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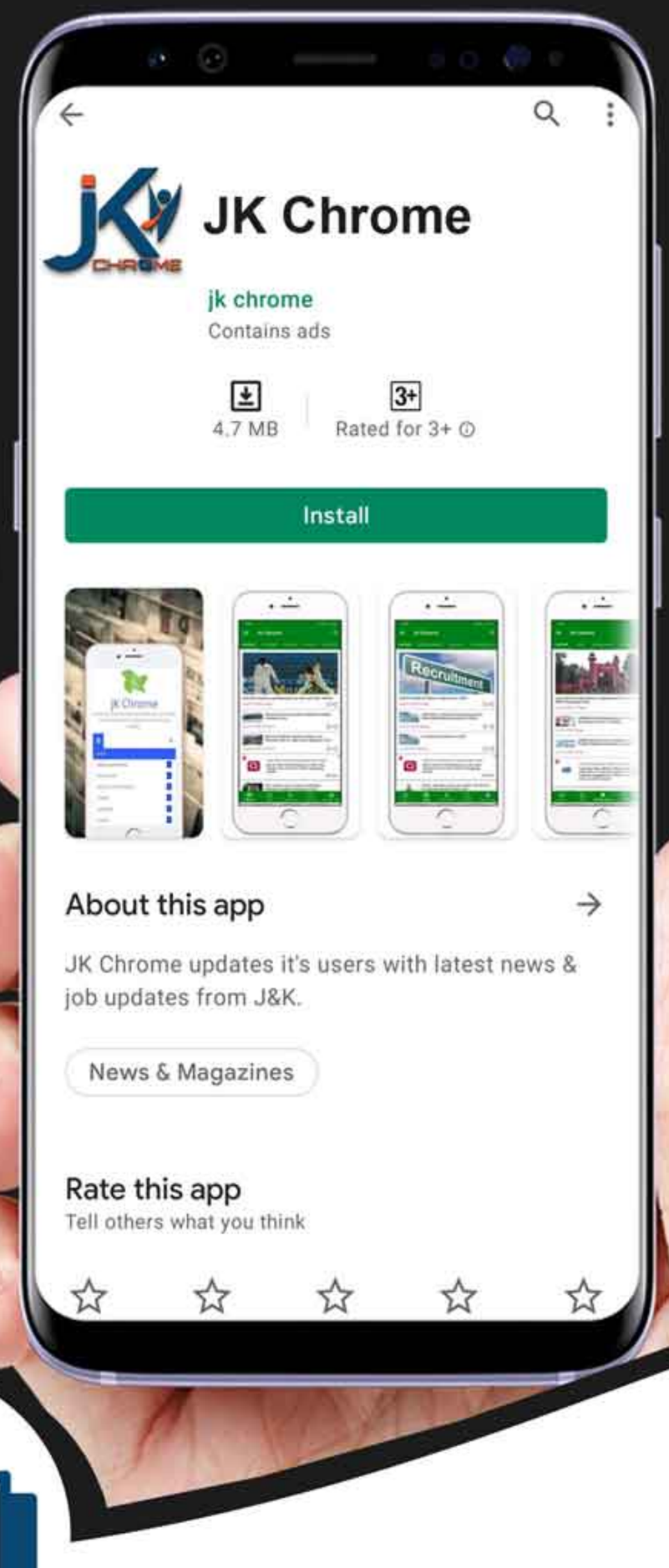

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Organisms and Population

Major Abiotic Factors

Temperature:

- 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.
- ranges from subzero levels in polar areas and high altitudes to >50 degree C in tropical deserts in summer.
- unique habitats such as thermal springs and deep-sea hydrothermal vents where average temperatures exceed 100 degree 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.
- A few organisms can tolerate and thrive in a wide range of temperatures (they are called eurythermal), but, a vast majority of them are restricted to a narrow range of temperatures (such organisms are called stenothermal).
- Some organisms are tolerant of a wide range of salinities (euryhaline) but others are restricted to a narrow range (stenohaline).
- Many freshwater animals cannot live for long in sea water and vice versa because of the osmotic problems, they would face.
- For aquatic organisms the quality (chemical composition, pH) of water becomes important.
- The salt concentration (measured as salinity in parts per thousand), is less than 5 per cent in inland waters, 30-35 per cent the sea and > 100 per cent in some hypersaline lagoons.

Responses to Abiotic Factors

- 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.

- An overwhelming majority (99 per cent) 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 changes with that of the ambient water osmotic concentration. These animals and plants are simply conformers.
- Thermoregulation is energetically expensive for many organisms.
- This is particularly true for small animals like shrews and humming birds.
- Heat loss or heat gain is a function of surface area.
- 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.
- 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 localized or remain only for a short duration, the organism has two other alternatives.
- Keolado National Park (Bhartpur) in Rajasthan host thousands of migratory birds coming from Siberia and other extremely cold northern regions.
- 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.
- Under unfavorable conditions many zooplankton species in lakes and ponds are known to enter diapause, a stage of suspended development.

Adaptations

- Adaptation is any attribute of the organism (morphological, physiological, behavioral) that enables the organism to survive and reproduce in its habitat.
- Many desert plants have a thick cuticle on their leaf surfaces and have their stomata arranged in deep pits to minimize 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.
- 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.
- altitude sickness 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.
- Body Solution-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 degree C).
- microbes (archaebacteria) that flourish in hot springs and deep sea hydrothermal vents where temperatures far exceed 100 degree C.
- 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.
- The tiger census in our national parks and tiger reserves is often based on pug marks and fecal pellets.

Population Growth

(i) Natality refers to the number of births during a given period in the population that are added to the initial density.

(ii) Mortalityis the number of deaths in the population during a given period.

(iii) Immigration is the number of individuals of the same species that have come into the habitat from elsewhere during the time period under consideration.

(iv) Emigrationis the number of individuals of the population who left the habitat and gone elsewhere during the time period under consideration.

- the 'intrinsic rate of natural increase' is a very important parameter chosen for assessing impacts of any biotic or abiotic factor on population growth.
- Populations evolve to maximise their reproductive fitness, also called Darwinian fitness (high r value), in the habitat in which they live.
- Some organisms breed only once in their lifetime (Pacific salmon fish, bamboo) while others breed many times during their lifetime (most birds and mammals).
- Some produce a large number of small-sized offspring (Oysters, pelagic fishes) while others produce a small number of large-sized offspring (birds, mammals).

Population Interaction

- Interspecific interactions arise from the interaction of populations of two different species.
- They could be beneficial, detrimental or neutral (neither harm nor benefit) to one of the species or both.
- Both the species benefit in mutualism and both lose in competition in their interactions with each other.
- In both parasitism and Predation only one species benefits (parasite and predator, respectively) and the interaction is detrimental to the other species (host and prey, respectively).
- The interaction where one species is benefitted and the other is neither benefitted nor harmed is called commensalism.
- In amensalism on the other hand one species is harmed whereas the other is unaffected.
- Predation, parasitism and commensalisms share a common characteristic– the interacting species live closely together.
- Besides acting as 'conduits' for energy transfer across trophic levels, predators play other important roles. They keep prey populations under control.
- But for predators, prey species could achieve very high population densities and cause ecosystem instability. When certain exotic species are introduced into a geographical area, they become invasive and start spreading fast because the invaded land does not have its natural predators.

- The prickly pear cactus introduced into Australia in the early 1920's caused havoc by spreading rapidly into millions of hectares of rangel and.
- cactus was brought under control only after a cactus-feeding predator (a moth) from its natural habitat was introduced into the country.
- Biological control methods adopted in agricultural pest control are based on the ability of the predator to regulate prey population.
- Predators also help in maintaining species diversity in a community, by reducing the intensity of competition among competing prey species.
- In the rocky intertidal communities of the American Pacific Coast the starfish Pisaster is an important predator.
- In a field experiment, when all the starfish were removed from an enclosed intertidal area, more than 10 species of invertebrates became extinct within a year, because of interspecific competition.
- If a predator is too efficient and overexploits its prey, then the prey might become extinct and following it, the predator will also become extinct for lack of food. This is the reason why predators in nature are 'prudent'.
- Prey species have evolved various defenses to lessen the impact of predation.
- Some species of insects and frogs are cryptically-coloured (camouflaged) to avoid being detected easily by the predator.
- Some are poisonous and therefore avoided by the predators.
- The Monarch butterfly is highly distasteful to its predator (bird) because of a special chemical present in its body.
- Interestingly, the butterfly acquires this chemical during its caterpillar stage by feeding on a poisonous weed.
- For plants, herbivores are the predators.
- Nearly 25 per cent of all insects are known to be phytophagous (feeding on plant sap and other parts of plants).
- Thorns (Acacia, Cactus) are the most common morphological means of defence.
- In general, herbivores and plants appear to be more adversely affected by competition than carnivores.
- The life cycles of parasites are often complex, involving one or two intermediate hosts or vectors to facilitate parasitisation of its primary host.
- The human liver fluke (a trematode parasite) depends on two intermediate hosts (a snail and a fish) to complete its life cycle.
- Parasites that feed on the external surface of the host organism are called ectoparasites.
- The most familiar examples of this group are the lice on humans and ticks on dogs.
- Many marine fish are infested with ectoparasitic copepods.

- Cuscuta, a parasitic plant that is commonly found growing on hedge plants, has lost its chlorophyll and leaves in the course of evolution.
- It derives its nutrition from the host plant which it parasitises.
- The female mosquito is not considered a parasite, although it needs our blood for reproduction.
- In contrast, endoparasitesare those that live inside the host body at different sites (liver, kidney, lungs, red blood cells, etc.).
- The life cycles of endoparasites are more complex because of their extreme specialisation.
- Their morphological and anatomical features are greatly simplified while emphasising their reproductive potential.
- Brood parasitismin birds is a fascinating example of parasitism in which the parasitic bird lays its eggs in the nest of its host and lets the host incubate them.
- During the course of evolution, the eggs of the parasitic bird have evolved to resemble the host's egg in size and colour to reduce the chances of the host bird detecting the foreign eggs and ejecting them from the nest.
- Try to follow the movements of the cuckoo (koel) and the crow in your neighborhood park during the breeding season (spring to summer) and watch brood parasitism in action.
- Commensalism: This is the interaction in which one species benefits and the other is neither harmed nor benefited. An orchid growing as an epiphyteon a mango branch, and barnacles growing on the back of a whale benefit while neither the mango tree nor the whale derives any apparent benefit.
- Mutualism: This interaction confers benefits on both the interacting species.
- Lichens represent an intimate mutualistic relationship between a fungus and photosynthesising algae or cyanobacteria.
- Similarly, the mycorrhizaeare associations between fungi and the roots of higher plants.
- The fungi help the plant in the absorption of essential nutrients from the soil while the plant in turn provides the fungi with energy-yielding carbohydrates.
- Orchids show a bewildering diversity of floral patterns many of which have evolved to attract the right pollinator insect (bees and bumblebees) and ensure guaranteed pollination by it.
- Not all orchids offer rewards.
- The Mediterranean orchid Ophrys employs 'sexual deceit' to get pollination done by a species of bee.
- One petal of its flower bears an uncanny resemblance to the female of the bee in size, colour and markings.

- The male bee is attracted to what it perceives as a female, ‘pseudocopulates’ with the flower, and during that process is dusted with pollen from the flower.
- When this same bee ‘pseudocopulates’ with another flower, it transfers pollen to it and thus, pollinates the flower.
- If the female bee’s colour patterns change even slightly for any reason during evolution, pollination success will be reduced unless the orchid flower co-evolves to maintain the resemblance of its petal to the female bee.