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ECOLOGY, ETHOLOGY, ENVIRONMENTAL SCIENCE AND WILDLIFE

B.Sc. VI SEM

- Brief and Intensive Notes
- Multiple Choice Questions

Based On NEP 2020

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Syllabus

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Introduction to Ecology

History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors

Unit II

Organization of Ecosystem

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- Population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion, Exponential and logistic growth,
- Types of ecosystems with one example in detail, Food chain, Food web, Energy flow through the ecosystem, Strategies for clean drinking water.
- Ecological pyramids and Ecological efficiencies, Nutrient and biogeochemical cycle with one example of Carbon cycle

UNIT III

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Unit VIII

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Unit I

Introduction to Ecology

History of ecology, Autecology and synecology, Levels of organization, Laws of limiting factors, Study of physical factors

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- Ecology is the branch of biology that deals with the relationships of organisms to one another and to their physical surroundings or immediate environment.
- It deals with the interactions between organisms and their natural habitats. We (humans) are also a part of the ecosystem and dependent on it for our survival because we too are after all just one more species on this planet earth.
- The term ecology ("**Ökologie"**) was coined in 1866 by the German Zoologist, **Ernst Haeckel** (1834–1919). It was derived in 19th century from the Greek word "**Ökologie**" meaning: οἶκος, "house", or "environment"; -**logie**, "study of".
- Ancient Indian writing reflects the reference of ecological thoughts like Vedic, Epic, Puranic etc. describe the importance of Vayu (air), Jala (water), Desha (topography) and Kaal (time).
- The inter-relationships between the organisms and their environment are described by some outstanding Greek scholars like Aristotle, Hipocrates, Theophrastus etc. Some of the scientists with their important contributions are:
- **Baron A.V. Humbolt (1804)** explored the tropical and temperate South America and published 26 volumes based on the data collected by him.
- **Alfred R. Wallace** published three books titled (i) The Malaya Archipelago (ii) The geographical Distribution of Animals and (iii) Island Life.
- **Geaffroy St. Hilaire (1859)** first used term **ethology** to refer the study of relationship of organisms with their environment.
- **St. George Jackson Milvart** proposed the term **'Hexicology'** to refer the study of organisms with their relation to environment regarding the nature of locality, temperature and amount of light that best suit them and also their

relation with other organisms as enemies, rivals or accidental and involuntary benefactors.

- **Rieter (1868)** first introduce the term **'Oekologie'** to describe the inter-relationship that exist between organisms and their environment**.**
- **Ernst Haeckel (1869)** was a German Biologist and was credited to have coined the term ecology and used it widely in his literature. He also precisely gave its definition.
- **Le Coq Sendfner** and **Kerner** introduced for the first time the plant communities as an aspect of ecology.
- **Karl Mobius (1877)** described the Animal communities.
- **Schroeter** and **Kirchner (1896)** introduced the term synecology.
- **Macfadyen (1957),** a British Biologist laid down the principles governing the relationship of plants and animals and their relations to environment.
- **K. Friederichs (1958)** defined ecology as The science of living beings as members of the whole of nature'.

  F. Fraster Darling (1963) defined ecology as the science of organisms in relation to their total environment, and the inter-relationship of organisms inter-specifically and between themselves'.
- **A.G. Tansley (1935)** introduced the term „ecosystem" and led to the development of concepts of productivity and energy relations in ecology which is now referred to as **bioenergic** approach.

Autecology

- It is the subdivision of ecology which deals with the ecological study of one species of organism throughout its life in relation to the ecological habitat factors like the life history, population dynamics, behavior, home range etc. thereby concentrating on the finer details of a particular organism.
- It sharply focuses on a particular organism with a purpose of seeing how it fits into general ecological picture.
- For example: Relationship of an oak tree to its environment.

Synecology

- ❖ It deals with the ecological studies of communities or entire ecosystems, describing the overall energy and material flow through the system.
- ❖ Hence it is the study of groups of organisms in relation to its environment which are associated together as a unit.
- ❖ For example: tropical forests or deserts. Synecology is further subdivided into aquatic and terrestrial ecology

Law of Limiting Factor:

1. **Law of minimum-**
   - ❖ **Carl Sprengel** developed a law, later popularized by **Liebig**, called as law of minimum. Other terminologies used for the law are: Liebig law or Liebig's law of minimum.
   - ❖ According to this law, the growth is regulated by the limited factors i.e. resources in scarcity and not by the resources in abundance. This law was originated after studying and observing the crop and plant growth.
   - ❖ The studies reveal that if we increase the supply of nutrients already present in enough amounts, it does not affect the growth of plants i.e. no further growth happens.
   - ❖ But when we provide the nutrients which are present in scarcity or in limited supply, growth improvements are detectable. Hence, it is the limiting factor that affects the growth of plants.
2. **Blackman's law of limiting factor:**
   - ❖ **Blackman's** was a plant physiologist with his most study on limiting factor on plant's photosynthesis system.
   - ❖ He stated that a number of factors regulate the biological processes but the factors in different amount affect the process on the whole.

3. **Law of tolerance-**
   - ❖ **Shelford**'s Law Till now we are concentrating on the minimal limiting factors affecting the growth or rate of biological process. But Shelford's law states that it's not only the factor present in limits/scarcity but also the excess/ abundance of that same factor can affect the growth,

development of organism or rate of biological process.

- For instance all nutrients required for the growth and development of organism/plant are equally important but any nutrient in abundance may limit other nutrients absorption, thus indirectly restricting or limiting the growth of organism/plant.
- Thus the law of tolerance by Shelford's revealed that the growth and development of organism depends on the maximum and minimum limits of factors involved in the biological process.
- Thus every factor has its own maximum and minimal limits in every organism and the "Zone of tolerance" is the range between these two limits.

MCQs based on Unit I:

Q. 1. The term ecology was coined by

a. E. Haeckel

b. Odum

c. Humbolt

d. Wallace

Ans: a

Q. 2. Who gave the term Hexicology?

a. Hilaire

b. Kerner

c. Milvart

d. Haeckel

Ans: c

Q. 3. Who coined the term Synecology?

a. Schroeter and Kirchner

b. Tansley

c. Haeckel

d. Mobius

Ans: a

Q. 4. The term ecosystem was coined by

a. Haeckel

b. F.F. Darling

c. Kerner

d. Tansley

Ans: d

Q. 5. Who first introduced the term Oekologie?

a. Tansley

b. Rieter

c. Odum

d. Wallace

Ans: b

Q. 6. The study of population is called

a. Ecology

b. Ethology

c. Demography

d. None of above

Ans: c

Q. 7. Which is the basic unit of ecological hierarchy?

a. Population

b. Landscape

c. Biome

d. Organism

Ans: d

Q. 8. A group of individuals of the same species living together in a common area at a particular given time is called

a. Community

b. Ecosystem

c. Population

d. None of above

Ans: c

Q. 9. The members of a local population which may be genetically adapted to their

specific environment is called

a. Demes

b. Local Population

c. Community

d. Ecotype

Ans: d

Q. 10. A group of populations of different species which live in a particular area is called

a. Biome

b. Community

c. Demes

d. Ecosystem

Ans: b

Q.11. A large regional unit delimited by a specific climatic zone, having a particular major vegetation zone and its associated fauna is called

a. Biosphere

b. Landscape

c. Biome

d. Community

Ans: c

Q. 12. The branch of ecology which deals with the study of one species of organism throughout its life is called

a. Forest ecology

b. Autecology

c. Synecology

d. None of these

Ans: b

Q. 13. The study of groups of organisms in relation to its environment which are

associated together as a unit is called

a. Autecology

b. Synecology

c. Avian ecology

d. None of these

Ans: b

Q. 14. Which branch deals with the study of Tropical rain forest?

a. Synecology

b. Autecology

c. Both a and b

d. None of these

Ans: a

Q. 15. The example of relationship of an oak tree to its environment comes in

a. Synecology

b. Autecology

c. Both a and b

d. None of these

Ans: b

Q. 16. Which is called population ecology?

a. Synecology

b. Autecology

c. Both a and b

d. None of these

Ans: b

Q. 17. Which branch is called community ecology?

a. Synecology

b. Autecology

c. Both a and b

d. None of these

Ans: a

Q. 18. The natural place of an organism or community is known as

a. Niche
b. Biome
c. Habitat
d. Habit

Ans: c

Q. 19. Which is the renewable exhaustible natural energy resource?

a. Coal
b. Petroleum
c. Kerosene
d. Biomass

Ans: d

Q. 20. According to Shelford's Law of Tolerance, the organisms wide environmental factor tolerance limit show

a. Narrow distribution with low population size
b. Wide distribution with high population size
c. Narrow distribution with high population size
d. Wide distribution with low population size

Ans: b

Q. 21. Plants growing under direct sunlight are known as

a. Heliophytes
b. Sciophytes
c. Psamophytes
d. Dicots

Ans: a

Q. 22. Plants growing under shade are known as

a. Psamophytes
b. Sciophytes
c. Heliophytes
d. Monocots

Ans: b

Q. 23. An orchid living on a tree exhibits

a. Predator
b. Mutualism
c. Commensalism
d. Parasitism

Ans: c

Q. 24. Which statement is correct with respect to the food chain?

a. Every component of the food chain forms a trophic level
b. Inter-relation between different food chains is known as a food web
c. All the chains formed by nutritional relations is used to understand energy flow.
d. All of the above

Ans: d

Q. 24. The process of vernalization is practised in

a. Cold countries
b. Hot countries
c. Only in sub-tropical countries
d. Only in tropical countries

Ans: a

Q.25. which of the following requires maximum energy?

a. Secondary consumer
b. Decomposer
c. Primary consumer
d. Primary producer

Ans: d

Q. 26. The bottom area where production is less than respiration in a pond ecosystem is termed as

a. Profundal zone
b. Tidal zone
c. Benthic zone
d. Limnetic zone

Ans: a

Q. 27. Which is not the characteristic of 'r' selected species?

a. Reproduce quickly
b. Parental care
c. A low survival rate of progenies
d. Produce a large number of progenies

Ans: b

Q. 28. Which is not the characteristic of a population?

a. Natality
b. Mortality
c. Stratification
d. Sex ratio

Ans: c

Q. 29. Lincoln index measures

a. Population mortality rate
b. Population natality rate
c. Population size

d. Population density

Ans: c

Q. 30. Allelopathy refers to

a. Inhibition of growth of one species by another by the production of toxins
b. Inhibition of sporulation of pathogen by the host
c. Altering the reproductive cycle of one organism by another
d. Inhibition of growth of one species by another by preventing reproduction

Ans: a

Q. 31. The ratio between energy flows at different points in a food chain is known as

a. Ecological capacity
b. Ecological efficiency
c. Ecological assimilation
d. Ecological potential

Ans: b

Q. 32. The ability of a population to increase under ideal environmental conditions is called

a. Natality
b. Carrying capacity
c. Biotic potential
d. Absolute natality

Ans: c

Q. 33. In an ecosystem, the energy flow is always

a. Always unidirectional
b. Always bidirectional
c. In any direction
d. Always down directional

Ans: a

Q. 34. In thermal stratification, the middle region which shows vertical temperature change is called

a. Mesolimnion
b. Epilimnion
c. Metalimnion
d. Hypolimnion

Ans: c

Q. 35. Select a non-denitrifying bacteria

a. *Pseudomonas aeruginosa*
b. *Thiobacillus*
c. *Thiobacillus denitrificans*
d. *Bacillus ramosus*

Ans: d

Q. 36. Which one is a 'K' selected species?

a. Aspergillus
b. Human
c. Taraxacum
d. Grass

Ans: b

Q. 37. All species of Lemur are endemic to which area?

a. Madagascar
b. Seychelles Island
c. Galapagos Island
d. New Caledonia

Ans: a

Q. 38. The upper part of an aquatic ecosystem contains

a. Nekton
b. Plankton
c. Benthos
d. both (1) and (2)

Ans: b

Q. 39. What type of food chain is it?

dead animals → blowfly maggot → maggots → frog → snake

a. Detrital food chain
b. Decomposer food chain

c. Predator food chain

d. Grazing food chain

Ans: a

Q.40. Identify the mismatched pair

a. Tundra – Permafrost

b. Savanna – Acacia trees

c. Prairie – Epiphytes

d. Coniferous forest – Evergreen trees

Ans: c

Q. 41. "The pyramid of energy is always upright" states that

a. The energy conversion efficiency of herbivores is better than carnivores

b. The energy conversion efficiency of carnivores is better than herbivores

c. Producers have the lowest energy conversion efficiency

d. Energy conversion efficiency is the same in all trophic levels

Ans: a

Q.42. The population of birds declined in an area where DDT was extensively used. Why?

a. The birds stopped laying eggs

b. The eggs laid by the birds did not hatch

c. The snakes ate the eggs

d. The DDT spray killed all the birds

Ans: b

Q. 43. Which of the following lake zones has phytoplankton's in abundance?

a. Littoral zone
b. Benthic zone
c. Limnetic zone
d. Profundal zone

Ans: c

Q. 44. Plant species with a wide range of genetic distribution evolve into a local population known as

a. Ecotype
b. Population
c. Ecosystem
d. Biome

Ans: a

Q. 45. dB is the abbreviation used for the quantitative expression of

a. The density of bacteria in a medium
b. A Particular Pollutant
c. Dominant Bacillus in a culture
d. A pesticide

Ans: b

Q. 46. The eggshell of birds becomes thin by the pollution from pesticides due to the interference in the activity of

a. Calmodulin
b. MgATPase
c. CaATPase
d. Calcium

Ans: c

Q 47. Law of limiting factor was popularized by

a. Shelford
b. E. P. Odum
c. Liebig
d. None of these

Ans: c

Q. 48. Law of Tolerance was proposed by

a. Rieter

b. Shelford

c. Liebig

d. None of these

Ans: c

Q. 49. Tropical rain forest covers ..... of the Earth's surface.

a. 1%

b. 7%

c. 50%

d. 80%

Ans: b

Q. 50. Which of the following is also known as boreal forest?

a. Savannah

b. Grassland

c. Taiga

d. Desert

Ans: c

Unit II

Organization of Ecosystem

● Population: Density, natality, mortality, life tables, fecundity tables, survivorship curves, age ratio, sex ratio, dispersal and dispersion, Exponential and logistic growth,

● Types of ecosystems with one example in detail, Food chain, Food web, Energy flow through the ecosystem, Strategies for clean drinking water.

● Ecological pyramids and Ecological efficiencies, Nutrient and biogeochemical cycle with one example of Carbon cycle

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❖ A **population** is an assemblage of individuals of a species which potentially interbreed in the given space. The population has various attributes whose functions are unique to the group and not of the individuals.

❖ **Population density** is one of the attribute that can be defined as number of individuals in relation to a definite unit of space. Population density is categorized as Crude density which means total number of individuals per unit of the total space and Ecological density as the number of individuals per unit of the habitat space.

❖ **Natality** is another important characteristic of the population which tells the production of new individuals which arises from hatching, germination or arises by fission. It is further explained as Absolute Natality which means the physiological ability of organisms to produce maximum number of new individuals under optimum conditions and Ecological Natality which is defined as increase in the population size under actual environmental conditions.

❖ **Mortality** is the number of individuals dying in a population at particular time. It can be categorized into two types. The first is known as ecological mortality which can be defined as actual death of organisms in a particular area at particular ecological conditions. It changes with the change in population and environment such as predator, diseases etc. and second type is called as minimum mortality which means number of death of individuals under ideal conditions. Therefore, the loss of individual occurs due to old age (senescence) and it is constant for the population.

- Age distribution is another component of population characteristics which includes the total number or percentage of individuals in a given population in different age group. It explains the projection of future population.
- Sex ratio explains the proportion of male and female in the population. Primary sex ratio is constant which indicate equal proportion of male and female in the population but actually or in real condition the ratio vary in population of different species.
- In sexually mature animals, there is a selection process of choosing mate. Monogamy involves the pairing of male and female whereas Polygamy is the acquisition by an individual of two or more mates. Environmental and behavioral conditions result in various types of polygamy. In polygyny, an individual male pairs with more than one female. In polyandry, an individual female pairs with more than one male.
- In a population the ultimate constituent is individual. The individuals either distinguished as single unitary organisms or a complex modular organism. The population also exhibit secondary characteristics which includes dispersion and dispersal.
- Dispersal is the movement of individuals into or out of the population. It affects distribution and genetic process in geographic differentiation. Dispersal can be divided into Emigration which involves one-way outward movement of organisms.
- Immigration involves inward movement of individuals from a population into an given area. It is useful for the survival and reproduction of the organisms and migration which is two way periodic or seasonal departures and return of organisms to the original place.
- Nomadism is the random movement of individuals from one place to another in search of food and shelter without having definite returning to their original place. The dispersal is common in motile animals but in sessile animals, it depends on wind, water, coats of animals and other agencies.

- Dispersion refers to mode of distribution of organisms. It is categorizes as Random distribution where individuals are uniformly and unevenly

distributed in the area. Uniform distribution implies even spacing of individuals between same species when competition is severe.

- ❖ Clumping Distribution is common pattern of distribution in which individuals congregate in groups with some scattered individuals outside the group. Refuging is a type of aggregation in which large socially organized group of animals disperse and return regularly to the place after satisfying their needs like food and material comforts.
- ❖ Temporal dispersion is observed in some nectar feeding insects and related to daily change in light and dark, lunar cycles, seasons and tidal cycles. To grow and sustain themselves in an ecosystem is an inherent property all populations.
- ❖ The population growth is a result of addition of new individuals through natality and by immigrations and their decline is by mortality and emigration.
- ❖ The difference between these two parameters (natality and mortality) is given as instantaneous rate ("r") of population increase.
- ❖ Malthus proposed that the populations increase in geometrical (2, 4, 8, 16, and so on) whereas, their food increases arithmetical (2, 4, 6, 8, and so on) progression
- ❖ When the environmental conditions are unlimiting the populations expand geometrically or exponentially. It is observed in small populations entering into a new vacant habitat.
- ❖ Exponential growth also known as Malthusian growth is characterized by constant birth and death rate (intrinsic rate of increase) and a stable age distribution maintained indefinitely.
- ❖ A species is considered semelparous when it reproduces only a single time before it dies

- ❖ Populations with Semelparous life history can have:

- Constant multiplication rate or
- Multiplication rate depends on population size (density Dependent)

- **Net reproductive rate as a linear function of population density** At equilibrium density N_q , dN / dt is 0 and R (net reproductive rate) is 1
- Iteroparous species can reproduce more than once in its lifetime. Thus there are two or more overlapping generation of organisms living at any one time
- In "r" selected populations that show exponential population growth after attaining their maximum size may show a decline or complete population crash because the resources are completely exhausted.
- "L" is multiple of equilibrium density and slope of the curve. The value of "L" determines the behavior of the population whether it converges towards equilibrium or show oscillations or fluctuations.
- "r" selected species are mostly Semelparous populations, show exponential growth , most of them have small life span(except some plants and fish), have high turnover rate and produce large number of eggs/ young ones.
- "K" selected species are mostly iteroparous and can have exponential or sigmoid growth pattern. They have a long life span and produce less number of progeny.
- Iteroparous species can reproduce more than once in their life time. Thus there are two or more overlapping generation of organisms living at any one time.
- In iteroparous life history the population growth depends on the R (geometric growth factor). Growth factor is the factor by which a quantity multiplies itself over time or also called **fundamental net reproductive rate.**
- Geometric growth factor is obtained from the difference in the number of birth per year and the number of death per year. **R=1+ (B-D)**
- Parameter 'r' is called as any one of the following and is different from "R' - Malthusian parameter and is expressed as _r_m (_m' the maximum contribution per female to population growth), intrinsic rate of increase or instantaneous rate of natural increase.
- The environment is never stable it limits the population growth with respect one or more than one factors therefore the rate of growth is

slowed down. It depends upon the carrying capacity (K) of the resource.

- **Carrying capacity** is the total amount of resource which may be space or food (sum total of all its requirements for its growth) for a population. On the graph it is indicated as the asymptote (K).
- Verhulst and Pearl independently derived an equation explaining the sigmoid growth form of a population depending on the carrying capacity and the population size at any given time
- "r" selected species live in more unpredictable harsh environmental conditions, mortality is high and a greater amount of energy is spent on reproduction. They expand rapidly when the conditions are favourable'
- "K" selected populations live under more predictable environment, they are subjected density related mortality, spend less energy on reproduction and favour efficient use of environment.
- **Exponential growth –** In an ideal condition where there is an unlimited supply of food and resources, the population growth will follow an exponential order. Consider a population of size N and birth rate be represented as *b,* death rate as d, the rate of change of N can be given by the equation

$$dN/dt = (b-d) \times N$$

If, (b – d) = r,

$dN/dt = rN$

Where r = intrinsic rate of natural increase

This equation can be represented with a graph which has a J shaped curve. According to calculus

$N_t=N_0e^{rt}$

Where, N_t = Population density at time t

N_0= Population density at time zero

r = intrinsic rate of natural increase

e = base of natural logarithms

t = time

- **Logistic growth** – This model defines the concept of 'survival of the fittest'. Thus, it considers the fact that resources in nature are exhaustible. The term 'Carrying capacity' defines the limit of the resources beyond which they cannot support any number of organisms. Let this carrying capacity be represented as K.
- The availability of limited resources cannot show exponential growth. As a result, the graph will have a lag phase, followed by an exponential phase, then a declining phase and ultimately an asymptote. This is known as Verhulst-Pearl Logistic Growth and is represented using the equation:

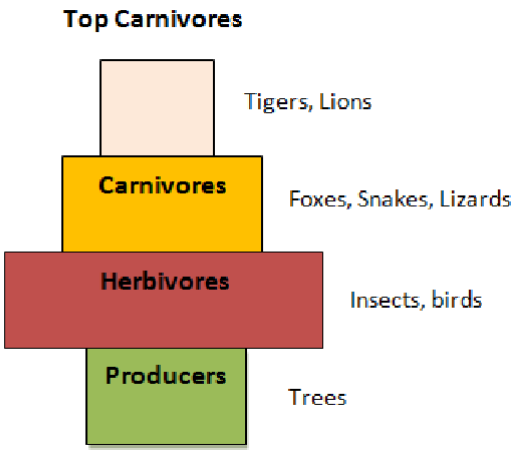
$$dN/dt = rN((K-N)/K)$$

- The term ecosystem was coined in 1935 by the Oxford ecologist Arthur Tansley to encompass the interactions among biotic and abiotic components of the environment at a given site. The living and non-living components of an ecosystem are known as biotic and abiotic components, respectively. Ecosystem was defined in its presently accepted form by Eugene Odum as, "an unit that includes all the organisms, i.e., the community in a given area interacting with the physical environment so that a flow of energy leads to clearly defined trophic structure, biotic diversity and material cycles, i.e., exchange of materials between living and non living, within the system"
- The living community of plants and animals in any area together with the non living components of the environment such as soil, air and water, constitute the ecosystem. Some ecosystems are equally vigorous and are less affected by a certain level of human disturbance. Others are highly fragile and are quickly destroyed by human activities. Mountain ecosystems are extremely fragile as degradation of forest cover leads to severe erosion of soil and changes in river courses.

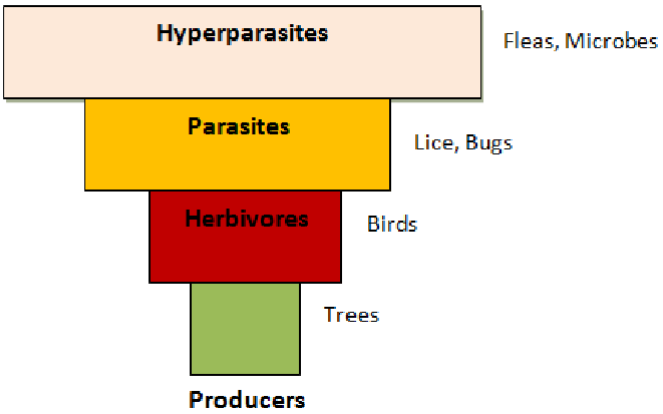
- The structure of an ecosystem can be split into two main components, namely: ➢ Biotic Components ➢ Abiotic Components The biotic and abiotic components are interrelated in an ecosystem. It is an open system where the energy and components can flow throughout the boundaries.
- The ecosystem functions through several biogeochemical cycles and energy transfer mechanisms. Observe and document the components of the ecosystem which consists of its non-living or abiotic features such as air, water, climate and soil. Its biotic components, the various plants and animals. Both these aspects of the ecosystem interact with each other through several functional aspects to form Nature's ecosystems.
- The most obvious aspect of nature is that energy must pass from one living organism to another. When herbivorous animals feed on plants, energy is transferred from plants to animals. In an ecosystem, some of the animals feed on other living organisms, while some feed on dead organic matter. The latter form the 'detritus' food chain. At each linkage in the chain, a major part of the energy from the food is lost for daily activities. Each chain usually has only four to five such links. However a single species may be linked to a large number of species.
- **Energy Flow:** Every ecosystem has numerous interconnected mechanisms that affect human life. These are the water cycle, the carbon cycle, the oxygen cycle, the nitrogen cycle and the energy cycle. While every ecosystem is controlled by these cycles, in each ecosystem its abiotic and biotic features are distinct from each other.
- All the functions of the ecosystem are in some way related to the growth and regeneration of its plant and animal species. These linked processes can be depicted as the various cycles. These processes depend on energy from sunlight.
- During photosynthesis carbon dioxide is taken up by plants and oxygen is released. Animals depend on this oxygen for their respiration. The water cycle depends on the rainfall, which is necessary for plants and animals to live. The energy cycle recycles nutrients into the soil on which plant life grows. Our own lives are closely linked to the proper functioning of these

cycles of life. If human activities go on altering them, humanity cannot survive on our earth.

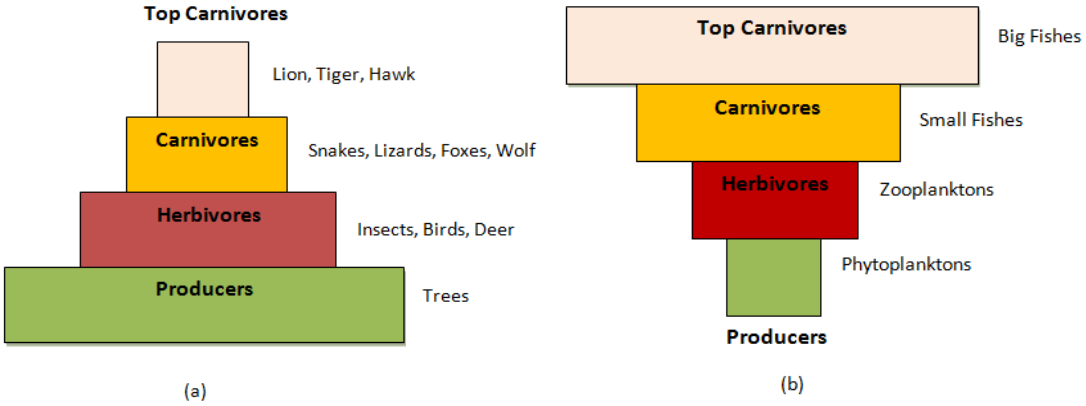
- **The ecological pyramids:** In an ecosystem, green plants – the producers, utilize energy directly from sunlight and convert it into matter. A large number of these organisms form the most basic, or first 'trophic level' of the food pyramid. The herbivorous animals that eat plants are at the second trophic level and are called primary consumers. The predators that feed on them form the third trophic level and are known as secondary consumers.
- Only a few animals form the third trophic level consisting of carnivores at the apex of the food pyramid. This is how energy is used by living creatures and flows through the ecosystem from its base to the apex. Much of the energy is used up in activities of each living organism.



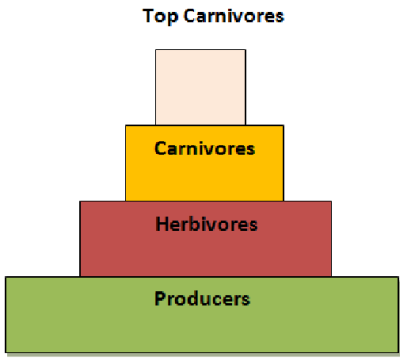
Pyramid of Numbers in Forest Ecosystem



Pyramid of Numbers in a Parasitic Food chain



a. Pyramid of Biomass in a Forest Ecosystem (Upright) b) Pyramid of Biomass in a Pond Ecosystem (Inverted)



Pyramid of Energy

- **Carbon cycle**: The physical cycle of carbon through the Earth's biosphere, geosphere, hydrosphere and atmosphere that includes such processes as photosynthesis, decomposition, respiration and carbonification.

- The carbon cycle describes the flow of carbon between the biosphere, the geosphere, and the atmosphere, and is essential to maintaining life on earth.
- Atmospheric Carbon Dioxide: Carbon in the earth's atmosphere exists in two main forms: carbon dioxide and methane. Carbon dioxide leaves the atmosphere through photosynthesis, thus entering the terrestrial and marine biospheres.

Carbon dioxide also dissolves directly from the atmosphere into bodies of water (oceans, lakes, etc.), as well as dissolving in precipitation as raindrops fall through the atmosphere.

- When dissolved in water, carbon dioxide reacts with water molecules and forms carbonic acid, which contributes to ocean acidity. Human activity over the past two centuries has significantly increased the amount of carbon in the atmosphere, mainly in the form of carbon dioxide, both by modifying ecosystems ability to extract carbon dioxide from the atmosphere and by emitting it directly, e.g. by burning fossil fuels and manufacturing concrete.
- Herbivorous animals feed on plant material, which is used by them for energy and for their growth. Both plants and animals release carbon dioxide during respiration. They also return fixed carbon to the soil in the waste they excrete. When plants and animals die they return their carbon to the soil. These processes complete the carbon cycle.

MCQs based on Unit II

Q. 1. The eggshell of birds becomes thin by the pollution from pesticides due to the interference in the activity of

a. Calmodulin
b. MgATPase
c. CaATPase
d. Calcium

Answer: c

Q. 2. In the energy flow of an ecosystem, the flow of energy comes to herbivores from

a. producers

b. Sunlight

c. Carnivores

d. None of above

Answer: a

Q. 3. In ecosystem, which of the following requires maximum energy

a. secondary consumer

b. Primary Consumer

c. Primary Producer

d. None of above

Answer: c

Q. 4. Which is/are the abiotic components of an ecosystem?

a. Soil

b. Protein

c. Carbon

d. More than above

Answer: d

Q. 5. Which ecological pyramid is always upright?

a. Pyramid of number

b. Pyramid of energy

c. Pyramid of biomass

d. Pyramid of Carbon

Answer: b

Q. 6. Identify an example of decomposers that are found in the bottom of a pond

a. Phytoplankton

b. Flagellates

c. Jelly fishes

d. Zooplanktons

Answer: b

Q. 7. Which of the following statements is correct?

a. Water is a cyclic resource

b. Water is a biotic resource

c. Water has only one state

d. Water is a non-renewable resource.

Answer: a

Q. 8. At the trophic level of consumers, the rate at which food energy is assimilated, is called

a. Net primary productivity

b. Secondary Productivity

c. Gross Primary Productivity

d. None of these

Answer: a

Q. 9. Net primary productivity is subtracted from Gross primary productivity

a. Loss due to mortality

b. that which is consumed by the producer in metabolism

c. secondary productivity

d. that which is consumed by herbivores

Answer: b

Q. 10. In a natural ecosystem, which pyramid can never be inverted

a. pyramid of biomass

b. Pyramid of numbers

c. pyramid of energy

d. None of these

Answer: c

Q. 11. The diurnal temperature of soil surface varies most in which habitat?

a. Shrub land

b. Grass land

c. Forest

d. Desert

Answer: d

Q. 12. The bottom area of the pond ecosystem where production is less than respiration is-

a. Benthic Zone

b. Limnetic Zone

c. Tidal Zone

d. Profundal zone

Answer: a

Q. 13. Biotic components of an ecosystem include-

a. producer only

b. consumers only

c. Producers, Consumers and decomposers

d. Decomposers

Answer: c

Q. 14. Every organism has a natural residence which is

a. Biome

b. Niche

c. Habit

d. Habitat

Answer: d

Q. 15. The following is not a type of Ecosystem-

a. Mountain

b. Aquatic

c. Desert

d. Grassland

Answer: a

Q. 16. An estuary

a. is an area where river join the sea/ocean

b. usually support an abundance of fish

c. is rich in nutrients

d. All of these

Answer: d

Q. 17. In desert ecosystem, shrubs or bushes are

a. consumers

b. decomposers

c. Producers

d. None of these

Answer: c

Q. 18. The Pyramid of biomass is based on

a. Total amount of living material

b. Total Dry weight

c. Calorific value

d. All of these

Answer: d

Q. 19. Ecological pyramids were first described by

a. Haeckel

b. C. Elton

c. Odum

d. None of these

Answer: b

Q. 20. The pyramid in which individuals at each successive trophic level are counted per unit area, known as

a. Pyramid of Energy

b. Pyramid of Biomass

c. Pyramid of Numbers

d. None of these

Answer: c

Q. 21. The pyramid in which the total biomass existing at each of the successive trophic levels is measured in terms of dry weight or caloric value, per unit area, known as

a. Pyramid of Energy

b. Pyramid of Biomass

c. Pyramid of Numbers

d. None of these

Answer: b

Q. 22. Which pyramid is also known as Pyramid of Productivity?

a. Pyramid of Energy

b. Pyramid of Biomass

c. Pyramid of Numbers

d. None of these

Answer: a

Q. 23. The pyramid of grassland and aquatic ecosystems is

a. Down

b. Up

c. Both a and b

d. None of these

Answer: b

Q. 24. The pyramid of numbers in a parasitic food chain is

a. Inverted

b. Upright

c. Both a and b

d. None of these

Answer: a

Q. 25. When energy is transferred to next trophic levels, only about ……..of it is utilized to assemble body mass and become stored energy-

a. 20%

b. 10%

c. 30%

d. 50%

Answer: b

Q. 26. Which pyramid's shape is not affected by size or rate of metabolism of organism?

a. Pyramid of Energy

b. Pyramid of Number

c. Pyramid of biomass

d. None of these

Answer: a

Q. 27. Which pyramid is considered as the most consistent pyramid of ecosystem?

a. Pyramid of biomass

b. Pyramid of Number

c. Pyramid of Energy

d. None of these

Answer: c

Q. 28. The photic zone extends to a maximum depth of .....meter below the surface of the water.

a. 50

b. 200

c. 150

d. 100

Q. 29. In the energy flow diagram of an ecosystem, the flow of energy comes to herbivores from-

a. producers

b. Carnivores

c. Sunlight

d. None of these

Answer: a

Q. 30. In loam soil, the proportion of soil particles is

a. 60% sand and 40% clay or slit or both

b. 50% sand and 50% clay or slit or both

c. 80% sand and 20% clay or slit or both

d. None of these

Answer: b

Q. 31. In ecosystem, which of the following requires maximum energy?

a. Secondary Consumer

b. Primary Consumer

c. Primary Producer

d. None of these

Answer: c

Q. 32. According to Allen's rule, the mammals from colder climates have

a. Longer ears and longer limbs

b. Shorter ears and Shorter limbs

c. Shorter ears and longer limbs

d. None of these

Answer: b

Q. 33. Which is/are the abiotic components of an ecosystem?

a. Carbon

b. Protein

c. Soil

d. More than one of the above

Answer: d

Q. 34. In a food web, hyenas and vultures are

a. Predators

b. Scavengers

c. Primary Consumers

d. Decomposers

Answer: b

Q. 35. Identify an example of decomposers that are found in the bottom of a pond.

a. Flagellates

b. Phytoplanktons

c. Jelly fishes

d. Zooplanktons

Answer: a

Q. 36. Which of the following statements is correct?

a. Water is a cyclic resource

b. Water has only one state

c. Water is a non-renewable resource

d. Water is a biotic resource

Answer: a

Q. 37. Who proposed the term Ecosystem?

a. Odum

b. Lindeman

c. A.G. Tansely

d. None of these

Answer: c

Q. 38. What can be visualized as a functional unit of nature?

a. Plants

b. Vehicles

c. Ecosystem

d. Humans

Answer: b

Q. 39. Through, which of the following energy enters in an ecosystem?

a. Decomposers

b. Consumers

c. Producers

d. None of these

Answer: c

Q. 40. In which of the following wheat eating Pigeons included?

a. Secondary Consumers

b. Decomposers

c. Producers

d. Primary Consumers

Answer: d

Q.41. As we proceed in food chain, biomass

a. increases

b. remain same

c. Decreases

d. None of these

Answer: c

Q. 42. In ecosystem the source of energy is

a. Sun

b. ATP

c. Green Plants

d. None of these

Answer: c

Q. 43. In which of the following is considered as primary consumer of the ecosystem?

a. Carnivores

b. Scavengers

c. Omnivores

d. Herbivores or Grazing animals

Answer: d

Q. 44. In which of the following weeds are placed?

a. Decomposers

b. primary consumers

c. Secondary Consumers

d. Producers

Answer: d

Q.45. when does the energy flow start in an ecosystem?

a. when any living organism gain food

b. when material cycle starts

c. when Sun rises

d. when light energy is converted into chemical energy

Answer: c

Q. 46. Which of the following is correct for the storage place phosphorus and nitrogen respectively?

a. Environment and Producers

b. Parental rock and environment

c. Consumers

d. None of these

Answer: b

Q. 47. Which of the following is the trophic level of the Orchid staying on Mango tree?

a. Fourth

b. Second

c. Third

d. First

Answer: d

Q. 48. Which age group in pyramid indicate less reproductive potential?

a. Triangular

b. Bell Shaped

c. Inverted Bell Shaped

d. None of these

Answer: c

Q. 49. The functional efficiency of ecosystem is effected when decomposers are removed from it, because

a. Flow of nutrient will stop

b. Energy flow will stop

c. Herbivores will not get energy

d. process of decomposition will faster

Answer: a

Q. 50. Detritus food chain will start from

a. Protozoa

b. Algae

c. Bacteria

d. Virus

Answer: c

Q. 51. Which source of Eutrophication is the modern source of phosphorus?

a. Faeces

b. Fertilizers

c. Detergent

d. Sewage

Answer: c

Q. 52. At producer level, if 20 J of energy is trapped, how much energy will be available to a peacock as food in the subsequent chain?

Plant > Mice > Snake > Peacock

a. 0.0002 J
b. 0.002 J
c. 0.2 J
d. 0.02 J

Answer: d

Q. 53. A characteristic feature of cropland ecosystem is

a. least genetic diversity

b. Absence of weeds

c. Absence of Soil entities

d. None of these

Answer: a

Q. 54. The example of primary producers of the deep sea hydrothermal vent ecosystem are

a. Green algae

b. Coral reef

c. Cynobacteria

d. Chemosynthetic bacteria

Answer: d

Q. 55. Which ecosystem has the maximum biomass?

a. Forest ecosystem

b. Lake ecosystem

c. Pond Ecosystem

d. Grassland Ecosystem

Answer: b

Q.56. The rate at which food energy is assimilated at the trophic level of consumers is known as

a. Net Primary Productivity

b. Gross Primary Productivity

c. Secondary productivity

d. None of these

Answer: c

Q.57. In an ecosystem, which one of the following types of entities occupies more than one trophic level?

a. Phytoplanktons

b. Zooplaktons

c. Fishes

d. Amphibians

Answer: c

Q. 58. Stable coexistence is possible in a classical two species Lotka-Voltera competition model when-

a. Inter and intra-specific competitive effects are balanced

b. Interspecific effects are offset by demographic position

c. Intraspecific competition is weaker than interspecific competition

d. Intraspecific competition is stronger than interspecific competition

Answer: d

Q. 59. A population which has a relatively low r value will most likely

a. have an early age of first reproduction and a short generation time

b. produce fewer offspring with more competitive capabilities

c. be found in environments that are highly variable

d. large size with relatively small offspring

Answer: b

Q. 60. Which one of the following trait set characterizes best a 'r' selected species?

a. usually a type III survivorship curve, short life span and density independent mortality

b. usually a type I survivorship curve, long life span and density independent mortality

c. type I survivorship curve, short life span, density dependent mortality

d. Type III survivorship curve, short life span, density dependent mortality

Answer: a

Q. 61. Which of the following is not a biogeochemical cycle?

a. Water Cycle

b. Nitrogen Cycle

c. Carbon Cycle

d. Ozone cycle

Answer: d

Q.62. select the correct option depicting the correct sequence in water cycle

a. precipitation, evaporation, Transpiration, Condensation

b. Transpiration, Condensation, Evaporation, Precipitation

c. Evaporation, Transpiration, Condensation, Precipitation

d. Condensation, Evaporation, Transpiration, Precipitation

Answer: c

Q. 63. Which of the following nutrient cycle is directly propelled by Sun Light?

a. Carbon Cycle

b. Nitrogen Cycle

c. Phosphorus cycle

d. None of these

Answer: c

Q. 64. Which one of the following is a sedimentary type of biogeochemical cycle?

a. Oxygen and Nitrogen

b. Phosphate and Nitrogen

c. Phosphorus and Sulphur

d. None of these

Answer: c

Q.65. which survivorship curve shows rapid decline in the number of individuals surviving into late life?

a. Type I Survivorship curve

b. Type II Survivorship curve

c. Type III Survivorship curve

d. None of these

Answer: a

Q. 66. In which survivorship curve, individuals have a high probability of surviving through early and middle life?

a. Type III Survivorship curve

b. Type I Survivorship curve

c. Type II Survivorship curve

d. None of these

Answer: b

Q. 67. Which survivorship curve shows a roughly constant mortality rate for the species through its entire life?

a. Type I Survivorship curve

b. Type III Survivorship curve

c. Type II Survivorship curve

d. None of these

Answer: c

Q. 68. Which survivorship curve is plotted as a diagonal line going downward on a graph?

a. Type III Survivorship curve

b. Type II Survivorship curve

c. Type I Survivorship curve

d. None of these

Answer: b

Q. 69. Which survivorship curve is plotted as a convex curve on a graph?

a. Type I Survivorship curve

b. Type II Survivorship curve

c. Type III Survivorship curve

d. None of these

Answer: a

Q. 70. Which survivorship curve is drawn as a concave curve on a graph?

a. Type II Survivorship curve

b. Type III Survivorship curve

c. Type I Survivorship curve

d. None of these

Answer: b

UNIT III

Community Ecology

Community characteristics: species richness, dominance, diversity, abundance, Ecological succession with one example

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Community Ecology

- ❖ A naturally occurring group of different plant and animal populations living in common environment constitute a biotic community.
- ❖ Assemblage of plant populations in a biotic community is called plant community and that of animal populations is called animal community.
- ❖ The study of an organisms living together in an interrelated manner in a given environment is termed as community ecology or synecology.

Features

- ❖ 1. A community is a highly complex structure, dominant species are tree and shrubs.
- ❖ 2. The number of species in a community is determined by variation of environmental conditions.
- ❖ 3. If the conditions are adverse, the number of species present in a community is also less than average.
- ❖ 4. Closely related species normally do not occur at the same place, at same time, or in closely related niches.
- ❖ 5. Community vary in size and composition, smaller is called microcommunity e.g. water in a pitcher.
- ❖ 6. Two different kinds of community meet at a transition zone, called Ecotone.

Classification of Communities

1. Terrestrial (land)
2. Aquatic (water)
   - ❖ These two basic types of community contain eight smaller smaller units known as Biomes.
   - ❖ Terrestrial Biomes: tundra, grassland, desert, taiga, temperate forest, tropical forest.

- Aquatic Biomes: marine, freshwater. Autotrophic communities require only the energy from the sun to drive the process of photosynthesis, such as forests and grasslands.
- Heterotrophic communities, such as organisms that inhabit a fallen log, depend on the autotrophic community for their energy source.
- All communities communities have certain certain characteristics characteristics that define their biological and physical structure, but these characteristics vary in both SPACE and TIME. A GUILD is a GROUP OF SPECIES within a community that interact MORE STRONGLY AMONG THEMSELVES than with others, utilizing HABITAT or FOOD resources in a SIMILAR MANNER.

Qualitative characteristics of Community

- Floristic composition
- Stratification
- Periodicity
- Vitality and vigor
- Growth forms
- Life forms
- Association of species
- Dominance

Quantitative Characteristics

- 1. Density
- 2. Cover
- 3. Abundance
- 4.Height, weight and volume
- 5. Frequency
- 6. Importance value index

ATTRIBUTES OF THE PLANT COMMUNITIES

- The attributes (characteristics) of a commit), are classified into three main groups: analytic, synthetic and physiognomic.

- (a) **Analytic** characteristics: The characteristics which can be analyzed by quantitative or qualitative methods are called analytic characteristics. These may be qualitative or quantitative characteristics. 1. Qualitative Characteristics The disruptive characteristic's which cannot be measured are called qualitative characteristics. These includes following characteristics. (i) Kinds of Species or Floristic Composition: A complete list of species is called floristic composition. It is essential for the study of a stand. (ii) Stratification: The plants occurring together with a similar ecology in definite strata are called stratification. The size and number of these strata depends on the type of life form.
- Stratification of the community causes differences in requirement of trees, shrubs and herbs. They require different light intensity, temperature, moisture condition and organic content of the soil.
- Most temperate forest communities are composed of 3 – 4 strata. ▪ Over story tree: The upper stratum consist of relatively large over storey trees. ▪ Crown: Below these taller trees, there is a stratum of the crown or secondary under storey trees. ▪ Herbaceous plants: Below the secondary trees there is one or more layers of herbaceous plants. ▪ Mosses or lichens: Mosses or lichens may be present in the low layer on the ground.
- (iii) Periodicity: The rhythmic phenomena related to seasonal changes is called periodicity. These changes are growth. flowering, pollination, ripening of- fruit and seed. Periodicity is controlled by different environmental factors like light, temperature etc. (iv) Vitality: The capacity of plants to complete its life cycle is called vitality. Some species have low vitality and die soon. Some have high vitality. They complete their life span. (v) Sociability: The degree of aggregation of plants in nature is called sociability. Sociability depends on life form, mode of reproduction, habitat condition and competition.
- 2. Quantitative characteristics The characteristics which can be measured are called quantitative characteristics. These include: (i) Density: The number of individuals of a specie in a unit area is called density. (ii) Relative density: The proportion of a density of a specie to a stand as a whole is

called relative density. (iii) Abundance: The. estimation of individuals of a specie is called abundance. (iv) Cover: The ground covered or shaded by the above ground parts of plant is called cover. Cover also includes basal area. The ground actually covered by crown is called cover. (v) Relative cover: The proportion of the cover of a species to sum of the all the plant of all the species is called relative cover.

- (vi) Frequency: The degree of occurrence of individuals of a species within an area is called frequency. (vii) Relative frequency: The proportion of the total frequency_ of specie to the sum of the frequency of all the species in the area is Called relative frequency. (viii) Frequency classes: Dacron classes are formed on the basis of relative frequencies. There are live frequency classes.

(b) Synthetic characteristics

The generalization and integration of characteristics that derived from data of analytic qualities are called synthetic characteristics. In this case, data is arranged in tubular form. Then synthetic characteristics are studied. There are following synthetic characteristics: (i) Presence: It is the uniformity of specie occurs in number of stands of the same type of community.

(ii) Constancy: A specie that occurs in 90% or more of the stand is called constant specie. (iii) Fidelity: The relative occurrence of specie in an association or a group of related association is called fidelity.

(iv) Dominance: The species which have high number and large volume are called dominant species.

(c) Physiognomic characteristics:

- The general appearance or outlines of the stand or community are called physiognomic characteristics. It includes: (I) Physiognomy: The appearance of stand is called physiognomy. (ii) Pattern: The group of individuals with physiognomic contrast (iii) Life-form: The vegetative appearance of the plant body and its longevity is called life-from.
- There are five principle life form classes. ▪ Phanerophytes: These plants include woody trees and shrubs. Their bud bearing shoots are elevated and exposed to the atmosphere. Example. Accaia sp. ▪ Chamaeophytes: They

include wood or semi woody perennial under shrubs. The bud is above the ground but less than 25 cm high. Example Salvia sp. ▪ Hemi-cryptophytes: The perennating buds are half hidden in the surface of soil. Example cuphorbia. ▪ Cryptophytes: Their buds are ill soil or under water, e.g. Hydrilla. ▪ Therophytes: It includes all the annual plants. Their only perennating buds are present in seeds.

- ❖ Characteristics of a Community Ecology Some of the major characteristics of a community ecology are as follows: (a) Species Diversity (b) Growth From and structure (c) Dominance (d) Self reliance (e) Relative abundance (f) Trophic structure.
- ❖ Community ecology deals with the group of various kinds of population in the areas. A group of several species (plants/ animals) living together with mutual tolerance in a natural area is called as a community. A forest, a pond and a desert are natural communities. A community has its own structure, development history and behaviours.
- ❖ The community has the following characteristics: (a) Species Diversity: Each community consists of different organisms like plants, animals, microbes etc. They differ taxonomically from each other. This species diversity may be regional or local. (b) Growth From and structure: Community can be analysed in terms of major growth forms like trees, shrubs, herbs etc.
- ❖ In each growth from as in trees, there may be different kinds of plants as-broad leave trees, evergreen trees etc. These different growth forms determine the structural pattern of a community. (c) Dominance: All species are not equally important in each community.
- ❖ The nature of the community is determined by a few species in a community. These limited species have control and dominating influence in the community. (d) Self reliance: Each community has a group of autotrophic plants as well as heterotrophic animals. The autotrophic plants are self dependent. (e) Relative abundance: Different populations in a community exist in relative proportions and this idea is called as relative abundance. (f) Trophic structure: Each community has a trophic structure that determines the flow of energy and material from plants to herbivores to

carnivores. Characteristics of Communities: Communities, like populations, are characterised by a number of unique properties which are referred to as community structure and community function.

- Community structure comprises of species richness (types of species and their relative abundances) physical characteristics of the vegetation and the trophic relationships among the interacting populations in the community.
- The characteristic features of a community are: A. Species composition: A community is a heterogeneous assemblage of plants, animals and microbes. In ecosystems, virtually every organisms of a community, including the most insignificant microbes, plays some role or the other in determining its nature.
- The species in a community may be closely or distantly related but they are interdependent and are interacting with each other in several ways. B. Species dominance: All the species of a community are not equally important. There are a few overtopping or dominant species who, by their bulk and growth, modify the habitat. They also control the growth of other species of the community, thus forming a sort of nucleus in the community.
- Some communities have a single dominant species and are thus named after that species, such as sphagnum bog community, deciduous forest community etc.
- Other communities may have more than one dominant species, for example, oak-hickory forest community. 1. Keystone Species: There are species upon whom several species depend and whose removal would lead to a collapse of the structure and ultimate disappearance of these other species. Such species are referred to as keystone species, the term coined by Paine in 1966. These species may exert their keystone role in several ways.
- The beaver is one example whose ponds provide homes for many organisms from pond weeds to black ducks. Paine through his classic experiments showed that predators and herbivores can manipulate relationships among species at lower trophic levels and, thereby, control the structure of the community. Such predator species are called Keystone predators as their removal can tumble the community. Paine's work on the star fish, Pisaster

ochraceus, is a classical example of keystone predator that feeds primarily on barnacles and mussles (Mytitus). After removal of this star fish from the experimental areas on the coast of Washington, Paine observed that the mussels spread very rapidly. They crowded other organisms out of the experimental plots, thereby reducing the diversity and complexity of local food webs. Similarly, removal of the herbivore sea urchin, Strongylocentrotus, allowed a small number of competitive macro algae to form healthy beds and crowding out limpets, chitons and other bottom dwelling invertebrates.

- 2. **Direct-Indirect Interactions**: In order to understand the structure of the community, one has to determine which possible interactions are the most important. When direct physical contact of one species with another is involved the interaction is said to be a direct interaction as in predation, herbivory and parasitism.
- When the interaction of one species with another is affected by the intermediance of a third species, then this interaction is called indirect interaction and this third species is called intermediary species.
- Depending on the role of the intermediary species, indirect interaction may result due to two mechanisms: 1. Any indirect effect resulting from a chain of direct effects known as interaction chain.
- 2. When interaction between two species is affected by the third species (I) is known as interaction modification.
- Five simple types of indirect effects may be identified — interspecific competition, trophic cascade, apparent competition and indirect mutualism comprising of interference and exploitation types. Even the simple effects are difficult to detect without extensive experimentation.
- 3. Chemical Interactions among Species: In a number of cases, species relationships are based on chemical interactions. The study of the production and uptake or reception by organisms of chemical compounds having effects on the organisms is termed chemical ecology.
- Chemical ecology is not used to include simple relationships, Whittaker and Feeny (1971) put forward a classification based on inter-organismic

chemical effects. They are: 1. Allelochemic effect: Chemical effects between different species and effects between individuals of the same species. 2. Pheromones: These serve as chemical messengers between members of a species. D. Spatial structure: The members of a community exhibit a spatial structural pattern.

- Structurally, communities may be divided into the following types: 1. Communities may be divided horizontally into sub-communities. They constitute the zonation in a community.
- Examples: (i) In deep ponds and lakes three zones may be recognised-upper littoral zone, middle limnetic zone, and a lower pro-fundal zone. Each zone constitutes different types of organisms.
- However, shallow ponds have very little zonation. (ii) Mountains show zonations of different distinct vegetational type. Altitudinal zonation in a mountain is due to climatic variations. 2. Another aspect of structure is stratification—which is very common.
- Ecosystems generally have noticeable vertical structure (strata). Examples: (i) Many ecosystems show two broad tropic strata – upper autotrophic and lower heterotrophic. In the upper part of the water of a lake, food production is restricted up to the part where light penetrates.
- The bottom of the lake comprises of heterotrophic organisms (animals and bacteria) that depend upon the autotrophs of the upper strata. Similarly, in a forest ecosystem, food-making activities take place in the upper part where the leaves are concentrated, while consumption and decomposition occur on or beneath the forest floor.
- (ii) Some community may comprise of more than two strata. Some forests-like a complex deciduous forest community-shows stratification where five vertical sub-divisions of different vegetational types are present. These vertical subdivisions are — sub-terranean, forest floor, herbs, shrubs, and trees.
- (iii) Some communities may lack some of the above strata or may have other strata comprising of the same group of vegetation. Bog forests have two

strata of herbs, a lower strata of plants like partridgeberry and gold thread and a higher strata of skunk cabbage leaves and ferns.

- Tropical rain forests may have three tree strata, while the herb and shrub layers are poorly developed. 3. Instead of occurring in zonation or strata, organisms may divide the habitat in a more complex manner by just occurring in layers.
- Example: In the Ponderosa pine forests of Colorado during winter, three different species of nuthatches live together. The familiar white-breasted nuthatch are generally seen scrambling in crevices in the bark of a tree in search of food A second slightly smaller species, the red-breasted nuthatch, obtains its food by foraging on large branches of the trees. A third, much smaller species, the pigmy nuthatch, gets its food from small branches and clusters of pine needles. The above example shows division of resources as they occupy different ecological niches. This probably reduces interspecific competition.
- 4. In aquatic communities, temperature may cause thermal stratification. Example: Large lakes and oceans, depending on the temperature, are formed of three layers — upper epilimnion, a middle thermocline (Metalimnion), and a lower hypolimnion.
- E. Community periodicity: Periodicity refers to the rhythmic activity of an organism for food, shelter and reproduction. The periodicity of a community is related to seasonal changes, day and night, lunar rhythms, and the inherent property of the animals. (a) Day-night changes: The daily periodicity is due to the occurrence of day and night.
- Accordingly, organisms that are active in the daylight hours and inactive (sleep) in the night are diurnal, while those active at night and inactive at day are nocturnal. A few organisms are either active at dawn or dusk or at both the times — they are said to be crepuscular.
- Most crepuscular animals like the whippoorwill, show increased activity mostly during bright moonlight. Some nocturnal animals like bats and moths are lunar phobic that is they become less active during bright moonlight. There are other 24 hour cycles occurring in organisms such as

daily patterns of physiological activity like production of new cells or the secretion of a particular enzyme. Many cycles like wakefulness, locomotion etc. persists even in environments with no alternation of light and dark. Such daily cycles are called circadian rhythms. Why are organism nocturnal or diurnal? There is no single evolutionary answer. The evolving of nocturnal animals may be due to high humidity at night or evading diurnal predators or competitors.

- (b) Seasonal changes: Many communities show seasonal changes in structure, appearance and function, depending on the changes in seasons.
- Example: 1. The most marked are the seasonal changes in temperate deciduous forests, where changes are seen during six recognisable seasons. 2. In many tropical and subtropical ecosystems, wet and dry conditions are more important than warm and cold seasonality. This is true in case of Sonora desert, monsoon forests etc.
- 3. Hot springs generally have constant temperature and salinity. They show changes during seasonal differences in sunlight. F. Synusia and Guild: Synusia, the term coined by DuRietz in 1930, denotes the subdivision of a plant community consisting of all the plants of the same life form. They also correspond to the layers of the community, like the canopy trees of a forest or the mosses of a bog. In a tropical rain forest, the larger epiphytes form a synusia and the epiphylls, that is the algae and lichens that grow on rain forest leaves, form another.
- Guild, the term put forward by Root in 1967, presents a group of species that exploit the same classes of environmental resource in a similar way, or, in other words, they eat similar foods. The frugivores of a tropical rain forest feed on the fruits and are thus considered as guild. Similarly, insects feeding on broad-leaved trees form one guild.
- Studies have shown constancy in the proportion of total species in certain guilds within a community. This is true in the case of the ratio between the predator species and prey species. This indicates that there might be certain common rules that govern community structure.

- G. Eco-tone and Edge effect: Communities generally have their boundaries well-defined. The intermediate zone lying between two adjacent communities are called eco-tones.
- The border between a forest and a grassland, the bank of a stream running through a meadow, an estuary (the junction where the river meets the sea), the transition between aquatic and terrestrial communities, between distinct soil types, are a few examples of eco-tone.
- Even the transition between north-facing and south-facing slopes of mountains is eco-tones where the transition between communities is abrupt and obvious. The eco-tone may be as broad as 100 kms or as narrow as 1 km. Species are distributed at random in respect to one another giving an open structure.
- The environmental condition in an eco-tone is variable, intermediate between the two adjacent communities. Boundaries between grassland and scrubland or between grassland and forest have sharp changes in surface temperature, soil moisture, light intensity and fire frequency. This results in replacement of many species.
- Grasses prevent the growth of shrub seedlings by reducing the moisture content of the surface layer of soil. Shrubs, on the other hand, depresses the growth of grass seedlings by shedding them. The edge between prairies and forests in mid-western United States is maintained by fire. Perennial grass resists fire damage to tree seedlings.
- Eco-tone generally offers an abundance of food and shelter. It contains organisms from both the communities. As a rule, eco-tone contains more species and often a denser population than the two concerned communities. This is called edge effect. There are certain species which are entirely restricted iii the eco-tone and are called edge species.
- However, it must be made clear at this point that the concept of eco-tone is not restricted to the interaction among communities, nor to the transition in the number of species. Eco-tone may be viewed as a surface forming common boundary between populations, or between ecosystems, as well as between communities. Eco-tone transitions will include fluxes of materials

as well as transition in number of species. H. Habitat and Ecological niche: The word habitat is used to denote where an organism lives, or the place where one would go to find it.

- The word habitat is a Latin word which literally means 'it inhabits' or 'it dwells'. It was first used in the eighteenth century to describe the natural place of growth or occurrence of a species.
- For example, the lowland gorilla (Gorilla gorilla) has as its habitat lowland tropical secondary forest. *Hericium abietis* (fungus) habitats on coniferous logs and trees in the Pacific, northwest of USA. Some species, like the tiger (Panthera tigris), have several habitats. It includes tropical rain forest, snowcovered coniferous and deciduous forests and mangrove swamps.
- The habitat of some smaller organisms is highly specialised. Certain species of leaf miners live only in the upper photosynthetic layer of leaves, while other species live in the lower cell layer in certain plant species. Thus, the habitat of the two species is different and such divisions of the environment are called microhabitats.
- Any one environment is divided up into many possibly thousands of microhabitats. The specific environmental variables in the microhabitat of a population is called micro- environment or microclimate. The term niche is used by ecologists to express the relationship of individuals or populations to all aspects of their environment.
- Niche, thus, is the ecological role of a species in the community. It represents the range of conditions and resource qualities within which an individual or species can survive and reproduce. Niche is multidimensional in nature.
- **Distinction between habitat and niche**: The words habitat and niche are often misunderstood. At this stage it is important to distinguish between the two terms in ecology. A habitat is a description of where an organism can be found, but its niche is a complete description of how the organism relates itself to its physical and biological environment. For example, the habitat of the back swimmer (Notonecta) and the water boatman (Corixa) is the shallow area of ponds and lakes. They, thus, occupy the same habitat.

However, the two species occupy much diversified trophic niches. The backswimmer is an active predator, whereas the water boatman feeds largely on decaying vegetation.

- ❖ Although species coexist they use different energy sources. The habitat is the address of the organism, while niche is its 'profession', that is its trophic position in food webs, how it lives and interacts with the physical environment and with other organisms in its community.
- ❖ Habitat refers not only to organisms, but it also refers to the place occupied by an entire community. The habitat of the sand sage grassland community occurs along the north sides of rivers in the Southern Great Plains of the United States. Thus, from the examples of the above, it can be said that the habitat of an organism or groups of organism (population) includes other organisms and the abiotic environment.

❖ **Species Richness:**

❖ The count, or total number, of unique species within a given biological community, ecosystem, biome, or other defined area. While species richness does not consider the population sizes of individual species in the area (*see* species abundance) or how even the distribution of each species is, it is an important, if simple, component of biodiversity.

❖ Species richness is often used to compare the biodiversity of different biological communities, compare the number of species within a particular taxonomic grouping (such as birds or mammals) at different locations, and monitor changes in a particular biological community over time.

❖ The simplest measure of spp diversity is spp richness i.e.; the No. of spp present in per unit area.

- ❖ Spp richness is only one aspect of diversity. Not all spp exist in equal numbers, some are rare, some are common but not numerous, and others are very abundant.
- ❖ Imagine, two forests, both of which contain a total of 100 individuals belonging to 5 different spp. In one forest, there are 20 individuals of each spp.
- ❖ In the other, one species has 60 individuals, while each of the other four spp has 10 individuals. These two samples differ in a property called evenness.

- The first, in which the spp are represented by the same number of individuals, is more even and thus, has high overall spp diversity.
- Therefore, the spp diversity of a community depends on both its richness as well as evenness, higher species numbers, with the individuals more evenly distributed among them, contribute to higher community diversity.
- In general, species richness increases with proximity to the Equator and decreases from the Equator to the poles. This pattern occurs across a range of scales. For example, taking the areas of entire countries into account, Colombia and Kenya each have more than 1,000 breeding species of birds, whereas the forestland of Great Britain and the forestland of eastern North America are each home to fewer than 200. Studies note that the number of beetle species present in 1 hectare (2.47 acres) of tropical rainforest in Panama rivals that of the whole of the United States, which spans 983,463,300 hectares (2,430,190,700 acres).
- Since the geographic limits of the biological community or other survey area are determined by the researcher, comparing the species richness of different studies and locations requires additional tools. Species richness may be divided into alpha diversity (or point diversity), beta diversity, and gamma diversity when changes in spatial scale are important to consider. Alpha diversity is the species richness in a local area or in an area smaller than an entire region or the collective geographic range of the species (such as a researcher's study area or the area of a small biological community or habitat).
- If the species richness of larger scales needs to be examined, ecologists use beta diversity or gamma diversity. Beta diversity examines the rate at which species richness changes from one habitat to another, and gamma diversity calculates the species richness of larger geographies (such as a large ecosystem or biome or a country). Mathematically, as larger and larger areas are surveyed (and, thus, as more and more species and their habitats are included), alpha diversity will approach gamma diversity, and beta diversity will approach zero.
- **species dominance** refers to the influence a species exerts over other species in a community, often due to its abundance, size, or impact on the

environment. Dominant species can significantly shape the community structure, influence resource availability, and affect ecosystem functions.

- **Biodiversity** is defined in the Convention on Biological Diversity as 'the changeability amongst living organisms from all sources comprising, inter alia, land-dwelling, marine and their aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems'.
- Another definition mentions biodiversity as "the diversity and distribution of plant and animal communities, (including vegetative and reproductive stages) arranged in space over time that reinforce self- sustaining populations of all natural and naturalized plants and wild animals." The third and more simplistic one defines as, 'Biodiversity is to describe the variety of life forms, the ecological roles they perform, and the genetic diversity they contain'

LEVELS OF BIODIVERSITY:

- 3 hierarchical levels- Genetic, spp and Ecosystem

1. GENETIC DIVERSITY:

- **"The variation in the genetic composition of individuals within or among spp."**
- It enables the population to adapt to its environment and respond to natural selection. The amount of genetic variation is the basis of speciation.
- It occurs at several levels of organization such as among higher taxonomic categories such as kingdoms, phyla and families, among spp and among populations.
- Most genetic diversity one can see between organisms of two kingdoms (such as plants versus animals), between phyla (Such as arthropods versus chordates), between classes (Such as birds versus reptiles) and so on.

2. SPECIES DIVERSITY:

- According to biological spp concept, spp are groups of actually or potentially interbreeding natural populations, which are reproductively isolated from other such groups.
- Simply, **spp. Diversity refers to the variety of spp within a region i.e; spp richness**.
- In broad sense, spp diversity includes spp richness, spp evenness as well as taxonomic /phylogenetic diversity.

- Taxonomic or phylogenetic diversity describes the genetic relationship between different groups of spp. A more taxonomically diverse community is therefore considered richer compared to the less taxonomically diversity community.

3. ECOSYSTEM DIVERSITY:

- Includes all the spp + all the abiotic factors characteristic of a region.
- For ex. A desert ecosystem has soil, temp., rainfall patterns, and solar radiation that affect not only what spp occur there, but also the morphology, behavior and the interactions among those spp.
- Describes the no. of niches, trophic levels and various ecological processes that sustain energy flow, food webs and the recycling of nutrients.
    - **Species abundance** refers to the number of individuals of a particular species found within a defined area or habitat. It's a key component of biodiversity, alongside species richness and diversity, and helps ecologists understand how ecosystems function. Abundance can be measured as the absolute number of individuals or as a proportion relative to other species in the community.
    - Species richness is simply the total number of different species in a given area, while species abundance focuses on the number of individuals within each of those species. For example, a forest might have high species richness if it contains many different tree species, but the abundance of each tree species might vary significantly.

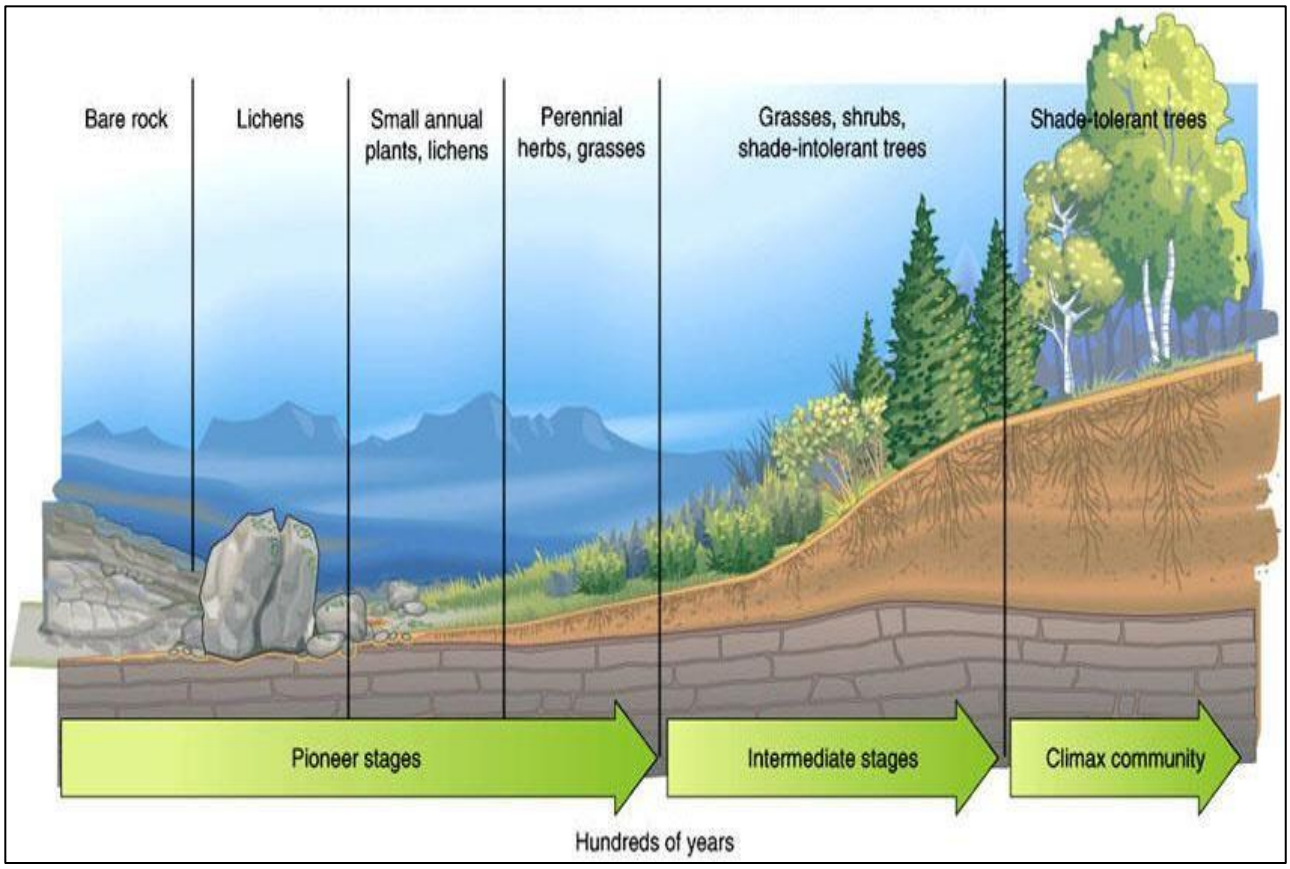
      Understanding species abundance is crucial for several reasons:
    - Ecosystem Functioning: Species abundance data can reveal insights into how different species interact, such as competition or predation.
    - Biodiversity Assessment: Abundance, alongside richness and diversity, helps assess the health and stability of ecosystems.
    - Conservation Efforts: Knowing which species are abundant or rare helps prioritize conservation efforts and manage threatened or endangered species.
    - Community Structure: Patterns in species abundance can indicate how communities are organized and structured within an ecosystem.
    - **Ecological Succession**: “the orderly changes in community structure and function in an ecosystem with time mediated through the modifications in

physical environment ultimately leading to a stable community over that area." It has following properties-

- ❖ It is an orderly process of changes in species structure and function with time within a community. It is a directional and continuous process and thus, predictable.
- ❖ It is a natural process and results from modifications in physical environment by the community species. These modifications may be brought by continuing struggle among species for physical factors (light and space) and resources for survival (energy and nutrients). Thus, the succession is a community controlled process even though the modifications in physical environment determine the patterns, rate of changes and development during the process.
- ❖ It involves either change in abundance of dominant species or a complete replacement of species from immature to more mature and stable communities over a period of time.
- ❖ It culminates in a stable ecosystem with a dominant species known as **climax** which is in more or less equilibrium with the surrounding environment.
- ❖ The entire sequence of communities that replace one another in a given area is called as **sere** and the transitory communities are called as **seral stages** such as grass stage, herb sage, shrub stage, etc.
- ❖ The initial stage is called **pioneer** stage and is characterized by early successional pioneer plant community. The last or terminal stage is known as **climax**. The pioneer community may be replaced more easily by the next seral stage where as climax community is considered as more mature and stabilized stage of ecosystem.
- ❖ **Primary Succession** starts in a newly formed area where environmental conditions are elementary, such as a bare area formed by lava flow, a new pond created by a landslide, sand dunes formation or bare rock surface formed by the retreating glaciers.
- ❖ **Secondary succession** starts in an area previously occupied by a community, but now devegetated by some natural or human activities like fire, storms, tree cutting, disease outbreak, cultivation, biotic interventions, etc. After several years, some new community again occupies that area. It is called

secondary succession.

- After the succession has begun, sometimes the community itself modifies its own environment which becomes unsuitable for that community, and its own replacement by new community takes place. This type of succession is known as **autogenic succession**, as it is self-made succession. In some cases, the replacement of existing community takes place due to some external force (e.g., fire or human activities) and not by the existing community. This is called as **allogenic succession**.



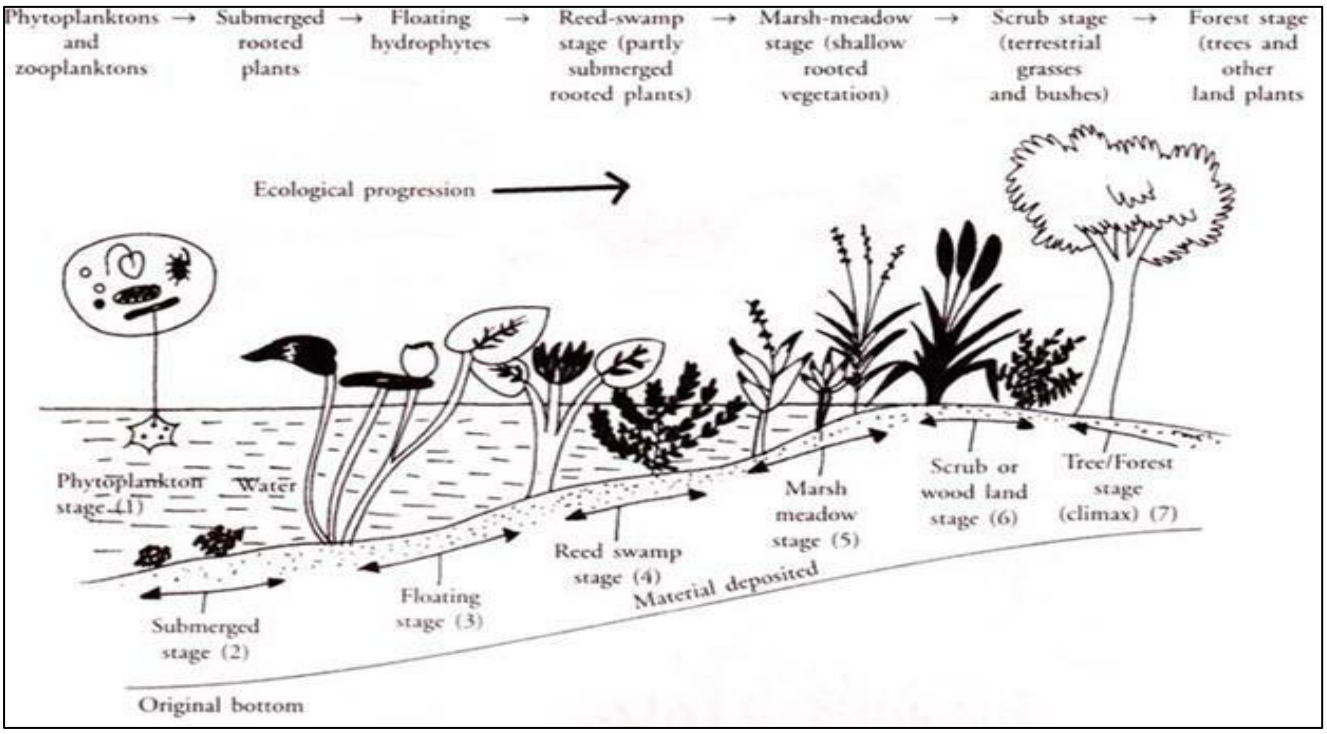
Hydrosere

Hydrosere is the ecological succession which occurs in a water body like pond, pool or lake. In a newly formed pond (e.g. due to a landslide), the process starts with the colonization of phytoplanktons, the pioneer community and through a number of intermediate seral stages, finally reaches a forest as climax community. The whole process of hydrosere from an open water body to a forest may take place at least two hundred years (probably much longer). Changes

occur both in plant community as well as in animal community during the course of succession.

1. **Plankton Stage**

The pioneer colonizers of the hydrosere include phytoplanktons like bluegreen algae (Cyanobacteria), green algae (e.g., *Spirogyra, Oedogonium*) and diatoms. This community begins when spores of phytoplanktons reach the site through air or animals. They are then consumed by zooplanktons like protozoans (e.g., *Amoeba, Paramecium, Euglena*, etc.) and fishes such as blue gill fish, sun fish etc.



2. **Rooted submerged stage**

The soft nutrient-rich mud at the bottom of pond now becomes suitable habitat for the growth of rooted hydrophytes like *Myriophyllum, Elodea, Hydrilla, Potomogetan, Vallisneria, Utricularia* etc. These submerged plants have roots at bottom and remaining portion in water.

3. **Floating stage**

Now rooted hydrophytes like *Nelumbo, Trapa, Nymphaea, Limnanthemum, Monochoria,* etc. with their large leaves floating on the water surface colonize the

habitat with their rhizomes. The habitat changes chemically as well as physically. The dead remains of plants are deposited at the bottom. The water depth in the pond decreases due to evaporation of water and deposition of organic matter, as a result, the concentration of the nutrients increases. Some free-floating species such as *Azolla, Lemna, Wolffia, Pistia, Spirodella, Salvinia,* etc. also become associated with rooted plants.

4. **Reed-swamp stage-** Pond margins, because of good environmental conditions of high moisture, enough light and aeration soon gets covered by emergent hydrophytes such as *Scirpus, Typha, Sagittaria and Phragmite.* Although their root system is completely under water and anchored in soil but their shoots are partly or completely exposed to air, so are like amphibian plants. They have well developed rhizome and form very dense vegetation. These plants start from margins and then cover the pond. They facilitate considerable decrease in water level resulting in change in substratum which in turn change the aquatic habitat into marshy land or swamp. This stage is often known as 'Red swamp stage'.

5. **Sedge-meadow stage-**

Further decrease in water level changes the nature of substratum. Species of some Cyperaceae and Gramineae such as *Carex, Juncus, Cyperus and Eleocharis* colonise the area.

6. **Woodland stage**

As the area is becoming dry due to exposure to sun, terrestrial plants like shrubs (*Salix, Cornus*) and trees (*Alnus, Populus*) form open vegetation or woodland. These plants can tolerate bright sunlight as well as water logged conditions. They cast the shade and make the area drier due to rapid transpiration. By this time, the area is rich in humus with rich flora of microorganisms, thus the conditions favour the arrival of new tree species.

7. **Forest stage**

Many trees whose seedlings are shade loving invade the area. They cover the whole area when they grow and develop. This is the climax community. Depending upon the climate, the climax will be rain forest, temperate forest or tropical forest. In tropical climate, with heavy rainfall, there develop tropical rain

forests. In temperate regions, mixed forest of *Ulmus, Acer and Quercus* are formed. Thus, an area once under the deep water gets finally converted into a forest.

MCQ based on Unit III

Q. 1. What is the term for a group of interacting species living in the same geographic area?

a.Population
b. Ecosystem
c. Community
d. Biome
Answer: c

Q. 2. Which of the following is NOT a characteristic of a community?

a. Species diversity
b. Trophic structure
c. Population density
d. Interactions between species
Answer: c

Q. 3. What is an ecotone?

a. A large area with similar climate and vegetation
b. A transition zone between two communities
c. A single, isolated population
d. A type of keystone species
Answer: b

Q. 4. Which of the following best describes niche partitioning?

a. Two species competing for the same resources
b. Different species using the same resources in different ways

c. Species helping each other survive

d. One species negatively affecting another

Answer: b

Q. 5. What is a keystone species?

a. A species that is very abundant in a community

b. A species that has a large impact on community structure

c. A species that is only found in one location

d. A species that is recently introduced to a community

Answer: (b)

Q. 6. The following statements represents possible outcomes of competition between two species-

1. Expansion of fundamental niche of both species

2. Character displacement between species

3. Expansion of realized niche of both species

4. Niche differentiation between species

Which one of the following option represents the correct set of possible outcomes?

a. 2 and 4
b. 2 and 3
c. 4 and 1
d. 1 and 3

Answer- a

Q. 7. Alien species experience ……. When introduced to a new ecosystem?

a. Character displacement

b. Exponential Growth

c. Secondary Succession

d. Extinction

Answer. C

Q. 8. Monogamy in sexually reproducing animals is seemingly paradoxical given that males must maximize their number of matings for higher fitness. Yet, many birds are known to be monogamous. Which one of the following statement represents a scenario where monogamy in birds is least likely to evolve?

a. Mates are scattered and hard to find

b. Males guard females after mating with them

c. Offspring do not require elaborate parental care

d. Poor quality of habitat wherein resources are hard to find.

Answer. C

Q. 9. Nearly, 25% of all insect species are known to be herbivores. Yet, in spite of such heavy herbivore pressure, globally green plants tend to persist, contributing to a green Earth. Which of the following account for the relative success of green plants?

1. Herbivore Insect densities are kept low by predator

2. Herbivore insects are inefficient feeders

3. Plants secrete herbivore deterrent chemicals

a. 1 and 3

b. 1 only

c. 1 and 2

d. 2 only

Answer. A

Q. 10. Which of the following characterizes natural communities under equilibrium?

a. Large Stochastic effects

b. Biotic decoupling

c. Density dependence

d. Species dependence

Answer. C

Q. 11. Annual weeds of arable lands are classified as

a. Therophytes

b. Geophytes

c. Chameophytes

d. Phonerophytes

Answer. A

Q. 12. Ruderal species are those which are found in the environments with

a. low disturbance, low competition

b. high disturbance, low competition

c. Low disturbance, high competition

d. high disturbance, high competition

Answer. B

Q. 13. Species serving as a proxy for entire communities and ecosystem, so that the entire system is conserved if they are conserved, are known as-

a. Umbrella species

b. Flagship species

c. indicator species

d. Keystone species

Answer. A

Q. 14. Which of the following statements is incorrect about a keystone species?

a. Removing a keystone spp. can effect successive trophic levels causing a trophic cascade

b. Removing a keystone spp can reduce spp. richness of a community

c. keystone spp has influence on a community proportionate to its abundance

d. spp other than consumers can be a keystone spp.

Answer. C

Q. 15. Species richness can be measured with the-

a. Number of spp in an area

b. Number of Genus in an area

c. Density of spp in an area

d. Abundance of spp in an area

Answer. a

Q. 16. Which of the following best defines biodiversity?

a. The variety of ecosystems in a region

b. The number of species in a specific area

c. The diversity of life forms on Earth

d. The genetic variation within a species

Answer: c

Q. 17. Which region is known for having the highest biodiversity in the world?

a. Arctic Tundra

b. Amazon Rainforest

c. Sahara Desert

d. Australian Outback

Answer: b

Q.18. Which of the following ecosystems typically has the highest species diversity?

a. Coral reefs

b. Deserts

c. Grasslands

d. Boreal forests

Answer: a

Q.19. Which factor does NOT directly contribute to the loss of biodiversity?

a. Habitat destruction

b. Climate change

c. Species introduction

d. Genetic diversity

Answer: d

Q. 20. Which of the following is a biodiversity hotspot?

a. Antarctica

b. The Himalayas

c. Mediterranean Basin

d. Greenland

Answer: c

Q. 21. What is the primary cause of the current high rates of species extinction?

a. Natural selection

b. Human activities

c. Volcanic eruptions

d. Meteor impacts

Answer: b

Q. 22. Which term describes the variety of genes within a particular species?

a. Species diversity

b. Genetic diversity

c. Ecosystem diversity

d. Functional diversity

Answer: b

Q. 23. Which of the following best describes an endemic species?

a. A species found in multiple regions

b. A species restricted to a particular area

c. A migratory species

d. A species that has gone extinct

Answer: b

Q. 24. Which of the following biomes is known for having low biodiversity?

a. Tropical rainforest

b. Desert

c. Savanna

d. Temperate forest

Answer: b

Q.25. Which type of biodiversity refers to the diversity of habitats, communities, and ecological processes?

a. Species diversity

b. Genetic diversity

c. Ecosystem diversity

d. Functional diversity

Answer: c

Q.26. Which of the following is the primary cause of habitat destruction, a major threat to biodiversity?

a. Natural disasters

b. Industrial agriculture

c. Conservation efforts

d. Ecotourism

Answer: b

Q.27. Which of the following invasive species is known to cause significant harm to native biodiversity in the Great Lakes of North America?

a. Zebra mussels

b. Monarch butterflies

c. American alligators

d. Bald eagles

Answer: a

Q.28. Which of the following best describes overexploitation as a threat to biodiversity?

a. Introducing non-native species to an area

b. Harvesting species at rates faster than they can reproduce

c. Planting large-scale monoculture crops

d. Protecting endangered species from hunting

Answer: b

Q. 29. How does climate change pose a threat to biodiversity?

a. By decreasing the genetic diversity within species

b. By altering habitats and making them unsuitable for certain species

c. By increasing the population of endangered species

d. By promoting the growth of native species

Answer: b

Q. 30. Which of the following is a major consequence of pollution on biodiversity?

a. Increased biodiversity in polluted areas

b. Disruption of food chains and ecosystems

c. Creation of new species through mutation

d. Enhanced growth of coral reefs

Answer: b

Q. 31. Which human activity is most directly linked to deforestation, a significant threat to biodiversity?

a. Mining

b. Urbanization

c. Logging and land clearing for agriculture

d. Recreational fishing

Answer: c

Q. 32. Which of the following is an example of how invasive species can threaten biodiversity?

a. By reducing the genetic diversity of native species

b. By improving soil fertility in degraded lands

c. By creating new ecosystems

d. By controlling the population of native predators

Answer: a

Q. 33. Which of the following is a threat to marine biodiversity caused by human activities?

a. Ocean acidification due to increased CO2 emissions

b. Preservation of coral reefs

c. Expansion of protected marine areas

d. Overfishing in freshwater lakes

Answer: a

Q.34. Which of the following contributes to the loss of biodiversity through habitat fragmentation?

a. Construction of roads and urban areas

b. Natural forest fires

c. Global climate treaties

d. Reforestation projects

Answer: a

Q. 35. What is a common impact of poaching on biodiversity?

a. Increase in the population of endangered species

b. Decrease in genetic diversity due to the loss of key species

c. Restoration of degraded habitats

d. Improvement in local ecosystems

Answer: b

Q.36. Which international agreement aims to ensure that international trade in wild animals and plants does not threaten their survival?

a. Kyoto Protocol

b. CITES (Convention on International Trade in Endangered Species)

c. Paris Agreement

d. Montreal Protocol

Answer: b

Q.37. What is the primary goal of the Endangered Species Act (ESA) in the United States?

a. To promote commercial fishing

b. To protect and recover imperiled species and the ecosystems upon which they depend

c. To regulate air and water pollution

d. To manage national parks

Answer: b

Q. 38. Which of the following is a key principle of the Convention on Biological Diversity (CBD)?

a. Exploiting natural resources for economic gain

b. Sustainable use of biological diversity

c. Elimination of all non-native species

d. Promotion of monoculture farming

Answer: b

Q.39. Which global conservation strategy focuses on protecting areas that are home to a large number of endemic species under threat from human activities?

a. Biodiversity hotspots

b. Global warming mitigation

c. Carbon trading

d. Urbanization

Answer: a

Q.40. Which policy is specifically aimed at reducing deforestation and forest degradation in developing countries?

a. REDD+ (Reducing Emissions from Deforestation and Forest Degradation)

b. Ramsar Convention

c. Basel Convention

d. World Heritage Convention

Answer: a

Q.41. What is the purpose of establishing Marine Protected Areas (MPAs)?

a. To promote commercial shipping routes

b. To conserve marine ecosystems and biodiversity

c. To increase tourism revenue

d. To expand fishing operations

Answer: b

Q.42. Which international treaty focuses on the protection of wetlands of international importance, particularly as habitats for waterfowl?

a. Ramsar Convention

b. Cartagena Protocol

c. Bonn Convention

d Vienna Convention

Answer: a

Q.43. Which conservation policy tool involves the protection of species by creating corridors between isolated habitats to allow movement and gene flow?

a. Wildlife corridors

b. Invasive species management

c. Carbon offsets

d. Selective logging

Answer: a

Q.44. What is the primary objective of the European Union's Natura 2000 network?

a. To promote industrial development

b. To protect Europe’s most valuable and threatened species and habitats

c. To subsidize agricultural production

d. To manage urban growth

Answer: b

Q.45. Which of the following is an economic tool used in conservation to encourage the protection of biodiversity?

a. Tax incentives for conservation easements

b. Penalties for non-compliance with environmental laws

c. Subsidies for fossil fuel industries

d. Grants for deforestation

Answer: a

Q. 46. Which of the following best describes ecological succession?

a. The sudden and drastic change in an ecosystem due to a natural disaster.
b. The gradual and predictable change in the species composition of a community over time.
c. The rapid growth of a single species in a new environment.
d. The complete extinction of all species in a given area.
Answer: b

Q.47. What is the term for the first community to colonize a new, barren habitat?

a. Climax community
b. Seral community
c. Pioneer community
d. Transitional community
Answer: c

Q.48. Which type of succession occurs on a site that has previously supported life?

a. Primary succession
b. Secondary succession
c. Tertiary succession
d. Quaternary succession
Answer: b

Q. 49. Which of the following is an example of primary succession?

a. A forest recovering after a fire.
b. A sand dune forming and being colonized by plants.
c. A field being ploughed and then left fallow.
d. A lake becoming a marsh.
Answer: b

Q.50. What is the final, stable community in ecological succession called?

a. Seral community
b. Pioneer community
c. Climax community
d. Transitional community
Answer: c

Q.51. Which of the following is a characteristic of ecological succession?

a. It is a random and unpredictable process.
b. It always leads to the dominance of a single species.
c. It involves changes in both the living (biotic) and non-living (abiotic) components of the ecosystem.
d. It occurs at the same rate in all ecosystems.
Answer: c

Q. 52. What role do pioneer species play in primary succession?

a. They are the last to colonize the area.
b. They are only found in aquatic environments.
c. They help create soil and make the environment more suitable for other species.
d. They outcompete all other species for resources.
Answer: c

Q.53. Which of the following is NOT a factor that can initiate ecological succession?

a. Volcanic eruption
b. Glacier retreat
c. Forest fire
d. Stable climate
Answer: d

Q. 54. What is the term for the gradual process of change in an ecosystem?

a. Evolution
b. Competition
c. Ecological succession
d. Adaptation
Answer: c

Q.55. In a hydrosere, which of the following would typically be found in the later stages?

(a) Phytoplankton
(b) Floating plants
(c) Submerged plants

(d) Trees and shrubs

Answer: (d)

Q. 56. In ecological succession, the intermediate developmental phase is known as

a. ecesis

b. climax

c. nudation

d. sere

Answer: d

Q. 57. This is true about secondary succession

a. follows primary succession

b. takes place on a deforested site

c. is similar to primary succession except that it has a relatively slower pace

d. begins on a bare rock

Answer: b

Q. 58. Lithosphere serves as a reservoir for

a. nitrogen cycles

b. carbon cycles

c. oxygen cycles

d. phosphorus cycles

Answer: d

Q. 59. This is not a climax vegetation

a. grasses

b. savannah

c. forests

d. hydrophytes

Answer: d

Q. 60. This about ecological succession is incorrect

a. food chain relationships become more complex

b. species diversity increases as succession proceeds

c. role of decomposers becomes all the more important

d. is a random process

Answer: d

Q. 61. An example of plants occupying the second stage of hydrosere is

a. *Salix*

b. *Vallisneria*

c. *Azolla*

d. *Typha*

Answer: b

Q.62. On the sand, ecological succession is

a. halosere

b. xerosere

c. hydrosere

d. psammosere

Answer: d

Q. 63. Order of basic processes involved in succession is

a. invasion -> stabilization -> completion and coaction -> reaction -> nudation

b. nudation -> stabilization -> completion and coaction -> invasion -> reaction

c. invasion -> nudation -> completion and coaction -> reaction -> stabilization

d. nudation -> invasion -> completion and coaction -> reaction -> stabilization

Answer: d

Q. 64. Process of the successful establishment of species in a new area is known as

a. climax

b. sere

c. ecesis

d. invasion

Answer: c

Q. 65. In ecological succession, the final stable community is known as

a. climax community

b. ultimate community

c. final community

d. seral community

Answer: a

Unit IV

Environmental Hazards

- Sources of Environmental hazards
- Climate changes
- Greenhouse gases and global warming
- Acid rain, Ozone layer destruction

Sources of Environmental hazards

- Our environment generally consists of physical, chemical and biological factors and our relationship with our environment is always interactive. This means that we affect our environment and our environment affects us. These interactions may expose us to **environmental health hazards**; that is any environmental factors or situations that can cause injury, disease or death.
- It is worth pausing here to clarify the difference between hazard and risk. A **hazard** is something which is known to cause harm, that is, a source of danger to health. **Risk** is the likelihood or probability of the hazard occurring and the magnitude of the resulting effects. For example, if you climb a ladder you know there is a chance you could fall off and be injured, although it is unlikely. The ladder is the hazard and the chance of injury is the risk you take by climbing the ladder.
- Hazards are generally categorized as follows:

1. Physical hazards
2. Biological hazards
3. Chemical hazards
4. Cultural/practice-related hazards
5. Social hazards

- **Physical hazards** are those substances or conditions that threaten our physical safety. Fires, explosive materials, temperature (hot or cold), noise, radiation, spills on floors and unguarded machines are some examples of physical hazards.

- **Biological hazards** are organisms, or by-products from an organism, that are harmful or potentially harmful to human beings. They include pathogenic bacteria, viruses and parasites, and also toxins (poisons) that are produced by organisms. Biological hazards are the cause of the majority of human diseases. For example, bacteria cause cholera, tuberculosis, leprosy, relapsing fever and many diarrhoeal diseases; viruses are responsible for hepatitis B and C, HIV, measles and polio; and there are many diseases caused by parasites.
- A *parasite* is any organism that lives on or in another organism, called the host, and causes damage, ill health or even death to the host. Some human parasites are external and live on the skin and hair, for example, mites that cause scabies. Internal parasites, living inside the body, include protozoa and helminths.

- **Chemical hazards** are present when a person is exposed to a harmful chemical at home or at work. The chemicals can be in the form of gases, solids or liquids. Exposure to chemicals could cause **acute health effects** (an immediate or rapid onset) if taken in large quantities in a single dose; and **chronic health effects** (long-term effects on health) if taken in small doses over an extended time. Detergents (powdered soap, bleaching powder), drugs (veterinary and human) and pesticides (DDT, malathion, diazinon, zinc phosphide, warfarin) are chemical hazards that are commonly found in rural households (Figure 2.3). Farmers, young children (under 5 years) and household animals are vulnerable to chemical exposure, but it is always possible that anyone might come into contact with the chemical during preparation, spraying, use or storage. A person is exposed to chemicals through various ways: through inhaling the vapours, gases or dusts; through skin contact with solvents, acids and alkalis; and through ingestion of unknown chemicals with food and water.
- Culture is the knowledge, belief, art, law, morals, customs and habits that are acquired by people as members of society. It is also the common ways of life and set of thoughts and feelings shared by the members of a society. Just as there are cultural practices that are good for health, such as breastfeeding a child, there are also cultural practices that adversely affect health and these

can be considered to be **cultural hazards**. There are practices that are widely accepted and found in different areas of Ethiopia that can be hazards for health; for example, the belief that evil spirits are the source of diseases, practices of storing drinking water uncovered, open defecation and not handwashing before meals and after latrine use.

- Poverty and illiteracy are examples of **social hazards**. We know that poor and uneducated people get sick more frequently, compared to wealthier and more educated people. Alcoholism, obesity, smoking and drug abuse are also social hazards that affect our health. A person with such habits is, over time, degraded, not respected by society, physically and mentally dissatisfied, and ultimately is likely to suffer with chronic illnesses such as lung and cardio-vascular diseases.
- **Climate change** is a broad term used to refer to changes in the Earth's climates, at local, regional, or global scales, and can also refer to the effects of these changes. In recent decades, the term 'climate change' is most often used to describe changes in the Earth's climate driven primarily by human activity since the pre-Industrial period (c. 1850 onwards), particularly the burning of fossil fuels and removal of forests, resulting in a relatively rapid increase in carbon dioxide concentration in the Earth's atmosphere.

Greenhouse and Greenhouse Effect

- A greenhouse is made up of glass walls and ceiling. Trees and plants are grown in it under controlled climatic conditions. Glass walls and ceiling are transparent to solar radiation, which are largely visible, so these are allowed to go into the greenhouse. Greenhouse does not allow most infrared radiation to go out, resulting its warming. The atmospheric gases which behave like glass walls and do not allow the infrared radiation released by Earth to go out to space are called greenhouse gases.
- Likewise, atmosphere is transparent to solar radiation, so these radiation reach Earth surface and heat it. The infrared radiation emitted by Earth are not allowed by greenhouse gases, viz., CO_2, water vapors, methane, etc., to go out, resulting in the warming of the atmosphere. This is greenhouse effect.

Solar and Terrestrial Spectra

- To understand how and why the greenhouse gases are transparent to solar radiation and opaque to infrared radiation, it is necessary to understand the solar and terrestrial radiation spectra and the absorption of solar radiation and their re-emission by Earth.

Solar Radiation Spectrum

Sun acts as a good black body with a surface temperature of about 5800 K. Important characteristics of Solar Spectrum are as follows:

1. Solar radiation peaks in the wavelength range 400 - 700 nm.
2. Maximum radiation are of >500 nm.
3. Nearly half the radiation are of >700 nm.
4. Only a small fraction is in the UV range <400 nm.
5. The radiation flux at sea - level is lower than that at top of the atmosphere due to reflection by clouds etc.
6. Major absorbers of UV radiation are O_2 and O_3 in the upper atmosphere. Water vapors along with other greenhouse gases are major absorber of IR.
7. Absorption is 100% efficient in UV region by electronic transitions of O_2 and O_3 in upper atmosphere.
8. Atmosphere is largely transparent to visible radiation because energy is too low for electronic transitions and too high for vibrational transitions.

Terrestrial Radiation Spectrum

Earth also behaves as a blackbody and some important characteristics of terrestrial radiation spectrum are as follows:

1. The radiation spectrum is a combination of black body spectra of different temperature ranging from 220-320^{o}C.
2. The wavelength range of maximum emission is 5000-20000 nm. The absorption of terrestrial spectrum (IR) is almost 100% efficient due to greenhouse gases, except at a window between 8000 to 13000 nm near the peak of terrestrial radiation. This *atmospheric window* allows the direct escape of radiation from the surface of the earth to space.

Radiation Balance of Earth and Its Atmosphere

- The temperature of Earth's surface and atmosphere is maintained by global energy

balance between the incoming short wave radiation from the sun, known as solar radiation, and the outgoing long wave radiation, called as infrared, thermal and terrestrial radiation. The incoming solar radiation at the top of atmosphere (TOA) is 342 W m^{-2} (where W = J s^{-1}). For the sake of simplicity, assuming 342 Wm^{-2} equal to 100 units, in percentage terms the energy balance can be explained as follows.

- ❖ The total 100 units of energy, received at the top of atmosphere, is appropriated as follows:

1. About 9 units are reflected back by Earth's atmosphere.
2. About 49 units are absorbed by Earth's surface.
3. About 22 units are reflected back into space by clouds, aerosols and gases.
4. About 20 units are absorbed by the atmosphere.

Greenhouse Gases and Their Sources

- ❖ The relative GWP values show the main greenhouse gases to be CO_2, CH_4, N_2O and CFCs . It may be pointed out that water vapor is an important greenhouse gas, but is not considered because human activities have little control or contribution to its atmospheric concentration. The sources of other gases are described below.

1. **Carbon Dioxide, CO_2**

CO_2 has largest amount in atmosphere among all greenhouse gases. The major obvious manmade contribution is the combustion of fossil fuels. Deforestation is another. The trees and plants work as carbon bank by storing carbon. The biological processes release CO_2 and fortunately, this amount is balanced by photosynthesis. It is in equilibrium with oceans, which absorb and release it. Human activities have led to net increase in CO_2 level. Beginning with industrial revolution, there is a rising trend in its concentration since 19th century. Since 1957, it is being continuously measured at Mauna Loa, Hawaii(USA). The estimated CO_2 concentration is ~ 280 ppm before the industrial revolution. On May 10, 2013, NOAA & Scripps first reported daily averages that temporarily reached 400 ppm.

2. **Methane CH_4**

Methane is continuously rising since the later part of 20th century, primarily due to increase in number of cattle and paddy fields. Methane is released by ruminants as stomach gas. In water -filled paddy fields, anaerobic biodegradations release methane. Municipal waste disposal landfills and coal- mines are other important sources.

3. **Nitrous Oxide, N2O**

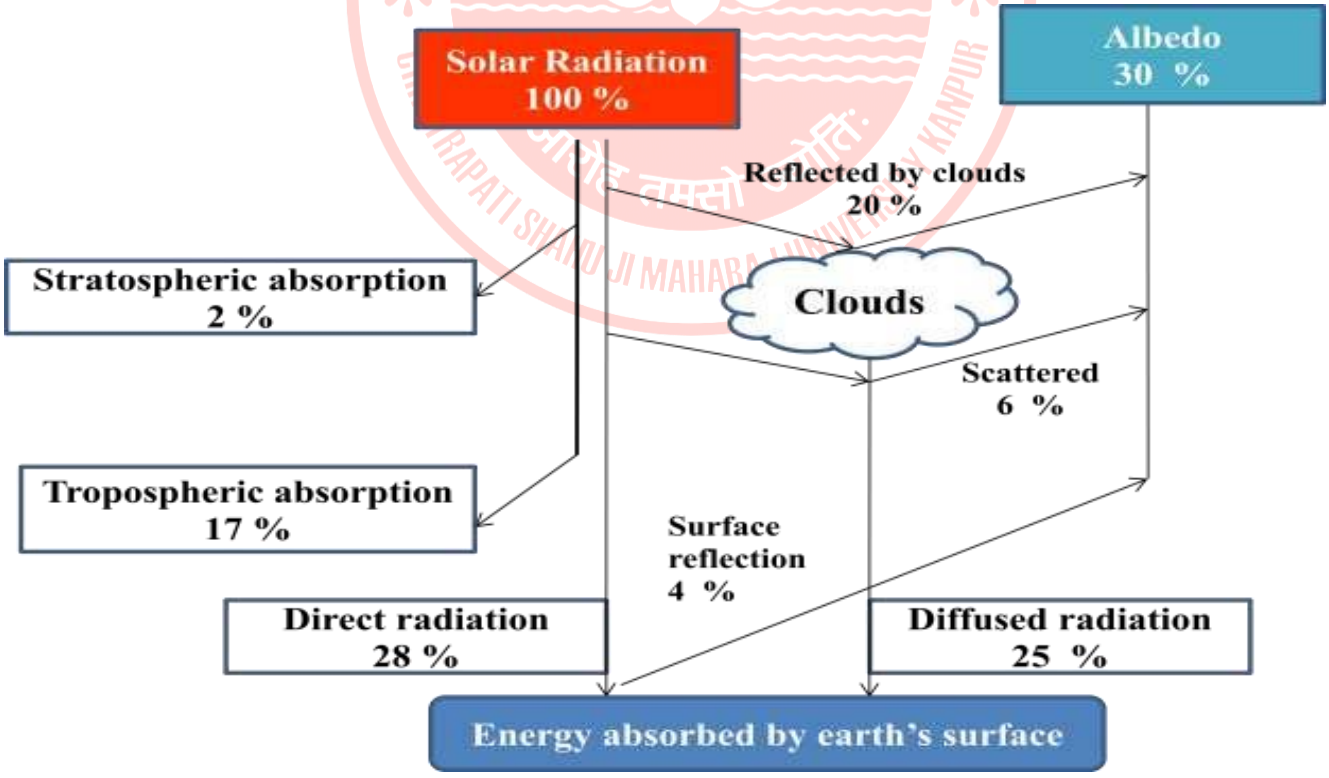
The microbiological processes in soil and ocean are the main sources. Increased use of nitrogen –based fertilizers is believed to be another cause. Other sources are change in agricultural practices and industrial manufacture of nylon.

4. **Chlorofluorocarbons, CFCs**

These are manmade compounds and there is no known natural source. These are inert and non-toxic and have a long lifetime of about 100 years. Since their synthesis in1930s, these are widely used as coolant, insulator in refrigeration, blowing agents in foams, in cleaning of electronic equipment, and propellants for aerosols. There is no removal mechanism for these in troposphere, so their concentration has continued to increase and some of it passed into stratosphere leading to ozone depletion.

5. **Tropospheric ozone and the greenhouse effect**

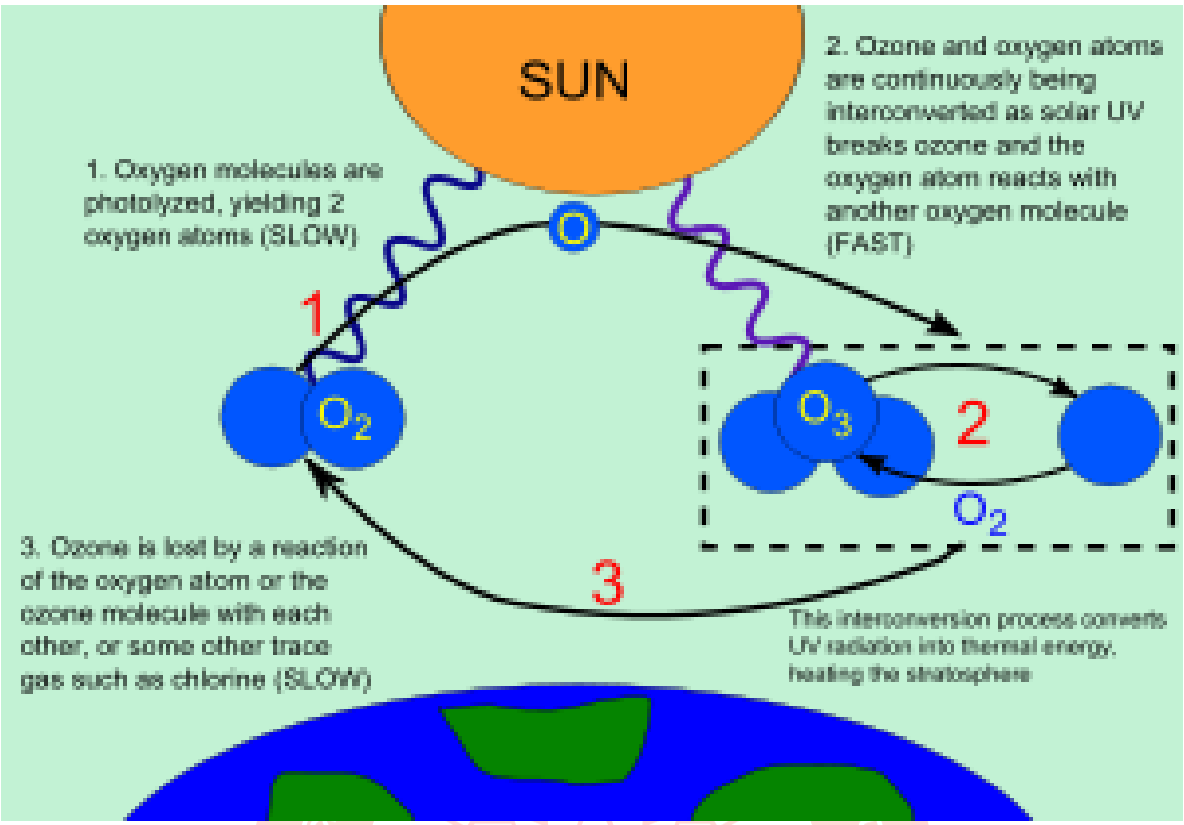
Tropospheric ozone contributes to the greenhouse effect. According to the 4th IPCC assessment report(2007), it is the third main greenhouse gas after CO_2 and CH_4, because of its radiative forcing of 0.35 W / m^2 (IPCC, 2007). The global warming due to climate change is helpful in tropospheric ozone formation.



- The term **acid rain** is often used as an overall expression for the wet deposition processes including rain, fog, dew and snow, although the actual meaning of

acid rain is the wash out of trace substances by rain events (Brands and van Eldik, 1995). Its is better to use the term acid precipitation, which includes all kinds of wet depositions. Dry acid deposition is generally not noticed and monitored, but it is also responsible for the effects caused by acid rain phenomenon. Now, the term acid deposition is used to describe both wet and dry depositions (Brandt and van Eldik, 1995).

- **Ozone depletion** describes two distinct but related phenomena observed since the late 1970s: a steady decline of about 4% per decade in the total volume of ozone in Earth's stratosphere (the ozone layer), and a much larger springtime decrease in stratospheric ozone over Earth's polar regions. The latter phenomenon is referred to as the **ozone hole**. In addition to these well-known stratospheric phenomena, there are also springtime polar tropospheric ozone depletion events.
- The details of polar ozone hole formation differ from that of mid-latitude thinning, but the most important process in both is catalytic destruction of ozone by atomic halogens. The main source of these halogen atoms in the stratosphere is photo dissociation of man-made halocarbon refrigerants (CFCs, freons, halons). These compounds are transported into the stratosphere after being emitted at the surface. Both types of ozone depletion were observed to increase as emissions of halo-carbons increased.
- CFCs and other contributory substances are referred to as **ozone-depleting substances** (**ODS**). Since the ozone layer prevents most harmful UVB wavelengths (280–315 nm) of ultraviolet light (UV light) from passing through the Earth's atmosphere, observed and projected decreases in ozone have generated worldwide concern leading to adoption of the Montreal Protocol that bans the production of CFCs, halons, and other ozone-depleting chemicals such as carbon tetrachloride and trichloroethane. It is suspected that a variety of biological consequences such as increases in skin cancer, cataracts, damage to plants, and reduction of plankton populations in the ocean's photic zone may result from the increased UV exposure due to ozone depletion.



Chemicals in the atmosphere CFCs and related compounds in the atmosphere

- Chlorofluorocarbons (CFCs) and other halogenated ozone depleting substances (ODS) are mainly responsible for man-made chemical ozone depletion. The total amount of effective halogens (chlorine and bromine) in the stratosphere can be calculated and are known as the equivalent effective stratospheric chlorine (EESC).
- CFCs were invented by Thomas Midgley, Jr. in the 1920s. They were used in air conditioning/cooling units, as aerosol spray propellants prior to the 1980s, and in the cleaning processes of delicate electronic equipment. They also occur as by-products of some chemical processes. No significant natural sources have ever been identified for these compounds — their presence in the atmosphere is due almost entirely to human manufacture.
- As mentioned in the *ozone cycle overview* above, when such ozone-depleting chemicals reach the stratosphere, they are dissociated by ultraviolet light to release chlorine atoms. The chlorine atoms act as a catalyst, and each can break down tens of thousands of ozone molecules before being removed from the stratosphere. Given the longevity of CFC molecules, recovery times are

measured in decades. It is calculated that a CFC molecule takes an average of about five to seven years to go from the ground level up to the upper atmosphere, and it can stay there for about a century, destroying up to one hundred thousand ozone molecules during that time.

MCQ based on Unit IV

Q. 1. Which of the following is a major source of air pollution in urban areas?

a. Nuclear power plants
b. Industrial emissions
c. Volcanic eruptions
d. Agricultural activities

Answer: b

Q. 2. Which gas is a primary contributor to the greenhouse effect and global warming?

a. Oxygen
b. Nitrogen
c. Carbon dioxide
d. Hydrogen

Answer. C

Q.3. What is the main source of water pollution from agricultural activities?

a. Runoff of pesticides and fertilizers
b. Industrial discharge
c. Acid rain
d. Radioactive waste

Answer. a

Q. 4. Which of the following is a source of radioactive pollution?

a. Volcanic eruptions

b. Nuclear power plants

c. Deforestation

d. Sewage

Answer. b

Q. 5. What is a major source of noise pollution in urban areas?

a. Wind turbines

b. Traffic noise

c. Agricultural machinery

d. Forest fires

Answer. b

Q. 6. Which of the following is a natural source of environmental hazards?

a. Industrial waste

b. Volcanic eruptions

c. Deforestation

d. Mining activities

Answer. c

Q. 7. What is the primary cause of acid rain?

a. Ozone depletion

b. Burning of fossil fuels

c. Agricultural runoff

d. Deforestation

Answer: b

Q. 8. Which of the following is a source of land pollution?

a. Noise from airplanes
b. Industrial discharge into rivers
c. Improper disposal of solid waste
d. Radioactive fallout

Answer. c

Q. 9. What is a major source of methane emissions?

a. Solar panels
b. Livestock and landfills
c. Wind turbines
d. Hydroelectric dams

Answer. b

Q. 10. What is a major source of water pollution from human activities?

a. Volcanic eruptions
b. Industrial discharge
c. Forest fires
d. Earthquakes

Answer. b

Q. 11. Which of the following facts is incorrect?

a. Global warming is the rise in the average temperature of the earth's climate system
b. Eutrophication is observed in water bodies

c. The greenhouse effect is a natural phenomenon

d. Ozone is harmless to breathe

Answer: d

Q. 12. Areas that are under the influence of DDT may observe a decline in the population of birds. This is due to the fact that

a. Birds stopped laying eggs altogether

b. The eggs did not hatch

c. Predation of the eggs increased

d. None of the above.

Answer. b

Q. 13. Measuring BOD (biological oxygen demand) is primarily used for

a. Estimating the types of microbes

b. Determine the level of dissolved oxygen

c. Estimating the quantity of organic matter in sewage water

d. None of the above

Answer. c

Q. 14. Cosmic rays, such as gamma rays are a source of

a. Soil Pollution

b. Noise Pollution

c. Thermal Pollution

d. Radiation pollution

Answer. d

Q. 15. The primary agenda of the Kyoto protocol is

a. Regulation of hazardous wastes
b. Regulate the production of nuclear energy
c. Control anthropogenic sources of greenhouse gases
d. None of the above

Answer: c

Q. 16. The presence of _____ in a water body is an indicator of water pollution.

a. Zygosporangium
b. E. coli
c. *Deinococcus radiodurans*
d. None of the above

Answer. b

Q. 17. Eggshells of birds become unusually thin when exposed to the pesticides in their environment. The protein that gets affected is _____

a. Calmodulin
b. Cysteine
c. Serine
d. None of the above

Answer: a

Q. 18. Lichens are good bioindicators for

a. Environmental radiation
b. Soil pollution
c. Water and air pollution
d. None of the above

Answer: c

Q. 19. A moth having a speckled wing, able to blend into its background due to its dark colouration is called

a. Industrial melanism
b. Adaptation
c. Predation
d. Evolution

Answer. a

Q. 20. Carbon dioxide is primarily called a greenhouse gas because

a. Traps heat
b. Traps light
c. Traps warm currents
d. None of the above

Answer. a

Q. 21. *Trichoderma harzianum* is a _____ that is predominantly used as a fungicide

a. Virus
b. Fungus
c. Bacteria
d. Protozoa

Answer. b

Q. 22. Greenhouse gases are those that absorb and emit infrared radiation. Examples include_____

a. Nitrogen
b. Ozone
c. Argon
d. None of the above

Answer. b

Q. 23. Depletion of the ozone layer is damaging to human health. Negative effects include

a. Skin cancers
b. Osteoporosis
c. Dyspepsia
d. None of the above

Answer. a

Q. 24. _____ is an organism used to gauge the quality of an ecosystem.

a. Decomposers

b. Predator

c. Bio-remediator

d. Bioindicator

Answer. d

Q. 25. _____ is a waste disposal method where solid organic wastes are converted to the residue and gaseous products through combustion.

a. Incarnation

b. Incineration

c. Incarceration

d. Incubation

Answer. b

Q. 26. These are features of higher energy level and shorter wavelengths

a. infrared radiation

b. alpha radiation

c. beta radiation

d. ultraviolet radiation

Answer: d

Q. 27. The normal greenhouse effect is essential for sustenance of life on Earth as it helps in maintaining the average temperature of the earth to

a. 15 ℃

b. 33 ℃

c. – 18 ℃

d. 50 ℃

Answer: a

Q. 28. The wavelength of infrared radiations is

a. shorter

b. longer

c. infinite

d. zero

Answer: b

Q. 29. Greenhouse gases present in a very high quantity is

a. ethane

b. carbon dioxide

c. propane

d. methane

Answer: b

Q. 30. Gas molecules absorbing thermal infrared radiation and present in large quantity to change the climate system is known as

a. ozone gases

b. beta radiations

c. alpha radiations

d. greenhouse gases

Answer: d

Q. 31. Burning of fossil fuels

a. increased oxygen level

b. increases greenhouse gases

c. decreases greenhouse gases

d. increased ethane level

Answer: b

Q. 32. This is the most potent greenhouse gas in terms of efficiency

a. N2O

b. CFC

c. C_2O

d. CH_4

Answer: b

Q. 33. This statement is false about the greenhouse effect

a. life on the earth is possible due to the greenhouse effect

b. the greenhouse effect is a natural process that maintains the earth's temperature

c. increased emission of greenhouse gases is a natural process

d. increased emission of greenhouse gases in the atmosphere increases earth's temperature

Answer: c

Q. 34. The one which is not considered as naturally occurring greenhouse gas is

a. CFCs

b. methane

c. carbon dioxide

d. nitrous oxide

Answer: a

Q. 35. The relative contribution of various greenhouse gases to total global warming will not be

a. CFCs – 14%

b. N_2O – 12%

c. Carbon dioxide – 60%

d. Methane – 20%

Answer: b

Q. 36. What are the primary gases that cause acid rain?

a. Carbon dioxide and carbon monoxide
b. Sulphur dioxide and nitrogen dioxide
c. Sulphur dioxide and nitrous oxide
d. Sulphur dioxide and carbon dioxide
Answer: b

Q. 37. Which of the following is NOT an effect of acid rain?

a. Damage to buildings and monuments
b. increased soil fertility
c. Harm to aquatic life
d. Respiratory problems in humans
Answer: b

Q. 38. What is the normal pH of clean rain?

a. 7
b. 5.6
c. 4
d. 10
Answer: b

Q.39. What is the term for the process of applying calcium and magnesium-rich substances to soil to neutralize acidity?

a. Liming
b. Flocculation
c. Filtration
d. Adsorption
Answer: a

Q. 40. What is the main cause of acid rain?

a. Natural phenomena like volcanic eruptions.
b. Burning of fossil fuels in power plants and vehicles.
c. Industrial emissions.
d. All of the above.
Answer: d

Q. 41. Which of the following is a wet deposition of acidic compounds?

a. Acid fog
b. Acid snow
c. Acidic aerosols
d. All of the above
Answer: b

Q. 42. What is the pH value considered as acid rain?

a. Less than 6.5
b. Less than 6.0
c. Less than 5.6
d. Less than 7.0
Answer: c

Q. 43. Which of the following is a dry deposition of acidic compounds?

a. Acid rain
b. Acid snow
c. Acidic aerosols
d. Acid fog
Answer: c

Q. 44. What happens to the Taj Mahal due to acid rain?

a. It becomes whiter

b. It turns yellow

c. It remains unaffected

d. It dissolves completely

Answer: b

Q. 45. What is the main impact of acid rain on aquatic life?

a. Increased fish population

b. Changes in water pH and toxicity, harming aquatic organisms

c. Increased algae growth

d. None of the above

Answer: b

Q. 46. Acid Rain is caused by emissions of

a. Sulphur dioxide

b. Nitrogen oxide

c. Both a and b

d. Carbon dioxide

Answer. c

Q. 47. Sulphur dioxide is produced by

a. Lightning strikes

b. Volcanic eruptions

c. Gasoline engine

d. All of the above

Answer. b

Q. 48. The adverse effect(s) of acid rain is(are)

a. Causing paint to peel

b. Corrosion of steel structures

c. Killing insects

d. All of the above

Answer. D

Q. 49. Liquids with a pH less than ___ are acidic

a. 10

b. 9

c. 8

d. 7

Answer. D

Q.50._____ and water in the air react together to form carbonic acid

a. Carbon monoxide

b. Carbon dioxide

c. Carbon

d. All of the above

Answer. b

Q. 51. Following is (are) the type(s) of acid deposition

a. Wet deposition

b. Dry deposition

c. Both a and b

d. Solid deposition

Answer. c

Q. 52. The hydronium ions of acid rain mobilizes toxins such as

a. Iron

b. Magnesium

c. Aluminium

d. All of the above

Answer. c

Q. 53. The acid rain leach away

a. Calcium

b. Magnesium

c. Both a and b

d. None of the elements

Answer. c

Q. 54. In cultivated, following may be added to increase the ability of the soil to keep the pH stable.

a. Iodine

b. Sodium

c. Limestone

d. All of the above

Answer. c

Q. 55. Acids in the rain react with the calcium compounds in the stones to create

a. Gypsum

b. Calcium carbonate

c. Calcium hydroxide

d. None of the above

Answer. a

Q. 56. Which of the following power station(s) produce sulphur dioxide

a. Coal firing power stations

b. Hydroelectric power plants

c. Nuclear power plants

d. All of the above

Answer. A

Q. 57. Which of the following is NOT a consequence of ozone layer depletion?

a. Increased ultraviolet radiation
b. Malignant melanoma (skin cancer)
c. Tides
d. Damage to cyanobacteria
Answer: c

Q. 58. What is the primary cause of ozone layer depletion?

a. Volcanic eruptions
b. Chlorofluorocarbons (CFCs)
c. Carbon dioxide emissions
d. Methane release
Answer: b

Q.59. Where is the ozone layer primarily located?

a. Troposphere
b. Stratosphere
c. Mesosphere

d. Thermosphere

Answer: b

Q. 60. Which international agreement aims to phase out ozone-depleting substances?

a. Kyoto Protocol

b. Paris Agreement

c. Montreal Protocol

d. Rio Declaration

Answer: c

Q. 61. What type of radiation does the ozone layer primarily absorb?

a. Infrared radiation

b. Ultraviolet radiation

c. Visible light

d. Microwaves

Answer: b

Q. 62. What is the name of the ozone-depleting substances used as refrigerants and in aerosols?

a. Nitrous oxides

b. Hydrocarbons

c. Chlorofluorocarbons (CFCs)

d. Sulfur dioxide

Answer: c

Q. 63. Which of the following is NOT an ozone-depleting substance?

a. Halons

b. Carbon tetrachloride

c. Hydrochlorofluorocarbons (HCFCs)

d. Methane

Answer: d

Q. 64. What is a consequence of increased UV radiation due to ozone depletion?

a. Decreased global warming

b. Improved crop yields

c. Increased risk of skin cancer

d. Increased cloud formation

Answer: c

Q.65. Which of the following is NOT a use of ozone-depleting substances?

a. Refrigeration

b. Aerosol propellants

c. Fire extinguishers

d Food preservation

Answer: d

Q. 66. What is the name given to the thinning of the ozone layer over the Antarctic?

a. Ozone hole

b. Ozone cloud

c. Ozone ring

d. Ozone wall

Answer: a

Q. 67. Montreal Protocol was signed in

a. 1986

b. 1987

c. 1988

d. 1989

Answer. B

Q. 68. Following is used as refrigerant in automobile

a. R-134a

b. R-134b

c. R-134c

d. All of the above

Answer. A

Q. 69. “International Day for the Preservation of the Ozone Layer” or “World Ozone Day” is celebrated on

a. September 16

b. September 18

c. October 16

d. October 18

Answer. a

Q. 70. Ozone depletion would magnify production of

a. Vitamin A

b. Vitamin B

c. Vitamin C

d. Vitamin D

Answer. d

Unit V

Effects of Climate Change

- Effect of climate change on public health
- Hazardous waste; Sources, types and their ill effects, Solid waste management, waste handling and disposal
- Management of Biomedical, Nuclear and Thermal waste
- Environmental disaster: Bhopal gas tragedy.

Effect of climate change on public health-

- A growing number of studies present evidence for the effects of observed climate change on vector borne and other infectious diseases. Although the literature to date does not constitute strong evidence of an impact of climate change on human vector-borne diseases (such as malaria), there is now evidence of vector species responding to recent climate change in Europe.
- There have been latitudinal shifts in ticks which carry Tick Borne Encephalitis in northern Europe but alternative explanations such as changes in con founding factors like land use or in socio-economic, demographic and other environmental factors remain plausible.
- **Heat waves** Mortality rises in hot weather, especially in elderly people. It is very likely that climate change will be associated with increases in the frequency of heatwaves. Much of the excess mortality from heatwaves is related to cardiovascular, cerebrovascular and respiratory causes and is concentrated in the elderly.
- **Infectious diseases-** Transmission of many infectious disease agents is sensitive to weather conditions, particularly those spending part of their lifecycle outside the human body. Pathogens that are carried by insects are exposed to ambient weather. Vector-borne diseases typically exhibit seasonal patterns in which the role of temperature and rainfall is well documented.
- **Some vector-borne diseases**, such as malaria, also display considerable year-to-year variation in some regions that can also be partly explained by climatic factors. Changes in climate that can affect the transmission of vector-borne infectious diseases include temperature, humidity, altered rainfall, soil

moisture and sea level rise. It is a complex task to determine how these factors may affect the risk of vector-borne diseases. The incidence and geo graphical distribution of vector-borne diseases are influenced by many demographic and societal, as well as climatic factors.

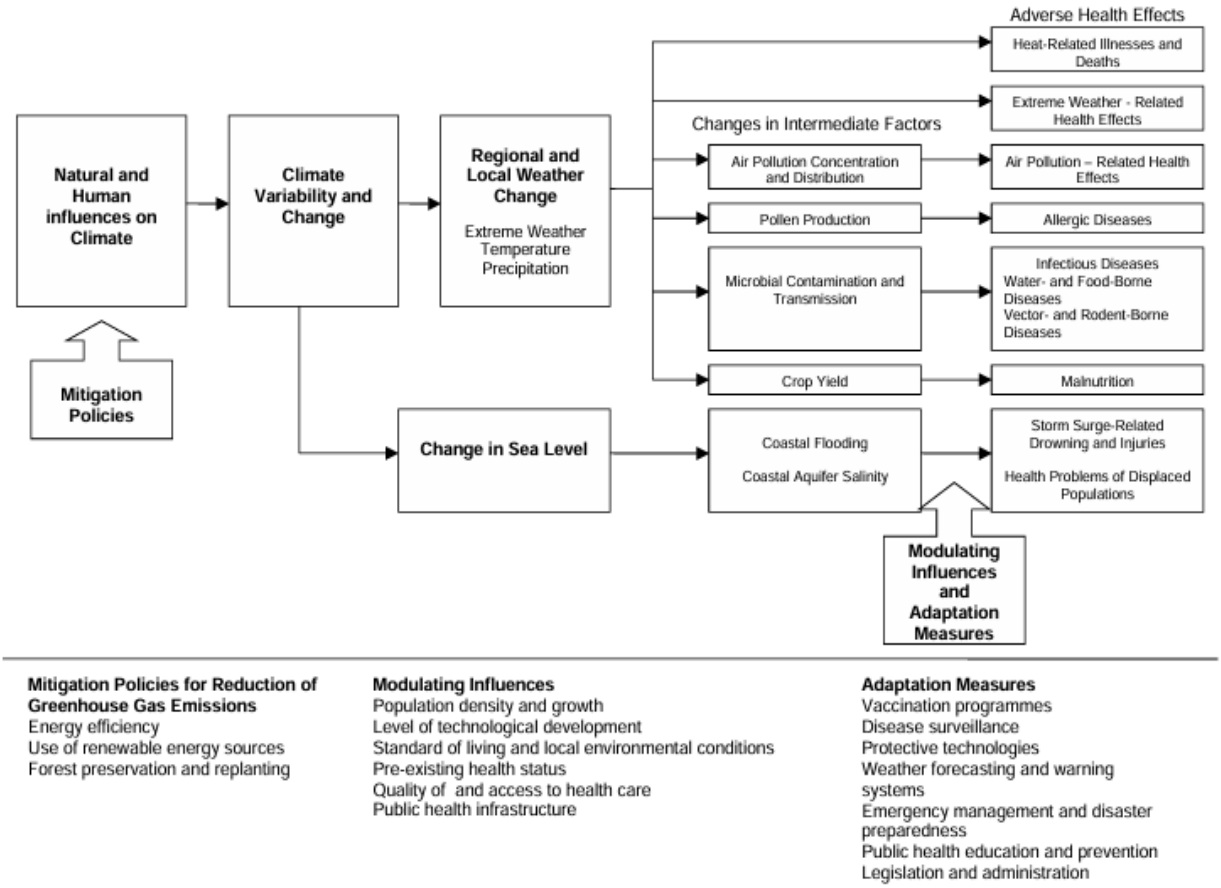
- ❖ Transmission requires that the reservoir host, a competent vector and the pathogen be present in an area at the same time, and in adequate numbers to maintain transmission. Global climate change could cause: increases or decreases in the overall incidence, and the duration of the transmission season, in particular sites. Small changes in seasonality may be important, as transmission rates tend to increase non-linearly in relation to the transmission season.
- ❖ Furthermore increases or decreases in the geographical distribution of disease transmission may occur, as climate-driven changes in vectorial capacity cause transmission to become unsustain able in previously endemic areas, or sustainable in previously non-endemic areas. Even small increases in disease distributions may mean that new populations are exposed. New populations often lack acquired immunity, which can result in more serious clinical disease.
- ❖ Although low- and middle-income countries are responsible for only a small percentage of global greenhouse gas emissions, the adverse health effects associated with climate change will likely fall disproportionately on their populations.
- ❖ High-risk areas include those already experiencing a scarcity of resources, environmental degradation, high rates of infectious disease, weak infrastructure, and overpopulation. In particular, tropical regions will experience significant changes in human–pathogen relationships because of climate change.
- ❖ Changing temperatures and precipitation patterns linked to climate change will further affect health by changing the ecology of various vector-borne diseases, such as malaria, dengue, chikungunya, Japanese encephalitis, kala-azar, and filariasis. Vulnerable populations include the elderly, children, urban populations, and the poor.

- Potential health impacts are divided into three categories: **heat stress** and **air pollution**, **waterborne disease**, and **vector-borne disease** focusing on malaria. Additional crosscutting sessions covered climate modeling and predictions for India, adaptation and vulnerability, surveillance and early warning systems, integration of spatial analysis, and bridging policy and science.
- The potential physical and social impacts of climate change in India will likely be diverse, and that many additional important factors were not covered in our workshop, such as food yields, malnutrition, child growth, river flow, monsoon rain patterns, and freshwater availability.
- Nevertheless, we believe the Goa workshop served to target many of the major public health concerns associated with climate change and began the process of conceptualizing research needs and approaches that are integrative and achievable in low- and middle-income countries.
- **Hazardous wastes** refer to wastes that may, or tend to, cause adverse health effects on the ecosystem and human beings. These wastes pose present or potential risks to human health or living organisms, due to the fact that they:
- **1.** are non-degradable or persistent in nature; 2. can be biologically magnified; 3. are highly toxic and even lethal at very low concentrations.
- The above list relates only to the intrinsic hazard of the waste, under uncontrolled release, to the environment, regardless of quantity or pathways to humans or other critical organisms (i.e., plants and animals). The criteria used to determine the nature of hazard include toxicity, phytotoxicity, genetic activity and bio concentration. The threat to public health and the environment of a given hazardous waste is dependent on the quantity and characteristics of the waste involved.
- Wastes are secondary materials, which are generally classified into six categories as inherently waste: like materials, spent materials, sludges, by products, commercial chemical products and scrap metals. Solid wastes form a subset of all secondary materials and hazardous wastes form a subset of solid waste. However, note that certain secondary materials are not regulated as wastes, as they are recycled and reused.
- There are **five** general categories of Hazardous waste:

- (i) **Radioactive substance:** Substances that emit ionizing radiation are radioactive. Such substances are hazardous because prolonged exposure to radiation often results in damage to living organisms. Radioactive substances are of special concern because they persist for a long period. The period in which radiation occurs is commonly measured and expressed as half-life, i.e., the time required for the radioactivity of a given amount of the substance to decay to half its initial value. For example, uranium compounds have half-lives that range from 72 years for U232 to 23,420,000 years for U236. The management of radioactive wastes is highly controlled by national and state regulatory agencies. Disposal sites that are used for the long-term storage of radioactive wastes are not used for the disposal of any other solid waste.
- (ii) **Chemicals:** Most hazardous chemical wastes can be classified into four groups: synthetic organics, inorganic metals, salts, acids and bases, and flammables and explosives. Some of the chemicals are hazardous because they are highly toxic to most life forms. When such hazardous compounds are present in a waste stream at levels equal to, or greater than, their threshold levels, the entire waste stream is identified as hazardous.
- (iii) **Biomedical wastes:** The principal sources of hazardous biological wastes are hospitals and biological research facilities. The ability to infect other living organisms and the ability to produce toxins are the most significant characteristics of hazardous biological wastes. This group mainly includes malignant tissues discarded during surgical procedures and contaminated materials, such as hypodermic needles, bandages and outdated drugs. This waste can also be generated as a by-product of industrial biological conversion processes.
- (iv) **Flammable wastes**: Most flammable wastes are also identified as hazardous chemical wastes. This dual grouping is necessary because of the high potential hazard in storing, collecting and disposing of flammable wastes. These wastes may be liquid, gaseous or solid, but most often they are liquids. Typical examples include organic solvents, oils, plasticisers and organic sludges.
- (v) **Explosives:** Explosive hazardous wastes are mainly ordnance (artillery) materials, i.e., the wastes resulting from ordnance manufacturing and some

industrial gases. Similar to flammables, these wastes also have a high potential for hazard in storage, collection and disposal, and therefore, they should be considered separately in addition to being listed as hazardous chemicals. These wastes may exist in solid, liquid or gaseous form.

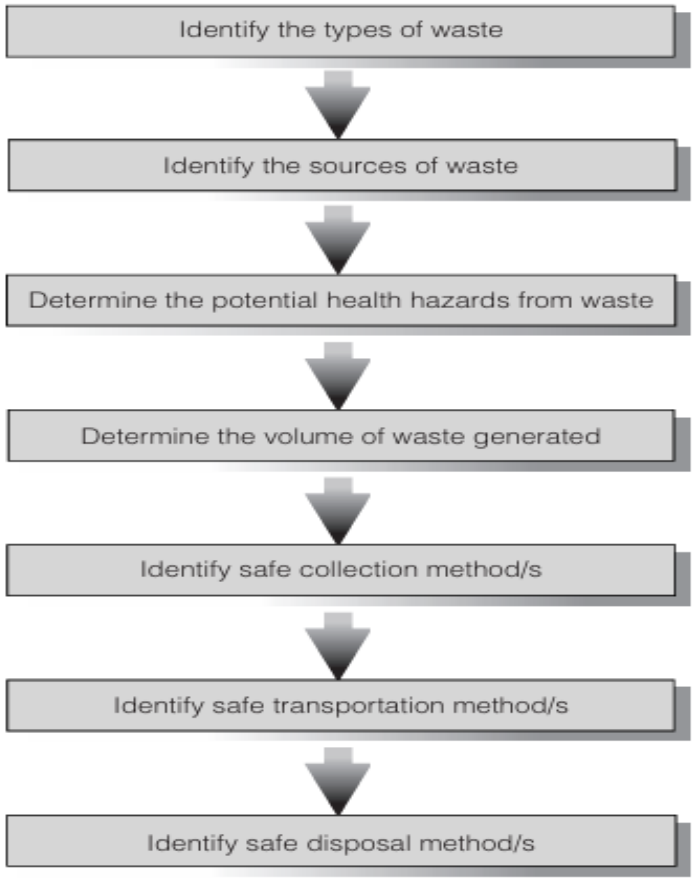
- (vi) **Household hazardous wastes**: Household wastes such as cleaning chemicals, batteries, nail polish etc in MSW constitute hazardous waste. Especially batteries contain mercury which are alkaline which is dangerous enough to kill people. Generic household hazardous material include non chlorinated organic, chlorinated organic, pesticides, latex paint, oil based paints, waste oil, automobile battery and household battery.
- The occurrence of adverse health effects is dependent on the way the



hazardous chemical enters the body. Some hazardous chemicals absorb rapidly through the skin, while others don't at all. The toxicity of a chemical also determines the effect on the body.

- ❖ There are many hazardous chemicals are toxic in very small amounts, whereas others can have large volumes of exposure before there is a reaction. Up to 300 man-made chemicals have been found in the average human. Having hazardous chemicals in the human body causes adverse reactions to fetuses, children, adolescents, adults and the elderly but the reaction each may have varies.
- ❖ A fetus and young child is more susceptible to adverse reactions than an adult because their developing organs may be permanently damaged. Some potential health conditions in people of all ages include:

- Behavior abnormalities
- Cancer
- Physiological malfunctions (e.g., kidney failure, reproductive impairment)
- Genetic mutations
- Physical deformations
- Birth defects



- **Solid waste** refers to non-soluble material such as agricultural refuse, industrial waste, mining residues, demolition waste, municipal garbage or even sewage sludge. Most of these kind of wastes cannot be recycled or rehabilitated for further use.
- Solid waste management is the entire process involved in the recycling process. Solid waste management starts with the trucks picking up recyclables, delivering them to the recycling.
- Solid waste management (SWM) is associated with the control of waste generation, its storage, collection, transfer and transport, processing and disposal in a manner that is in accordance with the best principles of public health, economics, engineering, conservation, aesthetics, publically attitude and other environmental considerations.
- Put differently, the SWM processes differ depending on factors such as economic status (e.g., the ratio of wealth created by the production of primary products to that derived from manufactured goods, per capital income, etc.), degree of industrialization, social development (e.g., education, literacy, healthcare, etc.) and quality of life of a location. In addition, regional, seasonal and economic differences influence the SWM processes.
- Classification of wastes based on types, i.e., physical, chemical, and biological characteristics of wastes, is as follows.
- (i) **Garbage:** This refers to animal and vegetable wastes resulting from the handling, sale, storage, preparation, cooking and serving of food. Garbage comprising these wastes contains putrescible (rotting) organic matter, which produces an obnoxious odour and attracts rats and other vermin. It, therefore, requires special attention in storage, handling and disposal.
- (ii) **Ashes and residues**: These are substances remaining from the burning of wood, coal, charcoal, coke and other combustible materials for cooking and heating in houses, institutions and small industrial establishments. When produced in large quantities, as in power-generation plants and factories, these are classified as industrial wastes. Ashes consist of fine powdery residue, cinders and clinker often mixed with small pieces of metal and glass. Since ashes and residues are almost entirely inorganic, they are valuable in landfills.

(iii) **Combustible and non-combustible wastes**: These consist of wastes generated from households, institutions, commercial activities, etc., excluding food wastes and other highly putrescible material. Typically, while combustible material consists of paper, cardboard, textile, rubber, garden trimmings, etc., non-combustible material consists of such items as glass, crockery, tin and aluminium cans, ferrous and non-ferrous material and dirt.

- (iv) **Bulky wastes:** These include large household appliances such as refrigerators, washing machines, furniture, crates, vehicle parts, tyres, wood, trees and branches. Since these household wastes cannot be accommodated in normal storage containers, they require a special collection mechanism.
- (v) **Street wastes:** These refer to wastes that are collected from streets, walkways, alleys, parks and vacant plots, and include paper, cardboard, plastics, dirt, leaves and other vegetable matter. Littering in public places is indeed a widespread and acute problem in many countries including India, and a solid waste management system must address this menace appropriately.
- (vi) **Biodegradable and non-biodegradable wastes**: Biodegradable wastes mainly refer to substances consisting of organic matter such as leftover food, vegetable and fruit peels, paper, textile, wood, etc., generated from various household and industrial activities. Because of the action of micro organisms, these wastes are degraded from complex to simpler compounds. Non-biodegradable wastes consist of inorganic and recyclable materials such as plastic, glass, cans, metals, etc.
- (vii) **Dead animals:** With regard to municipal wastes, dead animals are those that die naturally or are accidentally killed on the road. Note that this category does not include carcasses and animal parts from slaughter-houses, which are regarded as industrial wastes.
- Dead animals are divided into two groups – large and small. Among the large animals are horses, cows, goats, sheep, pigs, etc., and among the small ones are dogs, cats, rabbits, rats, etc. The reason for this differentiation is that large animals require special equipment for lifting and handling when they are removed. If not collected promptly, dead animals pose a threat to public health

since they attract flies and other vermin as they decay. Their presence in public places is particularly offensive from the aesthetic point of view as well.

- (viii) **Abandoned vehicles**: This category includes automobiles, trucks and trailers that are abandoned on streets and other public places. However, abandoned vehicles have significant scrap value for their metal, and their value to collectors is highly variable.
- (ix) **Construction and demolition wastes:** These are wastes generated as a result of construction, refurbishment, repair and demolition of houses, commercial buildings and other structures. They consist mainly of earth, stones, concrete, bricks, lumber, roofing and plumbing materials, heating systems and electrical wires and parts of the general municipal waste stream. (x) **Farm Wastes:** These wastes result from diverse agricultural activities such as planting, harvesting, production of milk, rearing of animals for slaughter and the operation of feedlots. In many areas, the disposal of animal waste has become a critical problem, especially from feedlots, poultry farms and dairies. (xi) **Hazardous wastes:** Hazardous wastes are those defined as wastes of industrial, institutional or consumer origin that are potentially dangerous either immediately or over a period of time to human beings and the environment. This is due to their physical, chemical and biological or radioactive characteristics like ignitability, corrosivity, reactivity and toxicity.
- Note that in some cases, the active agents may be liquid or gaseous hazardous wastes. These are, nevertheless, classified as solid wastes as they are confined in solid containers. Typical examples of hazardous wastes are empty containers of solvents, paints and pesticides, which are frequently mixed with municipal wastes and become part of the urban waste stream.
- Certain hazardous wastes may cause explosions in incinerators and fires at landfill sites. Others such as pathological wastes from hospitals and radioactive wastes also require special handling. Effective management practices should ensure that hazardous wastes are stored, collected, transported and disposed of separately, preferably after suitable treatment to render them harmless.
- (xii) **Sewage wastes:** The solid by-products of sewage treatment are classified as sewage wastes. They are mostly organic and derived from the treatment of

organic sludge separated from both raw and treated sewages. The inorganic fraction of raw sewage such as grit and eggshells is separated at the preliminary stage of treatment, as it may entrain putrescible organic matter with pathogens and must be buried without delay. The bulk of treated, dewatered sludge is useful as a soil conditioner but is invariably uneconomical. Solid sludge, therefore, enters the stream of municipal wastes, unless special arrangements are made for its disposal.

- **Medical waste management** involves the safe handling, storage, transportation, treatment, and disposal of waste generated by healthcare facilities and related activities. Effective management is crucial to prevent the spread of infections and protect public health and the environment. Key aspects include waste segregation, treatment methods like incineration and autoclaving, and proper disposal techniques.

Elements of Medical Waste Management:

- **Segregation:**

Separating different types of waste (e.g., infectious, sharps, pathological) at the point of generation is essential to minimize contamination and facilitate appropriate treatment.

- **Storage:**

Designated areas are needed for storing different waste categories, ensuring containment and preventing leaks or spills.

- **Transportation:**

Special procedures and vehicles are used to transport medical waste, minimizing risks to workers and the public.

- **Treatment:**

Various methods are employed to treat medical waste, including incineration, autoclaving, and chemical treatment.

- **Disposal:**

Final disposal methods depend on the treatment method and may include landfills or other approved sites.

Common Treatment Methods:

- **Incineration:** Burning waste at high temperatures, but can cause air pollution.
- **Autoclaving:** Using steam and pressure to sterilize waste, a common method for infectious waste.
- **Chemical Treatment:** Utilizing chemicals to disinfect or neutralize waste.
- **Shredding:** Reducing the volume of waste, often as a preliminary step before other treatments.

Types of Medical Waste:

- **Infectious Waste:** Waste suspected of containing pathogens.
- **Pathological Waste:** Human tissues, organs, and body parts.
- **Sharps:** Needles, syringes, scalpels, and other sharp objects.
- **Pharmaceutical Waste:** Expired or unused medications.
- **Genotoxic Waste:** Waste containing substances that can damage DNA.
    - **Nuclear waste** refers to materials that are radioactive and no longer useful in nuclear fuel cycles, encompassing a range of materials from spent fuel to contaminated equipment.
    - These wastes can be categorized into high-level waste (HLW), intermediate-level waste (ILW), low-level waste (LLW), and very low-level waste (VLLW), each with varying levels of radioactivity and requiring different management strategies. Proper management and disposal of nuclear waste are crucial to protect human health and the environment.

Types of Nuclear Waste:

- **High-Level Waste (HLW):**

This is the most radioactive waste, typically spent nuclear fuel from reactors, requiring significant shielding and long-term storage.

- **Intermediate-Level Waste (ILW):**

  This waste contains significant amounts of radioactivity but doesn't require the same level of shielding as HLW.

- **Low-Level Waste (LLW):**

  This waste has low levels of radioactivity and often includes contaminated items like protective clothing, tools, and filters.

- **Very Low-Level Waste (VLLW):**

  Radioactivity levels are only slightly above background levels, making it suitable for some near-surface disposal options.

- **Very Short-Lived Waste (VSLW):**

  This waste can decay naturally over a short period, making it suitable for storage and decay before disposal.

Management and Disposal:

- **Temporary Storage:**

  Spent fuel is initially stored in cooling pools and then moved to dry cask storage.

- **Reprocessing:**

  Some countries reprocess HLW to recover usable materials, but this process is complex and can have proliferation risks.

- **Deep Geological Disposal:**

  The most widely accepted method for HLW disposal, involving storage in stable geological formations deep underground.

- **Transmutation:**

  Research is ongoing to convert long-lived radioactive elements into shorter-lived or stable elements.

  Key Considerations:

- **Protection of Human Health and Environment:**

  Nuclear waste management aims to minimize risks to people and the environment.

- **Long-Term Storage:**

  Some types of nuclear waste require long-term storage due to the long half-lives of some radioactive materials.

- **Cost:**

  Nuclear waste management and disposal can be expensive, requiring careful planning and investment.

- **Public Perception:**

  Public acceptance of nuclear waste disposal methods is a significant factor in implementing long-term solutions.

  Examples of Nuclear Waste:

- Spent nuclear fuel from reactors
- Contaminated protective clothing, gloves, and shoe covers
- Used filters, cleaning materials, and tools from nuclear facilities
- Resins and sludges from coolant purification
- Sealed radioactive sources used in medicine and industry
- Laboratory equipment like glassware and syringes from radiopharmaceutical research

- **Thermal waste** refers to waste materials with temperatures significantly higher or lower than the natural temperature of the surrounding environment, particularly groundwater. These wastes often require specialized treatment methods to minimize environmental impact.
- Common thermal treatment methods include incineration, gasification, and pyrolysis, each employing high temperatures to reduce waste volume and potentially recover energy.
- Thermal waste is defined by its deviation from the ambient temperature, usually groundwater temperature, by more than 30 degrees Fahrenheit. Wastes from thermal power plants, like fly ash and slag, can be utilized in construction materials.

- **Bhopal Gas Tragedy:** On the night of 2 December 1984, a gas leak at the Union Carbide India Limited (UCIL) pesticide plant in Bhopal led to the deaths of about 4000 people and adversely affected the health of lakhs of people.
- UCIL was a pesticide plant which manufactured the pesticide carbaryl (chemical name: 1-naphthyl methylcarbamate) under the brand name Sevin.
- Carbaryl was discovered by an American company Union Carbide Corporation (UCC) which was UCIL's parent company holding a majority stake. Minority stakes were held by Indian banks and the public.
- UCIL manufactured carbaryl using **methyl isocyanate (MIC)** as an intermediate. Although there are other methods to produce the end-product, they cost more.
- MIC is a highly toxic chemical and extremely dangerous to human health.
- Around midnight of 2 December 1984, residents of Bhopal surrounding the pesticide plant began to feel the irritating effects of MIC and started fleeing from the city. However, thousands were dead by morning.

1. Initial effects of exposure:
    - Coughing
    - Feeling of suffocation
    - Severe eye irritation
    - Burning in the respiratory tract
    - Breathlessness
    - Stomach pain and vomiting
    - Blepharospasm (abnormal contraction or twitching of the eyelid)
2. By the morning of 3rd December, thousands of people had perished due to choking, pulmonary oedema and reflexogenic circulatory collapse. Autopsies indicated that not only lungs, people's brains, kidneys and liver were also affected.

MCQ based on Unit V

Q. 1. The Bhopal gas tragedy involved the release of toxic gas from a factory owned by:

a. Indian Oil Corporation
b. Hindustan Petroleum
c. Union Carbide India Limited
d. Reliance Industries

Answer. c

Q. 2. The toxic gas that leaked in the Bhopal disaster was:

a. Carbon Monoxide
b. Methyl Isocyanate
c. Sulphur Dioxide
d. Chlorine

Answer. b

Q. 3. What was the primary cause of the gas leak at the Union Carbide factory?

a. Intentional sabotage
b. A natural disaster
c. Faulty safety mechanisms and poor construction
d. A sudden chemical reaction

Answer. c

Q. 4. In what year did the Bhopal gas tragedy occur?

a. 1980
b. 1982

c. 1984

d. 1986

Answer. c

Q. 5. Which of the following best describes the immediate impact of the gas leak?

a. Widespread flooding

b. A sharp increase in temperature

c. A mass respiratory illness

d. A power outage

Answer. c

Q. 6. Who was the chairman and CEO of Union Carbide at the time of the tragedy?

a. Ajay Sharma

b. Warren Anderson

c. Rajesh Kumar

d. Amitabh Bachchan

Answer. b

Q. 7. What action did the Madhya Pradesh police take against Warren Anderson after the tragedy?

a. They immediately arrested him and held him without bail.

b. They arrested him, released him on bail, and then allowed him to leave the country.

c. They refused to arrest him, stating it was not their jurisdiction.

d. They deported him immediately.

Answer. b

Q. 8. What is the name of the Act passed by the Indian Parliament to deal with the claims arising from the Bhopal gas disaster?

a. The Bhopal Gas Leak Disaster (Processing of Claims) Act, 1985
b. The Bhopal Gas Tragedy Compensation Act, 1986
c. The Union Carbide Liability Act, 1987
d. The Environmental Protection Act, 1984

Answer. a

Q.9. What was the main function of the Union Carbide India Limited factory in Bhopal before the disaster?

a. Producing textiles
b. Refining petroleum
c. Manufacturing pesticides
d. Assembling electronic devices

Answer. c

Q. 10. What is the recommended color-coded bag for the disposal of infectious non-sharp biomedical waste?
a. Yellow
b. Red
c. Blue
d. Black
Answer: a

Q.11. What is the main principle of biomedical waste management?
a. Incineration of all waste
b. Segregation of waste at the source
c. Collecting all waste in a single bin

d. Dumping waste in landfills

Answer: b

Q. 12. Biomedical waste management rules in India were first introduced in which year?

a. 1989

b. 1998

c. 2000

d. 2016

Answer: b

Q. 13. Which of the following is NOT considered biomedical waste?

a. Blood-soaked bandages

b. Expired medicines

c. Office paper waste

d. Discarded syringes

Answer: c

Q. 14. What is the preferred method for the disposal of sharp waste like needles and scalpels?

a. Burning in open spaces

b. Autoclaving

c. Disinfection and shredding

d. Sharp pit or incineration

Answer: d

Q. 15. What is the correct symbol used for indicating biohazard waste?

a. Cross mark

b. Radiation symbol

c. Three interlocking circles

d. Skull and crossbones

Answer: c

Q.16. What is the treatment method for human anatomical waste?

a. Autoclaving

b. Deep burial or incineration

c. Landfill disposal

d. Chemical disinfection

Answer: b

Q. 17. How often should biomedical waste be collected and disposed of according to the rules?

a. Weekly

b. Daily

c. Every two days

d. Once a month

Answer: b

Q.18. Which of the following chemicals is commonly used for the disinfection of biomedical waste?

a. Sodium hydroxide

b. Sodium hypochlorite

c. Sulfuric acid

d. Formaldehyde

Answer: b

Q.19. What is the primary objective of biomedical waste management?

a. To reduce healthcare costs

b. To minimize environmental and health hazards

c. To improve hospital efficiency

d. To comply with government regulations

Answer: b

Q. 20. Which type of biomedical waste is disposed of in blue color-coded containers?

a. Human anatomical waste

b. Expired medicines

c. Glassware and metallic implants

d. General waste

Answer: c

Q. 21. According to the Biomedical Waste Management Rules, 2016, how many categories of waste are defined?

a. 6

b. 8

c. 4

d. 10

Answer: c

Q. 22. What is the maximum time biomedical waste can be stored without treatment?

a. 24 hours

b. 48 hours

c. 12 hours

d. 72 hours

Answer: b

Q. 23. Which healthcare facilities are required to follow biomedical waste management rules?

a. Hospitals only

b. Clinics only

c. All healthcare facilities generating biomedical waste

d. Laboratories only

Answer: c

Q. 24. What is the purpose of the autoclave in biomedical waste management?

a. Incineration

b. Sterilization through high-pressure steam

c. Shredding of waste

d. Chemical treatment

Answer: b

Q. 25. What is the major problem in nuclear plants?

a. Drawing out energy

b. Fusion of particles

c. Disposal of nuclear waste

d. Handling of fuel

Answer c

Q. 26. Moderate liquid nuclear wastes are disposed into _____

a. Deep pits

b. Buried underground

c. Left into rivers

d. Left into deep oceans

Answer. a

Q. 27. How are active liquids of nuclear waste disposed?

a. Stored in concrete tanks and buried underground

b. Stored in concrete tanks and buried in sea

c. Mixed with other chemicals and left into free atmosphere

d. They are reused and burnt away in gaseous fumes

Answer. a

Q. 28. How is High Level solidified nuclear wastes (HLW) stored?

a. Concrete tanks

b. Canisters

c. Packed rock salt

d. Soil bins

Answer. b

Q.29. For how many days is radioactive solid waste kept is kept under water at 6m deep for initial cooling?

a) 1. days

b. 50 days

c. 30 days

d. 100 days

Answer. d

Q.30. What are released into biosphere from nuclear power plants?

a. Gaseous effluents

b. Waste Product

c. Smoke

d. The obtained product

Answer. a

Q.31. Which of the following is the primary cause of ionizing radiation that affects the activities of most enzymes?

a. Photoemission of electrons

b. Structural change of enzyme by α-particles, β- and γ-rays

c. Interaction of electrons with the body

d. Interaction of radiation with substrate

Answer. b

Q.32. Which radioactive element is classified as an indoor pollutant?

a. Oxygen-16

b. Nitrogen-13

c. Carbon-14

d. Radon

Answer. d

Q. 33. Which of the following types of radiation has the highest penetration power?

a. Alpha radiation

b. Beta radiation

c. Gamma radiation

d. Neutron radiation

Answer. c

Q.34. Which of the following organs is most sensitive to the effects of ionizing radiation?

a. Liver

b. Skin

c. Bone marrow

d. Kidneys

Answer. c

Q. 35. What is the primary pathway through which radioactive pollutants enter the human body?

a. Inhalation

b. Ingestion

c. Dermal absorption

d. Injection

Answer. b

Q.36. What is the main environmental concern associated with radioactive pollution?

a. Acid rain formation

b. Ozone depletion

c. Global warming

d. Long-term health effects

Answer. d

Q.37. In which unit radiation's biological effect on living tissue is measured?

a. Roentgen

b. Gray

c. Sievert

d. Curie

Answer. c

Q.38. What is the primary reason for long-term storage of radioactive waste?

a. To prevent radioactive decay

b. To reduce the risk of accidental exposure

c. To minimize baseline radiation levels in the environment

d. To promote the spread of radiation

Answer. b

Q.39. What is the main factor determining the biological effects of radiation exposure?

a. Type of radiation

b. Distance from the radiation source

c. Duration of exposure

d. Individual susceptibility

Answer. d

Q.40. Which aquatic organism is more sensitive to changes in water temperature caused by thermal pollution?

a. Phytoplankton

b. Zooplankton

c. Fish

d. Algae

Answer. c

Q.41. How does thermal pollution affect dissolved oxygen levels in aquatic ecosystems?

a. It increases dissolved oxygen levels

b. It decreases dissolved oxygen levels

c. It does not affect dissolved oxygen levels

d. It causes fluctuations in dissolved oxygen levels

Answer. b

Answer. 42. What is the primary mechanism through which thermal pollution can harm aquatic organisms?

a. Alteration of pH levels

b. Disruption of reproductive cycles

c. Increased sedimentation rates

d. Oxygen depletion

Answer. d

Q.43. How does thermal pollution impact the efficiency of wastewater treatment plants?

a. It enhances treatment efficiency

b. It reduces treatment efficiency

c. It does not affect treatment efficiency

d. It increases the lifespan of treatment facilities

Answer. b

Q. 44. How does thermal pollution impact the behaviour of aquatic organisms?

a. It does not affect behaviour

b. It stimulates feeding activity

c. It disrupts migration patterns

d. It promotes territorial aggression

Answer. c

Q.45. Which pollutant is commonly associated with thermal discharges from power plants?

a. Heavy metals

b. Pesticides

c. Pathogens

d. Mercury

Answer. d

Q.46. What is the primary mechanism through which thermal pollution affects the reproductive success of aquatic organisms?

a. Alteration of hormone levels

b. Disruption of mating behaviour

c. Enhanced egg fertilization rates

d. Reduction in offspring survival

Answer. d

Q.47. Which of the following is a potential consequence of thermal pollution on aquatic ecosystems?

a. Decreased evaporation rates

b. Increased primary productivity

c. Expansion of hypoxic zones

d. Promotion of biodiversity

Answer. c

Q. 48. What is the primary concern associated with thermal pollution in marine ecosystems?

a. Coral bleaching

b. Ocean acidification

c. Salinity fluctuations

d. Sea level rise

Answer. a

Q.49. How does thermal pollution affect the dissolved oxygen levels in the hypolimnion of stratified lakes?

a. It increases dissolved oxygen levels

b. It decreases dissolved oxygen levels

c. It does not affect dissolved oxygen levels

d. It promotes algal blooms

Answer. b

Q.50. Which of the following is a potential long-term consequence of thermal pollution on aquatic ecosystems?

a. Accelerated eutrophication

b. Restoration of natural habitats

c. Recovery of fish populations

d. Extinction of sensitive species

Answer. d

Q.51. What is the primary form of pollution caused by excess nutrients in coastal waters?

a. Thermal pollution

b. Chemical pollution

c. Eutrophication

d. Radioactive pollution

Answer. c

Q. 52. Which of the following pollutants is commonly associated with ocean acidification?

a. Carbon monoxide

b. Sulfur dioxide

c. Carbon dioxide

d. Nitrogen oxides

Answer. c

Q. 53. What is the primary mechanism through which microplastics enter marine ecosystems?

a. Plastic usage and discharge due to marine fishery and coastal aquaculture

b. High-speed circulation of atmosphere and deposition on water surface

c. Surface runoff

d. Deep-sea mining and oil exploration

Answer. c

Q. 54. Which of the following pollutants is commonly associated with red tides?

a. Heavy metals

b. Oil

c. Harmful algal blooms

d. Plastic debris

Answer. c

Q. 55. What is the primary route of exposure for marine organisms to persistent organic pollutants?

a. Inhalation

b. Ingestion

c. Dermal absorption

d. Injection

Answer. b

Q.56. Waste removal system was established in which of the following cities for the first time?

a. Athens

b. Lahore

c. Paris

d. London

Answer. a

Q.57. Which of the following solid wastes describes the term 'Municipal Solid Waste'?

a. Toxic

b. Hazardous

c. Non-toxic

d. Non-hazardous

Answer. d

Q. 58. Why is it difficult to recycle plastics?

a. It is very hard

b. It comes in different sizes

c It is adhesive

d. It contains different types of polymer resins

Answer. d

Q. 59. Which of the following is done on an individual level?

a Burning

b. Disposal

c. Recycling

d. Source reduction

Answer. d

Q. 60. Why is recycled paper banned for use in food containers?

a. Because it creates a lot of spaces

b. Because it creates contamination

c. Because paper can be used only one time

d. Because paper is very thick and can't cover the food containers

Answer. b

Q. 61. Which of the following plans is used as a waste management plan?

a. Plan for reuse

b. The integrated plan

c. Plan for recycling

d. Plan for reducing

Answer. b

Q. 62. The organic material of the solid waste will decompose

a. By the flow of water

b. By the soil particles

c. By the action of microorganisms

d. By oxidation

Answer. c

Q. 63. Which of the following wastes is called the Municipal Solid Waste (MSW)?

a. Food wastes

b. Wood pieces

c. Plastic cans

d. All of the above

Answer. d

Q. 64. The process of burning municipal solid wastes under suitable temperature and conditions in a specific furnace is called _____.

a. Landfill

b. Incineration

c. Recycling

d. Vermicomposting

Answer. b

Q. 65. The burning of solid waste is not recommended because

a. It is very costly

b. It requires a lot of space

c It requires modern technologies

d. It causes several environmental issues

Answer. d

Q. 66. When the organic matter present in the sanitary landfill decomposes, it generates

a. Methane

b. Nitrogen

c. Hydrogen

d. All of the above

Answer. a

Q. 67. Which of the following is the oldest and the most common method used to dump solid wastes?

a. River

b. Ocean

c. Landfill

d. None of the above

Answer. c

Q.68. The disposable wastes contain

a. Solids

b. Slurries

c. Liquids

d. All of the above

Answer. d

Q.69 . Find the correct statement

a. The waste from one process becomes the input for another process

b. All the processes related to consumption and production produce some kind of waste

c. There is no real waste in nature

d. All of the above

Answer. d

Q. 70. Which of the following methods is better for the solid waste problem?

a. Recycling

b. Landfilling

c. Both a and b

d. None of the above

Answer. a

Q. 71. Which of the following statements is incorrect for plastic wastes?

a. It is used to make compost

b. It lasts for a longer period of time

c. Toxic fumes are produced when burnt

d. All of the above

Answer. a

Q. 72. Which of the following can be recycled many times?

a. Wood

b. Plastic

c. Aluminium

d. Organic materials

Answer. c

Q. 73. Which of the following gas is produced from landfill wastes?

a. Biogas

b Natural gas

c Liquified petroleum gas

d. All of the above

Answer. a

Q. 74. Which of the following statements is true about zero waste management?

a. Separate collection of each kind of waste

b. Segregation of garbage at the source

c. Community involvement

d. All of the above

Answer. d

Q. 75. How many main components are there in integrated waste management?

a. Two

b. Three

c. Seven

d. Eleven

Answer. b

Q. 76. Which of the following is NOT a characteristic of hazardous waste?

a. Ignitability

b. Corrosivity

c. Biodegradability

d. Reactivity

Answer. c

Q. 77. The term "TSD facility" in hazardous waste management refers to:

a. Treatment, Storage, and Disposal

b. Transportation, Storage, and Disposal

c. Treatment, Segregation, and Disposal

d. Transportation, Segregation, and Disposal

Answer. a

Q. 78. Which of the following is a method for disposing of hazardous waste?

a. Open dumping

b. Landfilling (with special precautions)

c. Composting

d. Recycling

Answer. b

Q. 79. What is the primary goal of hazardous waste management?

a. To minimize waste generation

b. To protect human health and the environment

c. To reduce waste disposal costs

d. To maximize waste recycling

Answer. b

Q. 80. Which international treaty aims to reduce the transboundary movement of hazardous waste?

a. Kyoto Protocol
b. Basel Convention
c. Montreal Protocol
d. Paris Agreement

Answer. b

Q. 81. What is the main purpose of solidification/stabilization in hazardous waste treatment?

a. To destroy the hazardous waste
b. To reduce the volume of the waste
c. To make the waste less mobile and toxic
d. To recover valuable materials from the waste

Answer. c

Q. 82. Which of the following is a common method for treating liquid hazardous waste?

a. Incineration
b. Landfilling
c. Adsorption
d. Composting

Answer. c

Q. 83. What is a key concern associated with the long-term storage of radioactive waste?

a. High volatility

b. High reactivity

c. Radiation leakage

d. Odor emission

Answer. c

Q. 84. Which of the following is a method for treating e-waste?

a. Incineration

b. Landfilling

c. Recycling of components

d. All of the above

Answer. d

Q. 85. What is the main purpose of a landfill liner system?

a. To prevent the escape of waste into the environment

b. To facilitate waste decomposition

c. To increase waste volume

d. To reduce landfill gas production

Answer. a

Unit VI

Behavioural Ecology and Chronobiology

- Origin and history of Ethology,
- Instinct vs. Learnt Behaviour
- Associative learning, classical and operant conditioning, Habituation, Imprinting,
- Circannual and circadian rhythms; Tidal rhythms and Lunar rhythms
- Chrono medicine

Origin and history of Ethology

- The scientific study of the characteristic behaviour patterns is called Ethology. It is a branch of science that deals with the study of scientific, biological and specific patterns of behaviour in animals.
- Ethology is originated from two Greek words i.e. Ethos=character/habit, logos=study. Ethology is a branch that analyses the reactions of animal to its environment, trying to determine its specific cause and effect relationships between the animal's actions and events and conditions experienced by the animal thus, behaviour is the study of what animals do as they react to their environment with particular patterns of muscular and glandular activity.
- An animal's behaviour is of primary importance particularly for its survival. It must find its food and shelter; it must escape from predators and should compete successfully with others of its kind.
- A scientific study of animal behaviour involves a variety of approaches. It can be explained in terms of its evolutionary history, in terms of benefits it brings to the animals in terms of psychological mechanisms. How an animal reacts to the changes in its environment and how it behaves with the other organisms around is behaviour.
- Behavioural changes are not passive. They are directed actions that promote survival. There are two factors that determine the way an animal responds in a particular circumstance, its genetic makeup and its previous exposure to similar circumstances.
- **HISTORY:** The history of ethology is as old as pre-historic man, because at that time, human beings were hunters they had to study the behaviour of

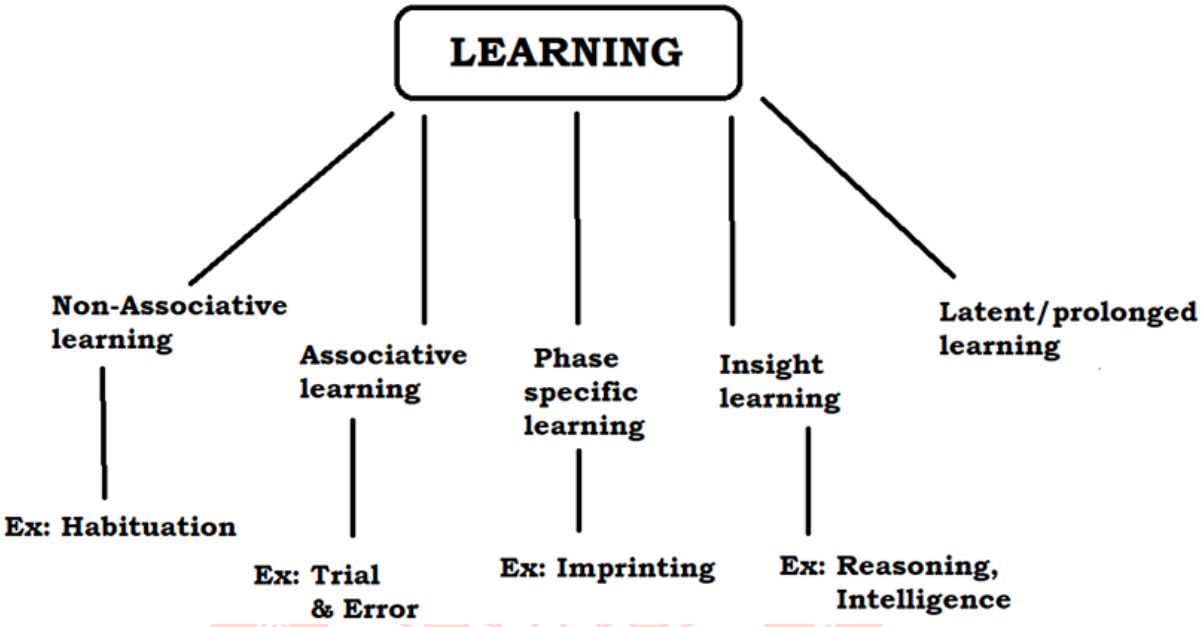
animals. This fact is revealed in' paintings on the walls of excavated caves. Aristotle (372 BC) wrote for the first-time, excellent descriptions of animal behaviour in his book Historia Animallum.

- In 18th century, naturalists like Gilbert White (1720 -1793), Charles Leroy (i723 -1789) and Charles Darwin (1809-1882) have described certain aspects of animal behaviour. Charles Darwin is regarded as the first one to make scientific study, of animal behaviour. Darwin wrote his first text book on behaviour "EXPRESSION OF EMOTION IN MAN AND ANIMALS" in 1872. In this book, he concentrated on the use of facial expressions as a means of communication.
- Famous ethologists of 19th century were Herbert Jennings, Douglas A. Spalding, Charles Whiteman and Ivan Pavlove. Pavlove, a Russian physiologist got Nobel Prize for his experiments in conditional reflexes.
- During 20th century, Oskar Hemroth wrote his major papers in imprinting in ducks and geese. In 1918, J.S. Szymanski demonstrated the existence of biological clocks in animals. In 1925, W. Rowan proposed photoperiodism hypothesis of bird migration. Classical ethology reached its peak with the works of Konrad Lorenz (1903 -1989) and Niko Tinbergen (1907-1983), two European ethologists who together with Karl Von Frisch (1886-1983) shared Nobel prize in 1973 for physiology.
- CONTRIBUTIONS:
- I. **KONRAD LORENZ:** i. He is founder father of Ethology ii. He was lecturer in Animal psychology at the University of Vienna, Austria iii. He got this initial inspiration from his teacher Oskar Hemroth iv. Lorenz in his farmhouse observed shrews, frogs, monkeys, dogs and mainly greylag geese on which he carried out extensive studies and developed a theory of imprinting or childhood learning during critical period. v. His popular works were King Solomon's ring, Man meets dog etc.
- II. **KARL VON FRISCH**: i. He was born in Vienna but spent his life in Germany. ii. His initial days of living was in farm land which allowed him to study on different types of animals and insects. iii. He carried out experiments using colour cards on insects. iv. His observations on honey bees

enabled him to discover fascinating things on their attraction toward coloured things. v. His most significant discovery was about the bee dance i.e. bees have 2 types of dancing behaviours, they were wagging and circular dance. vi. He also studied behaviour of bees during total solar eclipse.

- III. **NIKO TINBERGEN**: i. He was born in Holland but lived in England. ii. He studied variety of animals from butterflies to gigger wasps to three spined stickle back fish and gulls. iii. Few of his books are; Animal Behaviour, The study of Instincts (1954), The animal in its world, Social Behaviour in Animals (1965). iv. His contribution on details of sign stimuli which are needed to elicit a specific instinctive behaviour is still appreciated.
- **Instincts** are more complex and fascinating form of stereotyped behaviour. There are **3** criteria for instinctive behaviour; i. They are unlearned, ii. They are adaptive, iii. They are characteristic of species.
- Instinct is an inherited pattern of fixed responses which are independent of an environment and learning. Instinctive behaviour of organisms is based genetically. Genes are responsible for all the behavioural patterns and these are modified and preserved with natural selection.
- Ex 1: Food begging behaviour in gull chicks. Shortly after emerging from the egg, the gull chick begins to peck at the tip of its parent's beak. The pecks in turn induce the adult gull to regurgitate a mass of half-digested food. This serves as first meal for the chick. The pecking response is considered as an innate behaviour because it is characteristic of all baby gulls.
- Ex 2: Nest building behaviour of tailor birds. Tailor bird builds nests by punching holes in the margins of two large leaves and sewing them with bits of string or spider webs. The tailor bird has not seen nest building by older birds and it has no previous experiences, but on its first try its nest is built. Ex 3: Construction of spider web.
- **ACQUIRED BEHAVIOUR (LEARNED BEHAVIOUR):** Learning can be defined as a process which brings about certain adaptive changes in the behaviour of an individual as a result of experience. The ability to learn is a striking feature seen in most of the living organisms. It is the modification of stereotyped behaviour based upon past experiences. Two criteria are used to

distinguish learning from other stereotyped behaviour, they are; 1. Learning must be permanent and not result of fatigue, 2. Learning must not be a simple permanent change in behaviour resulting from maturation.

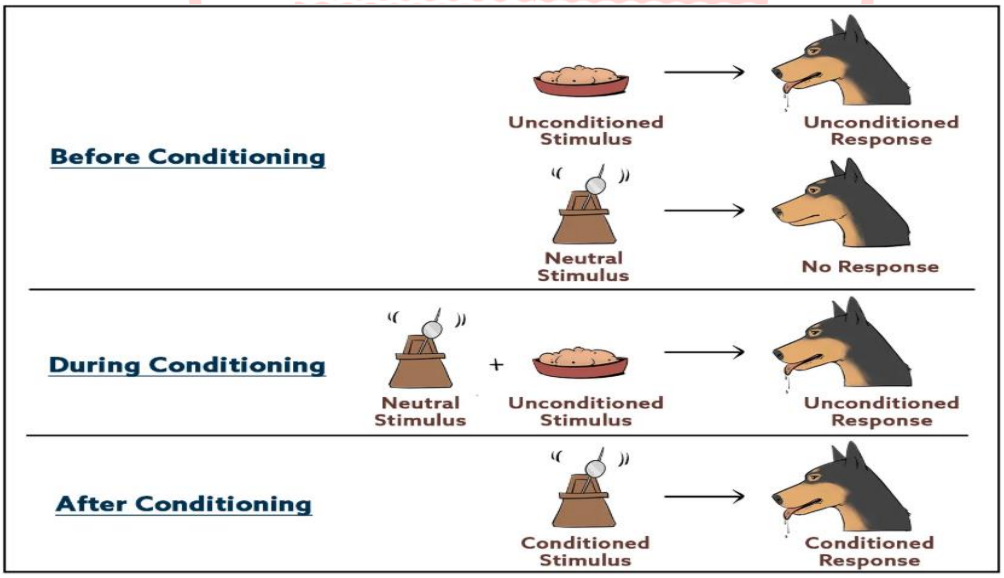


- **HABITUATION:** Habituation is the simplest kind of learning. It is a form of non-associative learning. Habituation is a process in which an animal learns to inhibit a response and is considered to be the most primitive and wide spread form of learning. It is the general suppression of a stereotyped behaviour pattern as a result of a repeated stimulus that is not followed by an adverse effect. In simple terms, it is a learning to ignore stimuli in the environment and not associated with any reward or punishment.
- Ex: If a garden snail is allowed to crawl across a surface and the surface is tapped sharply, the snail will rapidly withdraw into its shell. After a few moments, it will come out again and starts crawling. Tapping the surface again will cause it to stop, withdraw, wait and re-emerge. This response will continue for a while but gradually the time taken to re-emerge diminishes and ultimately the snail will not respond to tapping at all. To sum up, repeated application of stimulus often results in decrease response. This phenomenon is called habituation. Habituation is regarded as a method of adjusting to the pressure of the environment and is found in complex animals as humans as well as in ones with a simple nervous system.

- **IMPRINTING:** Imprinting is a specialized form of leaming that is seen clearly in many kinds of birds during their early period of life. When the early period is over, the birds are unable to learn.
- Ex: Young ducks will normally follow their mother soon after they hatch. This following behaviour is the result of hatching. Imprinting occurs for a short period of time after hatching. If imprinting is prevented from occurring by hatching the egg in an incubator, and not exposing the young birds to an adult bird for some days, it never gets imprinted.
- Experiments have been performed with ducks and other birds hatched in incubators. In case of many, the first large moving object seen by the newly hatched birds will be the stimulus for imprinting. If the first such object seen is a man, the young birds follow the man about. In simple form, if the young ducklings are hatched artificially and then exposed early to some moving object other than their true mother, they will behave towards the object as they normally would do their mother duck. Imprinting, besides birds, is also been reported in insects and man. It is a limited and restricted type of learning which unlike other learning is not possible at all times of the life, but occurs only during early stage of life.
- **TRIAL AND ERROR**: It is also called as **selective learning.** This learning is generally associated with a reward or punishment. The animal learns either to get a reward or to avoid a punishment. Various types of mazes (i.e. problem apparatus) as well as other multiple-choice situations have been developed to measure learning ability in various animals.
- Ex: A hungry cat is placed in a box. The box has two chambers which are separated by glass door. Food is kept in another chamber. The cat can see the food but cannot reach it. The door has many levers. The desperate cat presses all the levers and when it presses the correct lever, the door opens and it reaches the food. After repeated trials, the cat learns how to get the food and as soon as it is placed in the box, presses the correct lever and takes the food. Most experiments on learning in animals involve mazes or problem apparatus. A maze is a series of pathways with many blind ends. The animal must choose the correct way to get out of the maze. If it makes a wrong

choice, the animal touches a blind end and will be punished (Ex: Electric shock). After repeated trials, the animal leans to avoid blind ends and chooses the right path.

- ASSOCIATIVE LEARNING: It is the type of learning where animals learn to link (associate) two different stimuli and behave accordingly. This is very well studied experimentally and is sub-classified under Classical conditioning and Operant conditioning.
- CLASSICAL CONDITIONING: This is a type of learning where a neutral stimulus is paired with an innate reflex of an animal. Now this neutral stimulus is also getting the same behavioural response as the innate reflex from the conditioned animal.
- Nobel Prize winning Russian physiologist, **Ivan P. Pavlov,** first demonstrated this type of learning. Pavlov was working on dog's digestive enzymes. While studying digestive enzymes in saliva, he attached a cannula through the cheek of the dog and redirected the saliva into it. When the dog was presented with food, it would salivate and saliva was collected in the cannula and measured. Over few experiments, Pavlov realized dogs began to salivate in



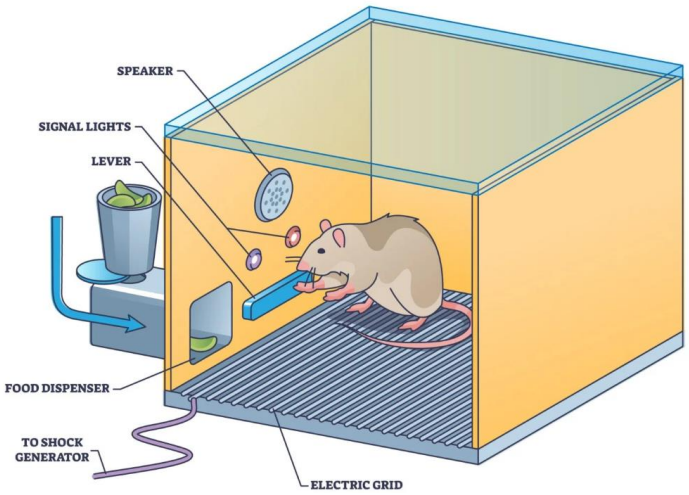
anticipation of food just by looking at the technician who fed that dog.

- This started to fill the cannula even without the actual presence of food. To prove this observation, Pavlov repeated it by giving food with the sound of metronome and then getting salivation from dog by just the sound of metronome. He used various other stimuli like sound of bell, light bulb and coupled with food and repeated the experiment. He got the same result with every neutral stimulus that he coupled with the food. Later he started giving dogs only food, without any coupled stimulus.
- After few days dogs stopped salivating to the coupled stimulus (sound of metronome, sound of bell etc.). They now salivated only at the presence of food. From these findings Pavlov concluded that dogs associated the surrounding stimulus present in the environment with the food and this led to saliva production only for the surrounding stimulus. Pavlov named this Conditioning, which is now known as classical conditioning.
  1) Unconditioned response (salivation) towards food
  2) Acquisition (creating association between sound of bell and food)
  3) Conditioned response (salivation) toward bell

Components of Classical Conditioning

- **Unconditioned Stimulus**: The stimulus, which will naturally produce a response. Now if we consider Pavlov experiment, unconditioned stimulus is represented by food.
- **Unconditioned Response**: The response produced for unconditioned stimulus is unconditioned response. Every time dog sees or eats food, it salivates which in this case is unconditioned response.
- **Neutral Stimulus**: Sound of bell is initially a neutral stimulus with respect to dog salivation. Dogs normally do not produce saliva in response to only ringing a bell.
- **Conditioned Stimulus:** Once the animal associates a neutral stimulus with unconditioned stimulus, it will start giving same response to neutral stimulus as it gave to unconditioned stimulus. Now when bell is rung along with the sight of the food, after a period of time dog will salivate for just the sound of the bell also. At this time point, sound of bell is Conditioned stimulus.

- **Conditioned Response:** Response given by animal towards conditioned stimulus. The saliva produced in response to sound of bell is conditioned response
- **OPERANT CONDITIONING (INSTRUMENTAL CONDITIONING):** This is the type of learning where consequence of a behaviour define whether it will be performed by an animal or not. Animal learns to operate in an environment and behave to either get a reward or to avoid punishment.
- **The Law of Effect:** This principle was first introduced in 1898 by Edward Thorndike, which became foundation for behavioural conditioning. This psychology principle says that the responses which produce desirable results in a given situation will be repeated by an organism and on the other hand responses that lead to undesirable or uncomfortable results will be avoided by animal. B.F. Skinner worked extensively with rats and studied behaviourism. He made a box with various setups to test "The law of effects" on rats. He analyzed the results and termed the learned behaviour as operant conditioning.



- Components of Skinner Box: The Skinner box (also known as operant condition Chamber) is made up of following components:
- A rectangular, properly aired rat cage
- Electrified grid at the base Food pellet Dispenser (on the wall) Response lever Red and green lights Speaker.
- The Skinner's box is used to subject model animal (rats) to various stimuli and record their responses.

- Based of experiments, Skinner identified three categories of responses: Neutral operants: The condition from the environment, which will neither increase nor decrease a behavioural response of an animal.
- **Reinforcer**: The conditions, which either lead to presentation or removal of a stimulus, that causes increase repetition of the behaviour. Punisher: The conditions, which either lead to presentation or removal of a stimulus, that decrease or sometime completely eliminate behavioural response.
- Circadian Rhythms: They are defined as an endogenous rhythm pattern that cycles on a daily (approximately 24 hour) basis under normal circumstances. The name circadian comes from the Latin circa dia, meaning about a day.
- The circadian cycle regulates changes in performance, endocrine rhythms, behavior and sleep timing. More specifically these physiological and behavioral rhythms control the waking/sleep cycle, body temperature, blood pressure, reaction time, levels of alertness, patterns of hormone secretion, and digestive functions.
- Due to the large amount of control of the circadian rhythm cycle it is often referred to as the pacemaker. Two specific forms of circadian rhythms commonly discussed in research are morning and evening types. There is a direct correlation between the circadian pacemaker and the behavioral trait of morning ness-evening ness. People considered morning people rise between 5 a.m. and 7 a.m. go to bed between 9 p.m. and 11 p.m., whereas evening people tend to wake up between 9 a.m. and 11 a.m. and retire between 11 p.m. and 3 a.m.
- The majority of people fall somewhere between the two types. Evidence has shown that morning types have more rigid circadian cycles evening types, who display more flexibility in adjusting to new schedules. One theory is that evening types depend less on light cues from the environment to shape their sleep/wake cycle, and therefore exhibit more internal control over their circadian rhythms.
- A **circannual cycle** is a biological process that occurs in living creatures over the period of approximately one year. This cycle was first discovered by Ebo Gwinner and Canadian biologist Ted Pengelley. It is classified as an **Infradian**

rhythm, which is biological process with a period longer than that of a circadian rhythm, less than one cycle per 28 hours.

- These processes continue even in artificial environments in which seasonal cues have been removed by scientists. The term circannual is Latin, circa meaning approximately and annual relating to one year.
- Chronobiology is the field of biology pertaining to periodic rhythms that occur in living organisms in response to external stimuli such as photoperiod. The location of the physical circannual timer in organisms and how it works are almost entirely unknown.
- In one study performed by Eberhard Gwinner, two species of birds were born in a controlled environment without ever being exposed to external stimuli. They were presented with a fixed Photoperiod of 10 hours of light and 14 hours of darkness each day. The birds were exposed to these conditions for eight years and consistently molted at the same time as they would have in the wild, indicating that this physiological cycle is innate rather than governed environmentally.
- Researchers Ted Pengelley and Ken Fisher studied the circannual clock in the golden-mantled ground squirrel. They exposed the squirrels to twelve hours of light and 12 hours of darkness and at a constant temperature for three years. Despite this constant cycle, they continued to hibernate once a year with each episode preceded by an increase in body weight and food consumption. During the first year, the squirrels began hibernation in late October.
- They started hibernating in mid august and early April respectively for the following two years, displaying a circannual rhythm with a period of about 10 months. A classic example in insects is the varied carpet beetle. Generating biological rhythms internally helps organisms anticipate important changes in the environment before they occur, thus providing the organisms with time to prepare and survive.
- For example, some plants have a very strict time frame in regards to blooming and preparing for spring. If they begin their preparations too early or too late they risk not being pollinated, competing with different species, or other factors that might affect their survival rate. Having a circannual cycle may

keep them from making this mistake if a particular geographic region experiences a false spring, where the weather becomes exceptionally warm early for a short period of time before returning to winter temperatures. Similarly, bird plumage and mammal fur change with the approach of winter, and is triggered by the shortening photoperiod of autumn.

- The circannual cycle can also be useful for animals that migrate or Hibernate. Many animals' reproductive organs change in response to changes in photoperiod. Male gonads will grow during the onset of spring to promote reproduction among the species. These enlarged gonads would be nearly impossible to keep year round and would be inefficient for the species.
- Many female animals will only produce eggs during certain times of the year. Changing climate may unravel ecosystems in which different organisms use different internal calendars. Warming temperatures may lead to earlier blooms of flora in spring. For instance, one study performed by Menzel et al., analyzed 125,000 phenological records of 542 plant species in 21 European countries from 1971 to 2000 and found that 78% of all plants studied advanced in flowering, leafing, and fruiting while only three percent were significantly delayed.
- They determined that the average advance of spring and summer was 2.5 days per decade in Europe. Meanwhile, fauna may breed or migrate based on the length of day, and thus might arrive too late for critical food supplies they co-evolved with.
- For example, the Parus major closely times the hatching of their chicks to the emergence of the protein-rich winter moth caterpillar, which in turn hatches to meet the budding of oaks. These birds are a single-brood bird, meaning they breed once a year with about nine chicks per brood. If the birds and caterpillars and buds all emerge at the right time, the caterpillars eat the new oak leaves and their population increases dramatically, and this hopefully will coincide with the arrival of the new chicks, allowing them to eat.
- But if plants, insects, and birds respond differently to the advance of spring or other phenology changes, the relationship may be altered. As another example, studies of the Pied Flycatcher **(Ficedula hypoleuca**) have shown

that their spring migration timing is triggered by an internal circannual clock that is fine tuned to day length.

- These particular birds overwinter in dry tropical forest in Western Africa and breed in temperate forests in Europe, over 4,500 km away. From 1980-2000, temperatures at the time of arrival and the start of breeding have warmed significantly. They have advanced their mean laying date by ten days, but have not advanced the spring arrival on their breeding grounds because their migration behavior is triggered by photoperiod rather than temperature. In short, even if each individual species can easily live with elevated temperatures, disruptions of phenology timing at ecosystem level may still imperil them.
- **Tidal rhythms :** Many marine organisms that visit or live in the intertidal zone exhibit tidally- organized behavioral rhythms that are, in most cases, endogenous and capable of being entrained by a number of different natural cues.
- For example, the shore crab, fiddler crabs (Uca pugnax; and the American horseshoe crab (Limulus polyphemus) generally express two bouts of activity per day that are associated with high or low tides and can be entrained by water pressure changes. Because of their association with the tides, these periodic bouts of activity are known as tidal rhythms and occur approximately every 12.4 h.
- However, while rhythms have been shown to be under the control of an endogenous timing system in many species, the underlying clock systems that drive these circatidal rhythms are poorly understood and remain controversial.
- The two primary competing theories that have been put forth to explain the underlying clock systems that give rise to these 12.4 h rhythms are: 1) The circatidal oscillator theory, which states that two bouts of activity per day are controlled by one, ~ 12.4 h, circatidal clock and; 2) the circalunidian theory, which states that the two bouts of activity are controlled by two separate, ~24.8 hr, circalunidian (the time between successive moonrises) oscillators. Throughout the years, Palmer, Naylor, and their associates and others gathered evidence that appear to support their respective hypotheses.

- However, the results to date are sufficiently unclear that each has reached opposite conclusions even when using the same data sets.
- In general, these earlier studies made use of data that were often heavily extracted because, it seemed at the time, that circatidal rhythms did not persist for long in constant tidal conditions and were notoriously "noisy".
- Further, because of the issue of a lack of persistence in green crabs, Naylor's results were generally derived from pooled, rather than individual, animals. Fortunately, the more recent discovery of clear, persistent circatidal rhythms in individuals from four intertidal species (Limulus Polyphemus, Eurydice pulchra, Apteronemobius ashania, Dimorphostylis asiatica,) may allow for more definitive evidence.
- Recent studies have demonstrated that horseshoe crabs express robust circatidal rhythms that both persist in constant conditions in the laboratory and can be entrained by artificial tides.
- While some preliminary observations have indicated that their tidal rhythms might be under the control of circalunidian clocks, the results were primarily descriptive. Because of the promising preliminary results, they might serve as a good model system in which to test the circalunidian theory in a more quantified way.
- To accomplish this goal, we measured the locomotor activity rhythms of horseshoe crabs exposed to several types of environmental "perturbations". Overall, we observed a number of characteristics that support the circalunidian oscillator hypothesis in this species: 1) the presence of two peaks of activity per day, each with a different period; 2) "skipping", or the sudden switch from unimodal to bimodal patterns; 3) "splitting", or the separation of one component or bout of activity into two components 4) the ability of animals to entrain to two bouts of activity to two different artificial tides, each with a different period, and further, to anticipate these tidal cue.
- **Lunar rhythms**, or circalunar rhythms, are biological cycles synchronized with the phases of the moon, particularly the 29.5-day lunar cycle. These rhythms are most prominent in marine organisms, especially invertebrates, influencing reproduction and other behaviors. Semilunar rhythms, a subset

of lunar rhythms, occur with a periodicity of 14.76 days, often associated with spring tides during new and full moons.

- **Periodicity:** Lunar rhythms have a period of approximately 29.5 days, corresponding to the time it takes for the moon to orbit the Earth.

- **Examples in Marine Life:**
  - **Palolo worm:** Releases gametes during the neap tides of the last quarter of the moon in October and November.
  - **Tide pool fishes:** Increase foraging activity with the rising tide.
- **Sea anemones:** Expand when immersed by the rising tide.
- **Planktonic foraminifers:** Some species reproduce monthly, triggered by the lunar cycle.
- **Tidal Influence:**

The moon's gravitational pull creates tides, with spring tides (highest high tides and lowest low tides) occurring during full and new moons, and neap tides (least difference between high and low tides) during the first and third quarter moons.

- **Reproduction:**

Many marine organisms synchronize their reproductive cycles with the lunar cycle.

- **Other Influences:**

Lunar rhythms can also influence other biological activities, such as bioluminescence, feeding, and migration.

- **Human Relevance:**

While less obvious in humans, especially in urban environments, moonlight can still influence biological rhythms and behavior, particularly in those living in dark environments.

- **Molecular Mechanisms:**

The mechanisms underlying lunar rhythms are still being investigated, but likely involve both transcriptional and post-transcriptional regulation of gene expression.

- **Chronomedicine** deals with the prevention, causation, diagnosis and treatment of diseases in humans. It particularly focuses on the role time plays in our physiology, endocrinology, metabolism and behaviour.
- Chronomedicine is defined as the application of chronobiology in order to understand the pattern of disease, which can be related to disturbances of circadian rhythm. The field of chronomedicine explores the interaction between biological rhythms, medicine and drugs.
- To make sure that the body has effective amount of drug the medications should be taken regularly. Taking medicines regularly means: taking medications at the proper intervals during the day and taking all the doses every day. Blood pressure medicines are taken at bedtime to lower the blood pressure during night and early morning. Thyroid replacement drugs are recommended to be taken in the morning (dosage adjusted based on the levels of hormones in the blood and the consistency of the medicine being taken).
- Phosphonates which are given to treat and prevent osteoporosis are recommended to be taken in the morning to ensure the medications work more efficiently.
- **Chronotherapy** is a behavioral technique in which bedtime is systematically delayed, which follows the natural tendency of human biology. It can be used for people having delayed sleep phase disorder.
- Here the bedtime is delayed by 3-hour increments each day, by establishing a 27-hour day. This process is done till the person's desired bedtime is reached or the normal schedule is established. Chronotherapy is effective when a person sleeps for several hours. It requires no drugs.
- The prediction of chronotherapy is easy because it possess beginning, middle and end stage. Chronotherapy provides the patient a period to adjust psychologically if their sleep is disturbed.
- To avoid the side effects the person needs to regularly consult the doctor and sleep specialists. Sometimes the patient experiences sleep deprivation and the degree of risk is unknown.

- Chronotherapy can also be used in the treatment of various diseases like hypertension, bronchial, asthma, peptic ulcer, myocardial infarction, arthritis, cerebrovascular accidents and hypercholesterolemia.

MCQ Based on Unit VI

Q. 1. Which of the following best describes the primary focus of early ethology?

a. Studying animal behavior in laboratory settings.
b. Investigating the genetic basis of behavior.
c. Analyzing instinctive and fixed-action patterns in natural environments.
d. Examining the cognitive abilities of animals.

Answer: c

Q. 2. In what decade did ethology as a distinct field of study emerge?

a. 1900s

b. 1910s,

c. 1930s,

d. 1950s.

Answer: c

Q. 3. Which of the following individuals is considered a founder of ethology?

a. B.F. Skinner

b. Ivan Pavlov

c. Konrad Lorenz

d. Albert Bandura.

Answer: c

Q. 4. Niko Tinbergen, a key figure in ethology, proposed "Tinbergen's Four Questions." Which of the following is NOT one of them?

a. Causation

b. Ontogeny

c. Evolution

d. Socialization.

Answer: d

Q. 5. Charles Darwin's 1872 book, "The Expression of the Emotions in Man and Animals," is considered influential in the field of ethology because:

a. It focused on animal learning through conditioning.
b. It explored the evolutionary basis of behavior and emotions.
c. It introduced the concept of fixed-action patterns.
d. It emphasized the role of the environment in shaping behavior.

Answer: b

Q. 6. The study of animal behavior

a. etiology

b. psychology

c. ethology

d. parapsychogy

Answer: c

Q. 7. An example of associative learning would be -

a. classical conditioning

b. operant conditioning

c. Pavlovian conditioning

d. all of the above

Answer: d

Q. 8. A songbird that hears the songs of of other species as well as its own-

a. will sing the song of its own species, but needs practice

b. will instinctively sing the song of its species perfectly

c. will sing other songs as well as its own

d. will be confused and not master any song

Answer: a

Q. 9. The level of specificity of signals may be-

a. species-specific

b. individually specific

c. anonymous

d. all of the above

Answer. a

Q. 10. Increased response to an increase in light intensity is called

a. positive phototaxis

b. kinesis

c. negative phototaxis

d. luminis

Answer. a

Q. 11. Which of the following is an example of a question about the ultimate causation of a behavior?

a. What muscles are involved when a hummingbird hovers over a flower?

b. When is the critical period for imprinting in young goats?

c. Which hormones must be present at what levels to make a female lizard receptive to male courtship?

d. all of the above

Answer. c

Q. 12. Which of the following involves trial-and-error learning?

a. habituation

b. classical conditioning

c. sensitization

d. operant conditioning

Answer. d

Q. 13. Human behavior, like other mammalian behavior, is determined

a. strictly by the genes

b. strictly by Learning

c. by a mix. of genes and Learning

d. None of above

Answer. c

Q. 14. Learning to not respond to a stimulus is called

a. imprinting

b. sensitization

c. kinesis

d. habituation

Answer: d

Q. 15. A goose retrieving a stray egg and rolling it back into its nest is an example of

a. instinctive behavior

b. operant conditioning

c. associative behavior

d. learning preparedness

Answer: a

Q. 16. A "Skinner box" is used for experiments in

a. classical conditioning

b. operant conditioning

c. migration

d. taxis

Answer. b

Q. 17. Which of the following statements is true?

a. Animals can learn to associate any stimuli using classical conditioning.

b. Animals are innately programmed to learn some things more easily than

c. Instinctive learning programs explain why most people speak only one language.

d. all of the above

Answer. b

Q. 18. Which of the following statements is true?

a. Animals can learn to associate any stimuli using classical conditioning.

b. Animals are innately programmed to learn some things more easily than others.

c. Instinctive learning programs explain why most people speak only one language.

d. all of the above

Answer: b

Q. 19. A rat that is "maze-dull"

a. will pass on that trait to its offspring

b. can never learn anything else either

c. both of the above

d. None of these

Answer. a

Q. 20. Chemical signals between individuals of the same species are called

a. endogenous

b. hormones

c. kineses

d. Pheromones

Answer. d

Q. 21. The component of an animal's nervous system that provides the instruction for carrying out a particular fixed action pattern is called a(n)

a. sign stimulus

b. stimulus/response chain

c. innate releasing mechanism

d. suprachiasmatic nuclei

Answer. c

Q. 22. All the thousands of human languages are based on the same set of how many consonant sounds?

a. 40

b.20

c. 50

d. 450

Answer. a

Q. 23. How many of the basic consonant sounds can a normal human baby distinguish?

a. all of them

b. half of them

c. only 1

d. it depends on the child's ethnic background

Answer. a

Q.24.A sensitive phase and critical period are associated with what type of behavior?

a. cognitive

b. kinesis

c. taxis

d. imprinting

Answer. d

Q. 25. Which of the following animals is a brood parasite?

a. lovebirds

b. Anolis lizards

c. fruit flies

d. cuckoos

Answer. d

Q. 26. The biological clock of mammals is located in the

a. suprachiasmatic nuclei of the hypothalamus

b. suprachiasmatic nuclei of the pineal gland

c. melatonin of the pineal gland

d. androgens of the gonads

Answer. a

Q. 27. Dog salivating at the sound of a can opener.

a. classical conditioning

b. fixed-action pattern

c. habituation

d. operant conditioning

Answer. a

Q. 28. Humans ignoring night sounds while asleep.

a. classical conditioning

b. fixed-action pattern

c. habituation

d. operant conditioning

Answer. c

Q. 29. A goose retrieves eggs that have rolled out of the nest with a stereotyped movement.

a. classical conditioning

b. fixed-action pattern

c. habituation

d. operant conditioning

Answer. b

Q 30. A rat in a box learns to associate pressing a lever with obtaining food.

a.Classical conditioning

b. FAP

c. Operont Conditioning

d. None of these

Answer. c

Q. 31. Courtship behaviors in animals involve all of the following except:

a. visual cues

b. acoustic signals

c. chemical signals

d. auditory cues

e. All the above

Answer. e

Q. 32. The behavior in which one animal is aggressive or attacks another animal, the other responds by returning the aggression or submitting is called

a. agnostic

b. Territory

c. Hierarchy

d. Altruism

Answer. a

Q. 33. The organization of group of animals in such a way that some members of the group have greater access to resources like food or mates than others is called:

a. agnostic

b. Altruism

c. Territory

d. Hierarchy

Answer. d

Q.34. The interaction in which an individual gives up or sacrifices some of its own reproductive potential to benefit another individual is called

a. agnostic

b. Territory

c. Hierarchy

d. Altruism

Answer. d

Q. 35. The site defend by territorial animal by agonistic behavior is-

a. Altruism

b. Territory

c. Hierarchy

d. Agnostic

Answer. b

Q. 36. Which of these stimuli is most likely to trigger hibernation behavior?

a. Lack of food

b. Shorter days

c. Higher temperatures

d. Reduced heartbeat

Answer. b

Q. 37. What do animals try to avoid when foraging?

a. Herbivores

b. Omnivore

c. Prey

d. Predator

Answer. c

Q. 38. Altruism is most likely to happen-

a. When the risk of predation is high

b. When the risk of predation is low

c. Between animals that are closely related

d. Between animals that are not related at all

Answer. c

Q. 39. In addition to advertising to mates, why might animals be brightly colored?

a. To warn potential predators of an animal's toxicity

b. To be camouflaged

c. To attract potential mate

d. To tell other animals where food is

Answer. c

Q. 40. Which phrase best describes an instinctive beahavior?

a. Typically innate and relatively inflexible

b. Usually performed incorrectly for the first time

c. Generally learned, flexible, and cumulative

d. Often occurs where mistakes are not costly

Answer. a

Q. 41. Animals are able to adapt to new situations because they can learn to

a. Imprint on individuals

b. Modify their behaviors

c. Imitate their parents

d. Perform innate behaviors

Answer. a

Q. 42. Which of the following best describes a circadian rhythm?

a. A 12-hour biological cycle.

b. A 48-hour biological cycle.

c. A 24-hour biological cycle.

d. The rotation of the Earth around the sun.

Answer: c

Q. 43. What is the body's primary circadian pacemaker?

a. The pineal gland.

b. The hypothalamus.

c. The suprachiasmatic nucleus (SCN).

d. The amygdala.

Answer: c

Q.44. What is the main function of circadian rhythms?

a. To regulate body temperature.
b. To control the sleep-wake cycle and synchronize other biological processes.
c. To affect hormone release.
d. All of the above.

Answer: d

Q. 45. Which of the following factors can affect the circadian rhythm?
a. Light exposure
b. Caffeine intake
c. Physical activity
d. All of the above

Answer: d

Q.46. Melatonin, a hormone that helps regulate sleep, is primarily released during which part of the day?
a. Morning.
b. Afternoon.
c. Evening.
d. Night.

Answer: d

Q. 47. Which of the following is NOT a consequence of disrupting your circadian rhythm?

a. Difficulty falling asleep and staying asleep.

b. Increased alertness and energy.

c. Mood changes.

d. Digestive problems.

Answer: b

Q. 48. What is the term for the study of circadian rhythms?

a. Chronobiology

b. Chronometry

c. Chronotherapy

d. Chronopharmacology

Answer: a

Q. 49. What is the approximate duration of a typical circadian rhythm?

a. 12 hours

b. 24 hours

c. 36 hours

d. 48 hours

Answer: b

Q. 50. What is a key role of light in regulating the circadian rhythm?

a. It inhibits the release of melatonin.

b. It stimulates the SCN, which then signals the pineal gland to release melatonin.

c. It has no effect on the circadian rhythm.

d. It directly triggers sleep.

Answer: b

Q. 51. Which of the following is NOT an example of a process governed by circadian rhythms?

a. The sleep-wake cycle.
b. Body temperature fluctuations.
c. Muscle growth.
d. Hormone secretion.

Answer: c

Q. 52. Which of the following best describes biological rhythms?

a. Random fluctuations in an organism's physiology and behavior
b. Naturally occurring cycles of physiological and behavioral changes in living organisms, often synchronized with external cues
c. Only related to sleep-wake cycles
d. Independent of an organism's internal clock

Answer. b

Q. 53. What is the primary classification of biological rhythms based on?

a. The organism's size
b. The length of their cycle
c. The type of organism
d. The environment they live in

Q. b

Q.54. Which type of biological rhythm lasts approximately 24 hours?

a. Ultradian
b. Infradian

c. Circadian

d. Circannual

Answer. c

Q.55. Which of the following is an example of a circadian rhythm?

a. Hibernation

b. Menstrual cycle

c. Sleep-wake cycle

d. Migration

Answer. c

Q. 56. What is the name of the biological rhythm with a cycle longer than 24 hours?

(a) Circadian

(b) Ultradian

(c) Infradian

(d) Diurnal

Answer. c

Q. 57. What is the role of the suprachiasmatic nucleus (SCN) in biological rhythms?

a. It regulates body temperature.

b. It is the main circadian clock in mammals.

c. It controls hormone secretion.

d. It is responsible for muscle movement.

Answer. b

Q. 58. What is the primary external cue that synchronizes the brain's circadian rhythm?

a. Sound

b. Temperature

c. Light and darkness

d. Food intake

Answer. c

Q. 59. Which organ is associated with the production of melatonin, a hormone related to sleep-wake cycles?

a. Pituitary gland

b. Pineal gland

c. Thyroid gland

d. Thymus gland

Answer. b

Q. 60. What can disrupt a healthy circadian rhythm?

a. Regular exercise

b. Consistent sleep schedule

c. Exposure to artificial light at night

d. Spending time outdoors during the day

Answer. c

Q.61. Chronomedicine is the study of:

a. The effects of drugs on the body

b The impact of the body's internal clock on health and disease

c. The diagnosis of sleep disorders

d. The use of light therapy for mental health

Answer. b

Q. 62. The body's internal clock, or circadian rhythm, primarily regulates:

a. Heart rate
b. Sleep-wake cycle and other physiological processes
c. Blood pressure
d. Digestive system

Answer. b

Q. 63. Chronotherapy is a treatment approach that involves:

a. Administering medication based on the patient's age
b. Administering medication based on the patient's weight
c. Administering medication based on the patient's biological rhythms
d. Administering medication based on the patient's gender

Answer. c

Q. 64. Chronopharmacology focuses on:

a. The study of how drugs affect the brain
b. The study of how the time of day affects drug response
c. The study of drug interactions
d. The study of drug metabolism

Answer. b

Q. 65. Which of the following is NOT a type of chronotherapy?

a. Bright light therapy
b. Wake therapy/sleep deprivation therapy

c. Drug therapy

d. Surgery

Answer. d

Q. 66. Chronotherapy can be used to treat conditions like:

a. Hypertension and asthma

b. Cancer and heart disease

c. Ulcers and heart attacks

d. All of the above

Answer. d

Q. 67. The body's biological clock is located in the:

a. Liver

b. Heart

c. Suprachiasmatic nucleus (SCN) in the hypothalamus

d. Kidneys

Answer. c

Q.68. Chronotherapy aims to:

a. Increase treatment effectiveness

b. Reduce side effects of medication

c. Both a and b

d. Neither a nor b

Answer. c

Q. 69. Triple chronotherapy involves:

a. Administering three different medications at once

b. Adjusting the timing of sleep, light exposure, and medication

c. Focusing on three different diseases simultaneously

d. None of the above

Answer. b

Q.70. Recent advances in chronomedicine include:

a. Development of drug delivery systems that match circadian rhythms

b. Gene therapy for sleep disorders

c. Artificial intelligence for medical diagnosis

d. Robotic surgery for all diseases

Answer. a

Unit VII

Introduction to Wild Life

● Values of wild life - positive and negative; Conservation ethics; Importance of conservation; Causes of depletion; World conservation strategies.

- ❖ Wildlife holds both positive and negative values for humans. Positively, wildlife contributes to ecosystems, provides resources like food and medicine, and offers recreational and aesthetic value. Negatively, wildlife can pose risks through attacks, spread of diseases, or damage to crops and property.

Positive Values:

- ❖ Ecological Balance:

Wildlife plays a crucial role in maintaining healthy ecosystems by pollinating plants, dispersing seeds, controlling populations, and cycling nutrients.

- ❖ Economic Value:

Wildlife provides resources like food (hunting, fishing), materials (fur, hides), and opportunities for tourism and recreation (ecotourism, hunting).

- ❖ Medicinal and Scientific Value:

Many medicines are derived from plants and animals, and wildlife is used in scientific research to study diseases and develop treatments.

- ❖ Cultural and Aesthetic Value:

Wildlife inspires art, literature, and spirituality, and its presence adds to the beauty and diversity of the natural world.

- ❖ Ecosystem Services:

Wildlife contributes to soil health, water purification, and climate regulation, among other essential services.

Negative Values:

- ❖ Human-Wildlife Conflict:

Wildlife can attack humans, livestock, or damage crops, leading to injuries, fatalities, or economic losses.

- Disease Transmission:

  Some wildlife can carry and transmit diseases that can affect humans or livestock.

- Damage to Property and Infrastructure:

  Animals can damage crops, infrastructure, and property, leading to financial burdens for individuals and communities.

- Competition for Resources:

  In some cases, wildlife may compete with humans for resources like water or grazing land.

- Impact on Tourism:

  While tourism can be a positive economic driver, excessive or poorly managed tourism can negatively impact wildlife and their habitats.

  - **Conservation ethics** for wildlife encompasses the moral principles that guide human interactions with wild animals and their habitats, aiming to ensure their well-being and survival.
  - This involves considering the intrinsic value of wildlife, promoting biodiversity, and minimizing human-caused harm. Sources on ethics in wildlife management and conservation say that these ethics also involve minimizing human interference in natural processes and addressing the ethical dimensions of wildlife management decisions.

Key aspects of wildlife conservation ethics include:

- Respect for intrinsic value:

  Recognizing that wildlife has inherent worth, regardless of its usefulness to humans.

- Minimizing harm:

  Reducing human-caused threats to wildlife, such as habitat destruction, pollution, and hunting.

- Promoting biodiversity:

  Conserving the variety of life on Earth, including all species and ecosystems.

- Ethical management:

  Ensuring that wildlife management practices are humane, scientifically sound, and consider the welfare of individual animals.

- Addressing human-wildlife conflict:

  Finding sustainable solutions that balance the needs of both humans and wildlife.

- Promoting coexistence:

  Fostering a society where humans and wildlife can live together harmoniously.

Different ethical perspectives on wildlife conservation:

- Anthropocentrism:

  Focuses on human well-being and uses wildlife as a resource. This perspective may prioritize human needs over wildlife conservation.

- Biocentrism:

  Values all living things equally and emphasizes the interconnectedness of all life. This perspective supports the protection of wildlife for its own sake.

- Ecocentrism:

  Focuses on the well-being of ecosystems and the environment as a whole. This perspective recognizes the importance of biodiversity and ecosystem health for both humans and wildlife.

Ethical considerations in wildlife management:

- The use of lethal control: Should animals be killed to protect human interests or other wildlife?
- The role of zoos and captivity: Are these institutions ethically justifiable, and if so, under what conditions?
- The impact of human activities on wildlife: How can we minimize the negative consequences of human actions on wildlife populations and habitats?

- The responsibility of humans to protect endangered species: What are our moral obligations to prevent extinction?
- The potential for conflicts between different ethical perspectives: How can we reconcile competing values and find solutions that are both ethically sound and practically feasible?
    - Conservation ethics are essential for guiding human actions towards wildlife and ensuring the long-term survival of both individual species and the ecosystems they inhabit. By considering the ethical implications of our actions, we can make more informed decisions and promote a more sustainable and harmonious relationship between humans and the natural world.
    - Wildlife conservation is crucial for maintaining healthy ecosystems, preserving biodiversity, and ensuring the well-being of both humans and the natural world.
    - It involves protecting wild animals and plants, along with their habitats, to prevent extinction and maintain ecological balance. Effective conservation efforts benefit humans through ecosystem services, economic opportunities, and cultural enrichment.

Key Reasons for Wildlife Conservation:

- Biodiversity:

  Wildlife conservation helps preserve the variety of species on Earth, ensuring the stability of ecosystems and preventing the extinction of endangered species.

- Ecosystem Services:

  Wildlife plays vital roles in pollination, nutrient cycling, and pest control, all of which are essential for healthy ecosystems and human well-being.

- Climate Regulation:

  Healthy ecosystems with diverse wildlife help regulate the climate by capturing carbon and buffering against extreme weather events.

- Human Health:

Protecting wildlife and their habitats can reduce the risk of disease transmission and ensure access to clean air and water.

- Economic Benefits:

  Wildlife conservation supports tourism, providing jobs and revenue for local communities, and enables sustainable resource management.

- Cultural Significance:

  Wildlife and their habitats are often integral to cultural heritage and provide inspiration for art, literature, and spiritual practices.

- Future Generations:
  Conservation efforts ensure that future generations can enjoy the benefits of a healthy planet and its diverse wildlife.

Examples of Conservation Efforts:

- Habitat Protection:

  Establishing protected areas like national parks and wildlife sanctuaries to safeguard critical habitats.

- Species-Specific Conservation:

  Implementing programs to protect endangered species, such as breeding in captivity and reintroduction into the wild.

- Combating Poaching:

  Enacting stricter laws and implementing anti-poaching patrols to protect vulnerable species from illegal hunting.

- Promoting Sustainable Practices:

  Encouraging responsible tourism, reducing waste, and supporting sustainable resource management.

- Public Awareness:
  Educating the public about the importance of wildlife conservation and encouraging participation in conservation efforts.

- By understanding the interconnectedness of all living things and the crucial role wildlife plays in maintaining healthy ecosystems, we can work towards a future where both humans and wildlife can thrive.

Wildlife depletion is primarily caused by habitat destruction, overexploitation, and climate change. Human activities like deforestation, pollution, and overhunting are major drivers, alongside invasive species and the illegal wildlife trade.

1. Habitat Loss and Degradation:

- Deforestation:

  Clearing forests for agriculture, timber, and urbanization reduces the area available for wildlife to live and thrive, according to a presentation on SlideShare.

- Habitat Fragmentation:

  Dividing habitats into smaller, isolated patches makes it harder for species to find food, mates, and suitable living conditions, according to Wikipedia.

- Urbanization:

  Expanding cities and infrastructure development encroach on natural habitats.

- Agriculture:

  Conversion of natural land for farming and livestock grazing reduces wildlife habitat.

- Pollution:

  Pollution of air, water, and soil contaminates habitats and harms wildlife.

2. Overexploitation:

- Overhunting and Poaching:

  Hunting for food, sport, or trade can decimate animal populations, especially when combined with habitat loss.

- Overfishing:

Unsustainable fishing practices deplete fish populations and disrupt marine ecosystems.

- Illegal Wildlife Trade:
  The trade in endangered species and their parts (e.g., ivory, rhino horn) fuels poaching and endangers populations.

3. Climate Change:

- Shifting Habitats:

  Rising temperatures and changing weather patterns can make existing habitats unsuitable for certain species, forcing them to migrate or face decline.

- Extreme Weather Events:
  Increased frequency and intensity of droughts, floods, and storms can directly kill wildlife and destroy habitats.

4. Other Factors:

- Invasive Species:

  Non-native species can outcompete native wildlife for resources or prey on them, disrupting ecosystems, according to Wikipedia.

- Disease:
  Outbreaks of disease can have devastating effects on vulnerable wildlife populations, according to Quora.

5. Human Population Growth:

- Increased Demand for Resources: A growing human population puts greater pressure on natural resources, leading to increased deforestation, habitat destruction, and overexploitation.
  - World conservation of wildlife involves protecting wild animals, plants, and their habitats to ensure their survival and the health of ecosystems. This includes addressing threats like habitat destruction, overexploitation, and climate change. International agreements, governmental efforts, and non-governmental organizations (NGOs) all play a role in these conservation efforts.

Key Aspects of Wildlife Conservation:

- **Protecting Habitats:**

  Ensuring the survival of species often means safeguarding their natural environments, including forests, wetlands, and grasslands.

- **Combating Threats:**

  Addressing issues like poaching, illegal wildlife trade, pollution, and the impacts of climate change is crucial.

- **Promoting Sustainable Practices:**

  Conservation involves finding ways for humans to interact with nature in a way that doesn't harm wildlife or ecosystems.

- **Raising Awareness:**

  Educating the public about the importance of wildlife and the threats they face is essential for fostering support for conservation.

- **International Cooperation:**

  Many conservation challenges require collaboration between countries to protect migratory species and address transboundary issues.

Organizations and Initiatives:

- **IUCN (International Union for Conservation of Nature):**

  This organization plays a vital role in assessing the conservation status of species and advocating for conservation action.

- **WWF (World Wildlife Fund):**

  WWF works on a wide range of conservation projects, from protecting specific species to promoting sustainable development.

- **CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora):**

  This agreement regulates the international trade of endangered species to prevent overexploitation.

- **UN World Wildlife Day:**

  Celebrated annually on March 3rd, this day aims to raise awareness about the importance of wildlife conservation.

- **National Wildlife Federations:**

  Organizations like the National Wildlife Federation focus on protecting wildlife within specific countries or regions.

The Importance of Conservation:

- **Ecological Balance:**

  Wildlife plays a vital role in maintaining healthy ecosystems, influencing everything from nutrient cycling to pollination.

- **Human Well-being:**

  Wildlife provides us with food, medicine, and other resources, and also contributes to our cultural and spiritual well-being.

- **Future Generations:**

  Conserving wildlife ensures that future generations can experience the beauty and wonder of the natural world.

MCQ based on Unit VII

Q.1. Which of the following is a major threat to wildlife conservation?

a. Sustainable land use practices
b. Habitat loss and fragmentation
c. Protected areas and reserves
d. Community-based conservation projects

Answer: b

Q. 2. What is the primary goal of "Project Tiger"?

a. To protect all endangered species
b. To conserve tigers and their habitats
c. To promote ecotourism in tiger reserves
d. To control tiger populations

Answer: b

Q. 3. Which of the following is NOT a benefit of protected areas for wildlife?

a. Preserving biodiversity
b. Providing habitat for endangered species
c. Increasing human settlement
d. Preventing poaching and illegal hunting

Answer: c

Q.4. What is a Biosphere Reserve?

a. An area strictly for research purposes
b. A protected area for conserving biodiversity and local communities

c. A zoo exhibiting endangered species

d. A forest area with no human presence

Answer: b

Q.5. What is the main purpose of a Wildlife Sanctuary?

a. To protect specific endangered species

b. To provide a safe haven for all wildlife

c. To promote tourism in wildlife areas

d. To study animal behavior

Answer: b

Q. 6. Which of the following is a significant factor contributing to wildlife decline?

a. Reforestation efforts

b. Sustainable agriculture

c. Climate change

d. Conservation initiatives

Answer: c

Q. 7. What does the term "buffer zone" in a protected area refer to?

a. An area with strict regulations and no human activity

b. An area surrounding the core zone, offering protection to biodiversity

c. An area for recreational activities like camping

d. An area for commercial logging

Answer: b

Q.8. What is the main goal of ecotourism in wildlife conservation?

a. To maximize profits for tourism companies
b. To promote wildlife conservation through responsible tourism
c. To encourage hunting of wild animals
d. To convert natural habitats into tourist resorts

Answer: b

Q.9. Which of the following is an example of a human-wildlife conflict?

a. Animals migrating to new areas
b. Animals adapting to new environments
c. Animals attacking humans or livestock
d. Animals being protected in their natural habitat

Answer: c

Q. 10. Which of the following is a way to support wildlife conservation?

a. Supporting illegal wildlife trade
b. Reducing your carbon footprint
c. Promoting deforestation
d. Using single-use plastics

Q. 11. What is called for any interaction between humans and wildlife that result in negative impacts on cultural life or on the environment?
a. Human-wildlife interactions
b. Human-wildlife services
c. Human-wildlife adjustment
d. Human-wildlife conflict

Answer. d

Q. 12. Which one of the following is the cause for man-wildlife conflicts?

a. Reduction in the availability of natural food resources

b. Increase in the forest area

c. Adequate rainfall

d. Curiosity of wildlife animals that leads for the invasion to outside the forest area

Answer. a

Q. 13. Which one of the following is not the outcome of man-wildlife conflict?

a. Damage to human property

b. Increase in the forest area

c. Injury and loss of life of humans and wildlife

d. Destruction of habitat

Answer. b

Q. 14. Which one of the following is a way to reduce human-wildlife conflict?

a. Killing all the wild animals

b. Shifting all the wild animals from natural forests to zoo

c. Use of strobe lights

d. Kill the animals when they invade outside the forests

Answer. c

Q. 15. What is called for the natural habitats under in-situ conservation?

a. Unprotected areas

b. Depleted areas

c. Exploited areas

d. Protected areas

Answer. d

Q. 16. Which one of the following is the way for conservation of biodiversity?

a. Increase in the pollution level in the ecosystem

b. Converting forest land into agricultural land in rapid way

c. Removal of exotic species

d. Overexploitation

Answer. c

Q. 17. What is a primary benefit of wildlife conservation?

a. Promoting urbanization

b. Preserving ecosystems and habitats

c. Increasing agricultural land

d. Enhancing deforestation

Answer: b

Q 18.How does wildlife contribute to human well-being?

a. By increasing pollution levels

b. By providing food, medicinal resources, and genetic resources

c. By reducing tourism opportunities

d. By promoting deforestation

Answer: b

Q. 19. What does the Red Data Book represent?

a. List of endangered species

b. List of invasive species

c. List of common species

d. List of extinct species

Answer: a

Q 20. Which of the following is a major threat to biodiversity?

a. Reduction in tree cutting

b. Increase in tree numbers

c. Climate change

d. Balanced predator-prey relationships

Answer: c

Q 21. What is the main role of a Wildlife Sanctuary?

a. To protect habitats for wildlife.

b. To promote urbanization.

c. To increase deforestation.

d. To enhance agricultural activities.

Answer: a

Q 22. Which of the following is NOT a primary goal of wildlife conservation?

a. Protecting endangered species

b. Maintaining biodiversity

c. Eliminating human-wildlife conflict

d. Promoting sustainable use of resources

Answer: c

Q 23. What does the term "anthropocentric" mean in the context of wildlife conservation ethics?

a. A focus on the intrinsic value of nature

b. A perspective that prioritizes human needs and interests above all else

c. A belief that all living things have equal value

d. A focus on the aesthetic value of nature

Answer: b

Q 24. Which of the following is an example of ex situ conservation?

a. Protecting a forest ecosystem

b. Establishing a national park

c. Creating a wildlife sanctuary

d. Keeping endangered species in a zoo or botanical garden

Answer: d

Q 25. What is the main ethical concern with wildlife tourism?

a. It can generate revenue for conservation efforts

b. It can educate people about wildlife

c. It can lead to habitat destruction and disturbance of wildlife

d. It can provide employment opportunities

Answer: c

Q 26. Which of the following is NOT a threat to biodiversity?

a. Habitat loss and fragmentation

b. Overexploitation of resources

c. Introduction of invasive species

d. Sustainable resource management

Answer: d

Q 27. What does "the precautionary principle" suggest in the context of wildlife conservation?

a. Proceed with caution when human actions might harm wildlife or ecosystems
b. Act quickly to exploit natural resources before they are depleted
c. Prioritize economic development over environmental protection
d. Assume that human actions have no impact on the environment
Answer: a

Q 28. What is the core idea behind the concept of "wilderness" in conservation?

a. Areas undisturbed by human activity
b. Areas with high biodiversity
c. Areas with recreational value
d. Areas that are easily accessible for tourism
Answer: a

Q 29. What is a "biodiversity hotspot"?

a. An area with low species diversity
b. An area where ecosystems are relatively stable
c. An area with a high concentration of endemic species and facing significant threats
d. An area with a high level of human activity
Answer: c

Q 30. What is the ethical justification for protecting endangered species?

a. They are important for maintaining ecosystem health
b. They have economic value
c. They are beautiful and aesthetically pleasing
d. All of the above

Answer: d

Q . 31. Which of the following is a major cause of wildlife depletion?

a. Conservation efforts
b. Habitat destruction
c. Captive breeding programs
d. Protected areas

Answer: b

Q 32. The illegal hunting and killing of wild animals for profit is known as:

a. Poaching
b. Ecotourism
c. Sustainable harvesting
d. Captive breeding

Answer: a

Q 33. Which of the following is a consequence of wildlife depletion?

a. Increased biodiversity
b. Ecosystem stability
c. Species extinction
d. Natural habitat preservation

Answer: c

Q 34. Climate change is a threat to wildlife because:

a. It leads to increased rainfall, which is beneficial for all species
b. It alters habitats, making them unsuitable for certain species
c. It increases the availability of food for all animals
d. It has no impact on wildlife populations

Answer: b

Q 35. Which of the following is NOT a factor contributing to the depletion of wildlife?

a. Overexploitation of resources
b. Sustainable farming practices
c. Pollution
d. Climate change

Answer: b

Q. 36. Which of the following is NOT a reason why some animals are poached?
a. Tiger: skin and bones
b. Elephant: ivory
c. Rhino: horn
d. Deer: antlers
Answer: d

Q 37. Which of the following is a method of sustainable forest management?
a. Felling of trees
b. Categorizing forests under reserved forests
c. Logging woods for industrial usage
d. Making the government a stakeholder in forest management
Answer: b

Q 38. What is the acronym "HIPPO" used to describe?
a. Habitat destruction, Invasive species, Pollution, Population, and Over-harvesting
b. Habitats, Interactions, Plants, Populations, and Organizations
c. Human interference, Invasive plants, Pollution, Predators, and Over-hunting
d. Herbicides, Insects, Pollution, Predators, and Overgrazing
Answer: a

Q 39. What is the main goal of wildlife conservation?

a. To eliminate all predators

b. To increase the number of exotic species

c. To support the survival of wildlife and educate others about sustainable practices

d. To convert natural habitats into human settlements

Answer: c

Q 40. Which of the following is an example of an endangered species?

a. Blue sheep

b. Asiatic elephant

c. Gangetic dolphin

d. All of the above

Answer: d

Q 41. What is the theme for World Wildlife Day 2024?

a. Protecting endangered species

b. Exploring digital innovation in wildlife conservation

c. Reducing pollution in wildlife habitats

d. Increasing human-wildlife interaction

Answer: b

Q 42. Namdapha Tiger Reserve is located in which state?

a. Madhya Pradesh

b. Arunachal Pradesh

c. Assam

d. West Bengal

Answer: b

Q 43. Which of the following is NOT a type of forest in India?

a. Reserved forests

b. Protected forests

c. Unclassed forests

d. Open forests

Answer: d

Q 44. What is the most important human activity that causes the extinction of wildlife?

a. Hunting valuable wildlife products

b. Introducing alien species

c. Destruction and alteration of natural habitats

d. Wildlife pollution

Answer: c

Q 45. Which of the following is NOT a method of wildlife conservation?

a. In-situ conservation

b. Ex-situ conservation

c. Habitat destruction

d. Sustainable forest management

Answer. c

Q 46. . Which of the following best describes the ethical principle of "biocentric egalitarianism" in wildlife conservation?

a .Prioritizing human needs and interests above all else.

b. Recognizing the inherent value of all living beings, including wildlife, regardless of their usefulness to humans.

c. Focusing on the conservation of endangered species only.

d. Using wildlife for human benefit as long as it doesn't cause extinction.

Answer: b

Q 47. What is the main ethical concern associated with trophy hunting?

a. It helps control animal populations.
b. It provides economic benefits to local communities.
c. It involves the intentional killing of animals for sport and display.
d. It can lead to the extinction of certain species.

Answer: c

Q 48. Which of the following is NOT an example of in-situ conservation?

a.Establishing a national park.

a. Creating a wildlife sanctuary.
b. Captive breeding of endangered animals in a zoo.
c. Protecting a forest area from logging.

Answer: c

Q 49. What is the primary ethical justification for reintroducing a species to a habitat where it has been extirpated?

a. To increase tourism revenue.
b. To restore ecological balance and functionality.
c. To provide more hunting opportunities.
d. To create a more aesthetically pleasing landscape.

Answer: b

Q. 50. What does the term "wildlife corridor" refer to in the context of conservation ethics?

a. A strip of land cleared for agriculture.
b. A protected area for endangered species.
c. A pathway connecting fragmented habitats to facilitate movement and gene flow.
d. A hunting ground for recreational purposes.

Answer: c

Unit VIII

Protected areas

● National parks & sanctuaries, Community reserve; important features of protected areas in India;

Tiger conservation - Tiger reserves in India; Management challenges in Tiger reserve

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- **National Parks and Wildlife Sanctuaries** are designated areas for protecting biodiversity, but they differ in their scope and management. National parks protect the entire ecosystem, including flora, fauna, and landscape, while wildlife sanctuaries primarily focus on the protection of specific animal species and their habitats. There are numerous National Parks and Wildlife Sanctuaries across India, each with unique characteristics and conservation priorities.

National Parks:

- Protect the entire ecosystem, including flora, fauna, and landscape.
- Activities like grazing, forestry, and private land ownership are restricted or prohibited.
- Examples include Jim Corbett National Park (Uttarakhand), Kaziranga National Park (Assam), and Bandhavgarh National Park (Madhya Pradesh).

Wildlife Sanctuaries:

- Focus on the protection of specific animal species and their habitats.
- Some human activities like grazing may be permitted under regulated conditions.
- Examples include Chambal Wildlife Sanctuary (Madhya Pradesh, Uttar Pradesh, Rajasthan), Gajner Wildlife Sanctuary (Rajasthan), and Mayani Bird Sanctuary (Maharashtra).
- Jim Corbett National Park (Uttarakhand): Known for its tiger population and diverse wildlife.
- Kaziranga National Park (Assam): Famous for the one-horned rhinoceros.
- Bandhavgarh National Park (Madhya Pradesh): A prominent tiger reserve with a high density of tigers.

- ❖ Ranthambore National Park (Rajasthan): Known for its freely roaming tiger population and historical significance.
- ❖ Tadoba National Park (Maharashtra): A popular tiger reserve in Maharashtra.

Wildlife Sanctuaries:

- ❖ Chambal Wildlife Sanctuary (Madhya Pradesh, Uttar Pradesh, Rajasthan): Focuses on the conservation of the critically endangered Gharial (a type of crocodile).
- ❖ Gajner Wildlife Sanctuary (Rajasthan): A haven for various bird species and animals like blackbuck, chinkara, and wild boar.
- ❖ Mayani Bird Sanctuary (Maharashtra): A popular destination for birdwatchers, especially during winter months.
- ❖ Wildlife sanctuaries refer to an area that provides protection and living conditions favourable to wild animals. On the other hand, the national park provides protection to the entire ecosystem, which includes flora, fauna, landscape, etc. of that region.
- ❖ Biosphere reserves are protected areas, which tend to preserve the genetic diversity of plants, animals, birds, etc. The following points explain the difference between the Wildlife Sanctuary and the National Park:
- ❖ The wildlife sanctuary is the region where wildlife and its habitat are protected from any disturbance. On the other hand, a national park is the area, which is specifically designed for wildlife, where they can live freely and use natural resources.
- ❖ Wildlife sanctuaries are famous for wildlife conservation, which includes animals, insects, microorganisms, birds, etc. of different genes and species. On the other hand, National Parks are well known for preserving flora, fauna, landscape and historical objects.
- ❖ Wildlife sanctuaries aim to ensure that a substantial population of wildlife and its habitats is maintained. On the contrary, national parks safeguard the environmental, landscape and cultural heritage of the region.
- ❖ National parks are highly restricted areas, which are permitted for limited people, whereas wildlife sanctuaries have fewer restrictions than national parks. To visit the national parks, the official permission must be taken from

the competent authorities. In contrast, no official permission is required to visit a wildlife sanctuary. The boundaries of wildlife sanctuaries are not sacrosanct.

- However, national parks have clearly delineated boundaries. Limited human activities are permitted in wildlife sanctuaries, but in national parks, they are strictly prohibited by the authorities.
- The Government of India passed Wildlife Protection Act in 1972 for the purpose of effectively protecting the wildlife of the country by controlling poaching, smuggling and illegal trade in wildlife.
- Another project called 'Project Tiger' was launched in 1973 to save the dwindling population of Royal Bengal Tigers. Later in 1992, 'Project Elephant 'was launched with an aim to protect the endangered wild Asian elephants and their habitat.
- **Community Reserves** are a type of protected area in India, established to conserve wildlife and habitats with the active participation of local communities. These reserves are declared on privately owned or community-owned land where the local community volunteers to protect the flora and fauna, as well as their traditions and cultural practices.
- They are managed by a Community Reserve Management Committee, and changes in land use require approval from both the committee and the state government.
- Community Involvement:

The core principle is that local communities play a vital role in both the establishment and management of the reserve.

- Legal Framework:

Community Reserves are established under the Wildlife (Protection) Amendment Act of 2002, which amended the Wildlife Protection Act of 1972.

- Land Ownership:

Land within a Community Reserve remains under the ownership of the community or individual.

- Management:

A Community Reserve Management Committee, including community representatives, manages the reserve.

- ❖ No Change in Land Use:

Altering land use within the reserve requires approval from the Management Committee and the state government.

- ❖ Buffer Zones:

Community Reserves often act as buffer zones around National Parks and Wildlife Sanctuaries or as corridors for wildlife migration.

Examples:

- ❖ Keshopur Chamb Community Reserve: Located in Punjab, it's known for its biodiversity and role in waterbird conservation.
- ❖ Gogabeel Community Reserve: Situated in Bihar, it's an important wetland area for migratory birds.
- ❖ Other examples: Areas in Meghalaya, Nagaland, and other Northeastern states where local communities have a strong tradition of conservation.

Significance:

- ❖ Conservation:

They help protect biodiversity, including flora and fauna, and contribute to the overall conservation efforts.

- ❖ Socio-economic Development:

Community involvement can lead to improved socio-economic conditions for local communities through sustainable tourism and resource management.

- ❖ Traditional Knowledge:

Community Reserves recognize and incorporate traditional ecological knowledge and practices.

In essence, Community Reserves are a successful model of inclusive conservation, where local communities are empowered to protect their natural heritage while also improving their own well-being.

- **Important features of protected areas in India**: PA including national parks, wildlife sanctuaries, and biosphere reserves, are crucial for biodiversity conservation, climate change mitigation, and supporting local communities. These areas, governed by the Wildlife Protection Act of 1972, restrict human activities to varying degrees to protect ecosystems and species.

Key Features of Protected Areas in India:

- Biodiversity Conservation:

Protected areas serve as vital habitats for a wide range of flora and fauna, including endangered and threatened species, helping to prevent extinction and maintain ecological balance.

- Ecosystem Services:

They play a crucial role in regulating climate by absorbing carbon dioxide, preventing soil erosion, and protecting water resources.

- Community Support:

Protected areas can provide economic benefits through ecotourism, sustainable resource management, and job creation for local communities.

- Habitat Preservation:

They act as refuges for wildlife, preventing habitat loss due to deforestation, urbanization, and other human activities.

- Legal Framework:

Protected areas are established and managed under the Wildlife Protection Act of 1972, which outlines the different categories and their specific regulations.

- International Cooperation:

India participates in international agreements and conventions like CITES and IUCN, demonstrating a commitment to global conservation efforts.

Types of Protected Areas:

- National Parks:

These are established by the State or central Legislature and have fixed, defined boundaries, with no human activities allowed.

❖ Wildlife Sanctuaries:

These areas are designated to protect specific species or ecosystems, allowing for some human activities, and have no fixed boundaries.

❖ Biosphere Reserves:

These are larger, more complex areas encompassing diverse ecosystems and often include buffer zones with varying levels of human activity.

❖ Community Reserves:

These are established by local communities and focus on the conservation of biodiversity and sustainable resource management.

❖ Conservation Reserves:

These are areas adjacent to existing protected areas or that act as connecting corridors.

❖ Tiger Reserves:

These are specifically established for the conservation of tiger populations and their habitats.

❖ Marine Protected Areas:
These areas protect marine ecosystems and biodiversity along the coast.

Challenges:

❖ Habitat Degradation:

Human encroachment, illegal poaching, and unsustainable resource extraction can threaten protected areas.

❖ Climate Change:

Shifting weather patterns and increased temperatures can negatively impact ecosystems within protected areas.

❖ Insufficient Funding:

Adequate funding is crucial for effective management, protection, and research within these areas.

Tiger conservation (Tiger Symbol for Power and Energy)

- Tiger is the National Animal of India and also has a significant position in Indian culture. Tiger usually symbolizes Power and enormous Energy.
- Nagpur is also known as the 'Tiger Capital' of India
- There are 13 tiger reserves in Vidharbha (including the Nagpur division of eastern) alone.
- The national parks around Nagpur include Umred Karhandla Wildlife Sanctuary, Pench National Park, Nagzira-Navegaon Tiger Reserve, Tadoba-Andhari Tiger Reserve, Melghat Tiger Reserve, and Bor Tiger Reserve.
- The Climatic condition of this forested region is very appropriate for tiger conservation.
- First white tiger sanctuary – Madhya Pradesh (The maiden 'White Tiger Safari' was inaugurated in 2016.)
- Tiger IUCN Status – Endangered
- Tiger conservation is crucial for maintaining healthy ecosystems, promoting biodiversity, and supporting local communities. Protecting tigers, an apex predator, helps safeguard a vast range of other species and their habitats, including forests and water sources.
- Initiatives like Project Tiger have shown success in increasing tiger populations and improving habitat management, but challenges like habitat loss, poaching, and human-wildlife conflict persist.

Importance of Tiger Conservation:

- Umbrella Species:

Tigers, as apex predators, are considered an "umbrella species." Their conservation automatically protects a wide array of other species within their ecosystem, including prey animals and other predators.

❖ Ecosystem Health:

Healthy tiger populations indicate a healthy ecosystem, with balanced prey populations, thriving forests, and clean water sources.

❖ Ecotourism:

Tiger reserves attract tourists, generating revenue and creating livelihood opportunities for local communities, fostering a sense of stewardship towards tiger conservation.

❖ Carbon Sequestration:

Healthy forests, which tigers rely on, play a vital role in carbon sequestration, helping to mitigate climate change.

❖ Biodiversity Hotspot:

India, with the majority of the world's tiger population, is a biodiversity hotspot, and tiger conservation efforts contribute to preserving this rich biodiversity.

❖ Symbol of India:

The tiger is India's national animal and a powerful symbol of the country's natural heritage.

Initiatives and Challenges:

❖ Project Tiger:

Launched in 1973, Project Tiger is a long-standing and successful initiative aimed at tiger conservation in India.

❖ National Tiger Conservation Authority (NTCA):

The NTCA is the governing body responsible for tiger conservation efforts in India.

❖ Community Participation:

Active involvement of local communities in park management and conservation efforts is crucial for long-term success.

❖ Habitat Loss and Fragmentation:

Loss and fragmentation of tiger habitat due to deforestation, infrastructure development, and agriculture are major threats.

- ❖ Poaching:

Illegal poaching for tiger parts and products remains a serious concern.

- ❖ Human-Wildlife Conflict:

Conflicts arise when tigers venture into human-dominated areas, leading to livestock depredation and sometimes human fatalities.

- ❖ Limited Habitat Connectivity:

Ensuring connectivity between tiger habitats is essential for maintaining viable tiger populations.

- ❖ Climate Change:

Climate change impacts can further exacerbate existing threats to tiger habitats and prey populations.

Measures for Tiger protection:

- ❖ Strengthening Anti-Poaching Measures:

Improving surveillance, enforcement, and international cooperation to curb illegal trade.

- ❖ Habitat Restoration and Management:

Protecting and restoring tiger habitats, including ensuring connectivity between reserves.

- ❖ Community Engagement:

Involving local communities in conservation efforts through education, livelihood opportunities, and benefit-sharing.

- ❖ Reducing Human-Wildlife Conflict:

Implementing measures to minimize conflict, such as improved livestock management practices and creating buffer zones.

- ❖ Promoting Sustainable Development:

Ensuring that development projects are planned and implemented in a way that minimizes their impact on tiger habitats.

- ❖ Raising Awareness:

Educating the public about the importance of tiger conservation and encouraging responsible tourism.

- ❖ Tiger conservation is a complex challenge that requires a multi-faceted approach involving government agencies, conservation organizations, local communities, and the public. By working together, we can ensure the survival of these magnificent creatures and protect the ecosystems they call home.

Management Challenges in Tiger Reserve:

- ❖ Tiger conservation faces numerous management challenges, primarily revolving around habitat loss and fragmentation, human-wildlife conflict, poaching, and limited community participation.
- ❖ These issues are exacerbated by inadequate funding, climate change impacts, and the need to balance conservation with development goals.

Key Management Challenges:

- ❖ Habitat Loss and Fragmentation:
- ❖ Urbanization, infrastructure development, and agricultural expansion reduce tiger habitats, leading to smaller, isolated populations that are more vulnerable to genetic issues and increased conflict with humans.
- ❖ Human-Wildlife Conflict:

As human populations grow and encroach on tiger territory, encounters and conflicts escalate, resulting in livestock predation, attacks on humans, and retaliatory killings.

Tiger Reserves in India

- Poaching and Illegal Wildlife Trade:

Demand for tiger parts for traditional medicine and other uses fuels poaching, threatening tiger populations and undermining conservation efforts.

- Limited Community Participation:

Effective conservation requires engaging local communities, who often bear the brunt of human-wildlife conflict, in the process.

- Climate Change:

Altered rainfall patterns and increased temperatures can affect tiger habitats and prey availability, further complicating conservation efforts.

- ❖ Inadequate Funding and Resource Allocation:

Sufficient funding is crucial for anti-poaching patrols, habitat restoration, and community engagement programs.

- ❖ Conflict between Conservation and Development:

Development projects like roads, dams, and mining can fragment habitats, displace wildlife, and create further conflict.

- ❖ Lack of Connectivity:

Fragmented habitats hinder tiger movement and gene flow, making populations more vulnerable.

- ❖ Weak Enforcement:

Insufficient patrolling and law enforcement in protected areas can allow poaching and other illegal activities to flourish.

- ❖ Inadequate Monitoring:

Lack of robust monitoring systems hinders the ability to track tiger populations, assess the effectiveness of conservation strategies, and adapt management approaches.

- ❖ Lack of Political Will:

Effective tiger conservation requires strong political commitment and policy support.

Addressing the Challenges:

- ❖ Strengthening Protection:

Improving anti-poaching efforts, enhancing law enforcement, and increasing patrols in key areas are crucial.

- ❖ Habitat Restoration and Management:

Restoring degraded habitats, creating wildlife corridors, and managing human activities in buffer zones are essential.

- ❖ Community Involvement:

Engaging local communities through benefit-sharing programs, ecotourism initiatives, and sustainable livelihood opportunities can foster a sense of ownership and support for tiger conservation.

- ❖ Conflict Mitigation:

Implementing measures like livestock insurance, compensation schemes for losses due to tiger attacks, and public awareness campaigns can help reduce human-wildlife conflict.

- ❖ Promoting Sustainable Development:

Balancing development needs with tiger conservation goals requires careful planning and implementation of infrastructure projects.

- ❖ Research and Monitoring:

Utilizing technology like camera traps and AI-powered monitoring systems can provide valuable data for effective tiger management.

- ❖ International Cooperation:

Strengthening collaborations with neighboring countries and international organizations can help address transboundary threats and promote coordinated conservation efforts.

MCQ based on Unit VIII

Q. 1.Which National Park in India was previously known as "Wandur National Park"?

a. Mahatma Gandhi Marine National Park

b. Rani Jhansi Marine National Park

c. Campbell Bay National Park

d. Galathea National Park

Answer. a

Q. 2. Which National Park is located in the state of Karnataka?

a. Rajiv Gandhi National Park

b. Anshi National Park

c. Keibul Lamjao National Park

d. Phawngpui Blue Mountain National Park

Answer. b

Q. 3. The"Great Himalayan National Park" located in?

a. Himachal Pradesh

b. Uttarakhand

c. Jammu & Kashmir

d. Sikkim

Answer. a

Q. 4. Which National Park in India is known for being one of the last refuges of the critically endangered Indian Rhinoceros?

a. Kaziranga National Park

b. Gir National Park

c. Bandipur National Park

d. Sundarbans National Park

Answer. a

Q. 5. Which state is home to the "Sundarbans National Park," the largest mangrove forest in the world?

a. Odisha

b. Kerala

c. West Bengal

d. Tamil Nadu

Answer. c

Q. 6. "Corbett National Park" is the oldest National Park in India and is located in which state?

a. Uttarakhand

b. Himachal Pradesh

c. Rajasthan

d. Madhya Pradesh

Answer. a

Q. 7. "Namdapha National Park" is situated in which northeastern state of India?

a. Meghalaya

b. Arunachal Pradesh

c. Mizoram

d. Tripura

Answer. b

Q. 8. Which National Park in India is known for its significant population of the endangered Indian One-Horned Rhinoceros?

a. Kanha National Park

b. Periyar National Park

c. Jim Corbett National Park

d. Manas National Park

Answer. d

Q. 9. "Ranthambore National Park" is famous for which animal species primarily?

a. Tigers

b. Elephants

c. Rhinoceroses

d. Lions

Answer. a

Q.10. Where in India is the "Valley of Flowers National Park" situated?

a. Uttarakhand

b. Himachal Pradesh

c. Jammu & Kashmir

d. Sikkim

Answer. a

Q. 11. "Gir National Park" is famous for which animal species primarily?

a. Tigers

b. Lions

c. Elephants

d. Rhinoceroses

Answer: b

Q. 12.The "Silent Valley National Park" located in?

a. Tamil Nadu

b. Kerala

c. Karnataka

d. Andhra Pradesh

Answer. b

Q. 13. Which Indian state is home to "Jim Corbett National Park"?

a. Madhya Pradesh

b. Uttar Pradesh

c. Uttarakhand

d. Himachal Pradesh

Answer: c

Q. 14. "Kaziranga National Park" is known for the conservation of which endangered species?

a. Bengal Tigers

b. Indian Rhinoceros

c.Asiatic Lions

d. Snow Leopards

Answer. b

Q. 15. What Indian state is home to "Bandipur National Park"?

a. Kerala

b. Karnataka

c. Andhra Pradesh

d) Tamil Nadu

Answer: b

Q. 16. In which state is the "Periyar National Park" located?

a. Tamil Nadu

b. Karnataka

c. Kerala

d. Andhra Pradesh

Answer. c

Q. 17. "Kanha National Park" is known for its conservation efforts related to which animal species?

a. Tigers

b. Indian Rhinoceros

c. Asiatic Lions

d. Elephants

Answer. a

Q. 18.Which country shares the "Sundarbans National Park" with India?

a. Bangladesh

b. Nepal

c. Bhutan

d. Myanmar

Answer. a

Q.19. In which state is the "Khangchendzonga National Park" located, which is a UNESCO World Heritage Site?

a. Arunachal Pradesh

b. Sikkim

c. Meghalaya

d. Nagaland

Answer. b

Q. 20. "Dachigam National Park" is situated in which region of India?

a. Western Ghats

b. Eastern Ghats

c. Western Himalayas

d. Eastern Himalayas

Answer. d

Q. 21. Which National Park is known for its efforts in the conservation of the Indian Sloth Bear?

a. Bandipur National Park

b. Rajaji National Park

c. Satpura National Park

d. Darrah National Park

Answer. c

Q. 22."Simlipal National Park" is located in which Indian state?

a. West Bengal

b. Odisha

c. Chhattisgarh

d. Jharkhand

Answer. b

Q. 23. Which National Park in India is known for being a habitat of the endangered "Keibul Lamjao" or the Manipur Brow-antlered Deer?

a. Nokrek National Park

b. Namdapha National Park

c. Keibul Lamjao National Park

d. Buxa Tiger Reserve

Answer: c

Q. 24. In which state is the "Balphakram National Park" located?

a. Assam

b. Meghalaya

c. Mizoram

d. Nagaland

Answer b

Q. 25. Which Indian state is home to the "Rajaji National Park"?

a. Uttarakhand

b Himachal Pradesh

c. Rajasthan

d. Madhya Pradesh

Answer- a

Q. 26. The forest and tree cover in India is estimated to be _____of its total geographical area.

a. Around 30%

b. Around 24%

c. Around 35%

d. Around 40%.

Answer: b

Q. 27. The open forests in India are _____ of its total geographical area.

a. Around 9%

b. Around 20%

c. Around 15%

d. Around 1%

Answer: a

Q. 28. Blue sheep, Asiatic elephants, and Gangetic dolphins are examples of _____.

a. Vulnerable species

b. Rare species

c. Endemic Species

d. Extinct species

Answer: a

Q. 29. Asiatic cheetah and pink head duck are examples of _____,

a. Endemic Species

b. Extinct species

c. Rare species

d. Vulnerable species

Answer: b

Q. 30. _____ is an example of Endemic Species.

a. Pink head duck

b. Asiatic cheetah

c. Asiatic buffalo

d. Nicobar pigeon

Answer: d

Q. 31 _____ was declared extinct in India long back in 1952.

a. Andaman wild pig

b. Andaman teal

c. Asiatic cheetah

d. Desert fox

Answer: c

Q. 32. _____ are the species which are in danger of extinction.

a. Endangered species

b. Rare species

c. Extinct species

d. Endemic species

Answer: a

Q. 33. Blackbuck, crocodile, Indian wild donkey and Indian rhino are examples of _____.

a. Normal species

b. Endangered species

c. Endemic species

d. Rare species

Answer: b

Q. 34. Substantial parts of the tribal belts, especially in the Northeastern and _____, have been deforested or degraded by shifting cultivation (Jhum), a type of 'slash and burn' agriculture.

a. Central India

b. Western India

c. South India

d. Northwest India

Answer: a

Q. 35. The Buxa Tiger Reserve in West Bengal is seriously threatened by the ongoing _____.

a. Coal mining

b. Iron ore mining

c. Copper mining

d. Dolomite mining

Answer: d

Q. 36. Teak monoculture has damaged the natural forest in _____.

a. North India

b. South India

c. Central India

d. Northeastern India

Answer: b

Q. 37. The Himalayan yew (Taxus wallichiana) is a medicinal plant found in various parts of _____ and _____.

a. Himachal Pradesh and Arunachal Pradesh

b. Uttarakhand and Assam

c. Uttarakhand and Ladakh

d. Jammu & Kashmir and Sikkim

Answer: a

Q. 38. A chemical compound called 'taxol', which is extracted from the bark, needles, twigs and roots of Himalayan yew, is used to treat _____, and it is the biggest-selling drug in the world for the treatment of this disease.

a. Tuberculosis

b. Malaria

c. Diabetes

d. Cancer

Answer: d

Q. 39. The Indian Wildlife (Protection) Act was implemented in _____, with various provisions for protecting habitats.

a. 1972

b. 1975

c. 1971

d. 1974

Answer: a

Q. 40. Which of the following animals were gravely threatened, and the Central Government announced several projects for protecting them?

a. Kashmir stag

b. The Asiatic lion

c. One-horned rhinoceros

d. All of the above

Answer: d

Q. 41. Manas Tiger Reserve is located in _____.

a. Tamil Nadu

b. Kerala

c. Assam

d. Orissa

Answer: c

Q. 42. Which of the following is located in the state of Rajasthan?

a. Corbett National Park

b. Bandhavgarh National Park

c. Periyar Tiger Reserve

d. Sariska Wildlife Sanctuary

Answer: d

Q. 43. _____ has the largest area under permanent forests, constituting 75 per cent of its total forest area.

a. Orissa

b. Madhya Pradesh

c. Chhattisgarh

d. Assam

Answer: b

Q 44.When was Project Tiger launched in India?

a. 1962

b. 1973

c. 1985

d. 1997

Answer. b

Q 45. Which of the following is the first National Park in India?

a. Kaziranga National Park

b. Bandhavgarh National Park

c. Jim Corbett National Park

d. Sunderbans National Park

Answer. c

Q 46. What is the main objective of Project Tiger?

a. To promote tourism in tiger habitats

b. To ensure a healthy population of tigers in India

c. To control the tiger population

d. To convert forest land into agricultural land

Answer. b

Q 47. Which of the following is NOT a threat to tiger populations?

a. Habitat loss and fragmentation

b. Poaching

c. Climate change

d. Increased prey availability

Answer. d

Q 48.What is the role of the National Tiger Conservation Authority (NTCA)?

a. To manage all national parks in India

b. To address ecological and administrative concerns for tiger conservation

c. To promote tourism in tiger reserves

d. To fund infrastructure development in tiger reserves

Answer. b

Q 49. Which of the following is not a tiger reserve in India?

a. Sundarbans Tiger Reserve

b. Ranthambore Tiger Reserve

c. Nagarjunasagar Srisailam Tiger Reserve

d. Periyar National Park

Answer. d

Q.50. In which state, Bhadra Wildlife sanctuary is situated?

a. Goa

b. Karnataka

c. Tamilnadu

d. Orissa

Answer. b

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