Survey and make a report of recycling of materials practiced at your home and create awareness about it among people.

26: List the recently occurred natural disaster phenomena likely in the Indian subcontinent. Describe the regional and seasonal profile of any two disasters.

27: Prepare a list of natural disasters, which are affect Maharashtra and explain their impacts and identify your role to reduce it.

28: Draw a chart of Do's and Don'ts for common disaster experienced in your region and display the same in your classroom/school or college notice board and also during festivals/public meetings.

29: Design the disaster emergency kit on a chart. Write the working/Functions uses of Kit material.

30: Make an evacuation plan for your school during emergency. Display it in your classroom/notice board. Explain during the assembly and National Day assembly too.

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Maharashtra State Bureau of Textbook Production and Curriculum Research, Pune.

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