

Environmental Studies: Unit II – Ecosystem**Instructor: Dr. Narendra K Bairwa****Assistant Professor****School of Biotechnology, Shri Mata Vaishno Devi University, Katra,
Reasi, Jammu and Kashmir****Let's have an overview of UNIT II: "Ecosystem"**

Module 1	Concept of an ecosystem,
Module 2	Structure and function of an ecosystem
Module 3	Energy flow in the ecosystem,
Module 4	Ecological succession
Module 5	Food chains, food webs & ecological pyramids
Module 6	Forest ecosystem
Module 7	Grassland & Desert ecosystem
Module 8	Q&A and Revision session

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Module I: “Concept of an ecosystem”

Readings:

1. Bharucha E, Environmental Studies for Undergraduate Courses, 2nd Ed., University Press (India) Pvt. Ltd. 2013
2. Cunningham W and Cunningham M, Principles of Environmental Science, 9th Ed., McGraw-Hill Education, 2019
3. Sharma PD, Ecology and Environment, 13th Ed. Rastogi Publications, 2017

Remember that any life form cannot live alone. They interact with other life forms and with the surrounding environment. Each life form makes independent communities which are dependent on each other. In holistic term an ecosystem term is referred as

“Structural and functional system of communities and their interactions with environment”

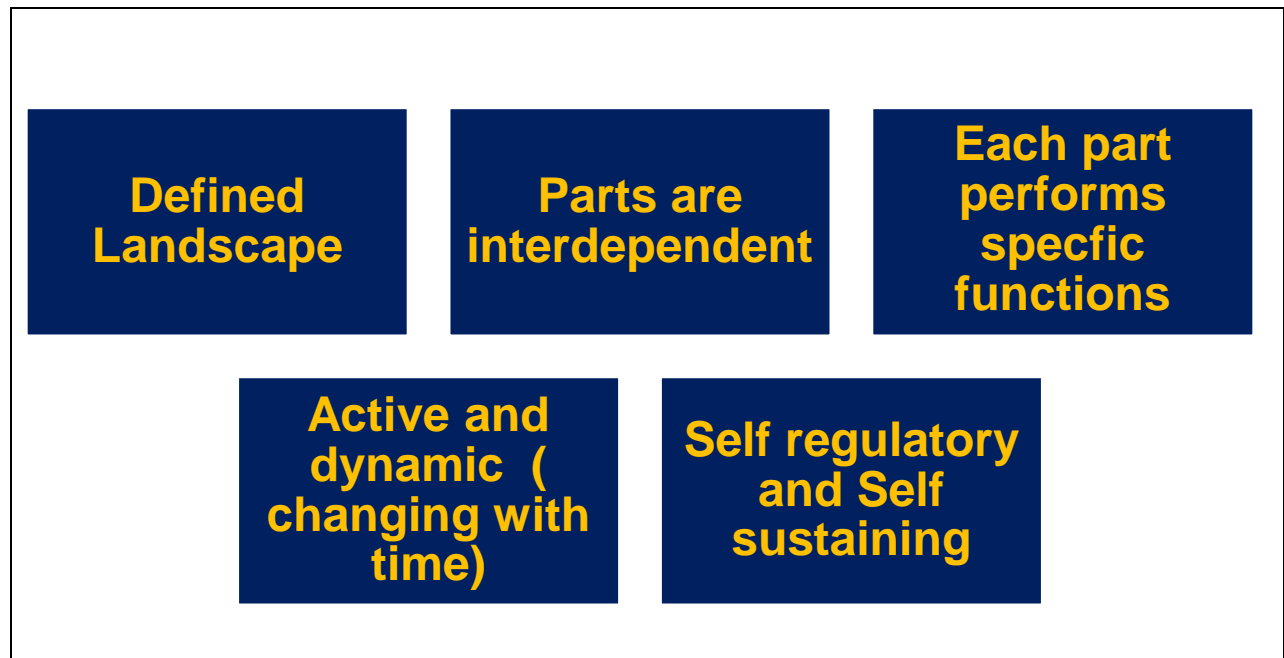
Sir Arthur Tansley (1935): First time used the term “Ecosystem”

Eugene P odium defined as basic unit of ecology:

The term ecology stand for the study of both organic and inorganic environment related to economy of the nature.

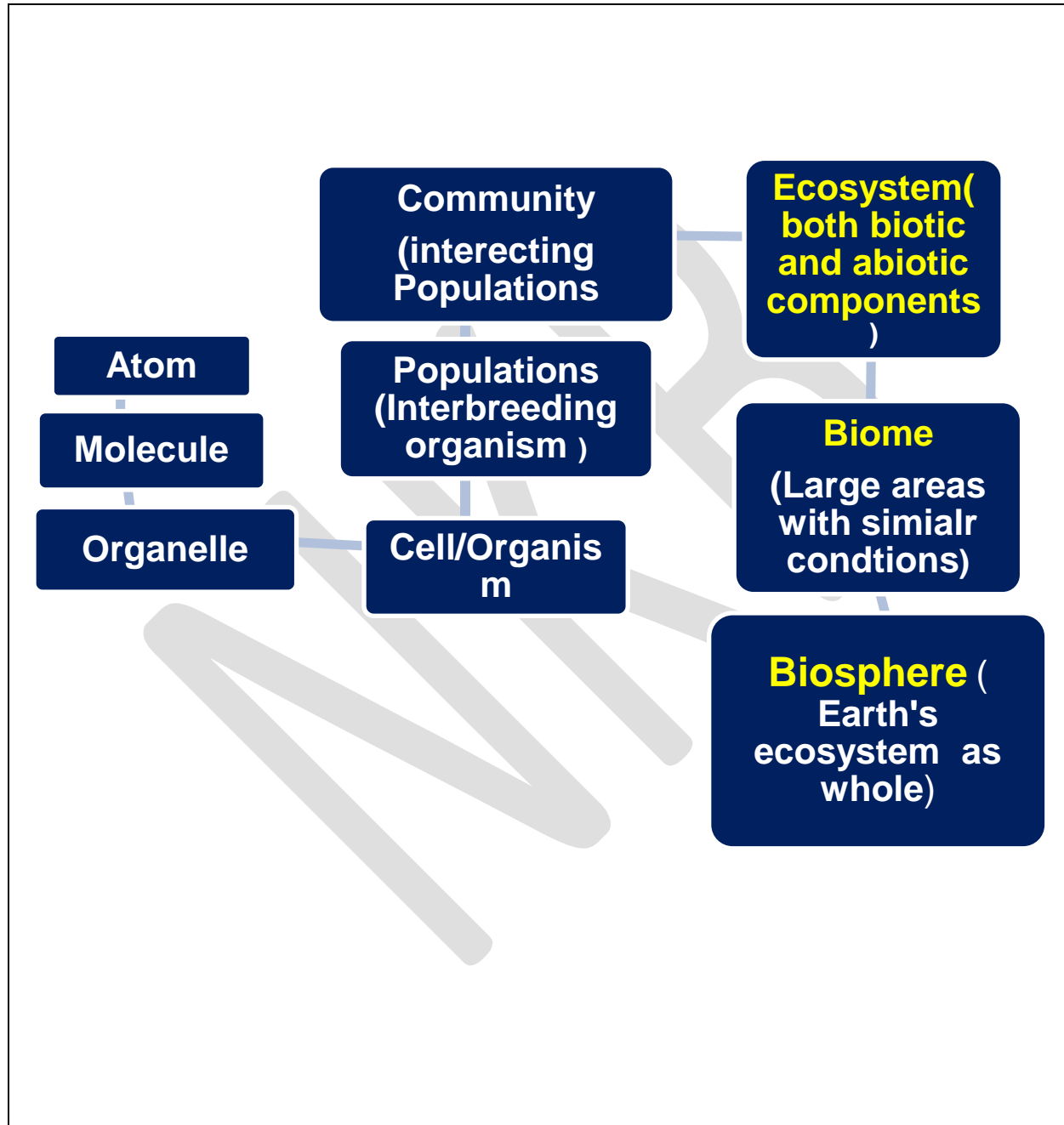
S. Mathavan (1974): interactions of living things with environment

An ecosystem with variable input of material and energy has unique properties which include:



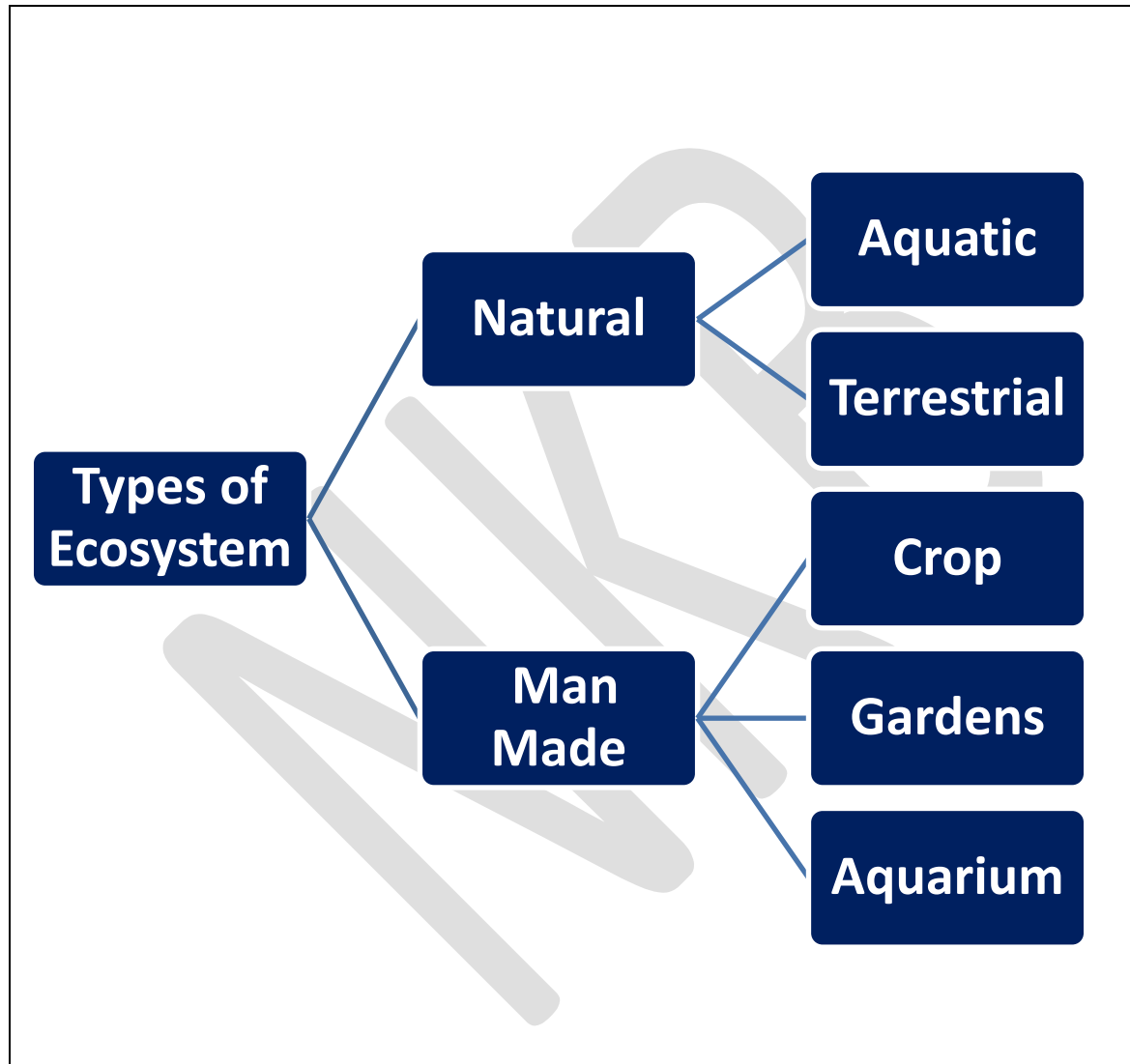
Component of an Ecosystem:

An ecosystem includes both living and non-living components.



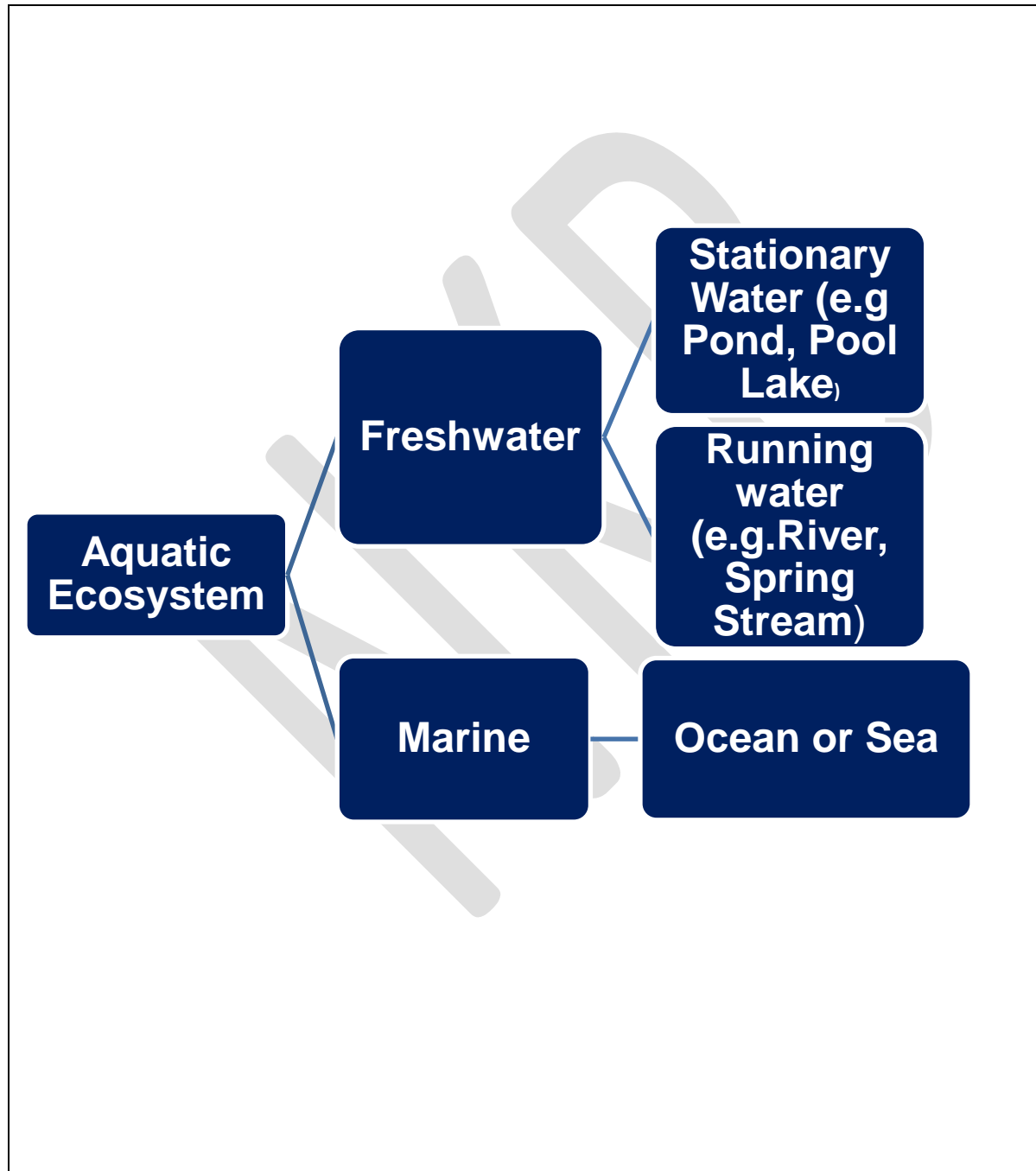
Kinds of Ecosystem: There are two basic type of ecosystem:

1. Natural ecosystem and
2. Man-made ecosystem



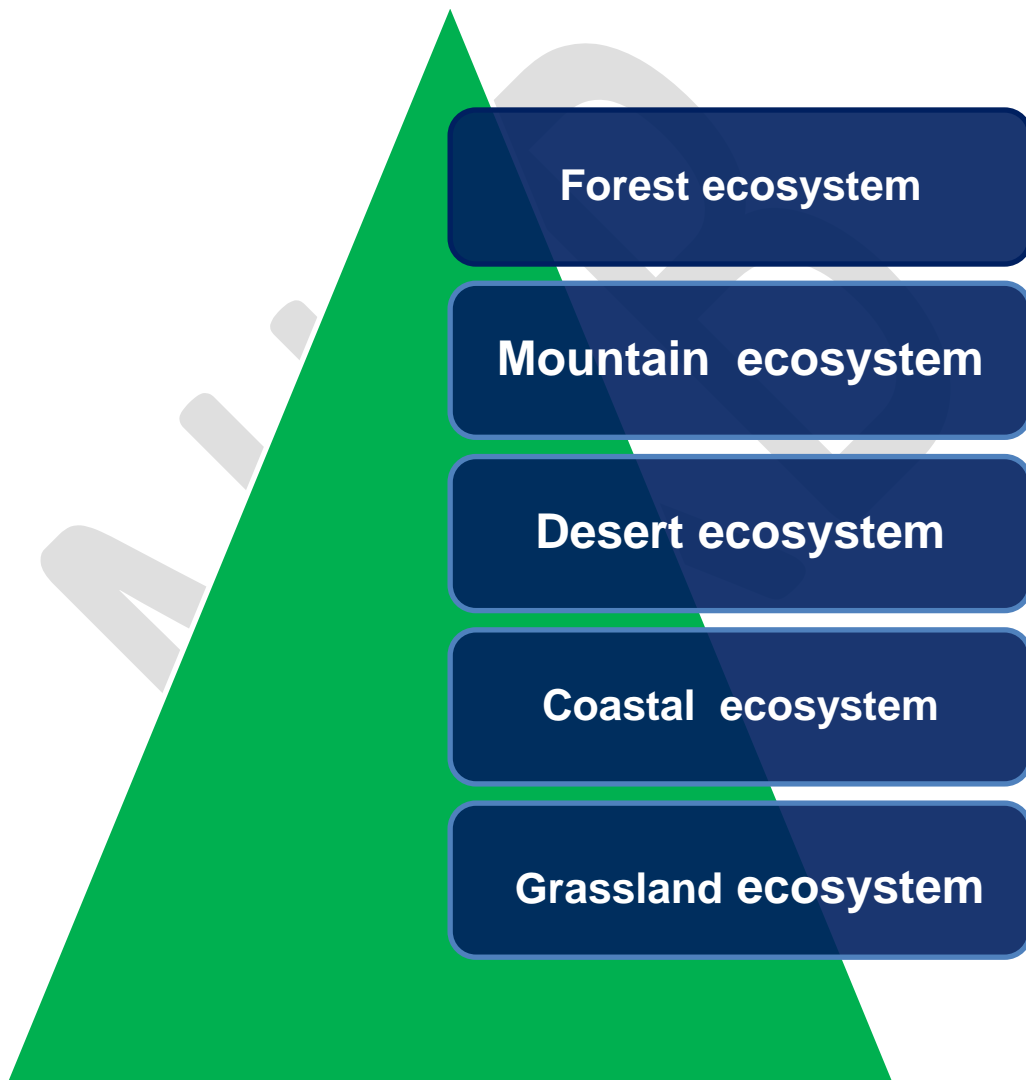
The aquatic ecosystem further can be categorized into two as:

- 1. Fresh water ecosystem**
- 2. Marine Ecosystem**



The terrestrial ecosystem further can be categorized into many types as per the land scape:

1. Forest ecosystem 2. Mountain ecosystem 3. Desert ecosystem 4. Coastal ecosystem 4. Grassland ecosystem



Summary of module I:

- 1. Ecosystems are structural and functional units of the biosphere.**
- 2. Ecosystems are self-sustaining and regulating.**
- 3. Ecosystem adjusts to the perturbations and changes.**
- 4. The cycling of nutrients and energy is hall mark of an Ecosystem.**

Module II: “Structure and function of an ecosystem”

Readings :

1. Bharucha E, Environmental Studies for Undergraduate Courses, 2nd Ed., University Press (India) Pvt. Ltd. 2013
2. Cunningham W and Cunningham M, Principles of Environmental Science, 9th Ed., McGraw-Hill Education, 2019
3. Sharma PD, Ecology and Environment, 13th Ed. Rastogi Publications, 2017

Hello! Students. Welcome to the module II of the Ecosystem. In the previous Module we have discussed about the concept of an ecosystem, definition, properties and types. In this module we will learn about the structure and function of an ecosystem.

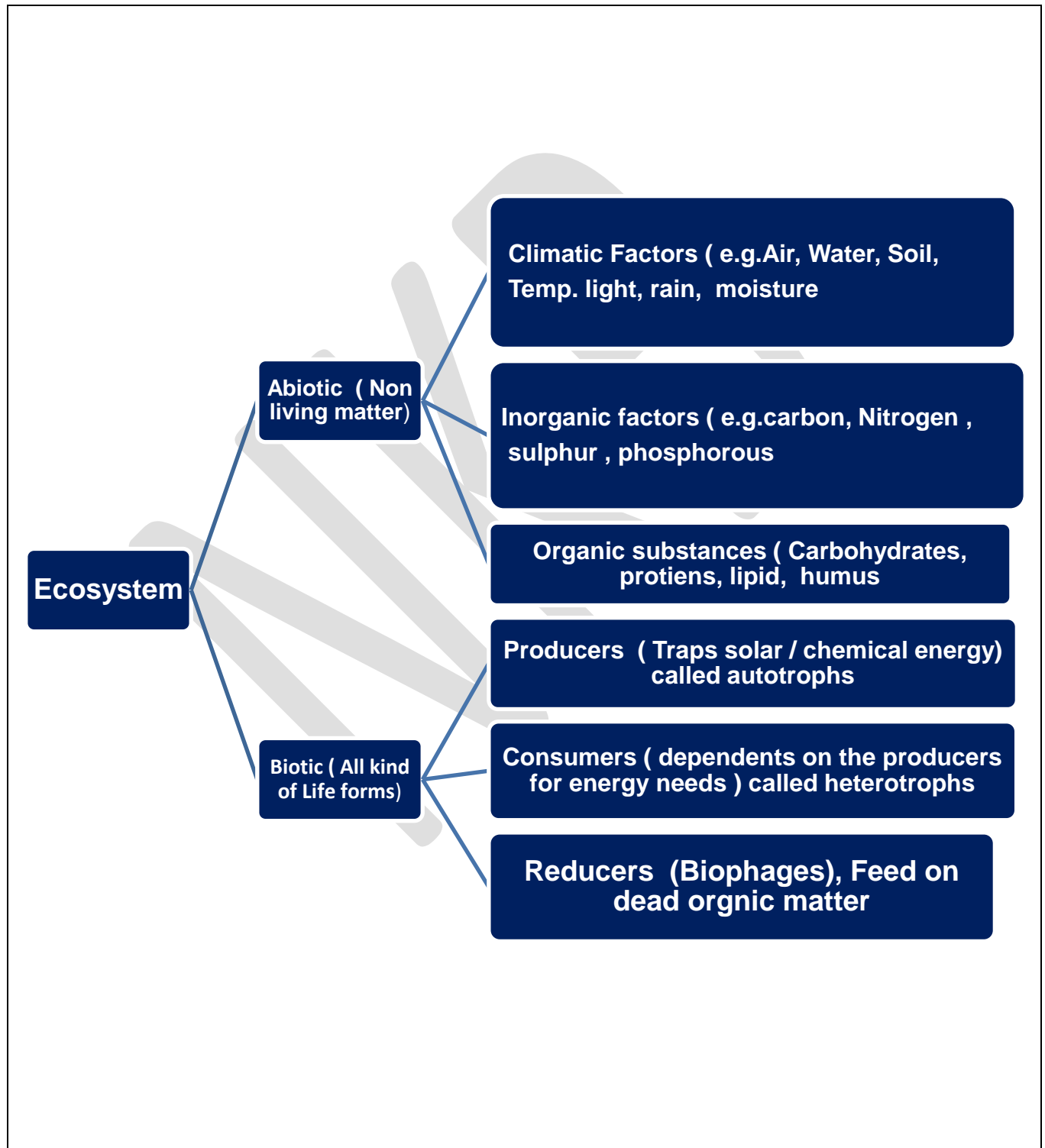
Structure of an Ecosystem:

As we discussed in previous module, there are two type of component which constitutes an ecosystem and they are interlinked.

1. Nonliving component or Abiotic

2. Living components or Biotic

Structural component of an ecosystem:



Terminology related to the structure of an ecosystem

Autotrophs: Self nourishing/ Energy trappers (auto=self, trophs=nutrition)

a. **Photoautotrophs:** Green pigment chlorophyll containing life forms such as trees, algae, phytoplankton's, blue green algae or cyanobacteria

b. **Chemoautotrophs:** Lacking chlorophyll but use chemical reaction for energy trapping such as Sulphur bacteria

Heterotrophs: Dependent on others for food and energy (hetero=others, trophs=nutrition)

a. **Herbivores:** dependent on plants for food (cattle, insects, zooplankton, deer, elephants etc.)

b. **Carnivores:** Flesh eating animals (wolves, dogs, tiger, foxes, leopards)

c. **Omnivores:** Consumes both plants and flesh (Man, ants, sparrow, bear and crow)

Decomposers: breaks organic compound into inorganic (proteins into carbon, nitrogen, oxygen) e.g. bacteria

Saprotrophs: absorbs dead organic matter (Mushroom)

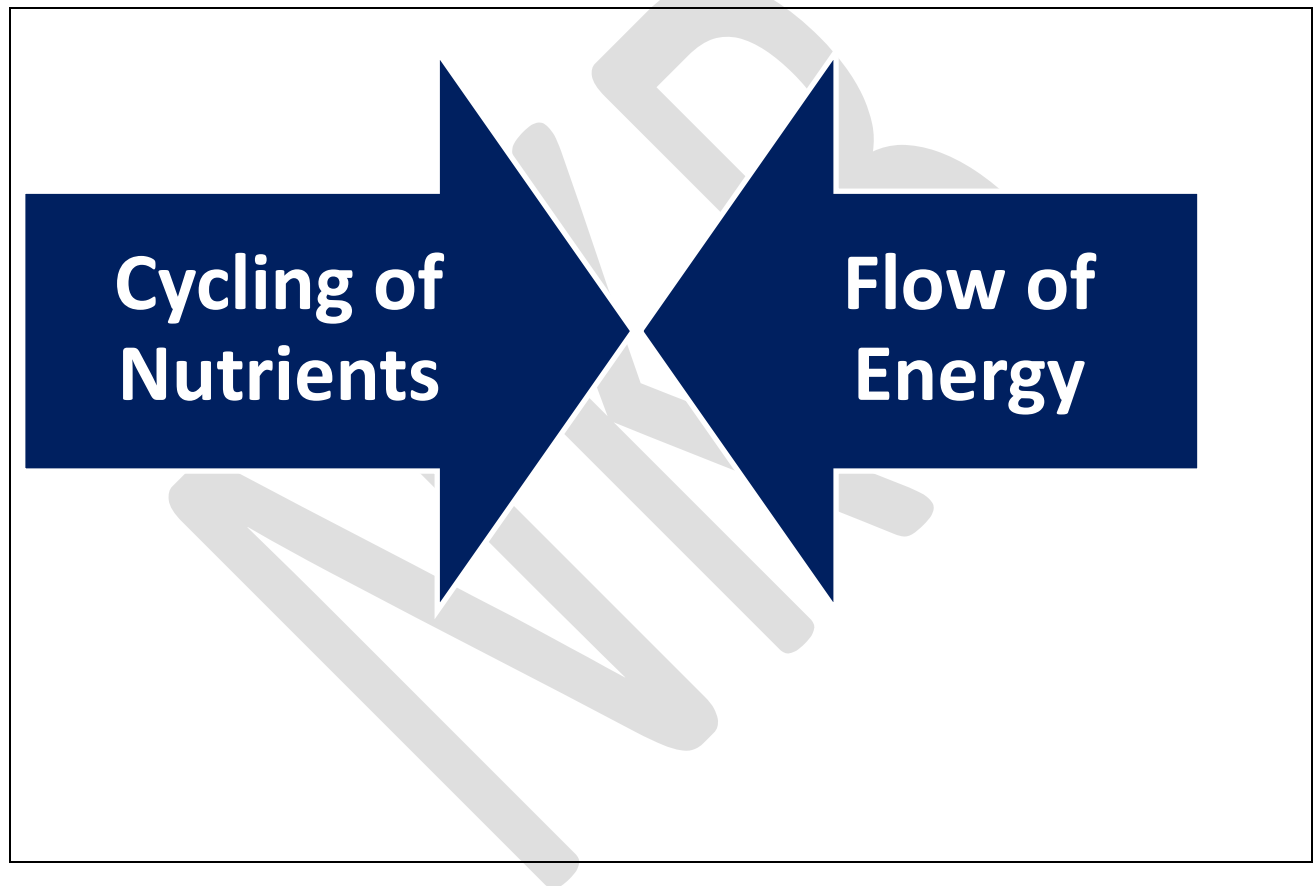
Transformers : convert organic matter into usable forms (Azobactor)

Function of an Ecosystem:

Hello! Students, what is the function of an ecosystem? Why an ecosystem is self-sustaining and self-regulatory?

The basic functions of the components of an ecosystem is to

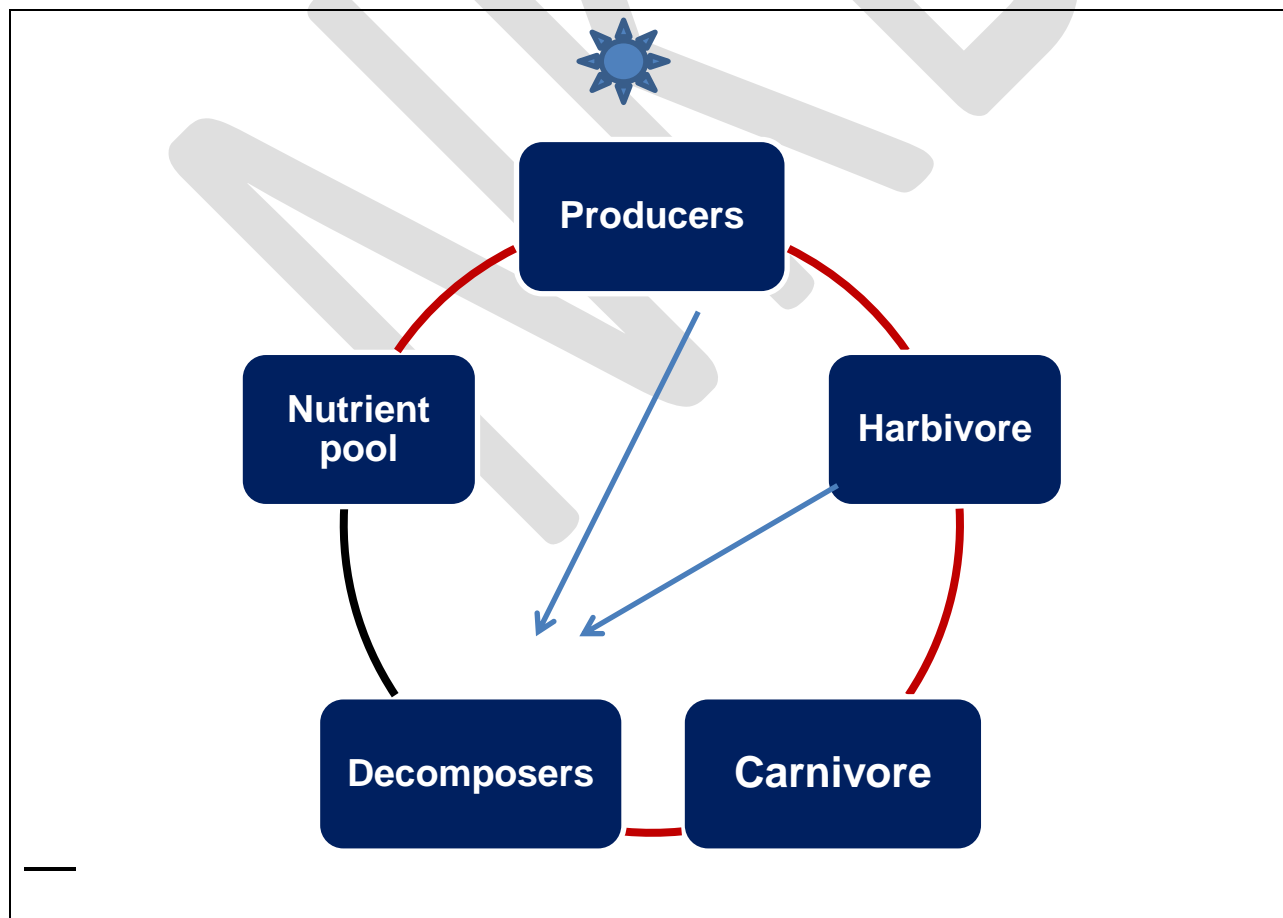
- **Cycle the nutrients**
- **Flow of the energy**



Cycling of nutrients:

Let's learn the fact that all the life forms require nutrients in order to survive. An ecosystem is limited to a geographical area and therefore the amount of nutrient is limited. The dynamic nature of an ecosystem is requiring the recycling of nutrients.

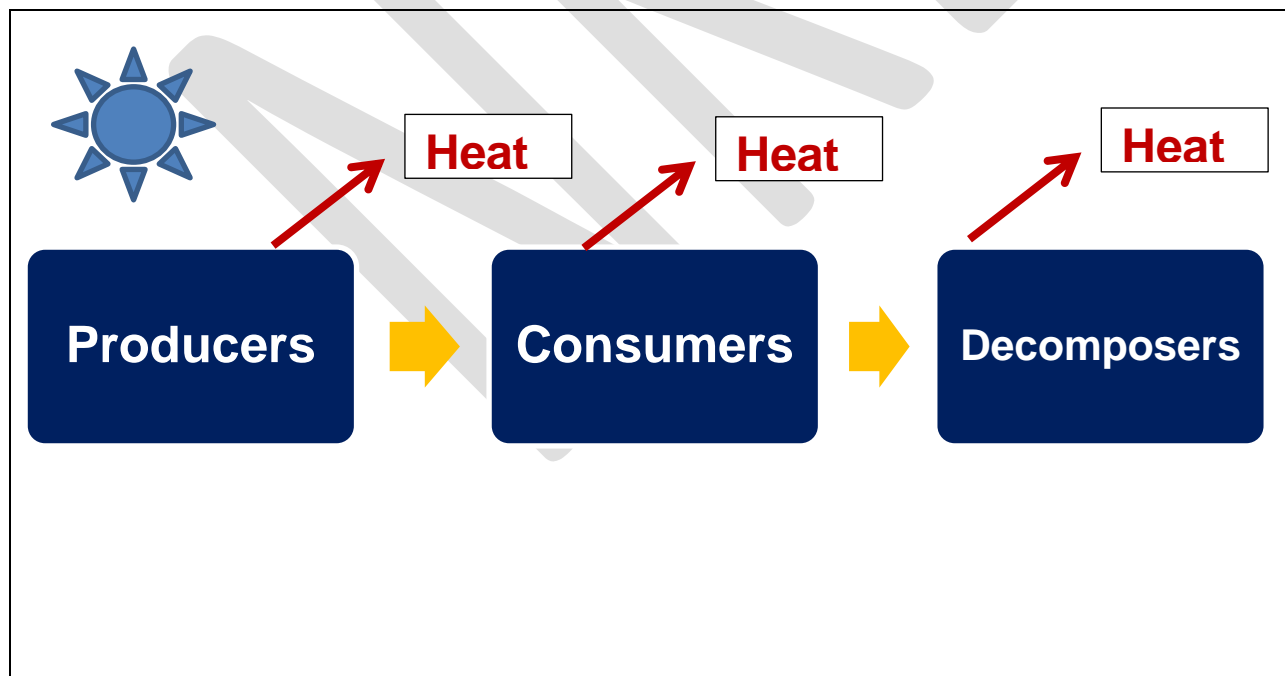
The nutrient cycling begins with the photosynthesis process where glucose is formed using solar energy, carbon dioxide and water by green plants. The plant and herbivores use the nutrient and grow later they are eaten by carnivores and omnivores and finally decomposer helps in decaying and recycling of the carbon back to the ecosystem. The entire scheme of nutrient cycling can be understood through the following chart.



Flow of Energy:

The cycling of nutrient is linked with the flow of energy. As it was discussed in the previous module that green plants traps the solar energy in the form of glucose and subsequently the same molecule upon disintegration release the energy for function of the organism. In any given ecosystem the principal source of energy is sunlight.

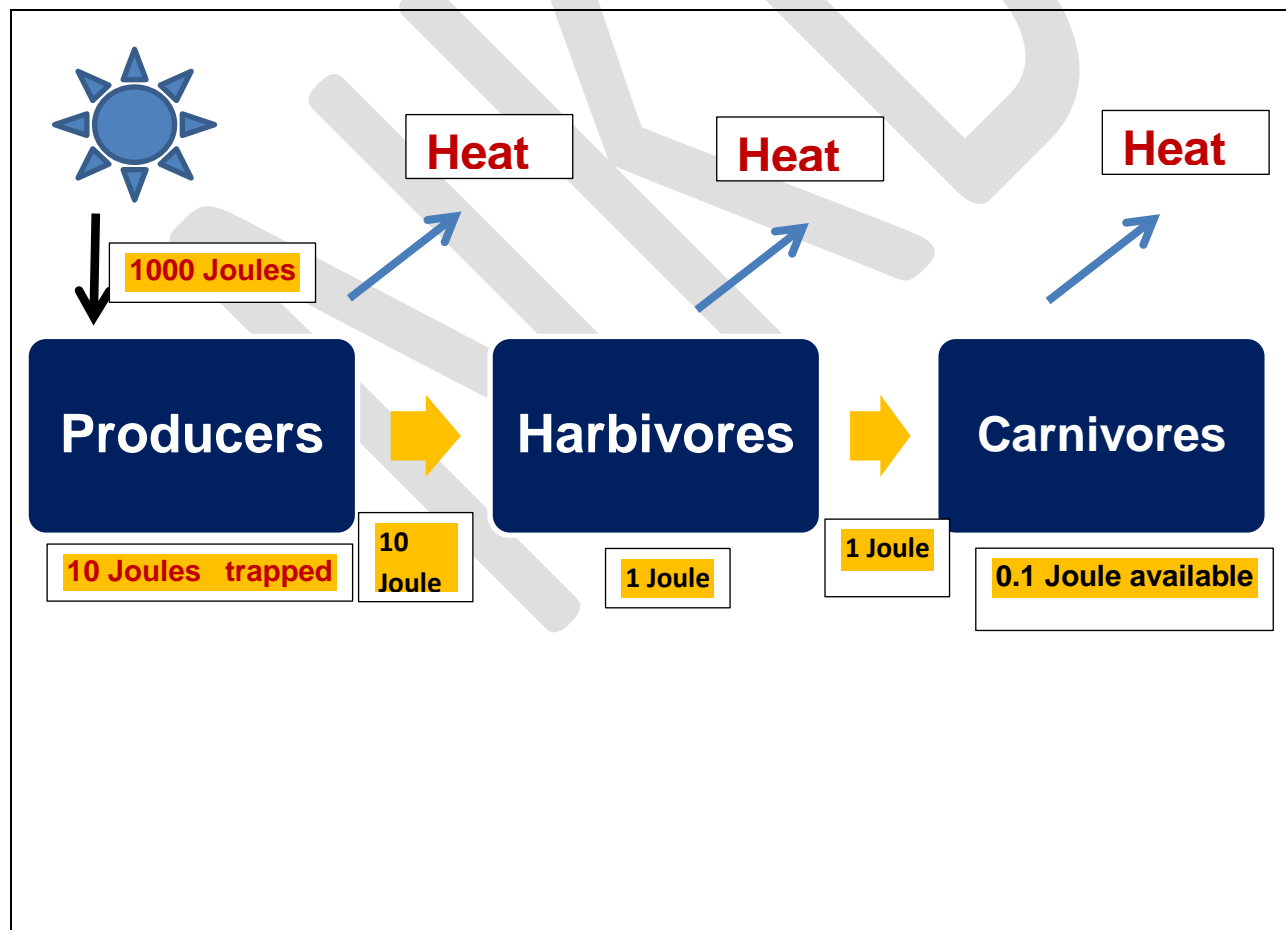
The flow of energy in the ecosystem is unidirectional. The energy trapped by green plants is being used by herbivores upon catabolism of the glucose molecule and in this process heat is released. The carnivore consumes the herbivores and again heat is released. So in any given ecosystem the energy flow is unidirectional and loss of energy in the form of heat.



Ten percent (10%) Law of energy flow in an ecosystem:

According to this law the energy rich food is consumed by the herbivores in comparison to other consumers. The concept is based on the assumption that if the 10 % of the total energy received from the sun is being used then due to loss of energy the next trophic level receives less energy in comparison to previous trophic level.

This can be understood through the following flow chart:



Summary:

- 1. In this module we have learnt about the structure and function of an ecosystem.**
- 2. Any given ecosystem has both living and nonliving component and both are crucial for optimum function.**
- 3. Sun energy is the principal source for functioning of any ecosystem.**
- 4. There is always loss of energy at different trophic levels. The producers store the maximum energy.**

Module 4: Food chains, food webs & ecological pyramids

Hello! Students, Welcome to the Module 4

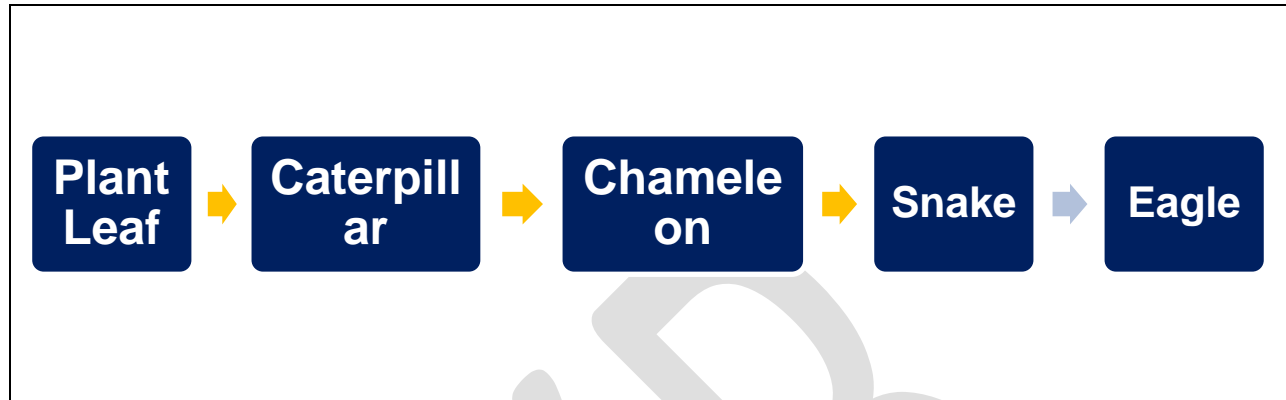
In the previous module we have learnt about the structure and function of an ecosystem. In this module we will describe the inter-relationship of different population group and their interwoven links. The linkage of the communities determines the flow of energy and cycling of nutrients therefore making an ecosystem dynamic.

Here are some terms which we must learn for **module 4**

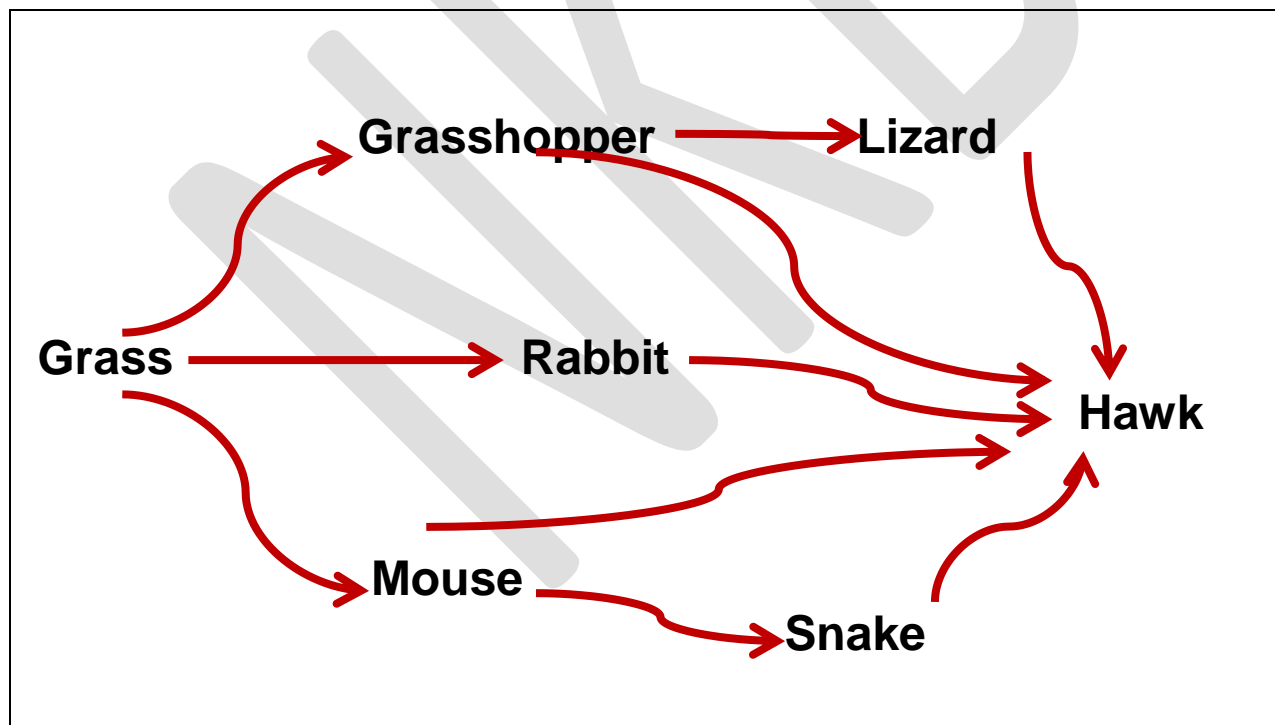
1. **Food Chains:** The sequence of organisms, interlinked by a process of eating and being eaten, which result in flow of energy and cycling of nutrients, is known as a food chain.
2. **Food web:** In any ecosystem there are number of food chains which are linked together and as a whole described as food web.
3. **Ecological pyramids:** The representation of the relationship between the different species in a food chain in the form of bar chart is called ecological pyramid.

Let's learn about these terms in the form of flow charts:

Food chain in grassland ecosystem

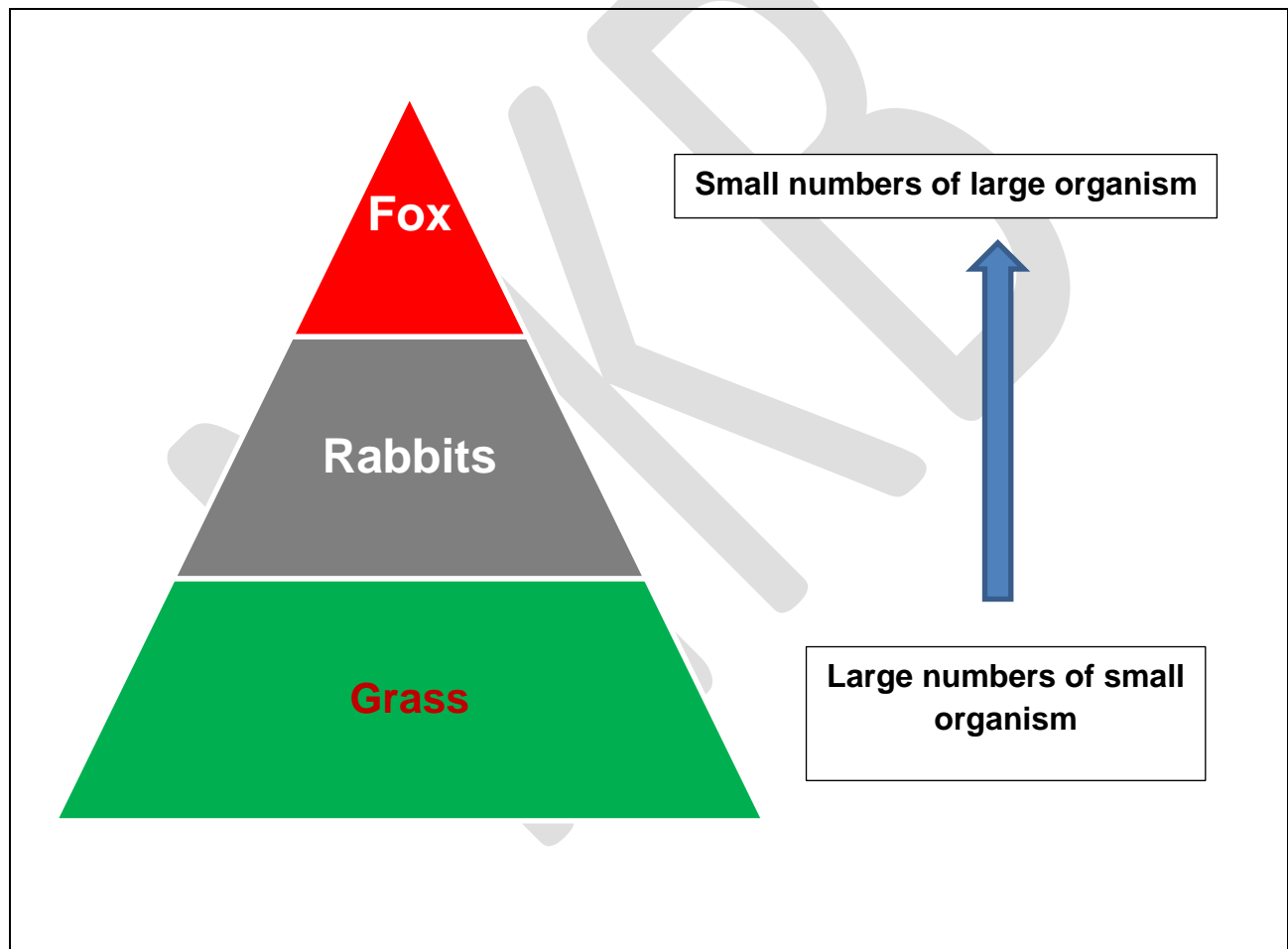


Food web in grassland ecosystem

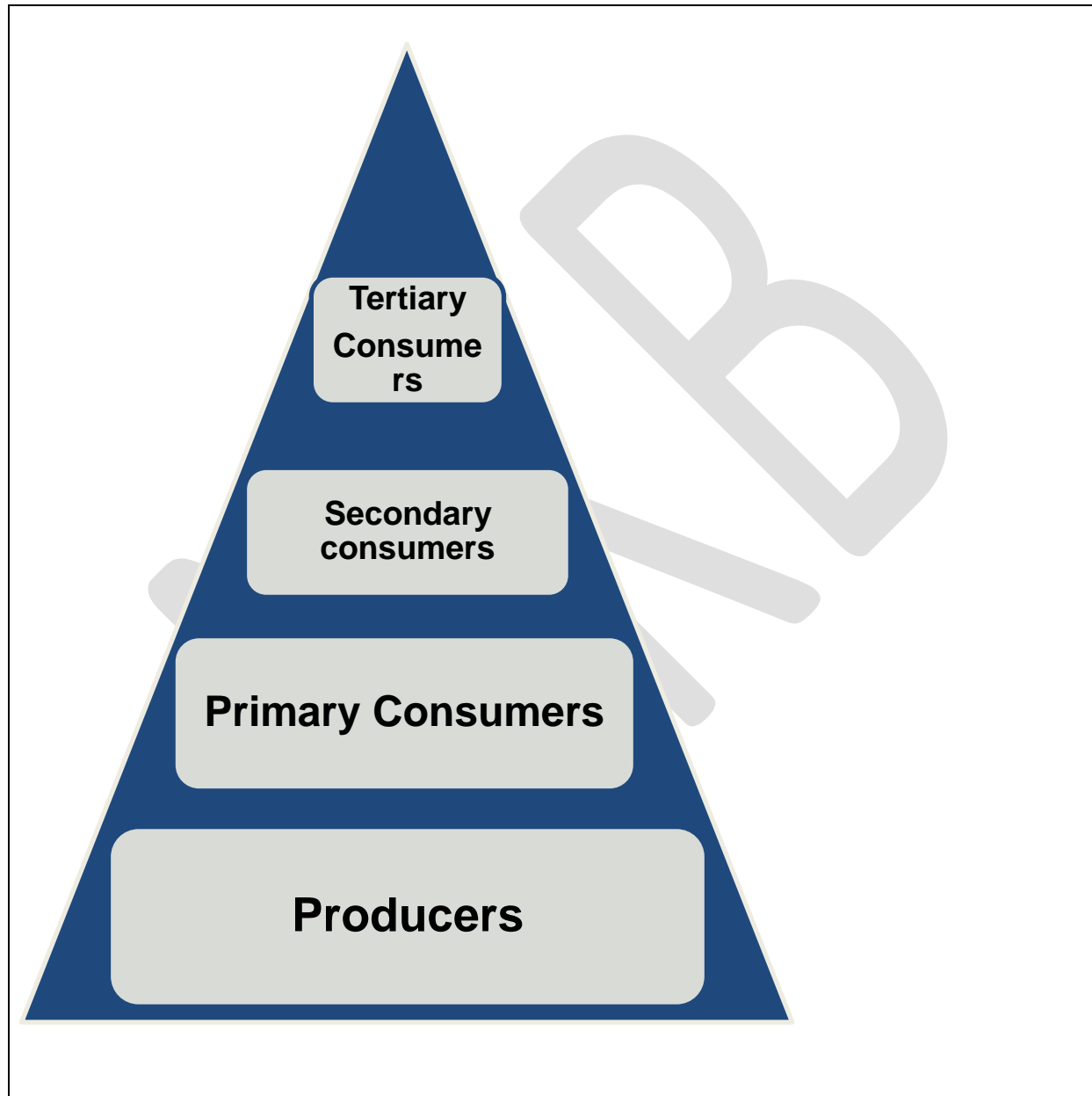


Ecological Pyramids

The representation of relationship between different levels of food chain in any given ecosystem in the form of bar chart is called ecological pyramids. This chart may represent various characteristics of the ecosystem such as, name of species, number of each organism, Mass or energy etc.



Another Example of Ecological Pyramids:



Summary:

- 1. In the ecosystem the living component are in relationship.**
- 2. These relationships are defined as food chain and food web**
- 3. The goal of relationship to transfer the energy from one trophic level to another and cycling of the nutrients.**

Module 5:

Ecological Succession:

Hello! Students, in previous module we have learn about the concept of an ecosystem, structure and function. We also have learnt that the ecosystem is dynamic and changing.

In this module we will learn about the term used about the changing nature of the ecosystem and some examples.

The term **Ecological Succession** refers to the gradual process of change which could be fast and slow by which an ecosystem is changed or developed.

Such as change of **pond ecosystem in to the forest** over a long period of time

Or change of a **cow dung into the manure or nutrient rich soil.**

There are two types of ecological succession

1. Primary

2. Secondary

Key definitions:

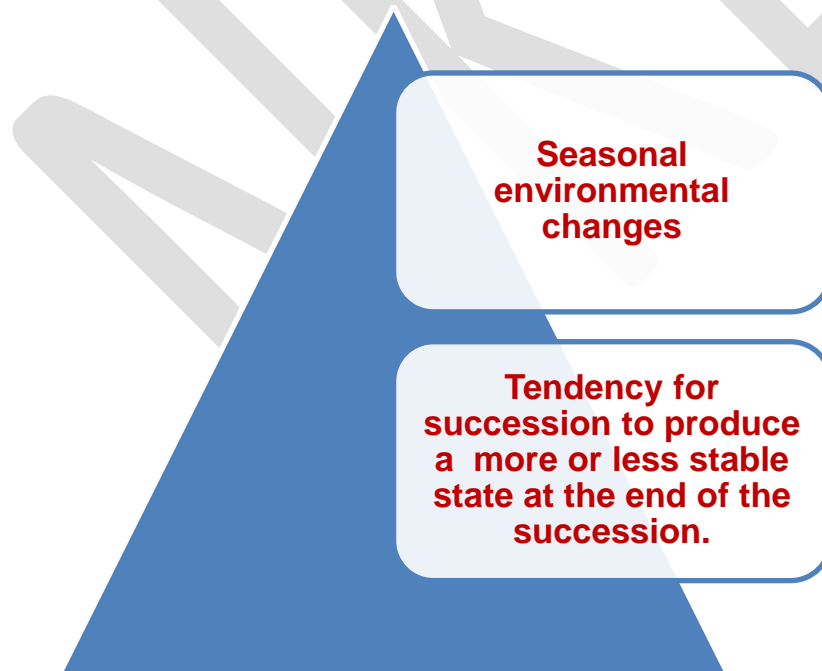
1. **Pioneer species** : The first organism to enter in ecological succession
2. **Primary succession**: is the series of community changes which occur on an entirely new habitat which has never been colonized before. For example, a newly quarried rock faces or sand dunes.
3. **Secondary succession** is the series of community changes; take place on a previously colonized, but disturbed or damaged habitat. For example, after felling trees in a woodland, land clearance or a fire.
4. **Seres** : The transitional series of communities which develop in an ecosystem are called seres or seral stages
5. **Climax community**: Communities which are end of the ecological succession and occupy the area for very long period of time are called **climax community**.

Ecosystem:

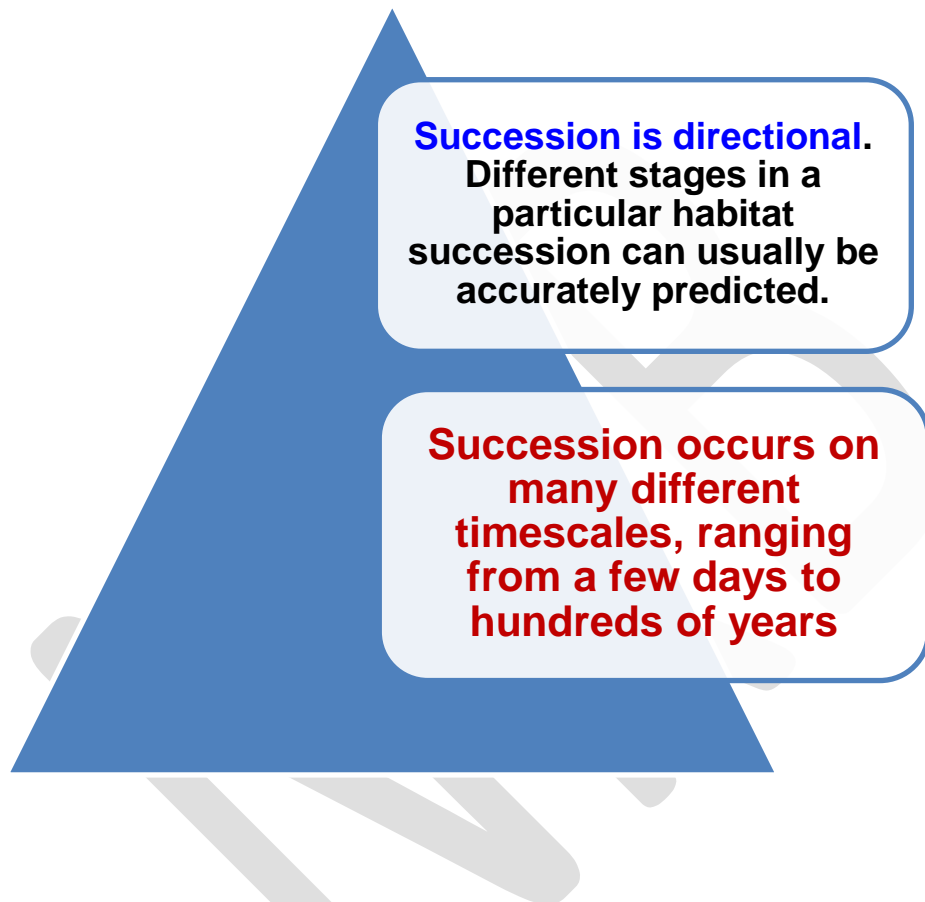
Two major components:

- a. Community: All of the species living in one area
- b. Population: the entire organism of one species living in one area

Communities of an area changes over time through a process called **Ecological succession or Community development**: A process through which ecosystems tend to change over a period of time, nothing remains the same, and habitats are constantly changing.



Succession occurs on many different timescales, ranging from a few days to hundreds of years



Examples of Ecological succession:

It may take hundreds of years for climax woodland to develop.

Pond to climax woodland



2. The Ecological succession in the cow dung

While the succession of invertebrates and fungi within a single cow pat (cow dung), may be over within as little as 3 months.



Transformation into humus, nutrients, and recycling back into the soil.

The holes clearly visible in the cow pat have been made by the animals which have colonized it.

- It is worth remembering that as plant communities' change, so will the associated micro-organism, fungus, and animal species. Succession involves the whole community, not just the plants.
- Communities change gradually from one sere to another. The **seres** are not totally distinct from each other and one will tend to merge gradually into another, finally ending up with a '**climax**' **community**.
- Succession will not go any further than the **climax community**. This is the final stage

Summary:

1. Ecological succession is dynamic process and relates to changing and developing of an ecosystem.

Module 7

Forest Ecosystem:

Hello! Students: in previous modules we have learn about the concept of ecosystem, definitions, component and how ecosystems are developed over the period. In this module we will learn about the forest ecosystem and their role in running the economy health and climate regulation.

We must remember that any one removal of a component from an ecosystem would trigger the collapse of an ecosystem.

The nature tries to balance between the component and this balance is known as ecological balance.

However due to increase in population and unprecedented exploitation of the natural resources is causing widespread problems.

Followings are the major causes of ecological balance

- 1. Deforestations**
- 2. Introduction to new species in the ecosystem**
- 3. Introduction of the pollutants in the ecosystem**

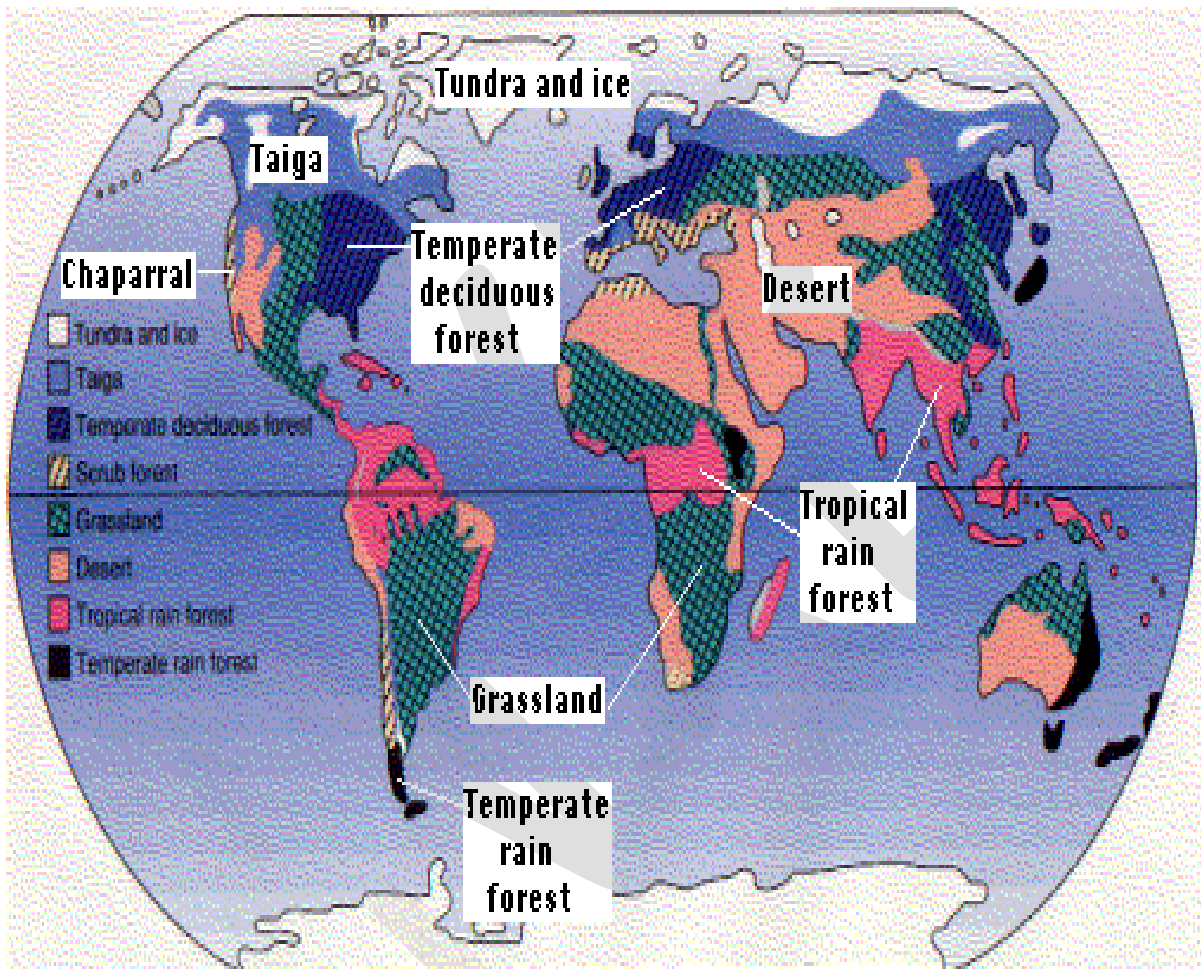
In this module we would learn about the forest or terrestrial ecosystem:

Definition: The living community of plants (Trees, shrubs, leaf mulch on the floor) and animals, microbes in any area together with the non-living components of the environment such as soil, air, and water, constitute the forest ecosystem.

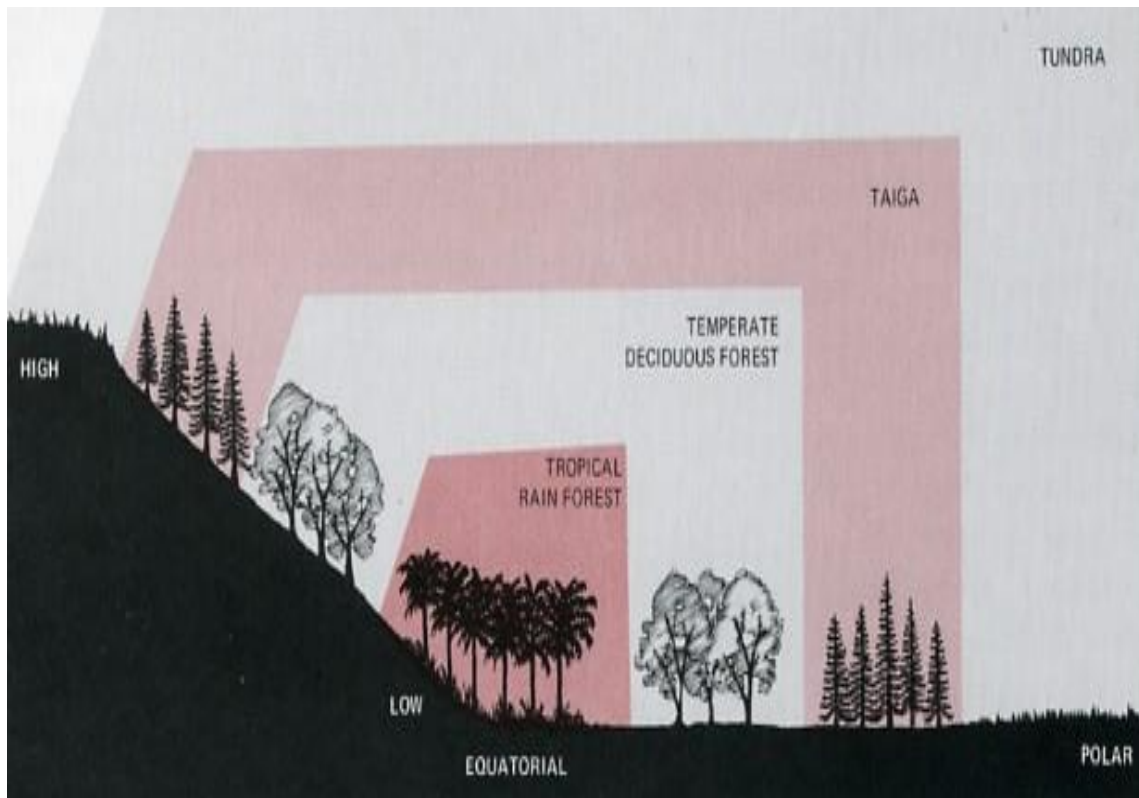
The constitution of the forest ecosystem is influenced by the factors such as

1. Climate:
2. Location such as Mountains or polar region
3. Density of trees:

Climate based categorization:



Source: <http://www.biology-pages.info/B/Biomes.html>



Source: <http://www.biology-pages.info/B/Biomes.html>

Types of Forest in India:

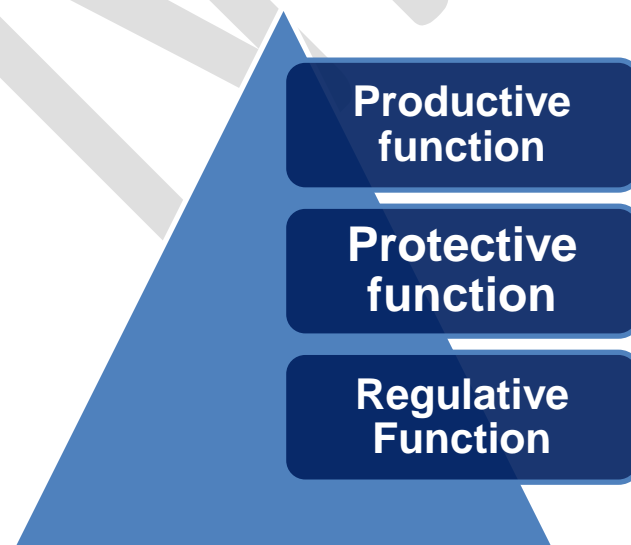
India is rich in biodiversity. We can categorize forest based on rainfall, climate soil type and leaves in India.

1. Evergreen
2. Deciduous
3. Xerophytic
4. Mangroves

Based on leaf there are two broad category of forest

1. Coniferous (Narrow leaved): Mostly in cold region
2. Broadleaved forest: Regions where there is excessive rainfall

Importance of forest:



Deciduous forest

Plant growth and pattern :
Shed their leaves during summer and winter

Rainfall: 100-200cm for few months

Tem: moderate

Vegetation :
Less Dense and light can reach till ground

Flora:
Teak
Sal

Founa:
Tiger,
chital,
flycatchers .

Locations:
western side of deccan plateau .

Evergreen forest

Plant growth and pattern : Green throughout the year	Rainfall: More than 200cm/year	Tem: 15-30 degree celcius	Vegetation : Dense and forms continuous canopy light cannot reach till ground	Flora: Jamun, ficus, ferns, orchid, oak, maple	Founa: Tiger, elephant, rhinoceros, leopard, bear, treefrog etc.	Locations: Western ghat, North east state, west bangal etc.
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Mangrove forests

Plant growth and pattern :

Aquatic trees and shrubs adapted for harsh conditions year

Rainfall: 100-150cm/year

Tem: Varies drastically

Vegetation : Salt tolerant plants (halophytes)

Flora: Mangroves

Fauna: sharks, mussels, crocodiles etc.

Locations: estuaries, rivers, delta islands

Thorn forest

Plant growth and pattern : Leafless most part of the year	Rainfall: 20cm-70cm/year	Tem: hot and dry	Vegetation : Small trees (8-10m high) thorny or spiny shrubs of stunted growth	Flora: Acacia Babul kekar, khejri	Founa: Camels, squirrels, lizards, snakes	Locations: South Panjab, most of Rajasthan, and part of Gujrat.
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Summary:

1. Forest ecosystem is crucial for the health of the earth and its residents.

Module 7: Grassland & Desert ecosystem

Readings :

1. Bharucha E, Environmental Studies for Undergraduate Courses, 2nd Ed., University Press (India) Pvt. Ltd. 2013
2. Cunningham W and Cunningham M, Principles of Environmental Science, 9th Ed., McGraw-Hill Education, 2019
3. Sharma PD, Ecology and Environment, 13th Ed. Rastogi Publications, 2017
4. Sarita Kumar, Fundamentals of Environmental studies, first edition., Sultan chand & Sons Pvt. Limited 2018

Hello! Students

Welcome to the module 7 on Grassland and Desert Ecosystem;

In previous module we have learnt about the forest ecosystem and its type based on type of leaves. In this module we will get familiar with the two other important ecosystems that is grassland and desert ecosystem.

- **Grassland ecosystem**: The open areas of land with low rainfall covered with grasses and grass like plants are considered as grass land ecosystem. They rarely have trees if so scattered.

They are used for agricultural purpose and pastures for growing livestock.

Types of Grassland:

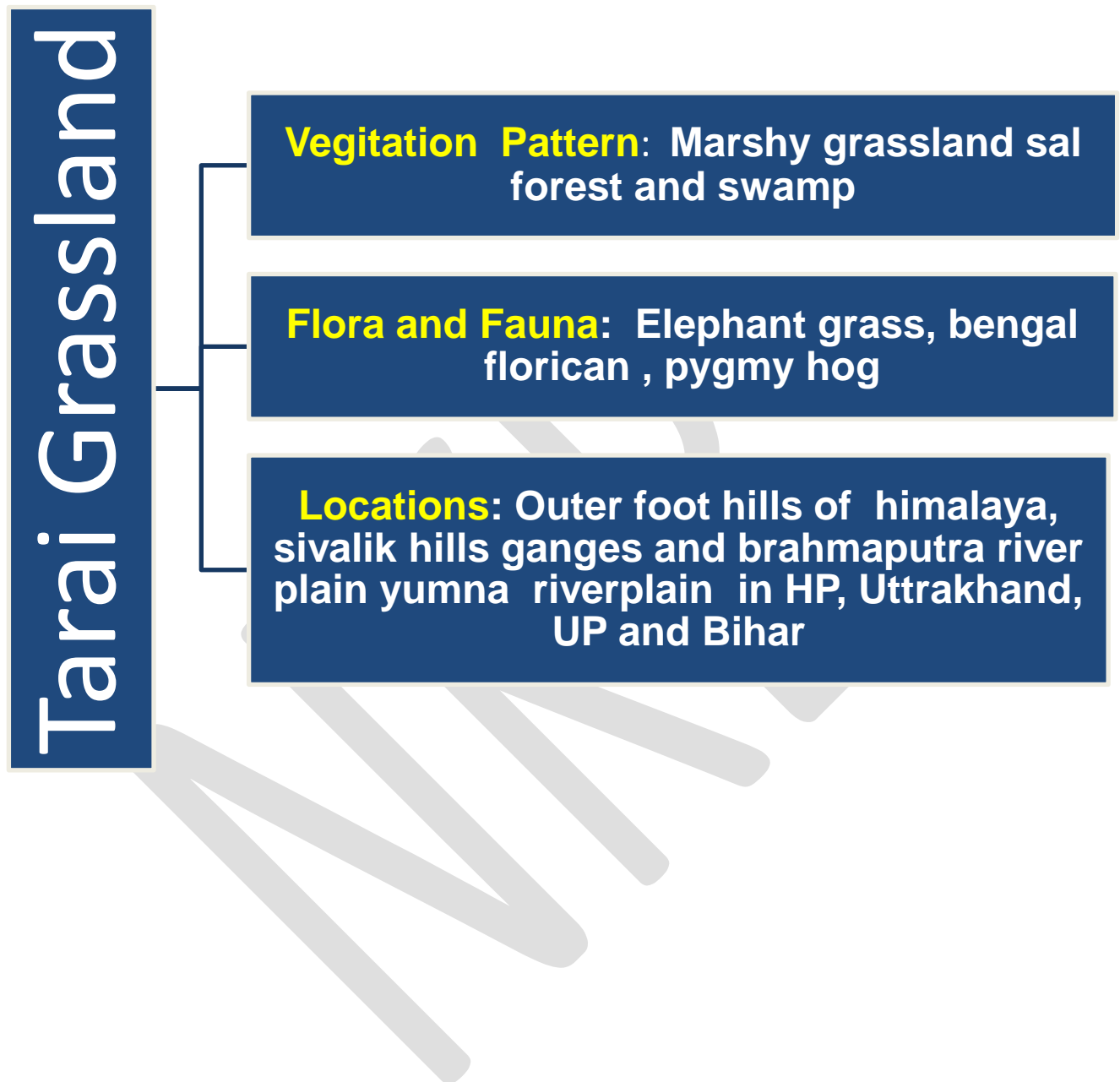
1. **Tropical Savannah:** Africa, South America, Indonesia (20-60 inches annual rainfall)
2. **Temperate Grassland (Prairies or steppes):** 15-35 inches of annual rainfall

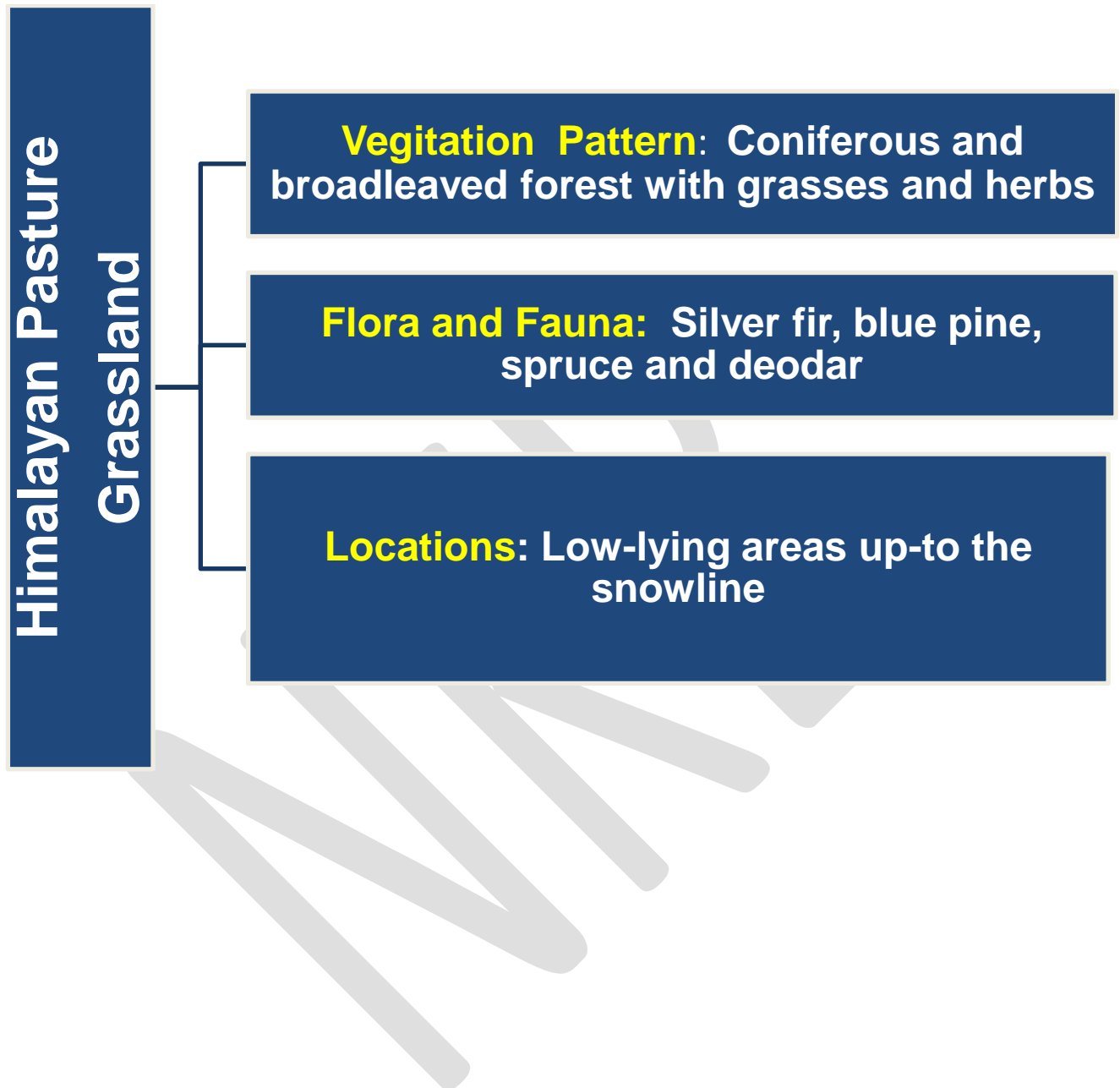
Grassland Ecosystem in India:

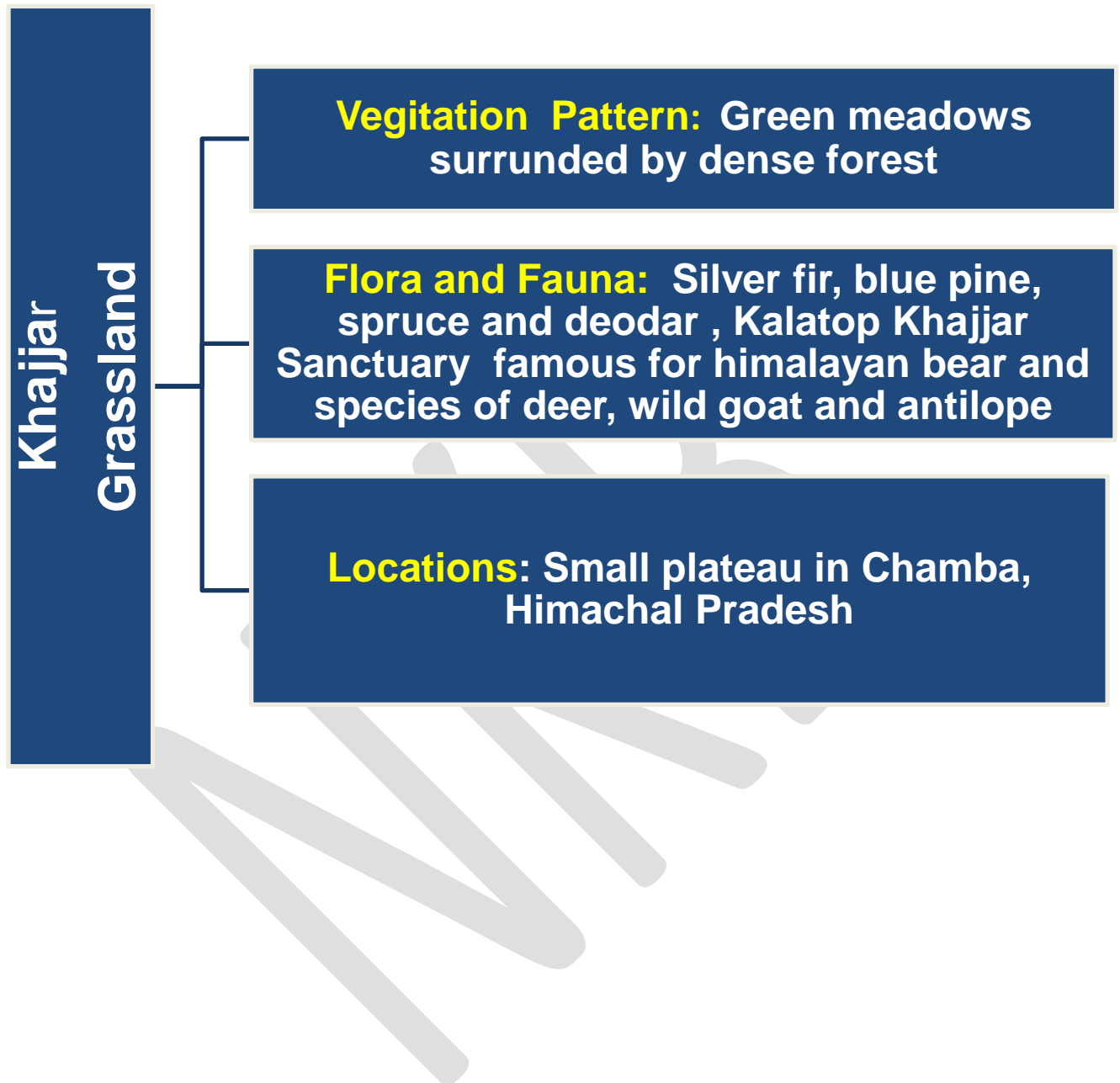
We have variable climatic regions ranging from Cold Mountain in the north, desert in the west and large area as river basin to coastal plains. The altitude of these areas range from 2200 meters to 150 meter above the sea surface level.

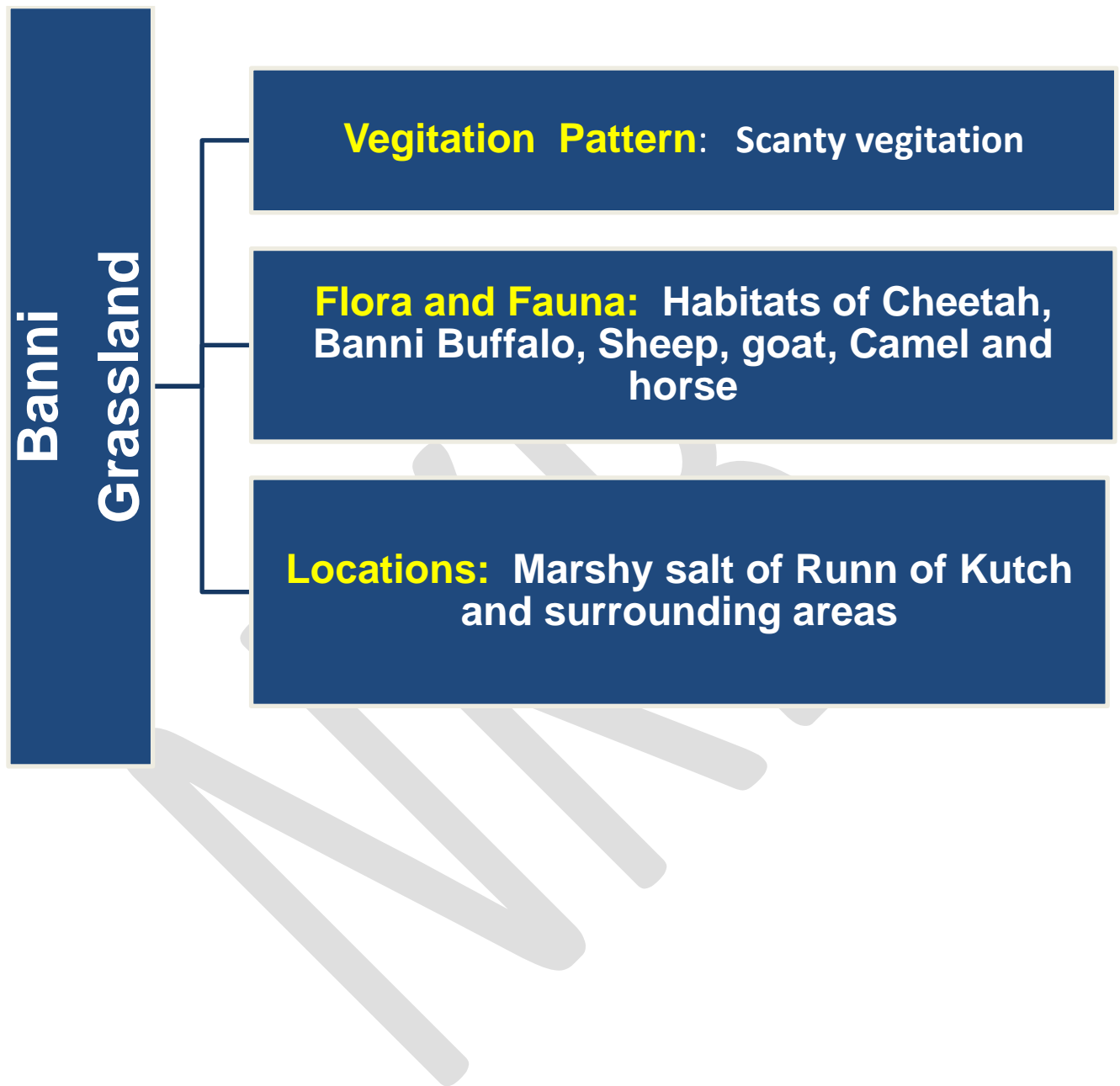
There are few examples of grassland ecosystem India.

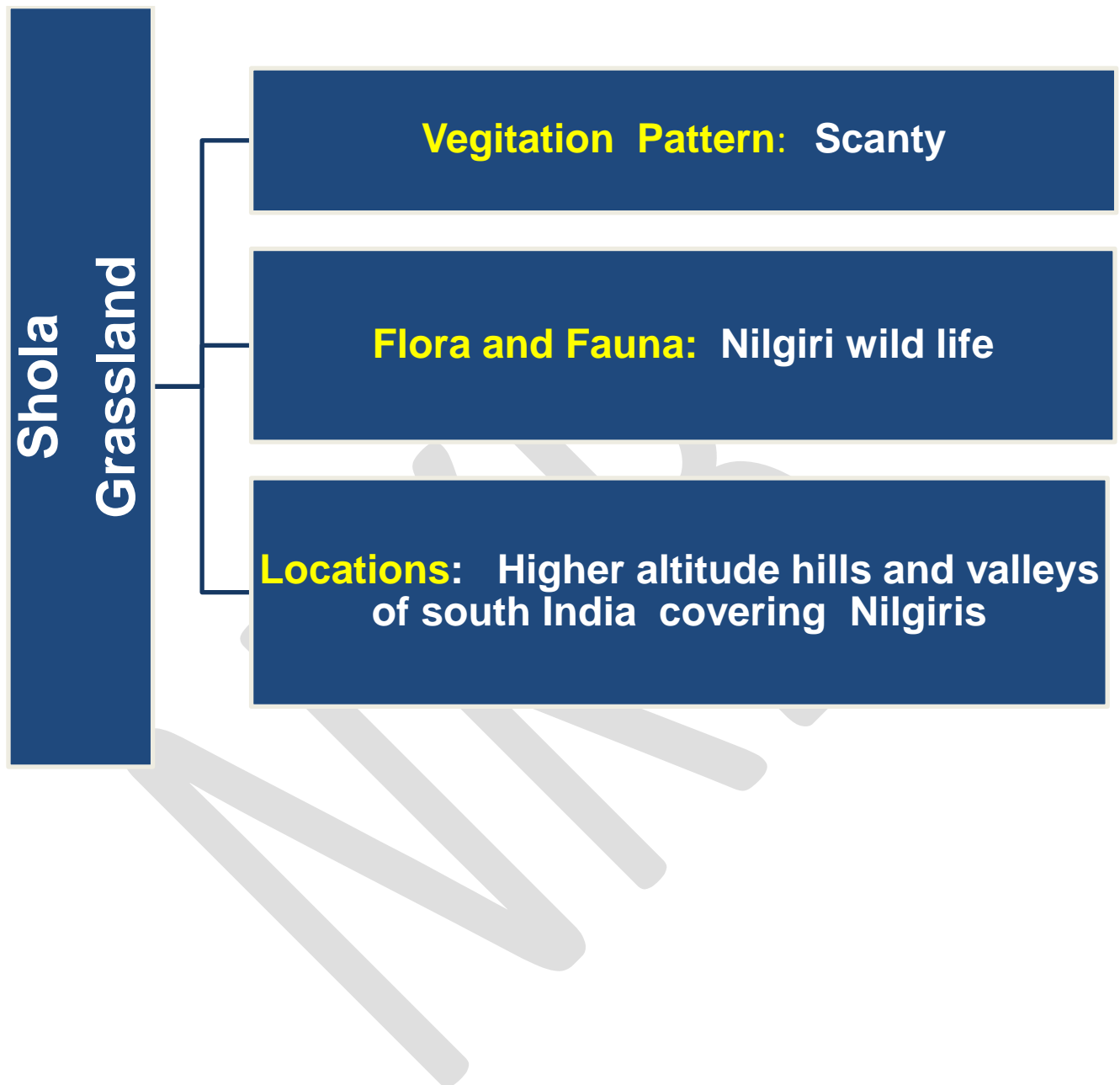
1. Terai Grassland
2. Himalayan Pasture Belt
3. Khajjar Grassland
4. Banni Grassland
5. Semi-arid
6. Shola Grassland

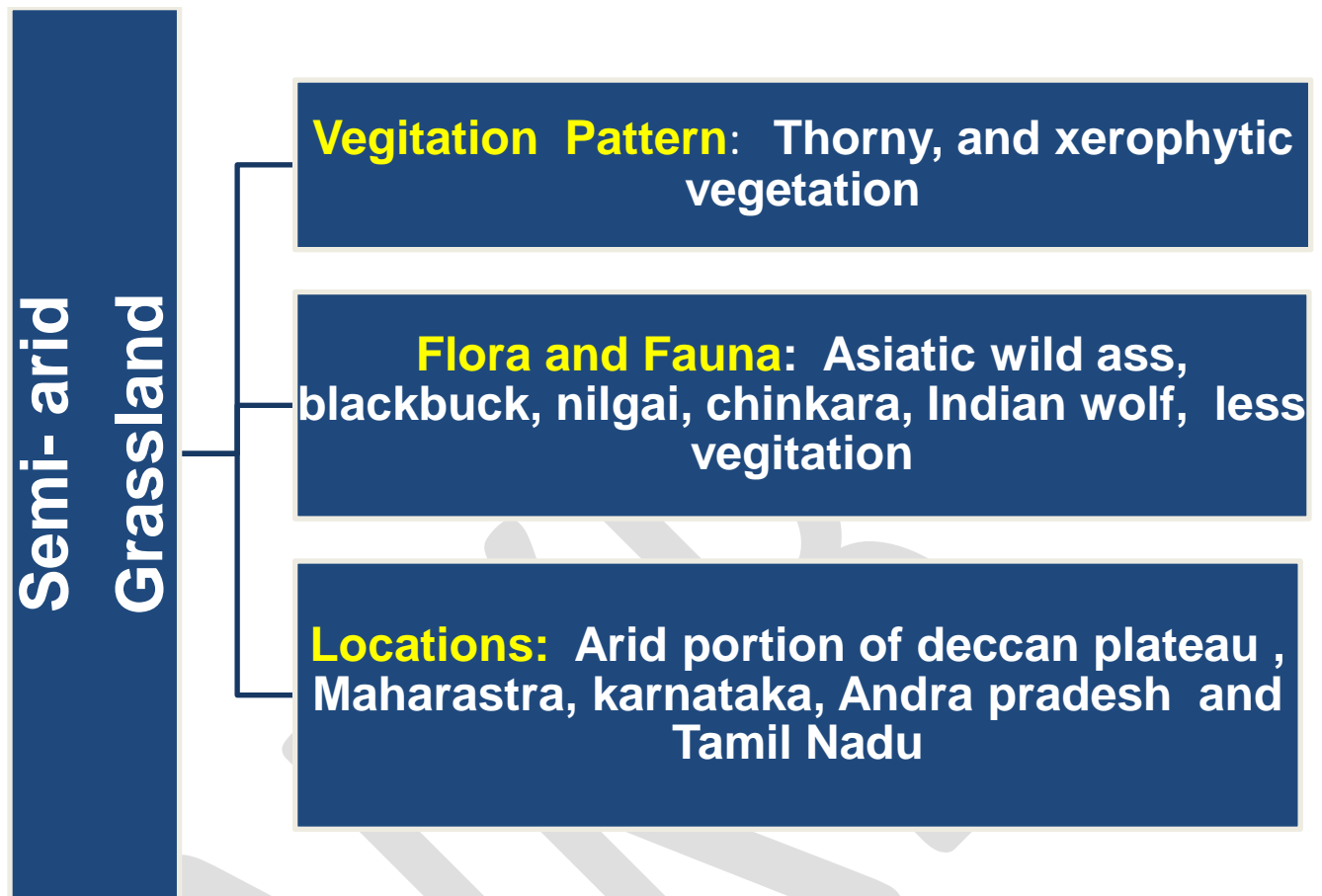












Summary:

1. Grassland ecosystem is home to many species and serves as the farmland and the pastures for animals.
2. Grassland ecosystem faces the overgrazing as problems.
3. The designation as sanctuaries and national parks can conserve the grassland ecosystem.

Desert Ecosystem

Hello! Students in the final module we will discuss about the desert ecosystem.

The desert ecosystem sees highly sparse and variable rain and high evaporation resulting lack of moisture and frequent droughts.

- **In India we have the Thar Desert region which covers 85 % in Rajasthan, Gujrat, Punjab, Haryana rest 15 % in the Pakistan.**
- **Ladakh region is considered as cold desert region which is surrounded by the snowcapped mountains tops. Andhra Pradesh and Karnataka desert region is due to the shadow of the coastal regions.**
- **The Rann of Kutch is specialized arid ecosystem which during summer's acts as desert and during rainy season that convert into the salt marsh.**

Summary:

1. The desert ecosystems are unique and harbors species which can tolerate variable amount of heat and water shortage. They offer great places for tourism and study of gene pools.