

DETAILS FOR STUDY MATERIAL

SEMESTER IV

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Subject: Environmental Science

**Hons. : Core course 08(Bio- Systematics and Biogeography)
Unit 2 (Taxonomic hierarchy)**

Concept of taxa and Taxonomic hierarchy

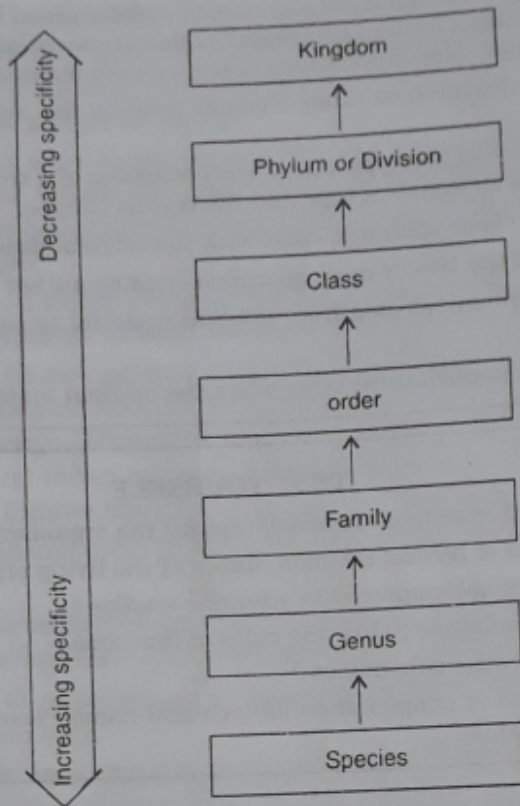


Fig. 4.2. Hierarchy of taxonomic categories.

Intermediate Categories

With the discovery of more and more organisms, sometimes, it becomes difficult to adjust an organism to the traditional obligate categories. Therefore, to make taxonomic position of a species more precise, the existing categories have been split by prefixing 'super' and 'sub' to the existing categories. Thus, we have **sub-kingdom**, **super-division** or **super-phylum**, **sub-division**, **super-class**, **sub-class** and so on upto the species level. A new category called **tribe** has been added between sub-family and genus. The categories, which have been introduced later on, in the hierarchial system are called **intermediate categories**. With the introduction of intermediate categories, it has become possible to identify the taxonomic position of a species more accurately.

Zoologists identify sub species a category. Therefore, some animal names may be trinomials with generic, species and sub-species names. For example *Gorilla gorilla gorilla* is a sub-species of gorilla. Botanists do not recognise sub-species a category.

Taxonomic Categories

The various obligate categories used in hierarchial classification are explained below :

1. **Species.** Species occupies a key position in taxonomy. It is the basic unit for understanding taxonomy as well as evolution. A species is defined as 'a dynamic genetically

distinct group of organisms, which resemble one another in all essential characters and interbreed freely in nature to produce fertile offsprings. Take the examples of mango (*Mangifera indica*), potato (*Solanum tuberosum*) and lion (*Panthera leo*). In this case, *indica*, *tuberosum* and *leo* are species of genera *Mangifera*, *Solanum* and *Panthera* respectively. The individuals of species also represent population of species and they do not breed with individuals of other species.

2. **Genus** (pl-genera). It is the first higher category above the species level. It is a group or assemblage of related species, which resemble one another in certain characters. In general, species in a genus usually have many features in common. Such groups of common features are called **corelated characters**. All the species of a genus are presumed to have evolved from a common ancestor.

The genus has a significant position in classification. By the rule of binomial nomenclature a species cannot be named, unless it is assigned to a genus. Sometimes a genus may consist of only one existing species. For example, modern man to the genus *Homo*. Such a genus is called **monotypic**. The others consisting of many species are called **polytypic**. For example, the genus *Panthera* has a large number of closely related species such as *Panthera leo* (lion), *P. tigris* (tiger), *P. pardus* (leopard), *P. onca* (jaguar). Similarly the genus *Brassica* has a large number of closely related species like *Brassica campestris* (Mustard), *B. nigrum* (black mustard), *B. alba* (white mustard), *B. rapa* (turnip) etc.

3. **Family**. It is the taxonomic category which contain one or more related genera. All the genera of a family have some common features. They are separable from the genera of a related family by some important and characteristics differences. For example, the genera *Brassica*, *Raphanus*, *Iberis* and *Senebiera* have some characters in common and have been placed in family Brassicaceae (*Cruciferae*). They are distinguishable from the genera *Papaver* (Poppy), *Argemone* (wild poppy) of related family *Papaveraceae*. Similarly, the genera *Panthera* (leopard, tiger etc.) and *Felis* (cats) are included in family *Felidae*. The genera of family *Felidae* are quite distinct from those of *Canidae* (dogs, foxes wolves etc.).

4. **Order**. It is the next higher taxonomic category which includes related families. Thus families like *Brassicaceae* (*Cruciferae*), *Papaveraceae* and *Cap. aridaceae* are placed under order **Parietales**. Similarly the families *Felidae*, *Canidae*, *Hyaenidae* and *Ursidae* are included under the order **Carnivora**.

5. **Class**. This category includes one or more related orders. Thus, the class **Dicotyledonae** of plants includes several orders like Ranales, Parietales, Geraniales, Rosales etc. Likewise class **Mammalia** of animals includes orders of all mammals like Chiroptera (bats), Marsupials (Kangaroos), Rodenta (rodents), Cetacea (whales), Carnivora (carnivores), Primates (the great apes and man).

6. **Division or Phylum**. This category includes one or more related classes. The term division is used for plants, while phylum is commonly employed for animals. The division **Spermatophyta** contains seven classes of gymnosperms and two classes of angiosperms. Similarly phylum **Chordata** of animals includes several classes like Agnatha, Chondrichytes, Osteichthyes, Amphibia, Reptilia, Aves and Mammalia.

7. **Kingdom**. It is the highest taxonomic category. It includes one or more related divisions or phyla. In the Linnaeus system of classification all plants are included in kingdom **Plantae** and all animals in the kingdom **Animalia**. But in the Whittaker's system of classification, various classes of the organisms have been included into five kingdoms—Monera, Protista, Fungi, Plantae and Animalia.

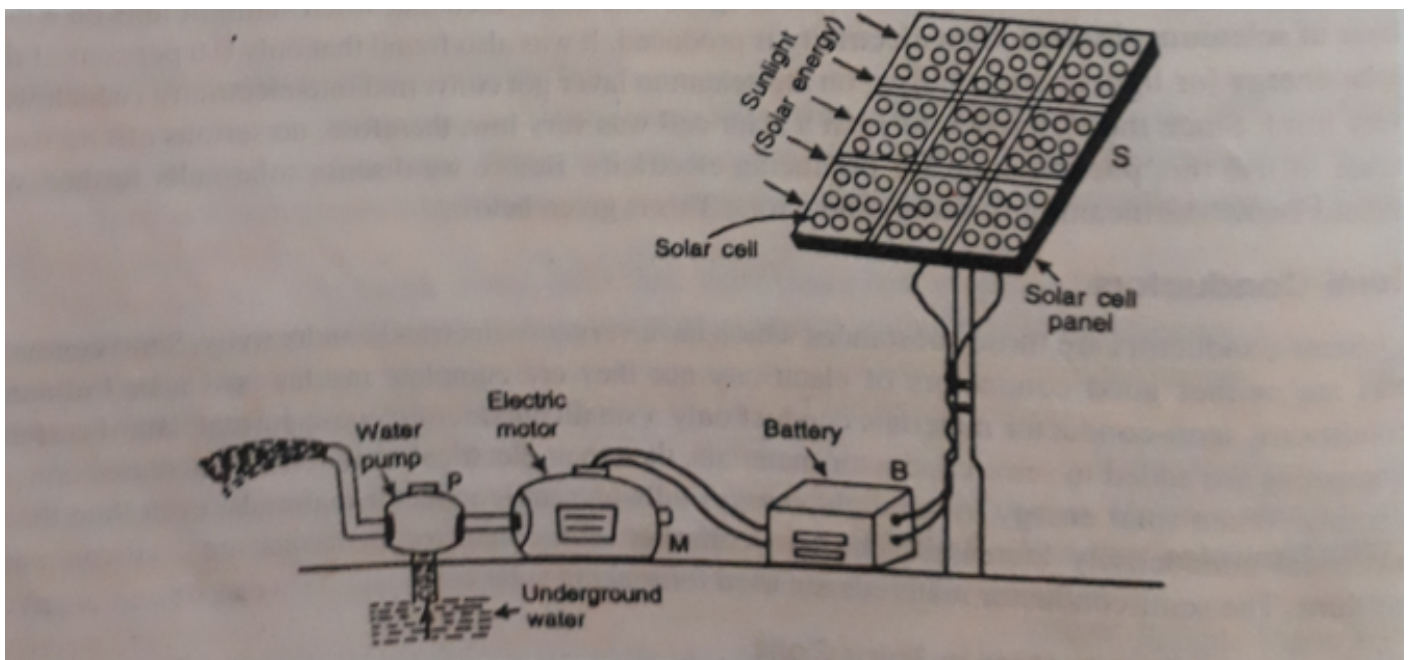
The higher the category lesser will be the number of common characteristics of organisms belonging to that category. For example, lion, tiger and leopard belonging to the genus

Unit 3 (Energy resources– Non-renewable and Renewable)

Solar cells

SOLAR CELLS

A solar cell is a device which converts solar energy directly into electricity. Since solar energy is also known as light energy, so we can also say that "solar cell is a device which converts light energy into electrical energy." About one hundred years ago it was discovered that when sunlight falls on a thin layer of selenium element, then electricity is produced. It was also found that only 0.6 per cent of the solar energy (or light energy) falling on the selenium layer got converted into electricity (which was very low). Since the efficiency of such a solar cell was very low, therefore, no serious efforts were made to use this phenomenon for producing electricity. Before we discuss solar cells further, we should know the meaning of semi-conductors. This is given below.



Tidal energy

Ans. Tides are created by the gravitational attraction of the moon and the sun acting on the oceans of the rotating earth. The relative motions of these bodies cause the surface of the oceans to be raised and lowered at a periodic interval. The difference in level of water between high tide and low tide is utilised to produce hydroelectricity.

Mechanism of production of tidal energy : The water at a higher level is stored and then the stored water is allowed to fall to the lower level by using a water turbine to produce hydroelectricity. The height of this turbine is shorter and the direction of rotation of turbine changes with the change in the direction of the flow of water. In river and oceanic deltaic region where occurrence of tide is more frequent, tidal energy is utilized to generate electrical energy.

Ocean Thermal Energy Conversion (OTEC)

There is a difference in temperature between the surface water and the water at a depth inside the ocean. It mainly exists in certain tropical and subtropical countries. The concept of OTEC utilizes this temperature difference to drive power plants to produce electricity.

The surface water is warmed by sun, so, it is considered as indirect solar technology.

Advantage :

In solar technologies we are not able to get continuous flow of electrical energy. But, from a reliable OTEC plant we will be able to get electricity continuously because, the temperature difference always exists.

Geothermal energy

Ans. Geothermal energy is enormous. The inner core of the earth is hot and molten. Its temperature is about 4000°C . In some places near hot spring or volcanic region, hot conducting rocks are present. When water comes in contact with these hot rocks, they cause hot springs or geysers. To generate power by geothermal energy, water is sent through the pipes inside the earth's core, where water undergoes evaporation and the vapour comes out through the pipe. If we fix a turbine in the pathway of the vapour, then the vapour pressure will rotate the turbine which generates electrical energy.

**Core course 10(Environmental Pollution and Human Health)
Unit 8(Chemistry of environmental pollutants)**

Organometallic compounds

Compounds that contain a metal-carbon bond are known as organometallic compounds.

E.g. Ferrocene

Organometallic compounds provide a source of nucleophilic carbon atoms which can react with electrophilic carbon to form a new carbon-carbon bond.

Bioaccumulation

This is the gradual accumulation of substance such as pesticides or other chemicals in an organism. Bioaccumulation occurs when an organism absorbs a substance at a rate faster than that at which the substance is lost by metabolism and excretion.

E.g. Mercury building up in fish.

Biotransformation

It means chemical alteration of chemicals such as nutrients, amino acids, toxins and drugs in the body. This is the process by which a substance changes from one chemical to another by a chemical reaction within the body. E.g. Biotransformation of vinyl chloride into vinyl chloride epoxide.

Acid mine drainage



Acid mine drainage refers to the outflow of acidic water from a mining site. In most cases, this acid comes primarily from oxidation of iron sulphide. Acid mine drainage is a major problem with many hardrock mines, including almost all mines where the metal ore is bound up with sulphur.

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