ENERGY & ENVIORNMENT

MODULE 3

ENVIRONMENT & ECOSYSTEM

Definition

- *Environmental studies deals with **every issue that affects** an organism.*
- *It is essentially a **multidisciplinary approach** that brings about an appreciation of our natural world and human impacts on its integrity.*
- *It is an **applied science** as it seeks practical answers to making human civilization sustainable on the earth's finite resources.*
- *Its components include biology, geology, chemistry, physics, engineering, sociology, health, anthropology, economics, statistics, computers and philosophy.*

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Scope

- *As we look around at the area in which we live, we see that our **surroundings were originally a natural landscape** such as a forest, a river, a mountain, a desert, or a combination of these elements.*
- *Most of us live in landscapes that have been **heavily modified by human beings**, in villages, towns or cities.*
- *But even those of us who live in cities get our **food supply from surrounding villages** and these in turn are **dependent on natural landscapes** such as forests, grasslands, rivers, seashores, for resources such as water for agriculture, fuel wood, fodder, and fish.*
- *Thus our **daily lives are linked with our surroundings** and **inevitably affects them**.*

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Scope Cont'd

- *The industrial development and intensive agriculture that provides the goods for our increasingly consumer oriented society* ***uses up large amounts of natural resources*** *such as water, minerals, petroleum products, wood, etc.*
- *Our dependence on nature has* led to **environmental degradation** *and we* ***cannot continue to live without protecting*** *the earth's environmental resources.*
- *Our natural resources can be compared with* ***money in a bank****. If we use it rapidly, the capital will be reduced to zero.*
- *On the other hand,* ***if we use only the interest****, it can sustain us over the longer term.*
- *This is called* ***sustainable utilization*** *or development.*

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Importance

- *Environment is not a **single subject**. It is an integration of several subjects that include both Science and Social Studies.*
- *To understand all the different aspects of our environment we need to understand biology, chemistry, physics, geography, resource management, economics and population issues.*
- *Thus the **scope of environmental studies is extremely wide** and covers some aspects of nearly every major discipline.*
- *We live in a world in which **natural resources are limited**.*
- *As **we keep increasing in numbers** and the quantity of resources each of us uses also increases, the **earth's resource base must inevitably shrink**.*

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Importance

- *The **earth cannot be expected to sustain** this expanding level of utilization of resources.*
- *Added to this is **misuse of resources**. We **waste or pollute large amounts of nature's clean water**.*
- *We create **more and more material like plastic** that we discard after a single use; and we waste colossal amounts of food, which is discarded as garbage.*
- *Manufacturing processes **create solid waste byproducts** that are discarded, as well as **chemicals that flow out as liquid waste** and pollute water, and **gases** that pollute the air.*
- ***Increasing amounts of waste** cannot be managed by natural processes.*

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Importance

- *These **accumulate in our environment**, leading to a **variety of diseases** and other **adverse environmental impacts** now seriously affecting all our lives.*
- *Air pollution leads to respiratory diseases, water pollution to gastro-intestinal diseases, and many pollutants are known to cause cancer.*
- *Improving this situation will only happen **if each of us begins to take actions in our daily lives** that will help preserve our environmental resources.*
- *Some common problems of pollution are Acid Rain, plastic, (cancer), Contaminated water, smog (Asthma), Mercury, Lead, Arsenic etc., Disrupted pattern of Rainfall, Natural calamities*

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NEED FOR PUBLIC AWARENESS

- *As the earth's **natural resources are dwindling** and our environment is being increasingly degraded by human activities, it is evident that something needs to be done.*
- ***We often feel that managing all this is something that the Government should do**.*
- *But if **we go on endangering our environment**, there is no way in which the Government can perform all these **clean-up functions**.*
- *It is the **prevention of environment degradation** in which we must all take part that must become a part of all our lives.*
- *This can only be made possible through **mass public awareness**.*

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NEED FOR PUBLIC AWARENESS

*We are **living on spaceship earth with a limited supply of resources**. Each of us is responsible for spreading this message to as many people as possible. Suggested activities are:*

- *Join a group to study nature, such as WWF or BNHS, or another environmental group. (**World Wide Fund for Nature, Bombay Natural History Society)***
- *Begin reading newspaper articles and periodicals such as 'Down to Earth', WWF-I newsletter, BNHS Hornbill, Sanctuary magazine, etc.*
- ***Lobby for conserving resources** by taking up the cause of environmental issues during discussions.*
- *Practice and promote issues such as **saving** paper, saving water, **reducing** use of plastics, practicing the 3Rs principle of reduce, reuse, recycle, and proper waste disposal.*

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NEED FOR PUBLIC AWARENESS

- ***Join local movements*** *that support activities such as saving trees in your area, go on nature treks, recycle waste, buy environmentally friendly products. (banning of plastics bags in Mysore City)*
- ***Practice and promote good civic sense*** *such as no spitting or chewing tobacco, no throwing garbage on the road, no smoking in public places, no urinating or defecating in public places. (Fine for* ***littering*** *on the road in US)*
- ***Take part in events*** *organised on World Environment Day, Wildlife Week, etc.*
- *Visit a National Park or Sanctuary, or spend time in whatever nature you have near your home to* ***realize its problems****.*

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CONCEPT OF AN ECOSYSTEM

- *An 'Ecosystem' is a region with a **specific and recognizable landscape** form such as forest, grassland, desert, wetland or coastal area.*
- ***Definition:** 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.*
- *Ecosystems are divided into terrestrial or land based ecosystems, and aquatic ecosystems in water.*
- *Ecosystems have been formed on land and in the sea **by evolution** that has **created species to live together** in a specific region.*

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Understanding ecosystems

- *Natural ecosystems include the forests, grasslands, deserts, and aquatic ecosystems such as ponds, rivers, lakes, and the sea.*
- ***Man modified ecosystems*** *include agricultural land and urban or industrial land use patterns.*
- *The ecosystem functions through several* ***biogeochemical cycles and energy transfer mechanisms****.*
- ***Ecosystems are the basis of life itself!!!..***
- *The natural ecosystems in the wilderness provide a variety of products and are regions in which a number of vital ecological processes are present,* ***without which human civilization would not be able to exist****.*

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STRUCTURE AND FUNCTIONS OF AN ECOSYSTEM

Structural aspects

Components that make up the structural aspects of an ecosystem include:

1) Inorganic aspects – C, N, CO_2, H_2O.
2) Organic compounds – Protein, Carbohydrates, Lipids – link abiotic to biotic aspects.
3) Climatic regimes – Temperature, Moisture, Light & Topography.
4) Producers – Plants.
5) Macro consumers – Phagotrophs – Large animals.
6) Micro consumers – Saprotrophs, absorbers – fungi.

Functional aspects

1) Energy cycles.
2) Food chains.
3) Diversity-interlinkages between organisms.
4) Nutrient cycles-biogeochemical cycles.
5) Evolution.

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ENERGY FLOW IN THE ECOSYSTEM

- *Every ecosystem has several **interrelated mechanisms** that affect human life.*
- *These are the water cycle, the carbon cycle, the oxygen cycle, the nitrogen cycle and the energy cycle.*
- *In an ecosystem, green plants – the producers, **utilize energy directly from sunlight** and convert it into matter/energy.*
- *The herbivorous animals **that eat plants** are called primary consumers.*
- *The predators **that feed on them** are known as secondary consumers.*
- *This is how energy is used by living creatures **and flows through the ecosystem** from its base to the apex.*

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The Water Cycle

- **When it rains**, the water runs along the ground and flows into rivers or falls directly into the sea.
- A part of the rainwater that falls on land **percolates** into the ground.
- This is **stored underground** throughout the rest of the year.
- Water is **drawn up** from the ground by plants along with the nutrients from the soil.
- The water is **transpired** from the leaves as water vapour and returned to the atmosphere.

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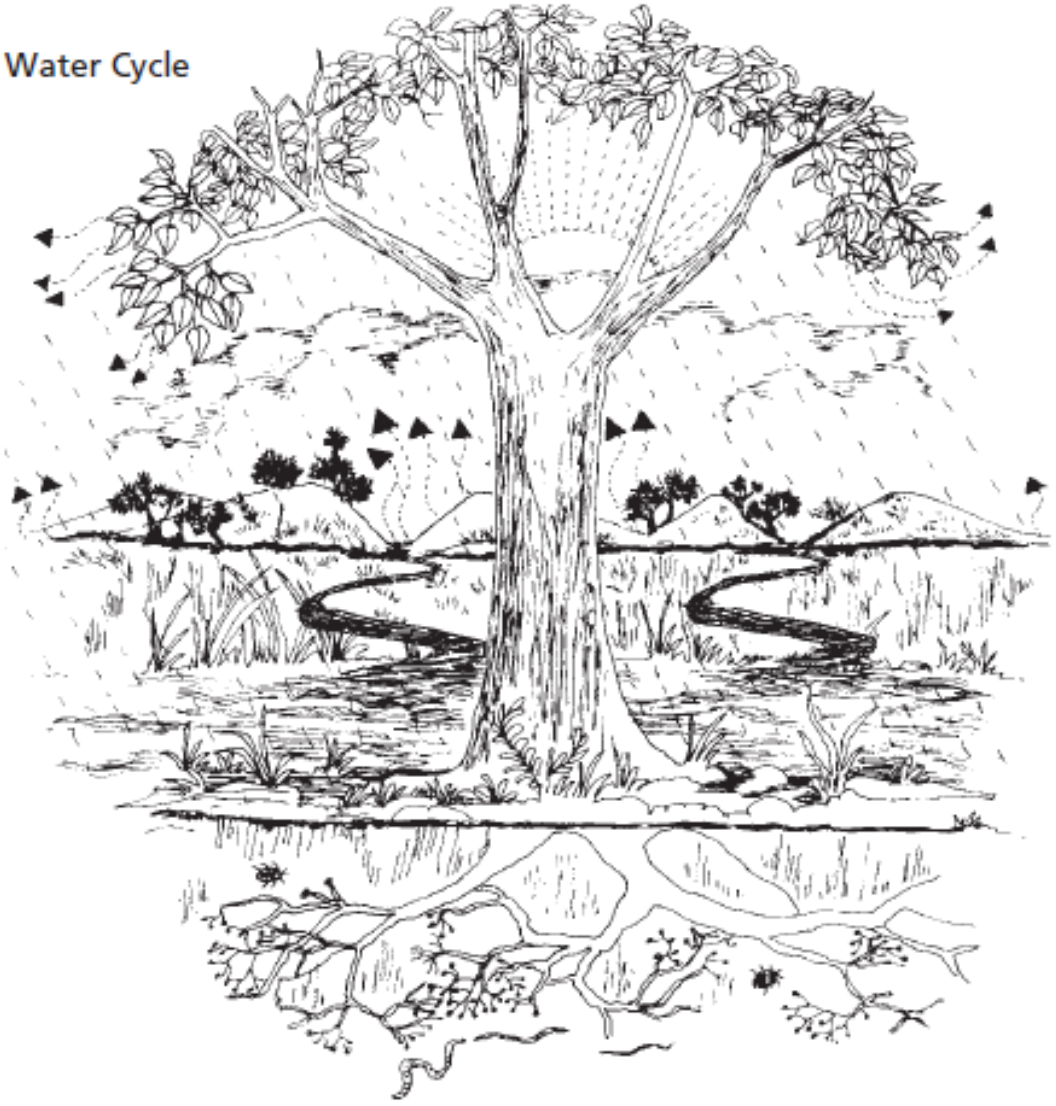

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The Water Cycle

- Also, water in the sea is **evaporated** by Sun to form water vapour. As it is lighter than air, water vapour rises and forms clouds.

- Winds blow the clouds for long distances and when the clouds rise higher, the **vapour condenses** and changes into droplets, which fall on the land as rain. (Mountains and Forest block more clouds)

- Though this is an **endless cycle on which life depends**, man's activities are making **drastic changes** in the atmosphere through pollution which is **altering rainfall patterns**.

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The Carbon cycle

- In the atmosphere, carbon occurs as carbon dioxide (CO2).
- In the presence of sunlight, **plants take up carbon dioxide** from the atmosphere through their leaves.
- The **plants combine carbon dioxide with water**, which is absorbed by their roots from the soil.
- In the **presence of sunlight** they are able to form carbohydrates that contain carbon. This process is known as photosynthesis.

  $$6CO_2 + 6H_2O + \text{light energy} = C_6H_{12}O_6 + 6O_2$$

- In this process, **plants release oxygen** into the atmosphere on which animals depend for their respiration.

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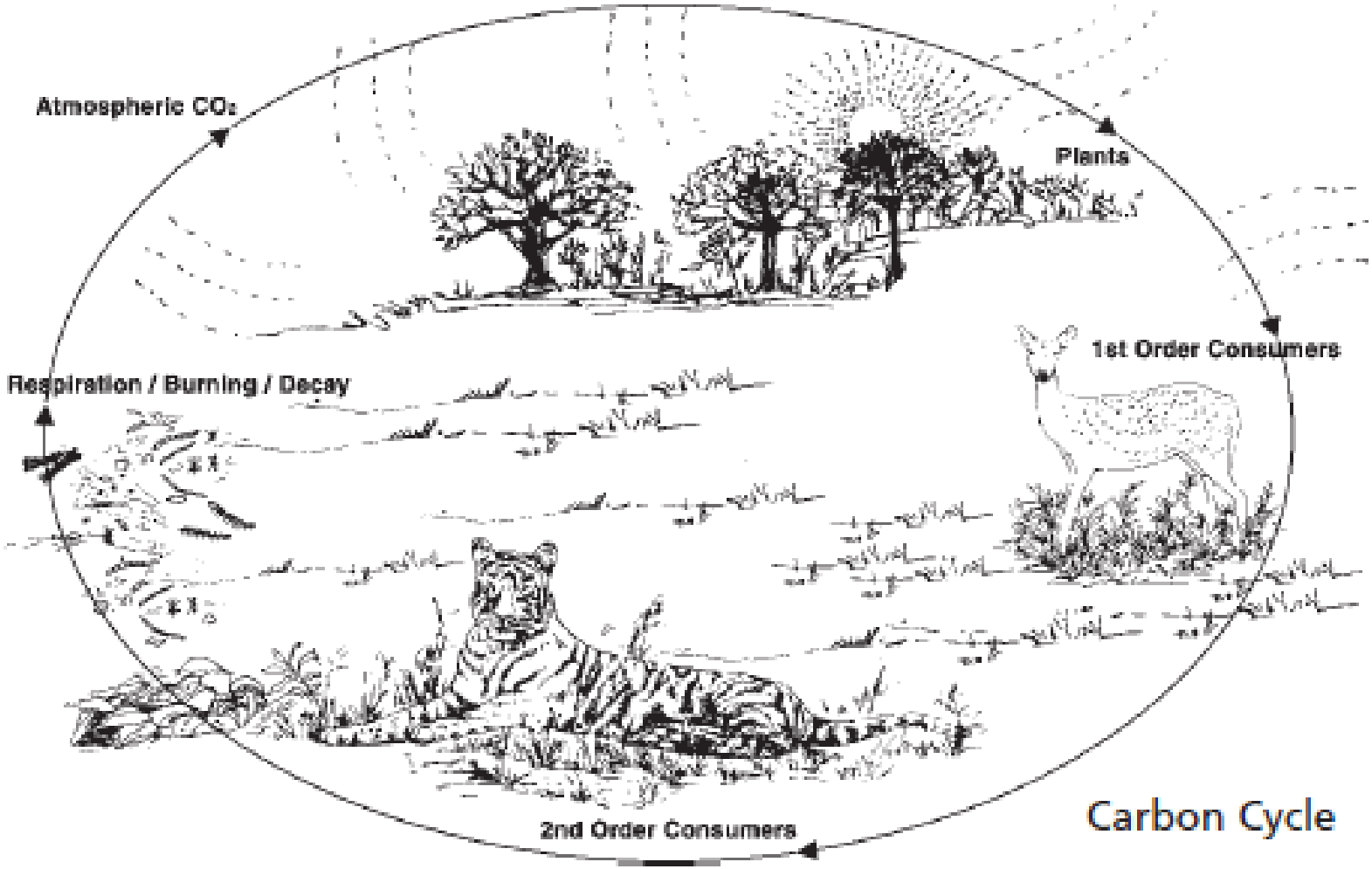

Carbon Cycle

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The Carbon cycle

- Herbivorous animals **feed on plant material**, which is used by them for energy (carbon) 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**.

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The Oxygen Cycle

- **Oxygen is taken up** by plants and animals from the air during **respiration**.
- The **plants return oxygen** to the atmosphere during **photosynthesis**.
- This links the Oxygen Cycle to the Carbon Cycle. **Deforestation** is likely to gradually reduce the oxygen levels in our atmosphere.
- Thus plant life plays an important role in our lives which we frequently do not appreciate.
- This is an important reason to participate in **afforestation** programs.

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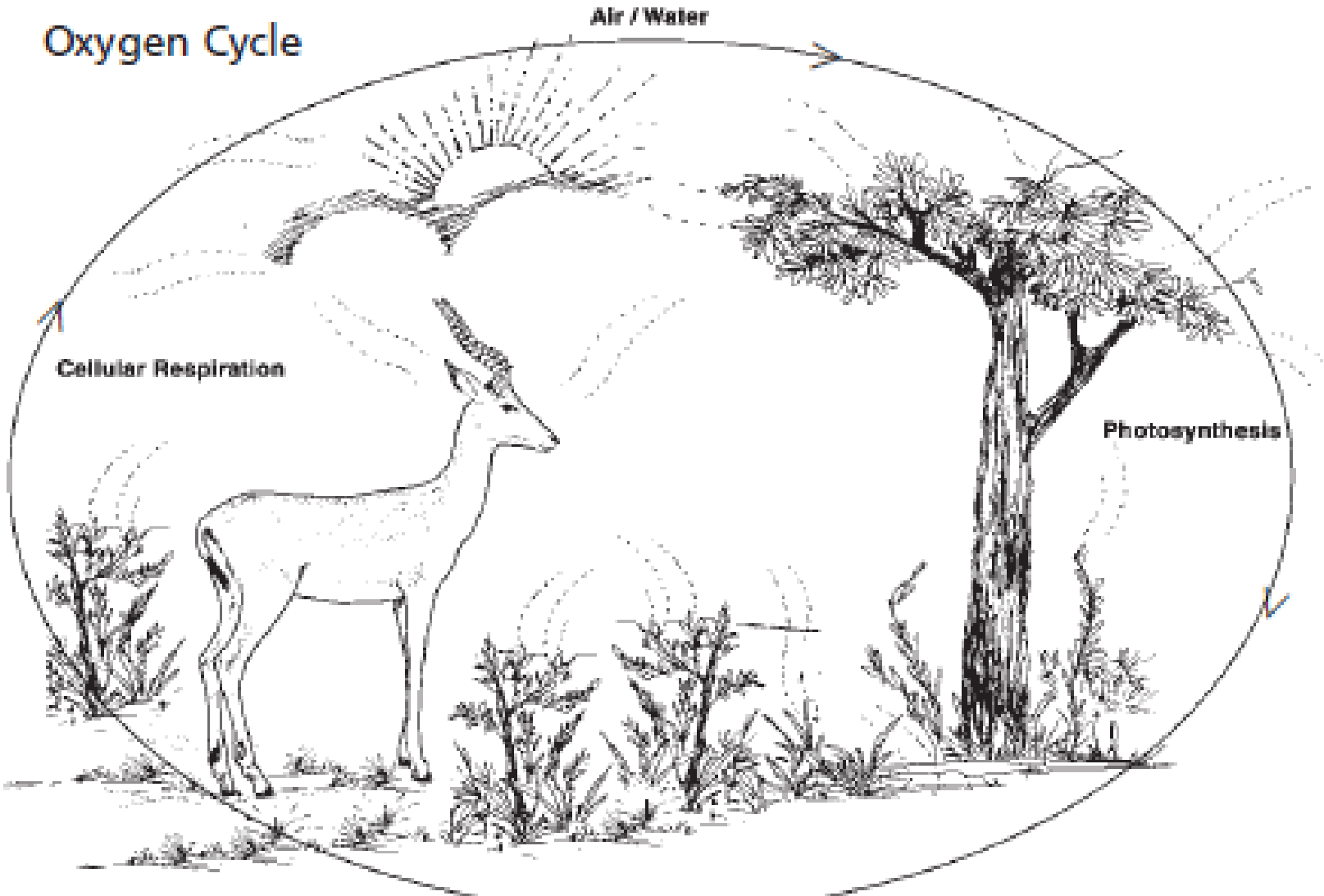

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The Nitrogen Cycle

- Nitrogen is transferred to carnivorous animals **when they feed on herbivorous animals** which in turn **feed on plants**.
- When animals defecate, the **waste material is broken down** by worms and insects mostly beetles and ants.
- These small 'soil animals' break the waste material into **smaller bits** on which microscopic bacteria and fungi can act. The smaller bits is broken down further by bacteria and fungi into **nutrients called nitrates**. (not seen)
- Plants can **absorb these nitrates** and use for their growth by forming new plant proteins.

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The Nitrogen Cycle

- Thus nutrients are recycled back from **animals to plants**.
- Similarly the bodies of dead animals are also **broken down** into nutrients that are used by the plants for their growth.
- Thus the nitrogen cycle on which life is dependent is completed.
- Thus our **own lives are closely interlinked** to soil animals, fungi and even bacteria in the soil. When we think of food webs, we usually think of the large mammals and other large forms of life.
- But we need to understand that it is the **unseen small animals, plants and microscopic forms of life** that are of great value for the functioning of the ecosystem.

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Integration of cycles in Nature

- These cycles are a **part of global life processes**. These biogeochemical cycles have specific features in each of the ecosystems.
- These cycles are however **linked to those of adjacent ecosystems**. Their characteristics are specific to the plant and animal communities in the region.
- This is related to the geographical features of the area, the climate and the chemical composition of the soil.
- **Together the cycles are responsible for maintaining life on earth.**
- **If mankind disturbs these cycles beyond the limits that nature can sustain, they will eventually break down and lead to a degraded earth on which man will not be able to survive.**

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- ***FOOD CHAINS, FOOD WEBS AND ECOLOGICAL PYRAMIDS***
  - *The **transfer of energy** from the source in plants through a series of organisms by eating and being eaten constitutes food chains.*
  - *At each transfer, a **large proportion of energy is lost in the form of heat**.*
  - *These food chains are **not isolated sequences**, but are interconnected with each other.*
  - ***This interlocking pattern is known as the food web.***
  - ***Each step** of the food web is called a **trophic level**.*
  - *Hence green plants occupy the first level, herbivores the second level, carnivores the third level and secondary carnivores the fourth level.*
  - *These trophic levels **together form** the ecological pyramid.*

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ECOLOGICAL SUCCESSION

- *Ecological succession is a process through which **ecosystems tend to change over a period of time**.*
- ***Succession** can be related to seasonal environmental changes, which **create changes** in the community of plants and animals living in the ecosystem.*
- *Other successional events **may take much longer periods of time** extending to several decades.*
- *For example, if a forest is cleared, it is initially colonized by a certain group of species of plants and animals, which gradually **change** through an orderly process of community development.*
- *One can predict that an opened up area will gradually be **converted** into a grassland, a shrub land and finally a woodland and a forest if permitted to do so without human interference.*

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Types of Ecosystems

Terrestrial Ecosystems	***Aquatic Ecosystems***
Forest	*Pond*
Grassland	*Lake*
Semi arid areas	*Wetland*
Deserts	*River*
Mountains	*Delta*
Islands	*Marine*

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- ***Forest Ecosystem***
  - *Forests are formed by a **community of plants** which is predominantly structurally defined by its trees, shrubs, climbers and ground cover.*
  - *Natural vegetation **looks vastly different** from a group of planted trees, which are in orderly rows.*

The forest ecosystem has two parts:

1. *The non-living or abiotic aspects of the forest.*
2. *The living or the biotic aspects of the forest.*

- *As the plant and animal species are closely dependent on each other, together they form different types of forest communities.*

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Forest types in India:

- *The forest type depends upon the abiotic factors such as climate and soil characteristics of a region.*
- *Forests in India can be broadly divided into*

1. *Coniferous forests &*
2. *Broadleaved forests.*

- *Coniferous forests grow in the Himalayan mountain region, **where the temperatures are low**. These forests have tall stately trees with needlelike leaves and **downward sloping branches** so that the snow can slip off the branches. They have cones instead of seeds and are called gymnosperms.*

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Forest types in India:

- *Broadleaved forests have several types, such as evergreen forests, deciduous forests, thorn forests, and mangrove forests. Broadleaved forests have large leaves of various shapes.*

Broadleaved forest

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Evergreen forests

Evergreen forests grow in the ***high rainfall areas of the Western Ghats****, North Eastern India and the Andaman and Nicobar Islands. Evergreen plants* ***shed a few of their leaves*** *throughout the year. An* ***evergreen forest thus looks green throughout the year****. The forest is rich in orchids and ferns.The barks of the trees are covered in moss.The forest abounds in animal life and is most rich in insect life.*

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Deciduous forests

Deciduous forests are found in regions with a ***moderate amount of seasonal rainfall*** *that lasts for only a few months. Most of the forests in which* ***Teak trees*** *grow are of this type.The deciduous trees* ***shed their leaves*** *during the winter and hot summer months.*

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Thorn forests

*Thorn forests are found in the **semi- arid regions of India**. The trees, which are sparsely distributed, are surrounded by **open grassy areas**. Thorny plants are called xerophytic species and are able to **conserve water**. Thorn forest trees have **long or fibrous roots** to reach water at great depths.*

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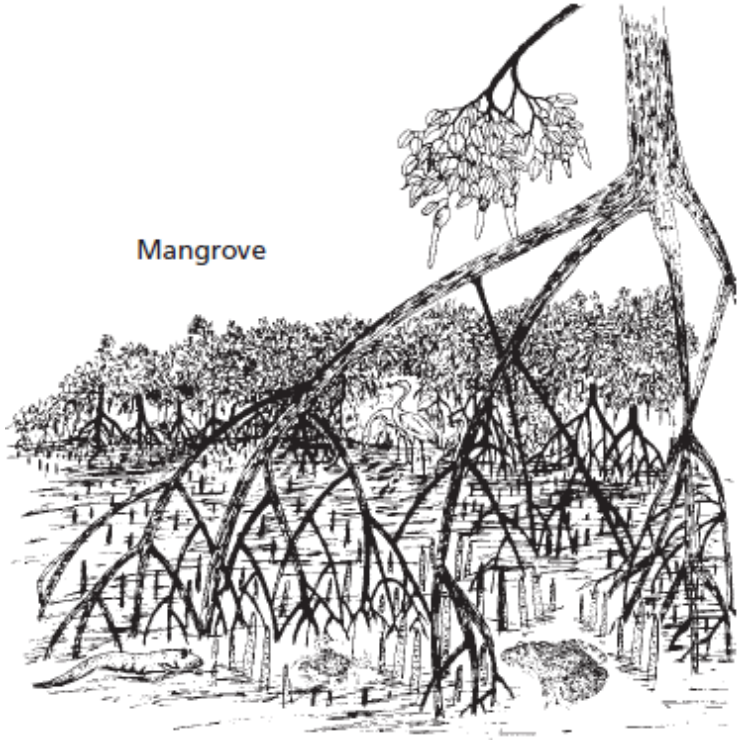
Mangrove forests

*Mangrove forests grow along the coast especially in the **river deltas**. These plants are able to grow in a **mix of saline and fresh water**. They grow luxuriantly in muddy areas covered with silt that the rivers have brought down. The mangrove trees have **breathing roots** that emerge from the mudbanks.*



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Forest communities:

Forest type	Plants Examples	Common Animal Examples	Rare Animal Examples
Himalayan Coniferous	Pine, deodar	Wild goats and sheep, Himalayan black bear.	Snow leopard, Hangul, Himalayan brown bear, Musk deer, Himalayan Wolf.
Himalayan Broadleaved	Maple, oak		
Evergreen North-east, Western Ghats, Andaman & Nicobar	Jamun, Ficus, Dipterocarpus	Tiger, Leopard, Sambar, Malabar whistling thrush, Malabar Pied hornbill, tree frogs.	Pigmy Hog, Rhino, Liontailed macaque
Deciduous – Dry	Teak, Ain, Terminalia	Tiger, Chital, Barking deer, Babblers, Flycatchers, Hornbills.	
Moist	Sal		
Thorn and scrub, Semiarid forests	Babul, Ber, Neem	Blackbuck, Chinkara, Fourhorned antelope, Partridge, Monitor lizard.	Wolf, Bustard, Florican, Bustards,
Mangrove Delta Forests	Avicenia	Crocodile, shorebirds – sandpipers, plovers, fish, crustacea.	Water monitor lizard.

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Direct uses of forest products

Fruits – mango, jamun, awla

Roots – Dioscoria

Medicine – Gloriosa, Foxglove

Fuelwood – many species of trees and shrubs

Small timber for building huts and houses

Wood for farm implements

Bamboo and cane for baskets

Grass for grazing and stall feeding livestock

Indirect uses of forest products

Building material for construction and furniture for the urban sector

Medicinal products collected and processed into drugs

Gums and resins processed into a variety of products

Raw material for industrial products and chemicals

Paper from bamboo and softwoods

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Threats to the forest ecosystem

- ***As forests grow very slowly**, we cannot use more resources than they can produce during a growing season.*
- ***If timber is felled beyond a certain limit** the forest cannot regenerate.*
- *The **gaps in the forest canopy change the habitat quality** for its animals. The **more sensitive species** cannot survive under these changed conditions.*
- ***Over utilizing forest resources** is an unsustainable way of misusing our limited forest resources.*
- *We are **now creating more and more goods** that are manufactured from raw material from the forest.*
- *This **leads to forest degradation** and finally changes the ecosystem into **wasteland**. **Wood is illegally extracted** from many forests leading to a highly disturbed ecosystem.*

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Threats to the forest ecosystem cont'd

- ***Forests are shrinking*** *as our need for agricultural land increases. It is estimated that India's forest cover has decreased from* ***about 33% to 11%*** *in the last century.*
- ***The increasing use*** *of wood for timber, wood pulp for paper & the extensive use of fuel wood results in continual forest loss.*
- *Forests are also lost by* ***mining and building dams****.*
- *As the forest resources are exploited beyond what they can produce* ***the forest canopy is opened up****, the ecosystem is degraded, and its wildlife is seriously threatened.*
- *As the forest is fragmented into small patches its wild plant and animal species become extinct. These can never be brought back.* ***Extinction is forever.***
- ***Rainfall also gets seriously affected*** *when the forest is destroyed.*

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- ***How can forest ecosystems be conserved?***
  - *We can conserve forests* ***only if we use its resources carefully****.*
  - *This can be done by* ***using alternate sources of energy*** *instead of fuel wood.*
  - *There is a* ***need to grow more trees*** *than are cut down from forests every year for timber and paper.*
  - ***Afforestation*** *needs to be done continuously from which fuel wood and timber can be judiciously used.*
  - *The natural forests with all their diverse species must be* ***protected*** *as* ***National Parks and Wildlife Sanctuaries*** *where all the plants and animals can be preserved.*

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- ***Grassland ecosystems***
  - *A wide range of landscapes in which the **vegetation is mainly formed by grasses and small annual plants** adapted to India's various climatic conditions form a variety of grassland ecosystems with their specific plants and animals.*
  - *Grasslands cover areas where **rainfall is usually low** and/or the **soil depth and quality is poor**.*
  - *The **low rainfall prevents** the growth of a large number of trees and shrubs, **but is sufficient to support the growth of grass** cover during the monsoon.*
  - *Many of the grasses and other small herbs become dry and the **part above the ground dies** during the summer months.*
  - *In the **next monsoon** the grass cover grows back from the root stock and the seeds of the previous year.*

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- ***Grassland Types in India:***
  - *Grasslands form a **variety of ecosystems** that are located in different climatic conditions ranging from near desert conditions, to patches of **shola grasslands** that occur on hill slopes alongside the extremely moist evergreen forests in South India.*
  - *In the Himalayan mountains there are the **high cold Himalayan pastures**.*
  - *There are **tracts of tall elephant grass** in the low-lying Terai belt south of the Himalayan foothills.*
  - *There are **semi-arid grasslands** in Western India, parts of Central India, and in the Deccan Plateau.*

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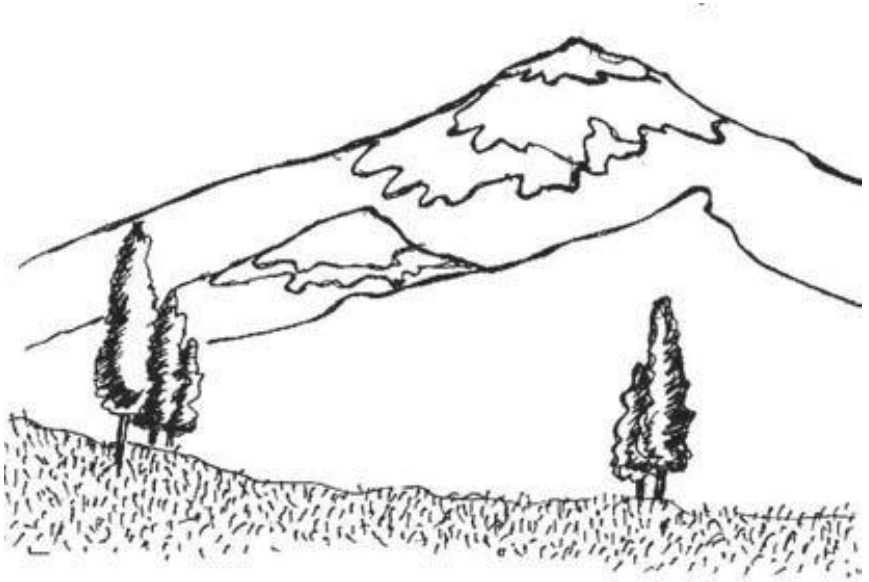
The Himalayan pasture *belt extends* ***up to the snowline.*** *The grasslands at a lower level form patches along with coniferous or broadleaved forests.* ***Himalayan wildlife require*** *both the forest and the grassland ecosystem as important parts of their habitat. The animals* ***migrate up into the high altitude grasslands*** *in summer and* ***move down into the forest in winter*** *when the snow covers the grassland. Himalayan hill slopes are covered with thousands of colorful flowering plants. There are also a large number of* ***medicinal plants.***



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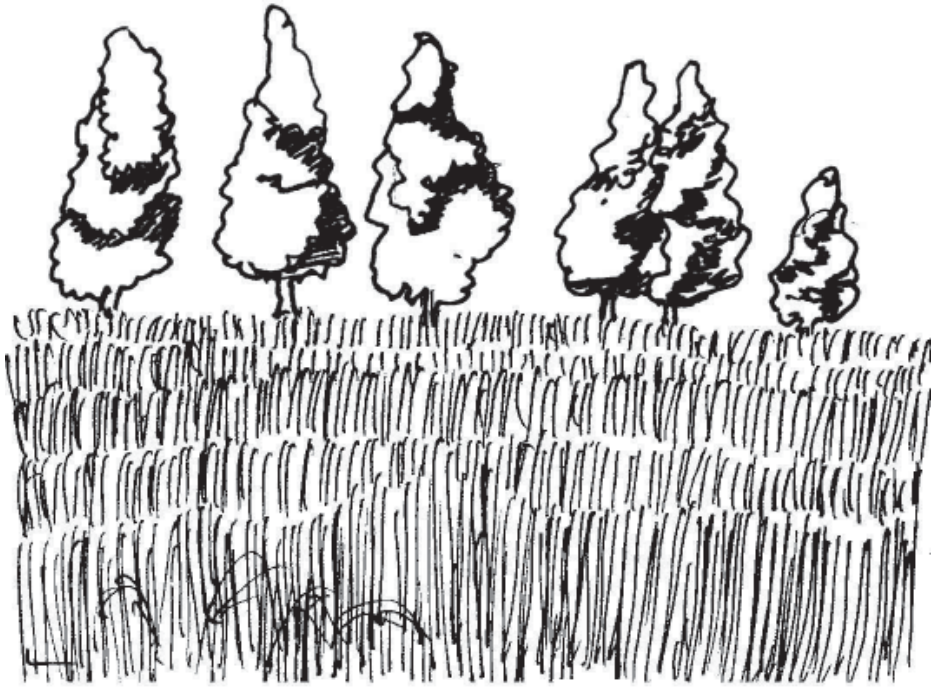
The Terai *consists of patches of* ***tall grasslands*** *interspersed with a Sal forest ecosystem. The patches of* ***tall elephant grass****, which grows to a* ***height of about five meters****, are located in the low-lying waterlogged areas. The Sal forest patches cover the elevated regions and the Himalayan foothills. The Terai also includes marshes in low-lying depressions. This ecosystem extends as a* ***belt south of the Himalayan foothills****.*



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The Semi-arid plains of Western India, Central India and the Deccan *are covered by* ***grassland tracts*** *with patches of thorn forest. Several* ***mammals*** *such as the wolf, the blackbuck, the chinkara, and* ***birds*** *such as the bustards and floricans are adapted to these arid conditions.The* ***Scrublands*** *of the Deccan Plateau are covered with seasonal grasses and herbs on which its fauna is dependent. It is teaming with insect life on which the insectivorous birds feed.*

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*The **Shola grasslands** consist of patches on hill slopes along with the Shola forests on the Western Ghats, Nilgiri and Annamalai ranges. This **forms a patchwork of grassland** on the slopes and forest habitats along the streams and low lying areas.*

*The **grasses are the major producers of biomass** in these regions. Each grassland ecosystem has a wide variety of species of grasses and herbs.*

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How are grasslands used?

- *Grasslands are the **grazing areas** of many rural communities. Farmers who keep cattle or goats, as well as shepherds who keep sheep, are **highly dependent** on grasslands.*
- ***Fodder** is collected and stored to feed cattle when there is no grass left for them to graze in summer.*
- *Grass is also used to **thatch houses and farm sheds**.*
- *The thorny bushes and branches of the few trees that are seen in grasslands are used as a major **source of fuel wood**.*
- *Grasslands have diverse species of insects that pollinate crops.*
- *There are also **predators** of these insects such as the small mammals like shrews, reptiles like lizards, birds of prey, and amphibia such as frogs and toads.*
- *All these carnivorous animals help to **control insect pests** in adjoining agricultural lands.*

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What are the threats to grassland ecosystems?

- *In many areas grasslands have been **used for centuries by pastoral communities**.*
- *Overutilization and changes in land use of the 'common grazing lands' of rural communities has lead to their **degradation**.*
- *The grassland cover in the country in terms of **permanent pastures now covers only 3.7 percent of land**.*
- *A major **threat** to natural grasslands is the **conversion** of grasslands into irrigated farmlands.*
- *After continuous irrigation such land **becomes saline** and useless in a few years.*
- *More recently many of these **residual grassland tracts** have been converted into **industrial areas**.*
- *This provides **short-term economic gains** but result in **long-term economic and ecological losses**.*

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How can grassland ecosystems be conserved?

- *Grasslands should not be **overgrazed** and areas of the grasslands should be **closed for grazing**. It is better to collect grass for **stall feeding cattle**.*
- *A **part of the grassland in an area must be closed** every year so that a **rotational grazing pattern** is established.*
- ***Fires** must be prevented and rapidly controlled in grasslands.*
- *In hilly areas **soil and water management** in each micro-catchment helps grasslands to **return to a natural highly productive ecosystem**.*
- *To protect the most natural undisturbed grassland ecosystems, **Sanctuaries and National Parks** must be created.*
- *Their management should focus on **preserving all their unique species of plants and animals** and not to convert it into tree plantations.*

ENVIRONMENT & ECOSYSTEM

Desert Ecosystem

- *Desert and semi arid lands are highly specialised and **sensitive ecosystems** that are easily destroyed by human activities. The **species of these dry areas** can live only in this specialised habitat.*
- *Deserts and semi arid areas are located in **Western India** and the **Deccan Plateau**. The climate in these vast tracts is **extremely dry**.*
- *There are also **cold deserts** such as in Ladakh, which are located in the high plateaus of the Himalayas.*

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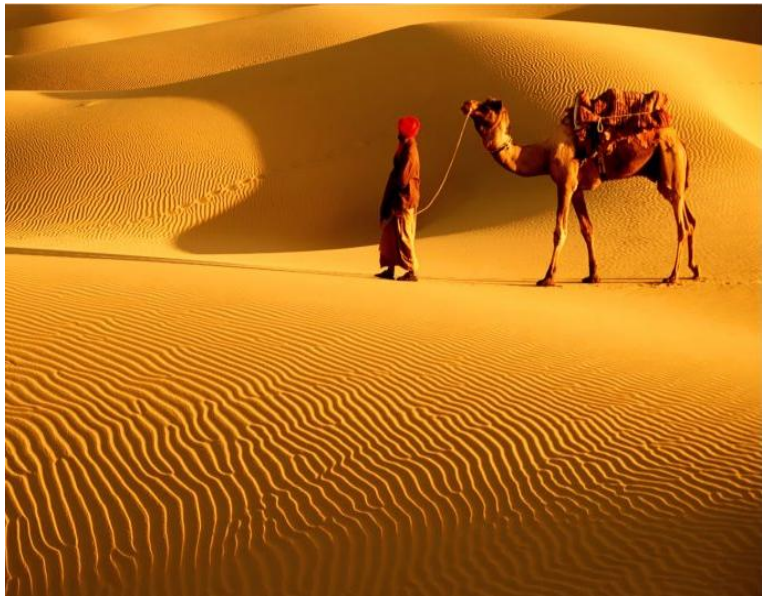
Desert Ecosystem

- *The most typical desert landscape that is seen in Rajasthan is in the **Thar Desert**. This has sand dunes.*
- *There are also areas covered with **sparse grasses** and a few **shrubs**, which grow if it rains.*
- *In most areas of the Thar the **rainfall is scanty and sporadic**. In an area it may rain only once every few years.*



ENVIRONMENT & ECOSYSTEM

How are desert and semi-arid ecosystems used?

- *Desert and semi arid regions have a number of **highly specialized insects and reptiles**.*
- ***The rare animals** include the Indian wolf, desert cat, desert fox and birds such as the Great Indian Bustard and the Florican.*
- *Areas of scanty vegetation with semi-arid scrubland have been used for **camel, cattle and goat grazing** in Rajasthan and Gujarat, and for sheep grazing in the Deccan Plateau.*
- *Areas that have a little moisture, such as along the watercourses, have been used for **growing crops** such as jowar, and bajra.*
- *The natural grasses and local varieties of crops have adapted to growing at **very low moisture levels**.*
- *These can be used for **genetic engineering** and developing arid land crops for the future.*

ENVIRONMENT & ECOSYSTEM

What are the threats to desert ecosystems?

- *Several types of development strategies as well as human population growth have begun to affect the natural ecosystem of the desert and semi arid land.*
- *Conversion of these lands through extensive irrigation systems has changed several of the natural characteristics of this region.The canal water evaporates rapidly bringing the salts to the surface.*
- *The region becomes highly unproductive as it becomes saline.*
- *Pulling excessive groudwater from tube wells lowers the water table creating an even drier environment.*
- *Thus human activities destroy the naturalness of this unique ecosystem.*
- *The special species that evolved here over millions of years may soon become extinct.*

ENVIRONMENT & ECOSYSTEM

How can desert ecosystems be conserved?

- *There is an urgent need to protect residual patches of desert ecosystem within National Parks and Wildlife Sanctuaries in desert and semi arid areas.*
- *The Indira Gandhi Canal in Rajasthan is destroying this important natural arid ecosystem, as it will convert the region into intensive Agriculture which has to be stopped.*
- *In Kutch, areas of the little Rann, which is the only home of the Wild Ass, will be destroyed by the spread of salt works.*
- *Development Projects alter the desert and arid landscape.*
- *There is a sharp reduction in the habitat available for its specialised species bringing them to the verge of extinction.*
- *We need a sustainable form of development that takes the special needs of the desert into account.*

ENVIRONMENT & ECOSYSTEM

Aquatic ecosystems

- *The aquatic ecosystems constitute the marine environments of the seas and the fresh water systems in lakes, rivers, ponds and wetlands.*
- *These ecosystems provide human beings with a wealth of natural resources.They provide goods that people collect for food such as fish and crustaceans.*
- *Natural aquatic systems such as rivers and seas break down chemical and organic wastes created by man.*
- *However, this function has limitations, as the aquatic ecosystem cannot handle great quantities of waste. Beyond a certain limit, pollution destroys this natural function.*
- *If aquatic ecosystems are misused or over utilized, their ability to provide resources suffers in the long term.*

ENVIRONMENT & ECOSYSTEM

What is an aquatic ecosystem?

- *In aquatic ecosystems, plants and animals live in water. These species are adapted to live in different types of aquatic habitats.*
- *The special abiotic features are its physical aspects such as the quality of the water, which includes its clarity, salinity, oxygen content and rate of flow.*
- *Aquatic ecosystems may be classified as being stagnant ecosystems, or running water ecosystems.*
- *The mud gravel or rocks that form the bed of the aquatic ecosystem alter its characteristics and influence its plant and animal species composition.*
- *The aquatic ecosystems are also classified into freshwater, brackish and marine ecosystems, which are based on the salinity levels.*
- *There is very little fresh water on earth, which is a key resource for people all over the world.*

ENVIRONMENT & ECOSYSTEM

Types of Aquatic ecosystems

Fresh water ecosystems			Marine ecosystems		
Flowing water		Still water	Brackish water	Saline water	
Streams	Rivers	Ponds, wetlands, lakes	Deltas	Coastal shallows, Coral reefs	Deep ocean

- *The fresh water ecosystems that have running water are streams and rivers.*
- *Ponds, tanks and lakes are ecosystems where water does not flow.*
- *Wetlands are special ecosystems in which the water level fluctuates dramatically in different seasons.*
- *They have expanses of shallow water with aquatic vegetation, which forms an ideal habitat for fish, crustaceaand water birds.*

ENVIRONMENT & ECOSYSTEM

Types of Aquatic Ecosystems Cont'd

- *Marine ecosystems are highly saline, while brackish areas have less saline water such as in river deltas.*
- *Coral reefs are very rich in species and are found in only a few shallow tropical seas.*
- *The richest coral reefs in India are around the Andaman and Nicobar islands and in the gulf of Kutch.*
- *Brackish water ecosystems in river deltas are covered by mangrove forests and are among the world's most productive ecosystems in terms of biomass production.*
- *The largest mangrove swamps are in the Sunderbans in the delta of the Ganges.*

ENVIRONMENT & ECOSYSTEM

The Pond Ecosystem

- The pond is the simplest aquatic ecosystem to observe.
- *There are differences in a pond that is temporary and has water only in the monsoon, and a larger tank or lake that is an aquatic ecosystem throughout the year.*
- *Most ponds become dry after the rains are over and are covered by terrestrial plants for the rest of the year.*
- *When a pond begins to fill during the rains, its life forms such as the algae and microscopic animals, aquatic insects, snails, and worms come out of the floor of the pond where they have remained dormant in the dry phase.*
- *Gradually more complex animals such as crabs frogs and fish return to the pond.*
- *The vegetation in the water consists of floating weeds and rooted vegetation on the periphery.*

ENVIRONMENT & ECOSYSTEM

Lake Ecosystem

- *A lake ecosystem functions like a giant permanent pond.*
- *A large amount of its plant material is the algae, which derives energy from the sun. This is transferred to the microscopic animals, which feed on the algae.*
- *There are fish that are herbivorous and are dependent on algae and aquatic weeds.*
- *The small animals such as snails are used as food by small carnivorous fish, which in turn are eaten by larger carnivorous fish.*
- *Some specialised fish, such as catfish, feed on the detritus on the muddy bed of the lake.*
- *Energy cycles through the lake ecosystem from the sunlight that penetrates the water surface to the plants.*

ENVIRONMENT & ECOSYSTEM

Stream and River Ecosystems

- *Streams and rivers are flowing water ecosystems in which all the living forms are specially adapted to different rates of flow.*
- *Some plants and animals such as snails and other burrowing animals can withstand the rapid flow of the hill streams.*
- *Other species of plants and animals such as water beetles and skaters can live only in slower moving water.*
- *Some species of fish, such as Mahseer, go upstream from rivers to hill streams for breeding.They need crystal clear water to be able to breed.They lay eggs only in clear water so that their young can grow successfully.*
- *As deforestation occurs in the hills the water in the streams that once flowed throughout the year become seasonal.*
- *This leads to flash floods in the rains and a shortage of water once the streams dry up after the monsoon*

ENVIRONMENT & ECOSYSTEM

Marine Ecosystems

- *The Indian Ocean, the Arabian Sea and the Bay of Bengal constitute the marine ecosystems around peninsular India.*
- *In the coastal area the sea is shallow while further away, it is deep. Both these are different ecosystems.*
- *The producers in this ecosystem vary from microscopic algae to large seaweeds.There are millions of zooplankton and a large variety of invertebrates on which live fish, turtles and marine mammals.*
- *The shallow areas near Kutch and around the Andaman and Nicobar Islands are some of the most incredible coral reefs in the world. Coral reefs are only second to tropical evergreen forests in their richness of species.*
- *Fish, crustacea, starfish, jellyfish and the polyps that deposit the coral are a few of the thousands of species that form this incredible world under the shallow sea.*

ENVIRONMENT & ECOSYSTEM

Seashore Ecosystems

- *Beaches can be sandy, rocky, shell covered or muddy.*
- *On each of these different types, there are several specific species which have evolved to occupy a separate niche.*
- *There are different crustacea such as crabs that make holes in the sand.*
- *Various shore birds feed on their prey by probing into the sand or mud on the sea shore.*
- *Several different species of fish are caught by fishermen.*
- *In many areas the fish catch has decreased during the last decade or two.*

ENVIRONMENT & ECOSYSTEM

How are aquatic ecosystems used?

- *Man uses aquatic ecosystems for the clean freshwater on which his life is completely dependent.*
- *We need clean water to drink and for other domestic uses. Water is essential for agriculture.*
- *Fisher folk use the aquatic ecosystems to earn a livelihood.*
- *People catch fish and crabs. They also collect edible plants.*
- *This is used locally as food or for sale in the market.*
- *Over fishing leads to a serious decline in the catch and a long-term loss of income for fisher folk.*
- *Marshes and wetlands are of great economic importance for people who live on their fish, crustacea, reeds, grasses and other produce.*

ENVIRONMENT & ECOSYSTEM

What are the threats to aquatic ecosystems?

- *Water pollution occurs from sewage and poorly managed solid waste in urban areas when it enters the aquatic ecosystem of lakes and rivers.*
- *Sewage leads to a process called eutrophication, which destroys life in the water as the oxygen content is severely reduced.*
- *Fish and crustacea cannot breathe and are killed. A foul odour is produced. Gradually the natural flora and fauna of the aquatic ecosystem is destroyed.*
- *In rural areas the excessive use of fertilisers causes an increase in nutrients, which leads to eutrophication. Pesticides used in adjacent fields pollute water and kills off its aquatic animals.*
- *Chemical pollution from industry kills a large number of life forms in adjacent aquatic ecosystems. Contamination by heavy metals and other toxic chemicals affects the health of people who live near these areas as they depend on this water.*

ENVIRONMENT & ECOSYSTEM

How can aquatic ecosystems be conserved?

- *For sustainable use of an aquatic ecosystem, water pollution must be prevented. It does not make sense to allow water to be polluted and then try to clean it up.*
- *Changing the nature of the aquatic ecosystem from a flowing water ecosystem to a static ecosystem destroys its natural biological diversity.*
- *Thus dams across rivers decrease the population of species that require running water, while favouring those that need standing water.*
- *Aquatic ecosystems, especially wetlands, need protection by including them in Sanctuaries or National Parks in the same way in which we protect natural forests.*
- *These sanctuaries in aquatic ecosystems protect a variety of forms of life as well as rare fish which are now highly endangered such as the Mahseer.*


THANK YOU