Contents

UNIT 1

Characteristics of Living Organisms

There is no one definition of life that is accepted by all scientists. Most biologists agree that living organisms are able to perform certain functions. These functions are characteristic of life and can be used to determine whether the given object is living, dead or non-living.

Key idea 1 Life functions

- Nutrition – the taking in of nutrients which are organic substances and mineral ions, containing raw materials or energy for growth and tissue repair, absorbing and assimilating them.
- Excretion – the removal from organisms of toxic materials, the waste products of metabolism (e.g. cellular respiration) and substances in excess of requirement.
- Respiration – the chemical reactions that break down nutrient molecules in living cells to release energy.
- Sensitivity – the ability to detect or sense changes in the environment (stimuli) and make responses.
- Reproduction – the processes that make more of the same kind of organisms.
- Growth – a permanent increase in size and dry mass by an increase in cell number or cell size or both.
- Movement – the action by an organism or part of an organism causing a change of position or place.

Key idea 2 Concept and use of a classification system

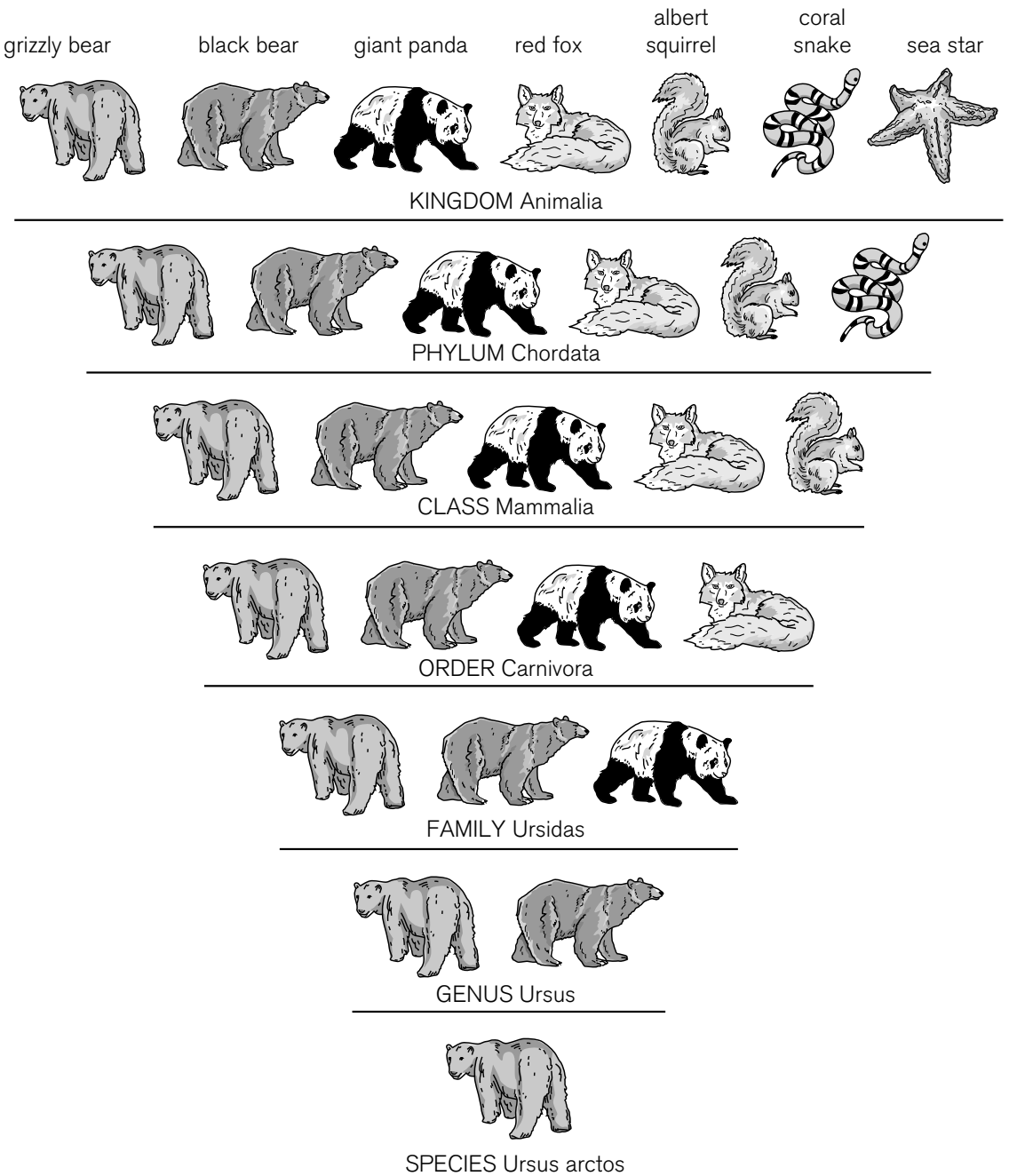
- A widely used classification system places every known organism in one of five large groupings known as kingdoms which are:

  (i) Monera **(ii)** Protoctista **(iii)** Fungi **(iv)** Plant and **(v)** Animal.

Kingdom	Common features
Monera	• Single cell (unicellular) organisms • Lack nucleus • Examples: bacteria and blue-green algae
Protoctista	• Single cell (unicellular) organisms • Contain nucleus • May contain chloroplast (photosynthesis) • Examples: *Euglena, Amoeba* and *Paramecium*
Fungi	• Made up of thread-like hyphae • Contain many nuclei throughout cytoplasm • Some species are parasites • Examples: mushrooms, toadstools, yeast and mould
Plant	• Multicellular organims • Contain cellulose cell wall • Contain chloroplast (photosynthesis) • Examples: algae, mosses, ferns, conifers and flowering plants
Animal	• Multicellular organims • Ingest solid food • Internal digestion • Examples: worms, insects, fish, amphibia, reptiles, birds, mammals, etc.

- The organisms within each kingdom share many broad characteristics but there is also considerable diversity or differences among them.
- Each kingdom is subdivided into smaller groups showing higher degrees of similarities.
- Species is the smallest group where the members share the greatest number of similarities.
- Closely related species are grouped into a genus (plural: genera).

- Related genera are grouped into a family; families into an order, orders into a class, classes into a phylum (plural: phyla); phyla into a kingdom.
- The members of a species are so similar biologically (e.g. anatomy, physiology and behaviour) that they share genetic information and reproduce more individuals like themselves.



A hierarchial classification system

- ***Note:*** There are other classification systems (e.g. cladistics based on RNA / DNA sequencing data).

Key idea 3 The binomial system (binominal nomenclature)

- A naming system (nomenclature) assists scientists to express the differences and similarities.
- The binomial system of naming species is a "two-parts" system showing the genus and species.
- The two names used are the genus name (always written in uppercase) and the species name (lowercase)
- The language used in the naming system is Latin and it was first devised by Carolus Linneaus in the 18^{th} century.

Key idea 4 The Biological species concept

- With such a vast number of organisms, it is important to name and place the different organisms into groups. A species is defined as a group of organisms that can reproduce to produce fertile offspring.
- Hence, classification systems aim to reflect evolutionary relationships. Traditional classification is based on studies of morphology and anatomy. Organisms that display similar morphological and anatomical features are likely to share a common ancestor. However, interpretation of such features could be subjective. Furthermore, it may be difficult to use these features to distinguish closely related species.
- A more accurate means of classification is to use sequences of bases in DNA and of amino acids in proteins. This involves comparing and analysis of the nucleotide sequence in DNA/RNA or amino acid sequence in proteins of different organisms.
- Organisms that are more closely related should share a greater similarity in their DNA or amino acid sequences. They would have shared a more recent common ancestor and inherited the DNA from their ancestor. As the descendent of same species evolve independently, there is an accumulation of mutations in their DNA.
- Molecular data is unambiguous and objective as it is based strictly on heritable material. The nucleotides A,T,C and G are easily recognisable compared to morphological and anatomical structures, where the interpretation may be subjective. Furthermore, such molecular data is quantifiable. It is also easily converted into numerical form and this can be used for statistical analysis.