



Ecology

**Based on GROUP-IV Examination syllabus -prepared by
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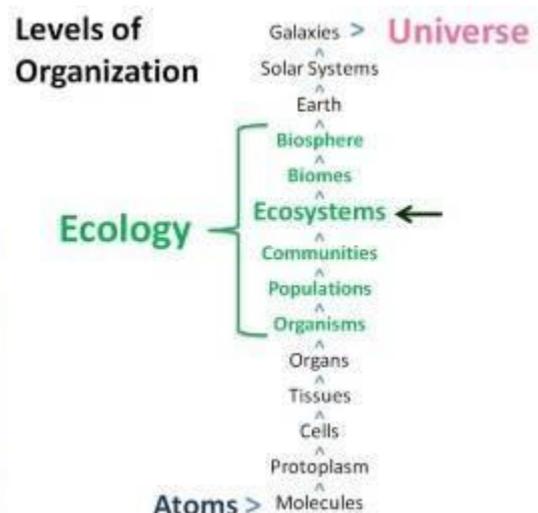
NOTE: Dear kalam achievers kindly read at lest 4 to 5 times you can easily understand..

Ecology

- The term ecology was derived from two Greek words 'Oikos' meaning home and 'logos' meaning study.
- Ecology is the branch of biology concerned with the relations of organisms to one another (energy flow and mineral cycling) and to their physical surroundings (environment).
- Ecology encompasses study of individual, organisms, population, community, ecosystem, biome and biosphere which form the various levels of **ecological organization**.
- The Indian texts of **Vedas**, the **Samhitas**, the **Brahmanas** and the **Aranyakas-Upanishads** contain many references to ecological concepts. The Indian treatise on medicine, the **Caraka-Samhita** and the surgical text **Susruta-Samhita**, show that people during this period had a good understanding of plant and animal ecology.

Levels Of Organizations In Ecology

- Ecology not only deals with the study of the relationship of individual organisms with their environment, but also with the study of populations, communities, ecosystems, biomes, and biosphere as a whole.



- **Individual:** Organism is an individual living being that has the ability to act or function independently. It may be any organism.

- **Species:** Species are a group of living organisms consisting of similar individuals capable of exchanging genes or of **interbreeding**, considered as the basic unit of taxonomy and denoted by a Latin binomial, e.g. *Homo sapiens*.
- **Population:** Population is a community of interbreeding organisms [**same species**], occupying a defined area during a specific time.
- Population growth rate is the percentage variation between the number of individuals in a population at two different times. It can be positive due to **birth** and/or **immigration** or negative due to **death** and/or **emigration**.
- The number of individuals per unit area at a given time is termed as population density.
- In case of large, mobile animals like tigers, leopards, lions, deer etc., the density may be determined by counting individual animals directly or by the **pugmarks** (foot imprints) left by the animals in a defined area.
- Pugmarks of each individual animals are unique and different from one others. Study of pug marks can provide the following information reliably if analyzed skillfully:
 1. *Presence of **different species** in the area of study.*
 2. *Identification of **individual animals**.*
 3. *Population of large cats (tigers, lions etc.).*
 4. ***Sex ratio** and age (young or adult) of large cats. [Even sex of tigers can be determined using*
- **Community:** Communities in most instances are named after the **dominant plant form** (species). For example: A grassland community is dominated by grasses, though it may contain herbs, shrubs, and trees, along with associated insects and animals of different species. A community is not fixed or rigid.
- On the basis of size and degree of relative independence communities may be divided into two types: Major Communities and Minor Communities.
 1. **Major Communities:** These are large sized and relatively independent. They depend only on the sun's energy from outside. Eg: Tropical evergreen forests.
 2. **Minor Communities:** These are dependent on neighboring communities and are often called **societies**. They are secondary aggregations within a major community. Eg: A mat of lichen on a cow dung pad.
- **Ecosystem:** An ecosystem is a community of organisms interacting with each other and with their environment such that energy is exchanged and system-level processes, such as the cycling of elements, emerge.

- **Biome:** Biome is a large naturally occurring community of flora and fauna occupying a major habitat. E.g. Rainforest biome or tundra biome.
- Plants and animals in a biome have common characteristics due to similar climates and can be found over a range of continents.
- Biomes are distinct from habitats, because any biome can comprise a variety of habitats (habitat: the natural home or environment of an organism).
- **Biosphere:** The biosphere is the biological component of earth which includes the lithosphere, hydrosphere and atmosphere. The biosphere includes all living organisms on earth, together with the dead organic matter produced by them.

Principles of Ecology

- On planet Earth, life exists not just in a few favourable habitats but even in extreme and harsh habitats – scorching Rajasthan desert, perpetually rain-soaked Meghalaya forests, deep ocean trenches, torrential streams, permafrost polar regions, high mountain tops, boiling thermal springs, and stinking compost pits, to name a few. Even our intestine is a unique habitat for hundreds of species of microbes. How is this possible?

Adaptation

- Each organism is adapted to its particular environment. An adaptation is thus, “the appearance or behavior or structure or mode of life of an organism that allows it to survive in a particular environment”. E.g. Neck of a giraffe.
- Adaptation is any attribute of the organism (morphological – when trees grew higher, the giraffes neck got longer; physiological – 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; behavioral – animals migrating temporarily to a less stressful habitat) that enables the organism to survive and reproduce in its habitat.
- We need to breathe faster when we are on high mountains. After some days, our body adjusts to the changed conditions on the high mountain.
- Such small changes that take place in the body of a single organism over short periods, to overcome small problems due to changes in the surroundings, are called acclimatization.

Examples of Adaptation

- Many adaptations have evolved over a long evolutionary time and are genetically fixed.

- 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** [less leaves = less area available for transpiration].
- Mammals from colder climates generally have **shorter ears and limbs to minimise heat loss**. (This is called the Allen's Rule.) Guess why an elephant has a huge ear.
- 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) 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 **acclimatized** and stop experiencing altitude sickness.
- How did your body solve this problem? The body compensates low oxygen availability by **increasing red blood cell production, decreasing the binding capacity of hemoglobin** and by **increasing breathing rate**.
- **Archaeobacteria** flourish in hot springs and deep sea hydrothermal vents where temperatures far exceed 100 degree C. How is this possible?
- A **hyper thermophile** is an organism that thrives in extremely hot environments — from 60 °C. Hyper thermophiles are a subset of **extremophiles** (can tolerate temperatures of around 100 °C).
- They are able to survive because of the **protein structure** and the nature of the **cell membrane**. The protein molecules in the hyper thermophiles exhibit hyper thermo stability—that is, they can maintain structural stability (and therefore function) at high temperatures. The cell membrane contains **high levels of saturated fatty acids** to retain shape at high temperatures.

- 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 behavioral 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.

Variation

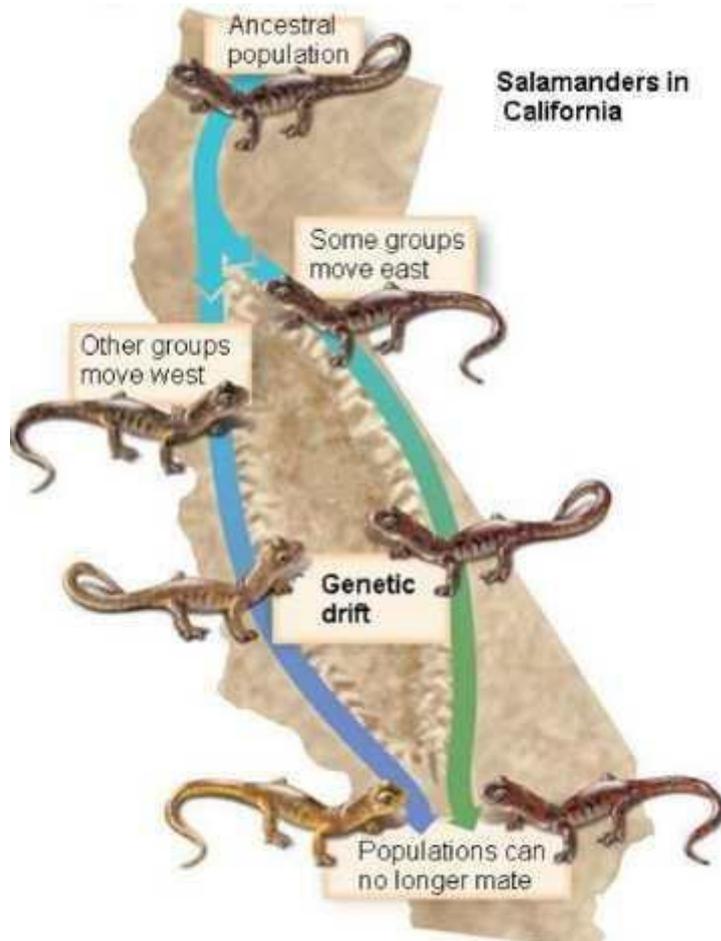
- Variations are induced by changes in genetic makeup due to **addition or deletion of certain genes**.
- Mutations, change in climate, geographical barriers etc. induce variations over a period of time.
- Species are generally composed of a number of distinct populations which freely interbreed even though they appear to be different in appearance [E.g. American man and Chinese women can interbreed. They sub species under Homo Sapiens].
- Difference in colour of skin, type of hair; curly or straight, eye colour, blood type among different ethnic groups represent variation within human species.

Adaptive radiation

- In evolutionary biology, adaptive radiation is a process in which organisms diversify rapidly from an ancestral species into a multitude of new forms, particularly when a change in the environment makes new resources available, creates new challenges, or opens new environmental niches

Speciation

- Speciation is the process by which new species are formed and evolution is the mechanism by which speciation is brought about.
- A species comprises of many populations. Often different populations of a species remain isolated due to some **geographic barrier** such as mountain, ocean, river, etc.
- The most common way a population undergoes speciation is by geographic isolation (**Allopatric speciation or geographic speciation**).



- After a long period of time, the sub-populations become very different and get isolated, reproductively, i.e. they no longer interbreed.
- Later even when the barrier is removed the sub-populations are unable to interbreed and thus subsequently the sub-populations become two different species.

Mutation

- Mutation (a change in genetic material that results from an **error in replication of DNA**) causes new genes to arise in a population.
- Further, in a sexually reproducing population, **meiosis** and fertilization produce new combination of genes every generation, which is termed **recombination**.
- Thus members of the same species show 'variation' and are not exactly identical. Variations are heritable.

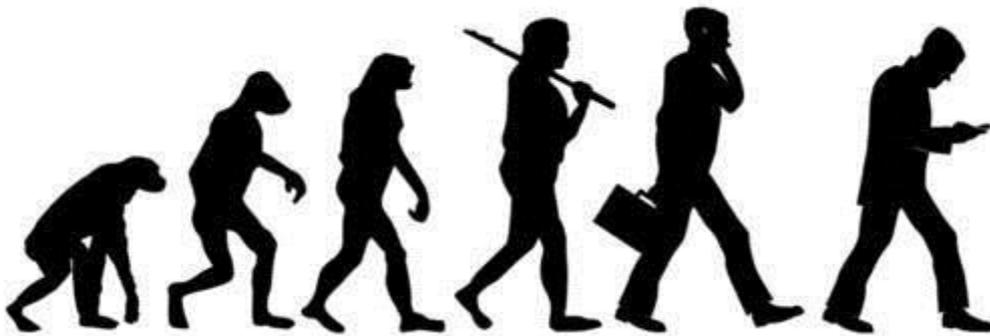
Natural Selection

- Natural Selection is the mechanism proposed by **Darwin** and Wallace. Natural selection is the process by which species **adapt** to their environment.

- It is an evolutionary force that selects among variations i.e. genes that help the organism to better adapt to its environment. Such genes are reproduced more in a population due to natural selection.
- Those offsprings which are suited to their immediate environment have a better chance of surviving, reaching reproductive age and passing on the suitable adaptations to their progeny.

Evolution

- Evolution is the change which gives rise to new species. It happens in order to make the organism better suited to the present environment.



- Climate change, competition, adaptability, need, changing environment etc. are the major forces behind evolution.
- **Mutation** and **recombination** are sources of 'variation' or differences in the genetic makeup or gene pool of a species. The variations over a period of time lead to the creation of a new species.
- Evolution involves the processes of natural selection, adaptation, variation etc.. Evolution leads to speciation or formation of new species.
- A valid theory of evolution was propounded by Charles Darwin and Alfred Wallace in 1859. This theory has been extended in the light of progress in genetics and is known as **Neo-Darwinism**.

Extinction

- Ever since life evolved on earth, new species better suited or adapted to the environment have appeared and older less successful forms have died or become extinct.
- The primary reason for these extinctions is environmental change or biological competition.

- Extinction occurs when species cannot evolve fast enough to cope with the changes taking place in their environment.
- Extinction may take place due to catastrophic natural phenomena such as tsunami, volcanoes etc.
- In recent time, human activities such as deportation, over exploitation, environmental pollution and environmental change are other factors responsible for extinction.

Q2. Which of the following are true?

1. The presence of specific features or certain habits, which enable a plant or an animal to live in its surroundings, is called Evolution.
2. The surroundings where an organism lives is called its habitat.
3. Small changes that take place in the body of a single organism over short periods, to overcome small problems due to changes in the surroundings, is called acclimatization
4. Gradual changes in an organism to survive in an environment is call Adaptation

Codes:

1. All
2. 2,3 only
3. 1,2,4 only
4. 1,2,3 only

Answer: b)

Explanation:

1. The presence of specific features or certain habits, which enable a plant or an animal to live in its surroundings, is called **Adaptation** and not evolution. E.g. Hibernation.
2. The surroundings where an organism lives is called its habitat. (True)
3. Small changes that take place in the body of a single organism over short periods, to overcome small problems due to changes in the surroundings, is called **acclimatization** (True). E.g. Soldiers undergo rigorous acclimatization training before they can serve in harsh climatic regions like Siachen Glacier.
4. Gradual changes in an organism to survive in an environment is call Evolution and not Adaptation. E.g. The evolution of Giraffes neck over a period of time.

Q3. Choose the incorrect pairs

Characteristic feature

Vegetation

- Sloping branches and needle like leaves Desert vegetation
- Deep roots Taiga vegetation
- Waxy stem, thick leaves or no leaves Tundra vegetation
- Canopy Tropical vegetation

Codes:

1. All
2. 4 only
3. 1,2,3 only
4. 2,3 only

Answer: c) – incorrect pairs

Explanation:

- Sloping branches (prevent accumulation of snow) and needle like leaves (reduce transpiration) – Taiga vegetation.
- Deep roots – Desert vegetation
- Waxy stem, thick leaves or no leaves – Desert vegetation
- Canopy – characteristic feature of tropical forests – rainforests, deciduous forests etc.