ZOOLOGY(H)/SEMESTER-I
ECOLOGY: ZOOACOR02T

Unit 1: Basics in ecology – Levels of organization, Hierarchy, Limiting factors and Autecology and Synecology

RITUPARNA MAITY
DEPT. OF ZOOLOGY, HMMCW

ECOLOGY DERIVED FROM GREEK WORD "OIKOS" MEANS "HOUSEHOLD" AND "LOGOS" MEANS "STUDY

Biotic Components *plus*

Abiotic Components

Equals

Biosystems

ECOLOGY IS THE STUDY OF "LIFE AT HOME" WITH EMPHASIS ON THE "TOTALITY OR PATTERN OF RELATIONS BETWEEN ORGANISMS AND THEIR ENVIRONMENT" – E.P. ODUM AND MERRIAM-WEBSTER'S COLLEGIATE DICTIONARY

- Ecology is largely, but not entirely, concerned with the system levels beyond that of the organism.
- Population originally coined to denote a group of people, is broadened to include groups of individuals of any one kind of organism.
- Community, Biotic Community, includes all the populations occupying a given area.
- Ecosystem concludes that the biotic community and nonliving environment function together as an ecological system.
- Landscape is defined as a " heterogenous area composed of a cluster of interacting ecosystems that are repeated in a similar manner throughout".
- Biome is a large regional or subcontinental system characterized by a particular major vegetation type and distinguished by the predominant plants associated with a particular climate.
- Ecosphere includes all the living organisms of Earth interacting with the physical environment as a whole to maintain a self-adjusting, loosely controlled pulsing state.

ECOLOGY IS SOMETIMES SUBDIVIDED INTO AUTECOLOGY AND SYNECOLOGY

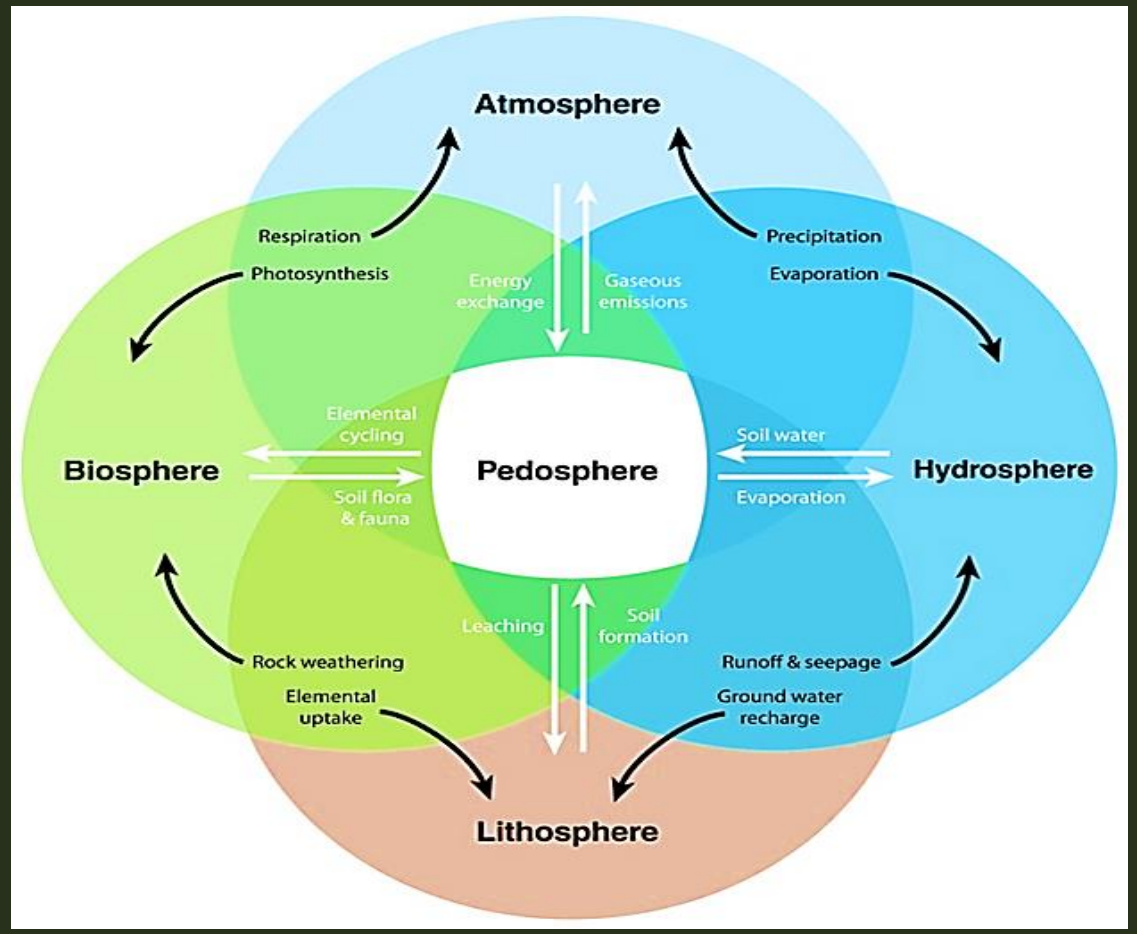
AUTECOLOGY

- Refers to study of the individual organism or an individual species with relation to its environment
- individual species
- Requirements and reaction of an individual species together with the influence of environment it at a given time particularly life histories and behaviour of the species
- Details of the morphology, taxonomical position, distribution, food habit, life cycle, reproduction, growth etc. along with various ecological factors which might influence different stages of their life cycle.
- Experimental and inductive
- In economic Biology like Pisciculture, prawn culture, Pearl culture Dairy Horticulture forestry
- Important for conservation of soil and wildlife
- Gives superficial information to asses and Ecosystem inclusively
- Trophic structure is not considered
- Energy flow cannot be assessed
- Autecology of European starling or a fern of which is most successful in the world.

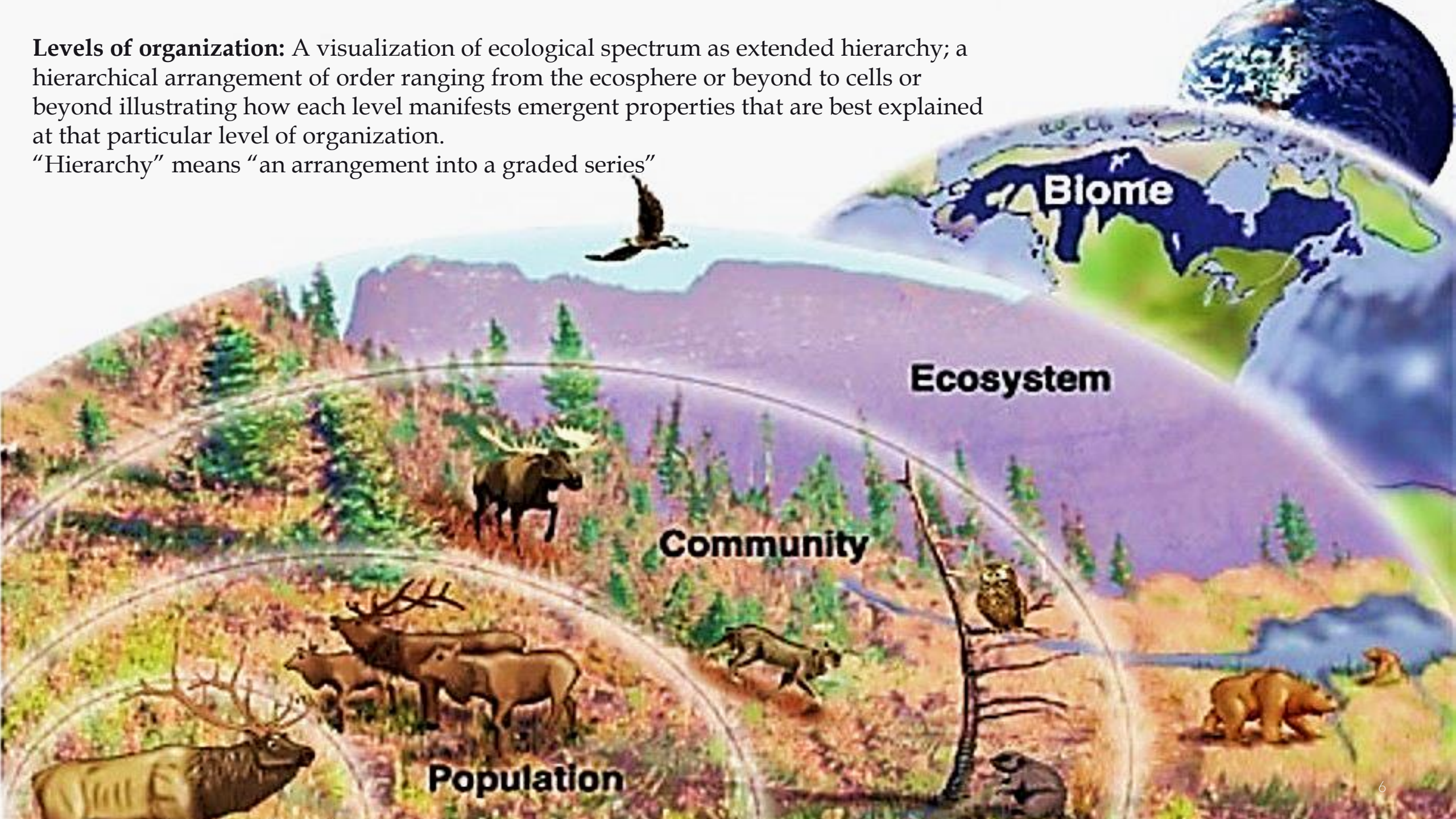
SYNECOLOGY

- Refers to the study of groups of organisms or communities which are associated together as a unit in relation to its environment population biome and ecosystem
- Biotic community
- Intra and interspecific relationship of the whole biotic organisms and also their interaction with environment at a given time as in case of the study in forest where trees and adjoining plants interact with each other.
- interrelationship and interactions between populations in respect to their growth development dispersion fluctuation, competition, predation and parasitism, regulations of speciation etc along with the influence of environmental factors upon them and for environmental modification by them.
- Philosophical and deductive
- Important role in various practical fields like setting up Strategies and planning cities and towns, regulation of populations, in the fields of Economics, pest control pollution Biology etc
- Provide information as a whole to conserve the ecosystem and the nature as a whole
- Give in-depth picture about an ecosystem and thus to help in its management
- Trophic structure of an ecosystem is considered
- Energy flow through ecosystem can be assessed
- The Galapagos finches all the biotic community of a pond of forest a study of cave, deep-sea system, intertidal Rocky shores etc

BIOSPHERE: THE PART OF THE ENVIRONMENT OF EARTH IN WHICH LIVING ORGANISMS ARE FOUND



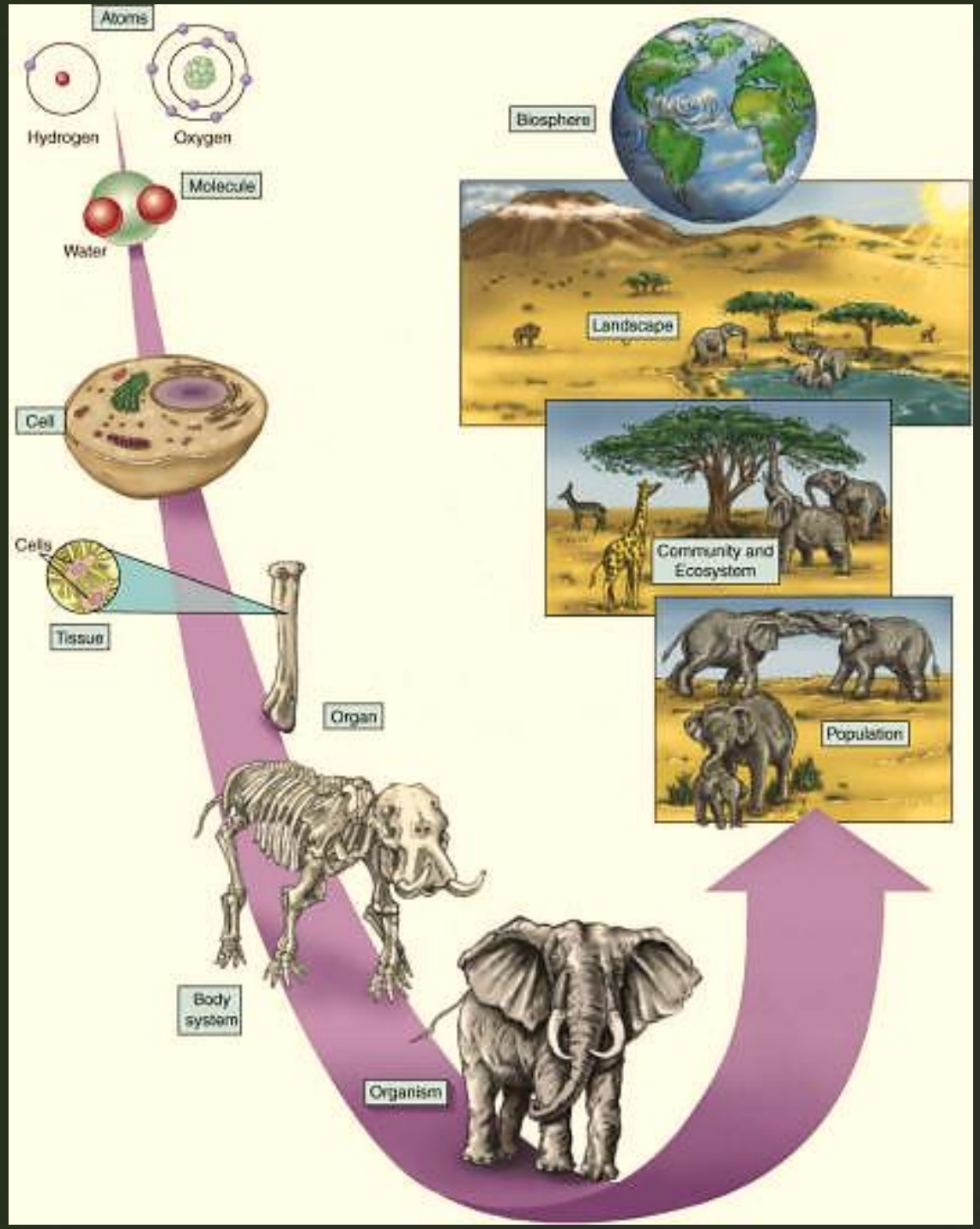
Levels of organization: A visualization of ecological spectrum as extended hierarchy; a hierarchical arrangement of order ranging from the ecosphere or beyond to cells or beyond illustrating how each level manifests emergent properties that are best explained at that particular level of organization.
"Hierarchy" means "an arrangement into a graded series"



LEVELS OF ORGANIZATION

Each level in the ecological hierarchy can be expected to have unique emergent and collective properties, there are basic functions that operate at all levels as Transcending functions and control processes - behavior, development, diversity, energetics, evolution, integration, and regulation; Some of these operate throughout the hierarchy and others differ in *modus operandi* at different levels.

HOMEOSTASIS AND HOMEORHESIS



HOMEOSTASIS AND HOMEORHESIS

- Homeostasis may be defined as a tendency of a system to resist change and maintain itself in a state of stable equilibrium.
- Balance within an organism.
- Control set point from genetic, hormonal, and neural controls on growth and development.

Nature governs by some transcending functions and there are control set point

- Homeorhesis refers to a tendency of a system to maintain itself in a pulsing state of equilibrium.
- Balance of Nature.
- There are no equilibriums at the ecosystem and ecosphere levels, but there are pulsing balances such as between production and respiration.

CONCEPT OF LIMITING FACTORS:

THE SUCCESS OF AN ORGANISM, A GROUP OF ORGANISMS OR A WHOLE BIOTIC COMMUNITY DEPENDS ON A COMPLEX OF CONDITIONS.

Any condition that approaches or exceeds the limits of tolerance is said to be a **Limiting conditions**

or

Resource that limits the abundance, growth, and distribution of an organism or species called a **Limiting factor.**

Liebig Law of minimum: This concept first stated by Baron J. von Liebig in 1840, that the essential material or resource most closely approaching the minimum need tends to be the limiting one.

Example: Liebig was a pioneer in studying the effect of various factors on the growth of plants, especially domestic crops. He found – In an Agriculture field the yield of crops was often limited not by nutrients needed in large quantities, such as carbon dioxide and water, they are plenty in environment; but by some raw materials such as zinc needed in minute quantities but very scarce in soil.

Limitations or Constraints: Two

1. The Liebig law of minimum is strictly applicable only under relatively stable conditions- that is, when the average inflows of energy and materials balance the outflows over an annual cycle.
2. The second important consideration is factor interaction. Thus a high concentration or availability of some substance, or the action of some factor other than the minimum constituent may modify the rate of use of the limiting factor.

Shelford law of tolerance: The law has been proposed by V. E. Shelford in 1911, stating that the presence and success of an organism or species depends on both the maximum and minimum resource or set of conditions.

Example: Coral reefs are very stenothermal, in that they prosper only within a very narrow range of temperature. A prolonged 2^0 C temperature drop is stressful, causing bleaching or loss of the symbiotic algae that make it possible for corals to prosper in very low-nutrient waters.

- All physical requirements may be well within the limits of tolerance for an organism, but the organism may still fail because of biological interrelations, such as competition or predation.
- Organisms may have wide ranges of tolerance for one factor and a narrow range for another.
- Organisms with wide ranges of tolerance for limiting factors are likely to be most widely distributed.
- When conditions are not optimal for a species with respect to one ecological factor , the limits of tolerance may be reduced for other ecological factors.
- Frequently, organisms in nature are not actually living at the optimum range of a particular physical factor.
- Reproduction is usually a critical period when environmental factors are most likely to be limiting.

Organisms have an ecological minimum and maximum: the range in between represents the *limits of tolerance*.
Upper and lower limits to the range of particular environmental factors such as light or temperature within which an organism or species can survive is called Limits of tolerance.

Degree of Tolerance

- ***Steno*** → **narrow; *Eury*** → **wide**
  - **Stenothermal – eurythermal → temperature range**
  - **Stenohydric – euryhydric → water range**
  - **Stenohaline – euryhaline → salinity range**
  - **Stenophagic – euryphagic → food range**
  - **Stenoecious – euryecious → habitat range**