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PSG PROGRAMME (NCQF LEVEL 5).

MODULE 7.

BASIC TAXONOMY.

OBJECTIVES (7.1)

- **On completion of this module you will:**
  - Know what the meaning of taxonomy is.
  - Have an understanding of why and how living organisms are classified.
  - Be able to name the six kingdoms of living organisms.
  - Be able to place living organisms into hierarchical order of classification.
  - Briefly understand how all living organisms are classified.

Principles And Practices Of Taxonomy (7.1.2).

- All living organisms are classified according to an international natural system of taxonomic categories, which attempts to reflect not only the similarities between things within groups but also relationships between groups.

- **The History and Purpose of Taxonomy:**
  - The Greek Philosopher and Biologist Aristotle was the first to classify organisms on the basis of their structural similarities. Following the renaissance in Europe (European Civilization), the English Naturalist John Ray (1627 – 1705) introduced a more comprehensive classification system and a new concept of species. The development of systematic culmination in the work of Carolus Linnaeus (1707 – 1778) who developed the present day scheme of classification. Linnaeus was a Swedish Botanist at the University of Uppsala. He produced an extensive system of classification for both plants and animals. This scheme, used morphology (the comparative study of organismal form) for arranging specimens in collections. He divided the Animal Kingdom into species and gave each one a distinctive name. He grouped species into genera; genera into orders and orders into classes. Much of his classification has been drastically altered, but the basic principle of his scheme is still followed.

The science of Taxonomy (7.1.3)

- Taxonomy is the science of naming, describing and classifying organisms and it includes all plants, animals and micro-organisms of the world. Using morphological (morphology – morph, meaning shape/form and ology to study something); behavioral, genetic and biochemical observations, - taxonomists identify, describe and arrange species into classifications. Essentially, taxonomy seeks to take all organisms of a particular collection (called Kingdom), define and separate smaller sub-groups based on similar characteristics. These divisions are called **taxa** and will ultimately allow a single type or species to be differentiated.

- The Swedish Botanist Carolus Linnaeus is regarded as the father of taxonomy, as he developed a system known as **Linnaean Classification** for categorization of organisms and binomial nomenclature for naming organisms. Today, traditional rank-based biological classifications persist in a structure largely unchanged since 1700`s; however, how the relationships of these taxa are investigated has changed drastically in recent decades. It is now common for biologists to devise a classification based on the results of phylogenetic analysis using DNA (deoxyribonucleic acid) sequence data.

- Scientists believe there may be as many as 30 million species of plants, animals and micro-organisms living on the earth today. Every one of them plays a part in the global ecosystem. Taxonomists have only identified and named approximately 1.7 million of them so far and use their knowledge to help produce lists of names and identification tools in the form of species databases, field guides collections & reference works. These tools help conservationists understand biodiversity and develop ways to protect it.

Recognized Kingdoms (7.1.3).

- Evolution is a process whereby populations are altered over time and may split into separate branches, hybridize together or terminate by extinction. The evolutionary branching process may be depicted as a hypothesis (theory) about the sequence in which evolutionary branching occurred.
  - **Kingdoms:** Traditionally, all living forms were placed into two kingdoms (animals and plants) and then more recently a five-kingdom system (animals, plants, fungi, protistans and monerans – any prokaryotic organism belonging to the group Monera) was followed. However living organisms are now classified into six kingdoms which includes:
    1. **Plantae –** (multicellular eukaryotic; - eukaryotes are organisms whose cells have a nucleus enclosed within membranes', unlike prokaryotes who have no membrane).
    2. **Animalia –** (multicellular eukaryotic). Animals are multi-cellular eukaryotic organisms that form the biological kingdom Animalia.
    3. **Fungi –** ((multicellular eukaryotic).
    4. **Protista –** (eukaryotic, unicellular and multicellular). Protostomes is where many groups of invertebrates are found.
    5. **Eubacteria –** (unicellular prokaryotic – more complex bacteria that most people talk about).
    6. **Archaebacteria –** (unicellular, prokaryotic – not complex).

Hierarchical Order of Classification (7.1.4).

- Taxonomy is a hierarchical system of classifying living organisms according to their common ancestry. In this way we can trace the relationships between organisms. The taxonomic hierarchy consists of the following levels: (to be remembered as – KP COF GS).
  - **Kingdom**
  - **Phylum**
  - **Class**
  - **Order**
  - **Family**
  - **Genus**
  - **Species**
- An example; Classification of a Spotted Hyena.

Kingdom - **Animalia**
Phylum - **Chordata**
Class - **Mammalia**
Order - **Carnivora**
Family - **Hyaenidae**
Genus - **Crocuta**
Species - **crocuta.**

- All living organisms are today classified into one of six kingdoms but we deal mainly with organisms from the kingdoms Animalia, Plantae and Fungi. From practical perspective we normally use Class, Order, Family, Genus and Species when identify or classify animals.

	Example 1	**Example 2**	**Example 3**	**Example 4**
Class -	Aves	Mammalia	Insecta	Reptalia
Order –	Passeriformes	Carnivora	Hemiptera	Chelonia
Family –	Passeridae	Felidae	Cicadidae	Testudinidae
Genus –	Passer	Felis	Platypleura	Geochelone
Species –	domesticus	lybica	stridula	pardus
C/Name –	House Sparrow	African Wildcat	Cicada	Leopard Tortoise

- When dealing with plants, we mainly use Family, Genus and Species for identification purposes.

	Example 1	**Example 2**
Family -	Combretaceae	Poaceae
Genus -	Combretum	Panicum
Species -	imberbe	maximum

- **C/ Name -** Leadwood Buffalo Grass

- A **Species** is defined as a potentially interbreeding group of organisms that can produce viable offspring that themselves can interbreed. Each species is given a so-called scientific name, that is divided into 2 parts as follows:
  - **Genus –** this is the first part of the name and essentially is like the surname; describing a group of closely related species. It is always written with a capital letter (upper case).
  - **Species –** this is the second part of the name and is essentially the first name; describing one type only. It is always written with a small letter (lower case).
  - Should there be a number of different populations of a single species that start to exhibit consistent variations/traits in behavior, call , breeding strategy or coloration/patterns, then these are called **Sub-species** or **Races** and therefore are denoted by a third name applied to the original scientific name. The original population from which the first specimen of the species was described to science is then referred to as the **Nominate Race** and has the same second and third name only.
  - As an example, les look at Blue wildebeest/Brindled gnu (Connochaetes taurinus)
    - Connochaetes taurinus taurinus (Nominate race) – Common blue wildebeest (black beard) of Southern Africa.
    - C.t. Cooksoni – Cookson's wildebeest of Luanga Valley Zambia.
    - C.t. Johnstini – Nyassa wildebeest of Southern Tanzania and Northern Mozambique.
    - C.t. Albojubatus – Eastern White-bearded wildebeest of Northern Tanzania and Southern Kenya.
    - C.t. Mearnsi – Western White-bearded wildebeest of Tanzania and Kenya (commonly seen on greater migration with white beard).

Understanding Why and How Living Organisms are Classified (7.1.5).

- The first of the taxonomic divisions is a very clear one in that; for example, an African wild cat is not related in any way to a Leadwood tree, each belonging to a completely different grouping. African wild cat is an animal and a Leadwood tree is a plant. This unit of division is called the **Kingdom** and is the largest unit in which to group organisms together.
  - **Phylum:** It is clear that African wild cat is not related to a Crayfish; one of the most obvious differences between a crayfish and a cat is that a cat has a backbone (spine) or vertebra, and crayfish does not. This is one of the criteria used to define the taxonomic unit of the phylum.
  - **Chordata:** Animals that have a spinal column are denoted by this phylum.
  - **Anthropoda:** Animals that have jointed legs and an exoskeleton belong to this phylum.
  - **Mollusca:** Snails, Slugs and Bivalves.
  - **Class:** Understanding that African wild cat belongs to the phylum Chordata, smaller divisions can be made. There is an understanding that a lizard is only distantly related to a cat, and differs in that it is **ectothermic (cold-blooded)**, and has a covering of scales. Cats are therefore more closely related to those animals that share with them a wide range of common features or characteristics such as being **warm-blooded (endothermic)**; giving birth to live young that are nursed with milk, and have hair covering the body. Animals that all share these common characteristics are grouped in the class **Mammalia,** the mammals.
  - **Other Classes Include:**
    - **Amphibia:** Amphibians – frogs and toads.
    - **Reptilia:** Reptiles – snakes, lizards, crocodiles etc.
    - **Pices: -** Fish.
    - **Aves:** Birds.
  - **Order: Within the class** Mammalia, many animals may have widely differing sets of characteristics. Although African wild cat and a Buffalo are both vertebrate animals that give birth to live young which are nursed with milk; a cat is a carnivore, whereas a buffalo is a herbivore. Clear distinctions such as this, between mammals have led to the establishment of the taxonomic unit called the Order. Orders of animals all have certain characteristics in common. Cats belong to the order carnivora (carnivorous mammals), whereas buffalo belong to the order rumenantea (even-toed ungulates).

  - **Some Orders described within the Class of Mammals:**
    - **Insectivora:** Insect-eating mammals – Golden moles, Shrews etc.

- **Chiroptera:** Bats.
- **Primates:** Monkeys, Baboons and Bush babies.
- **Rodentia:** Rodents – Squirrels, Dormouse, Porcupine.

- **Family:** Orders are subdivided into families, the names of families always end in "idae". Looking at an example, it has been determined that lions belong to the order Carnivora; but Wild dogs are also carnivores, yet they are quite different to lions. It is important to now make a smaller unit of classification once again, in the form of the Family. A family of animals consists of a range of very similar animals that are placed together in a group because they have common characteristics. Cats are all grouped in the family **Felidae** because they have a specific dental arrangement and they also have retractile claws.

- **Other Families within the Order Carnivora:**
  - **Hyaenidae:** Hyenas.
  - **Herpestidae:** Mongoose, Civets & Genets.
  - **Mustelidae:** Badgers & Polecats.
  - **Canidae:** Wild dog, Jackals &b Foxes.

- **Genus:** This classification is the taxonomic equivalent to a surname. Within the family felidae, all the members are very similar, but they also have specific differences that require another unit of classification; this unit is known as the Genus. Members of a genus are all very similar to one another, but they differ from members of another genera in some way or other manner. A leopard is very similar in general characteristics to a domestic cat, but there are certain number of differences that make it important to group them separately.

- **Within the Family Felidae, there are the following Genera:**
  - **Felis:** True cats.
  - **Acionony**x: Cheetah.
  - **Panthera:** Lion & Leopard.

- **Species:** A species of a plant or animal is the basic taxonomic unit in nature. A species is a population of organisms that interbreed freely, always producing offspring of like kind.
- **Sub-species**: Geographically distinct populations within a species often display certain consistent characteristics that serve to distinguish them from other populations of the same species. If these differences are apparent enough, they are often designated as a sub-species classification (refer to the wildebeest example).
- **The Genus and Species Names:** It is by means of these two names (Genus & Species) that all vast numbers of recorded organisms (both living and extinct) on earth are distinguished from each other. In scientific papers, journals and books, these two names are usually printed in italics, first the generic name (Genus) with a capital letter and the species name with a small letter, e.g. Loxodonto africana (African Savanna Elephant).
- **Names Given To Living Organisms:** The often strange sounding names given to living organisms are derived from Greek or Latin are continuously given to organisms as new species are discovered and advances in technology are made in terms of DNA analysis. These names describe the common, most outstanding characteristics of each phylum, class, order, family, genus and species (going sometimes to sub-species). For example the phylum name Arthropoda comes from the Greek word "arthron" meaning joint and "podos" meaning foot and thus all animals that belong to this phylum have jointed legs.

Mammal Taxonomy (7.1.6)

- There are about 5,500 species of living mammals. They are divided into three subclasses and about 26 orders (there is no consensus among biologists). Unlike other animals, mammals have body hair, 3 middle ear bones (**the malleus, incus, and stapes)**, nourish their young with milk that females produce in modified sweat glands that are called **mammary glands,** and they have a part of the brain called the **neocortex.**

- The 6 largest orders, in descending order are; Rodentia, Chiroptera, Soricomorpha (shrews & moles), Primates, Cetartiodactyla (even-toed hoofed mammals and whales), and Carvivora. Recent research has revealed that nearly a third of all the recognized placental mammal Orders share a common descent. This group has been given the name **Afrotheria** (a superoder) and includes the Golden moles, Elephant shrews, Aardvark, Hyraxes, Elephants, Dugongs and Manatees. Mammals have traditionally been divided into three subclasses; namely **Protheria** (egg-laying), **Matatheria** (masupials) and **Eutheria** (placentals). The latter, being the only indigenous subclass and now called Placentalia.

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