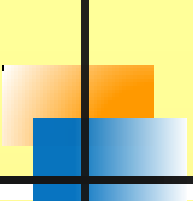
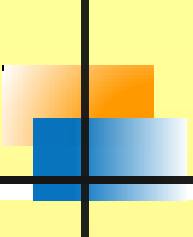
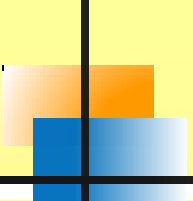





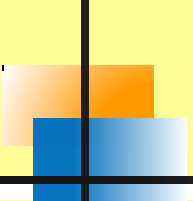
# **ORGANISMS AND THE ENVIRONMENT**

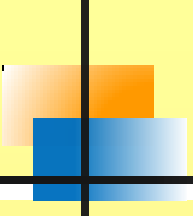
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- **By environment we mean the surroundings of an organism.**
  - **In the absence of an organism, it is meaningless to speak of environment and vice-versa.**
  - **Every habitat has its own peculiar type of environment.**
  - **The environmental factors can be classified into two types- abiotic and biotic.**
  - **The abiotic factors are non-living in nature , and are also known as non-living or physical factors.**
  - **The biotic factors are the living creatures present in the organisms environment.**
  - **They are also referred to as living or biological factors.**
  - **The biotic factors influence both the physical environment as well as the other organisms living in it.**
  - **The science of ecology is multidisciplinary in approach and almost boundless in its concern.**
  - **German biologist Ernst Haeckel (1869) was the first to coin the term ecology.**

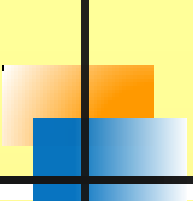
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- **“The environment can be defined as the aggregate of all the external conditions and influences affecting the life and development of an organism in its natural habitat.”**
  - **“The place of living of an organism is called its habitat.”**
  - **“The individual conditions such as light, air, water, minerals, prey or predator around an organism are termed factors of the environment.”**
  - **“The term Ecology refers to the study of interrelationships of living organisms (animals, plants and micro-organisms) with their physical and biological environment.”**

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- **An organism is a living unit in nature.**
  - **It has the following characteristics-**
    - **An organism may be small, unicellular or large, multicellular.**
    - **The parts of an organism, whether organelles, cells, tissues, organs, or organ-systems, are organized into a functional whole and cannot survive apart from the whole.**
    - **An organism is growing, self-regulating, self-repairing, self-perpetuating entity often capable of autonomous movements.**
    - **An organism has its own structure which is maintained by life processes occurring in its own body, distinct from those taking place in the bodies of others.**
    - **It cannot survive in strict isolation in nature. It depends on others around it. It derives matter and energy for its survival from the environment, which also changes in the process.**
    - **The organisms are often distinct and easily observable units in nature.**
  - **These include the non-living physic-chemical factors of environment.**

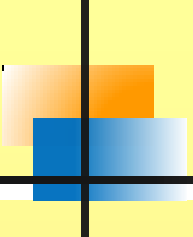
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- **These are divided into the following categories-**
    - **Climatic Factors**
    - **Edaphic Factors**
  - **Climatic Factors include the physical factors of environment like-**
    - **Light**
    - **Temperature**
    - **Humidity**
    - **Wind**
    - **Rainfall**
    - **Water**
    - **Atmospheric Gases**
  - **Temperature is the most ecologically relevant environmental factor.**
  - **The average temperature on land varies seasonally, decreases progressively from the equator towards the poles and from plains to the mountain tops.**


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- **It ranges from subzero levels in polar areas and high altitudes to  $>50^{\circ}\text{C}$  in tropical deserts in summer.**
  - **There are, however, unique habitats such as thermal springs and deep-sea hydrothermal vents where average temperatures exceed  $100^{\circ}\text{C}$ .**
  - **Mango trees do not and cannot grow in temperate countries like Canada and Germany, snow leopards are not found in Kerala forests and tuna fish are rarely caught beyond tropical latitudes in the ocean.**
  - **Temperature affects the kinetics of enzymes and through it the basal metabolism, activity and other physiological functions of the organism.**
  - **A few organisms can tolerate and thrive in a wide range of temperatures (they are called eurythermals), but, a vast majority of them are restricted to a narrow range of temperatures (such organisms are called stenothermal).**

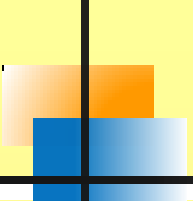
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- **The levels of thermal tolerance of different species determine to a large extent their geographical distribution.**
  - **Water is second most important ecological factor after the temperature. Water is essential for life.**
  - **Even the origin of life occurred in water on primitive earth.**
  - **It covers more than 70% of the earth's surface.**
  - **The chief source of soil water is atmospheric precipitation.**
  - **It may occur in the form of snow, rain, hail, sleet, frost, dew, fog or mist.**
  - **About 45% of water flows into rivers, 20% percolates into soil and 35% lost by evaporation.**
  - **Melting of snow and ice are also important sources of water.**
  - **Land plants derive water from the soil while the land animals derive water from the pools, ponds, lakes, rivers, springs etc.**

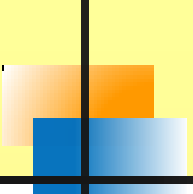
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- **The organisms have to face different problems of water scarcity or abundance,. So osmoregulation is required for their proper functioning.**
  - **Since plants produce food through photosynthesis, a process which is only possible when sunlight is available as a source of energy.**
  - **Many species of small plants (herbs and shrubs) growing in forests are adapted to photosynthesise optimally under very low light conditions because they are constantly overshadowed by tall, canopied trees.**
  - **Many plants are also dependent on sunlight to meet their photoperiodic requirement for flowering.**
  - **For many animals too, light is important in that they use the diurnal and seasonal variations in light intensity and duration (photoperiod) as cues for timing their foraging, reproductive and migratory activities.**

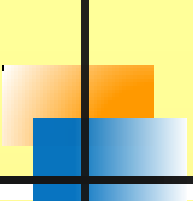


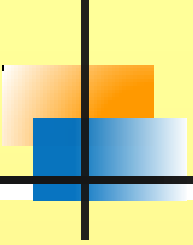
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- **The availability of light on land is closely linked with that of temperature since the sun is the source for both.**
  - **But, deep (>500m) in the oceans, the environment is perpetually dark and its inhabitants are not aware of the existence of a celestial source of energy called Sun.).**
  - **The spectral quality of solar radiation is also important for life.**
  - **The UV component of the spectrum is harmful to many organisms while not all the colour components of the visible spectrum are available for marine plants living at different depths of the ocean.**
  - **The nature and properties of soil in different places vary; it is dependent on the climate, the weathering process, whether soil is transported or sedimentary and how soil development occurred.**

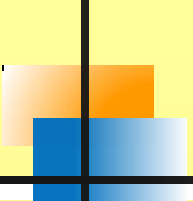
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- **Various characteristics of the soil such as soil composition, grain size and aggregation determine the percolation and water holding capacity of the soils.**
  - **These characteristics along with parameters such as pH, mineral composition and topography determine to a large extent the vegetation in any area.**
  - **This in turn dictates the type of animals that can be supported.**
  - **Similarly, in the aquatic environment, the sediment-characteristics often determine the type of benthic animals that can thrive there.**
  - **During the course of millions of years of their existence, many species would have evolved a relatively constant internal (within the body) environment that permits all biochemical reactions and physiological functions to proceed with maximal efficiency and thus, enhance the overall 'fitness' of the species.**

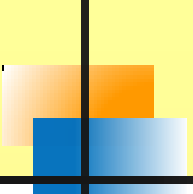
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- **This constancy, for example, could be in terms of optimal temperature and osmotic concentration of body fluids.**
  - **Ideally then, the organism should try to maintain the constancy of its internal environment (a process called homeostasis) despite varying external environmental conditions that tend to upset its homeostasis.**
  - **Suppose a person is able to perform his/her best when the temperature is 25°C and wishes to maintain it so, even when it is scorching hot or freezing cold outside.**
  - **It could be achieved at home, in the car while travelling, and at workplace by using an air conditioner in summer and heater in winter.**
  - **Then his/ her performance would be always maximal regardless of the weather around him/her. Here the person's homeostasis is accomplished, not through physiological, but artificial means.**

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- **Some organisms are able to maintain homeostasis by physiological (sometimes behavioural also) means which ensures constant body temperature, constant osmotic concentration, etc.**
  - **All birds and mammals, and a very few lower vertebrate and invertebrate species are indeed capable of such regulation (thermoregulation and osmoregulation).**
  - **Evolutionary biologists believe that the 'success' of mammals is largely due to their ability to maintain a constant body temperature and thrive whether they live in Antarctica or in the Sahara desert.**
  - **The mechanisms used by most mammals to regulate their body temperature are similar to the ones that we humans use.**
  - **We maintain a constant body temperature of – 37°C. In summer, when outside temperature is more than our body temperature, we sweat profusely.**

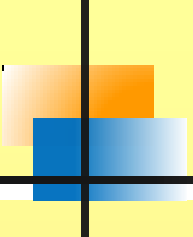
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- **The resulting evaporative cooling, similar to what happens with a desert cooler in operation, brings down the body temperature.**
  - **In winter when the temperature is much lower than 37°C, we start to shiver, a kind of exercise which produces heat and raises the body temperature.**
  - **Plants, on the other hand, do not have such mechanisms to maintain internal temperatures.**
  - **Majority (99 %) of animals and nearly all plants cannot maintain a constant internal environment.**
  - **Their body temperature changes with the ambient temperature.**
  - **In aquatic animals, the osmotic concentration of the body fluids change with that of the ambient water osmotic concentration.**
  - **Heat loss or heat gain is a function of surface area.**

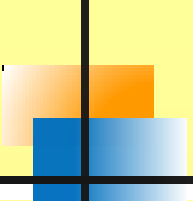
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- **These animals and plants are simply conformers. Considering the benefits of a constant internal environment to the organism.**
  - **Thermoregulation is energetically expensive for many organisms. This is particularly true for small animals like shrews and humming birds.**
  - **Since small animals have a larger surface area relative to their volume, they tend to lose body heat very fast when it is cold outside; then they have to expend much energy to generate body heat through metabolism.**
  - **This is the main reason why very small animals are rarely found in Polar Regions.**
  - **During the course of evolution, the costs and benefits of maintaining a constant internal environment are taken into consideration.**

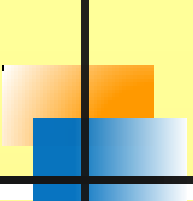
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- **Some species have evolved the ability to regulate, but only over a limited range of environmental conditions, beyond which they simply conform.**
  - **If the stressful external conditions are localised or remain only for a short duration, the organism has two other alternatives.**
  - **The organism can move away temporarily from the stressful habitat to a more hospitable area and return when stressful period is over.**
  - **In human analogy, this strategy is like a person moving from Delhi to Shimla for the duration of summer.**
  - **Many animals, particularly birds, during winter undertake long-distance migrations to more hospitable areas.**
  - **Every winter the famous Keoladeo National Park, Bharatpur in Rajasthan host thousands of migratory birds coming from Siberia and other extremely cold northern regions.**

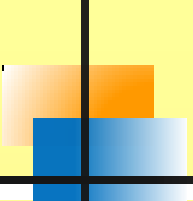
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- **In bacteria, fungi and lower plants, various kinds of thick walled spores are formed which help them to survive unfavourable conditions – these germinate on availability of suitable environment.**
  - **In higher plants, seeds and some other vegetative reproductive structures serve as means to tide over periods of stress besides helping in dispersal – they germinate to form new plants under favourable moisture and temperature conditions.**
  - **They do so by reducing their metabolic activity and going into a state of 'dormancy'.**
  - **In animals, the organism, if unable to migrate, might avoid the stress by escaping in time.**
  - **The familiar case of bears going into hibernation during winter is an example of escape in time. Some snails and fish go into aestivation to avoid summer–related problems–heat and desiccation.**

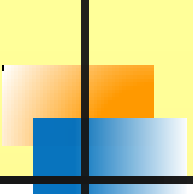


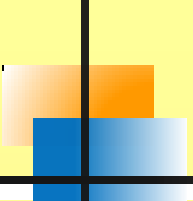
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- **Under unfavourable conditions many zooplankton species in lakes and ponds are known to enter diapause, a stage of suspended development.**
  - **While considering the various alternatives available to organisms for coping with extremes in their environment, we have seen that some are able to respond through certain physiological adjustments while others do so behaviourally (migrating temporarily to a less stressful habitat).**
  - **These responses are also actually, their adaptations.**
  - **Adaptation is any attribute of the organism (morphological, physiological, behavioural) that enables the organism to survive and reproduce in its habitat.**
  - **Many adaptations have evolved over a long evolutionary time and are genetically fixed.**

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- **In the absence of an external source of water, the kangaroo rat in North American deserts is capable of meeting all its water requirements through its internal fat oxidation (in which water is a byproduct).**
  - **It also has the ability to concentrate its urine so that minimal volume of water is used to remove excretory products.**
  - **Many desert plants have a thick cuticle on their leaf surfaces and have their stomata arranged in deep pits to minimise water loss through transpiration.**
  - **They also have a special photosynthetic pathway (CAM) that enables their stomata to remain closed during day time.**
  - **Some desert plants like Opuntia, have no leaves – they are reduced to spines—and the photosynthetic function is taken over by the flattened stems.**

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- **Mammals from colder climates generally have shorter ears and limbs to minimise heat loss. (This is called the Allen's Rule.)**
  - **In the polar seas aquatic mammals like seals have a thick layer of fat (blubber) below their skin that acts as an insulator and reduces loss of body heat.**
  - **Some organisms possess adaptations that are physiological which allow them to respond quickly to a stressful situation.**
  - **If you had ever been to any high altitude place (>3,500m Rohtang Pass near Manali and Mansarovar, in China occupied Tibet) you must have experienced what is called altitude sickness.**
    - **Its symptoms include nausea, fatigue and heart palpitations.**
    - **This is because in the low atmospheric pressure of high altitudes, the body does not get enough oxygen. But, gradually you get acclimatised and stop experiencing altitude sickness.**

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- **The body compensates low oxygen availability by increasing red blood cell production, decreasing the binding capacity of hemoglobin and by increasing breathing rate.**
  - **Many tribes live in the high altitude of Himalayas.**
  - **In most animals, the metabolic reactions and hence all the physiological functions proceed optimally in a narrow temperature range (in humans, it is – 37°C).**
  - **But there are microbes (Archaeobacteria) that flourish in hot springs and deep sea hydrothermal vents where temperatures far exceed 100°C.**
  - **Many fish thrive in Antarctic waters where the temperature is always below zero.**
  - **A large variety of marine invertebrates and fish live at great depths in the ocean where the pressure could be >100 times the normal atmospheric pressure that we experience.**
  - **Organisms living in such extreme environments show a fascinating array of biochemical adaptations.**

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- **Some organisms show behavioural responses to cope with variations in their environment.**
  - **Desert lizards lack the physiological ability that mammals have to deal with the high temperatures of their habitat, but manage to keep their body temperature fairly constant by behavioural means.**
  - **They bask in the sun and absorb heat when their body temperature drops below the comfort zone, but move into shade when the ambient temperature starts increasing. Some species are capable of burrowing into the soil to hide and escape from the above-ground heat.**
  - **As a branch of biology, Ecology is the study of the relationships of living organisms with the abiotic (physico-chemical factors) and biotic components (other species) of their environment.**
  - **It is concerned with four levels of biological organisation-organisms, populations, communities and biomes.**

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- **Temperature, light, water and soil are the most important physical factors of the environment to which the organisms are adapted in various ways.**
  - **Maintenance of a constant internal environment (homeostasis) by the organisms contributes to optimal performance, but only some organisms (regulators) are capable of homeostasis in the face of changing external environment.**
  - **Others either partially regulate their internal environment or simply conform.**
  - **A few other species have evolved adaptations to avoid unfavourable conditions in space (migration) or in time (aestivation, hibernation, and diapause).**
  - **Evolutionary changes through natural selection take place at the population level and hence, population ecology is an important area of ecology.**



**Thanks...**