ECOLOGY

6.7 Classification

Objectives :

- Explain that:
  - ❖ The binomial system of names for species is universal among biologists and has been agreed and developed at a series of congresses.
  - ❖ When species are discovered they are given scientific names using the binomial system.
  - ❖ Taxonomists classify species using a hierarchy of taxa.
  - ❖ All organisms are classified into three domains.
  - ❖ The principal taxa for classifying eukaryotes are kingdom, phylum, class, order, family, genus and species.
- Recognize features of porifera, cnidaria, platylhelmintha, annelida, mollusca, arthropoda and chordata.
- Recognize features of birds, mammals, amphibians, reptiles and fish.
- Recognize features of bryophyta, filicinophyta, coniferophyta and angiospermophyta.
- Construct dichotomous keys for use in identifying specimens

There are many different living organisms in the world. **Sorting out living organisms based on similarities is called classification.**

Grouping organisms makes it easier for scientists to study their characteristics.

Carl Linnaeus was a Swedish botanist. His binomial nomenclature is the basis for the system (often known as the Linnaean system) currently used by zoologists, botanists and taxonomists all over the world.

Key features of Linnaeus's system of classification are:

- The placement of organisms into groups (taxa) based on their shared characteristics
- Using scientific names to identify each organism instead of the myriad of names that different communities may have for it.

For instance, **Linnaeus used a genus and species name for each organism** he described and classified.

Hierarchy of taxa

Living organisms are arranged in hierarchies of groups (taxa) based on their shared features. In the hierarchy of taxa, groups of living organisms are placed in large groups which are further divided into smaller groups.

All organisms are classified into three domains:

- ✓ Archaea
- ✓ Eubacteria
- ✓ Eukaryota.

Eukaryotes are further classified into seven main principal taxa: kingdom, phylum, class, order, family, genus and species (figure 21). Organisms can exist in only one group at each level of classification. For example, an organism can only belong to one kingdom.

Table 6. Mnemonic for hierarchy of taxa

Domain	**D**ear
Kingdom	**K**ing
Phylum	**P**hilip
Class	**C**ame
Order	**O**ver
Family	**F**or
Genus	**G**ood
Species	**S**oup

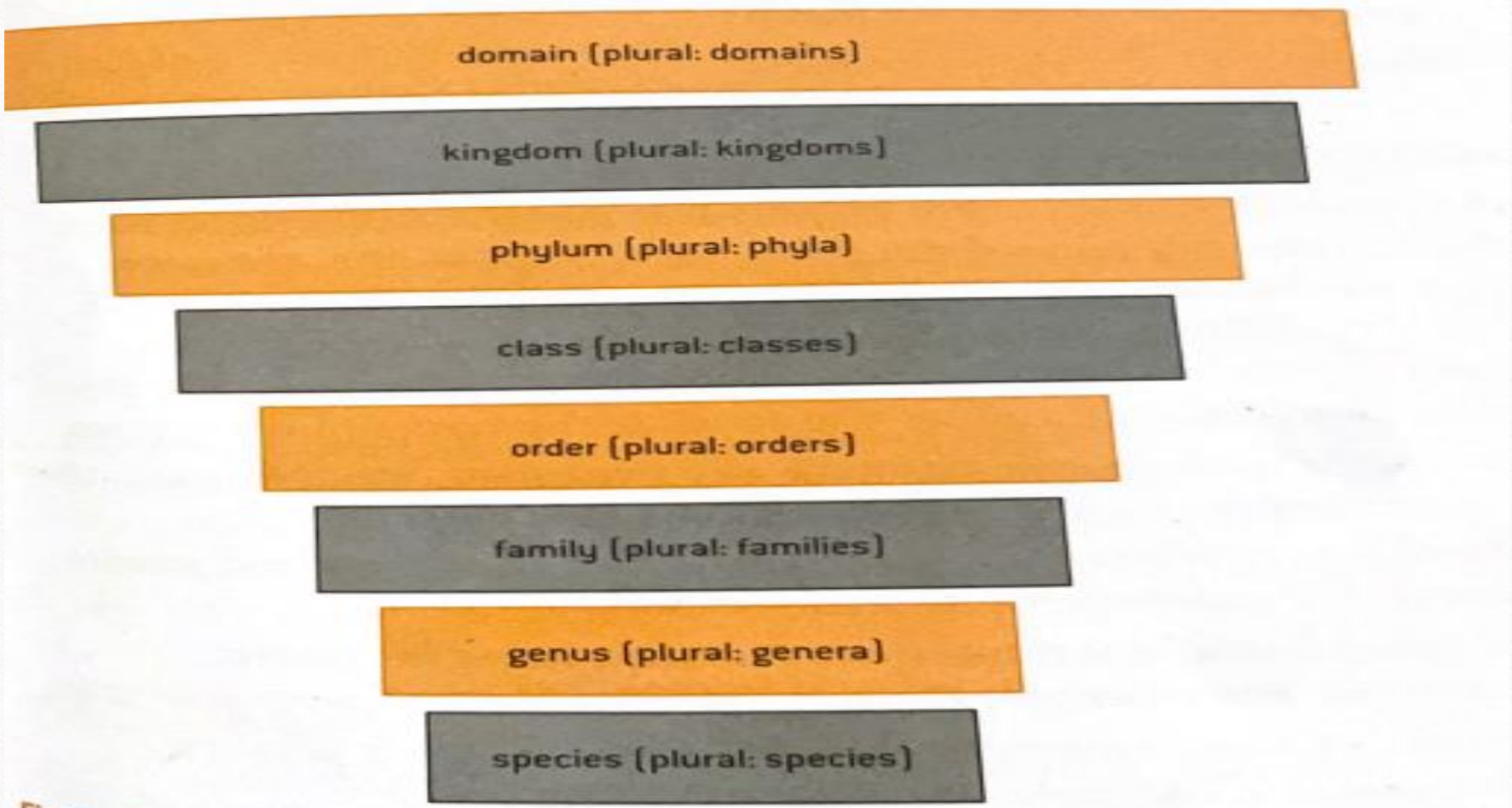


Figure 21. Hierarchy of taxa

Table 7 shows the seven principal taxa for the classification of humans.

Table 7. Classification of humans (*Homo sapiens*)

Taxa	Human
Kingdom	Animalia
Phylum	Chordata
Class	Mammalia
Order	Primates
Family	Hominidae
Genus	*Homo*
Species	*sapiens*

Binomial system of nomenclature

In the binomial system, every organism is given a name using Latin words. Linnaeus developed the binomial system so that the same name is used around the world. **The name given to living things is made of two parts: genus and species.**

For example, the scientific name for humans is Homo sapiens. "Homo" is the name of the genus while "sapiens" is the name of the species.

When writing the scientific name of any organism, the following rules must be followed:

- *If the name is printed*, italics are used (for the genus and species names). If hand-written, it is underlined.
- The **genus** name is written first. The first letter is **always capitalized**. For example, Homo.
- The **species** name is written second. The first letter is **never capitalized**. For example, sapiens.
- Both names are joined together: Homo sapiens.
- You can use abbreviations to write the scientific name. The genus name can be abbreviated to just its initial: H. sapiens.

Table 8 shows some examples of the binomial names for different species.

Table 8. Examples of the binomial system of names for some species

	Genus	Species	Complete name	Abbreviation
Lion	*Panthera*	*leo*	*Panthera leo*	*P. leo*
Garden pea	*Pisum*	*sativum*	*Pisum sativum*	*P. sativum*
Wolf	*Canis*	*lupus*	*Canis lupus*	*C. lupus*

The three domains

The first classification system was based on classifying living organisms into five kingdoms: Prokaryotes, Protista, Plantae, Fungi and Animalia. However, when the nucleic acids of prokaryotes were compared, prokaryotes were split further into two different groups: Archaea and Eubacteria.

Therefore a higher grade of taxonomic group was needed to reflect this, now called a domain. Differences in nucleic acids and proteins are used to reflect evolutionary relationships. As a result, living organisms are classified into three domains:

1. **Eubacteria**: "true" bacteria; prokaryotes without a nucleus and without membrane-bound organelles.
2. **Archaea**: "ancient" bacteria; are also prokaryotes. Most groups live in extreme environments. These include:

a) **Methanogens,** which live in anaerobic conditions such as swamps and the gut of animals. They use carbon dioxide to make methane.

b) **Thermophiles** (heat lovers), which live in very hot habitats such as hot springs in volcanic areas.

c) **Halophiles** (salt lovers), which live in habitats with a very high salt content such as the Dead Sea.

3. **Eukaryota** (also known as Eukarya): single-celled and multicellular organisms which all have their DNA contained in a nucleus. **This domain includes the kingdoms of plants, animals, protists and fungi.**

The animal kingdom

The multicellular organisms in the animal kingdom can be further divided into two major groupings, animals without backbones (invertebrates) and animals with backbones (vertebrates). Figure 23 shows examples of invertebrates and figure 24 shows examples of vertebrates.

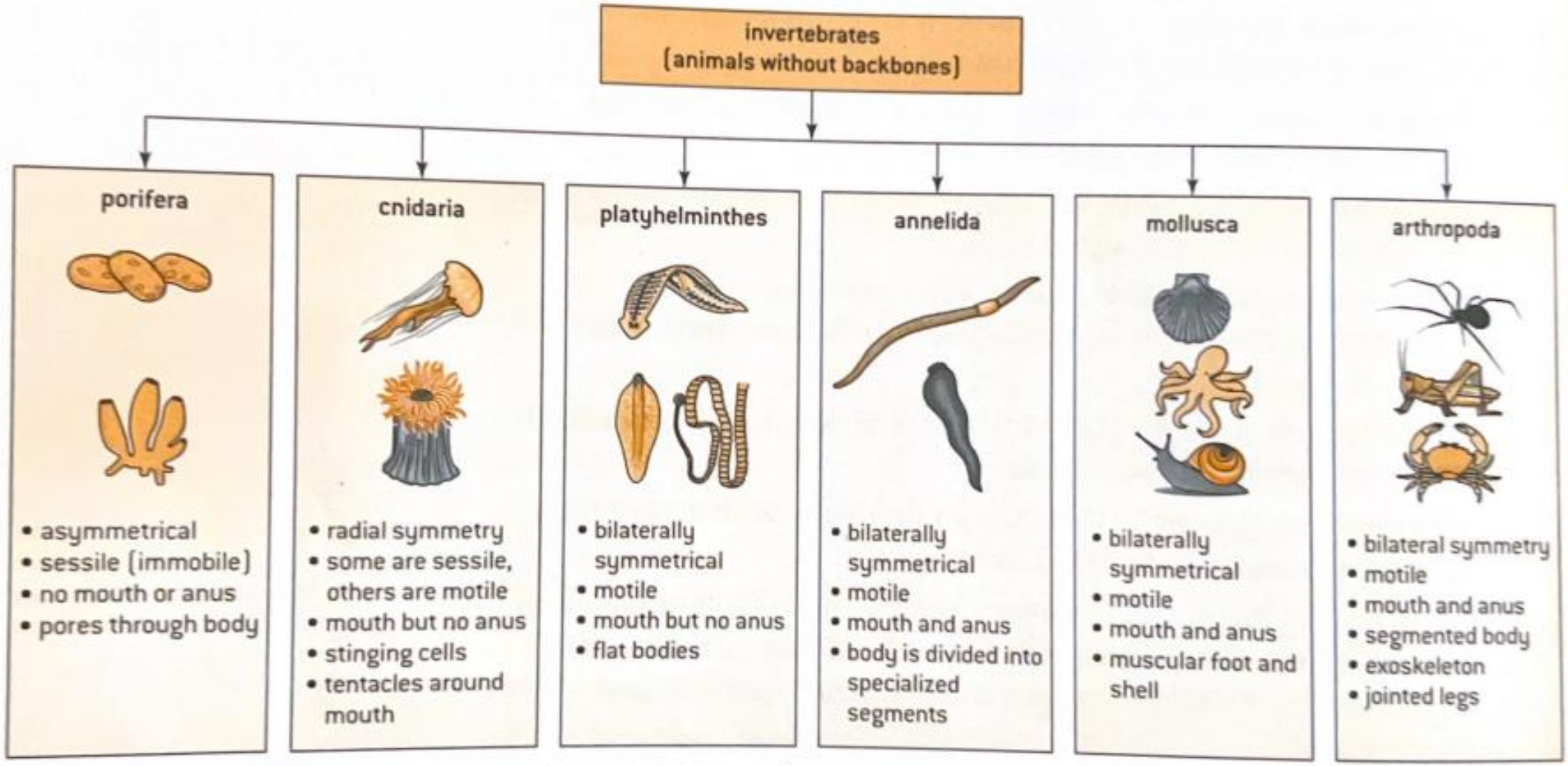
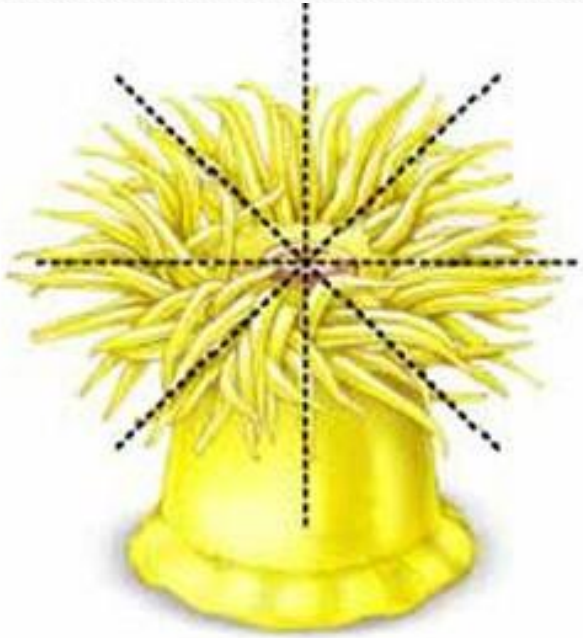


Figure 23. Invertebrates (animals without backbones)

This ant has **bilateral symmetry.** The two halves of its body mirror each other. On each side you see one eye, one antenna, and three legs.



This sea anemone has **radial symmetry.** Animals with radial symmetry have a body organized around the center, like spokes on a wheel.

This sponge is **asymmetrical.** You cannot draw a straight line so that its body is divided into two equal halves.

Invertebrate Phyla Recognition Features:

	Symmetry	Body Cavity	Segmentation	Other Features	Examples
Porifera	Asymmetrical	None (have pores)	None	Spicules for support	Sea sponge
Cnidaria	Radial	Mouth but no anus	None	Stinging cells (cnidocytes)	Jellyfish, coral, sea anemone
Platyhelmintha	Bilateral	Mouth but no anus	None	Flattened body (↑ SA:Vol ratio)	Tapeworm, planaria
Annelida	Bilateral	Mouth and anus	Segmented	Move via peristalsis	Earthworm, leech
Mollusca	Bilateral	Mouth and anus	Non-visible (mantle & foot)	May have a shell (made by mantle)	Snail, octopus, squid, bivalves
Arthropoda	Bilateral	Mouth and anus	Segmented	Exoskeleton (chitin)	Insects, spiders, crustaceans

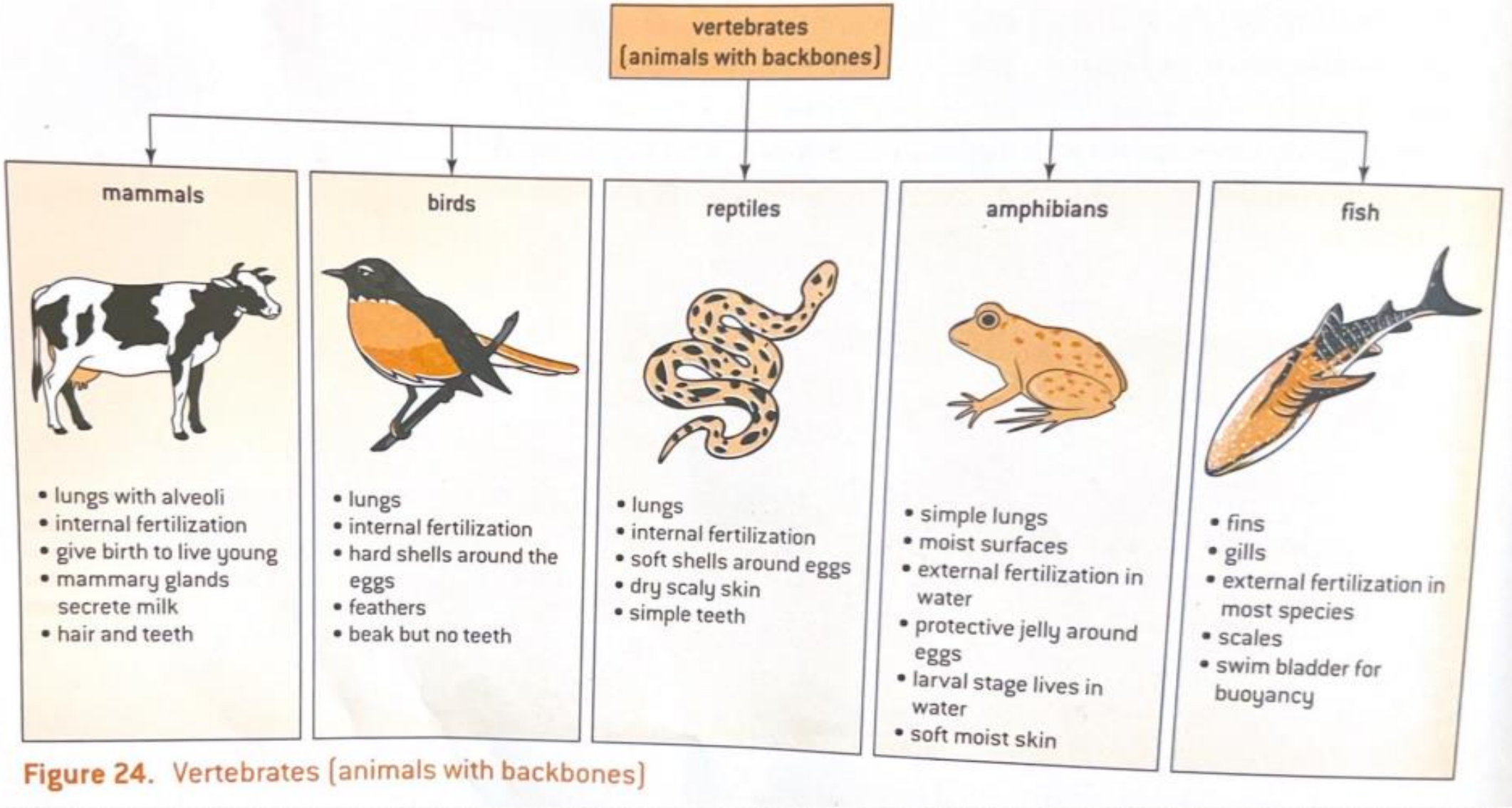


Figure 24. Vertebrates (animals with backbones)

Vertebrate Classes Recognition Features:

	Body covering	Reproduction	Breathing	Temperature	Other Features
Fish	Scales made out of bony plates	External	Gills	Ectothermic	Have a swim bladder
Amphibian	Moist skin	External	Simple lungs (and via skin)	Ectothermic	Larval state in water, adult state on land
Reptile	Scales made out of keratin	Internal (lays soft eggs)	Lungs with extensive folding	Ectothermic	Simple teeth with no living tissue
Bird	Feathers	Internal (lays hard eggs)	Lungs with bronchial tubes	Endothermic	Have wings and beaks with no teeth
Mammal	Hair	Internal – live births (except monotremes)	Lungs with alveoli	Endothermic	Feed young with milk from mammary gland

https://www.youtube.com/watch?v=cRCck4niz5o

Overview of Plant Phyla

Bryophyte	Filicinophyte	Coniferophyte	Angiospermophyte
			
Sphagnum Moss	Tassle Fern	Pine Tree	Sunflower

The plant kingdom

Some of the major groupings within the plant kingdom can be seen in figure 25.

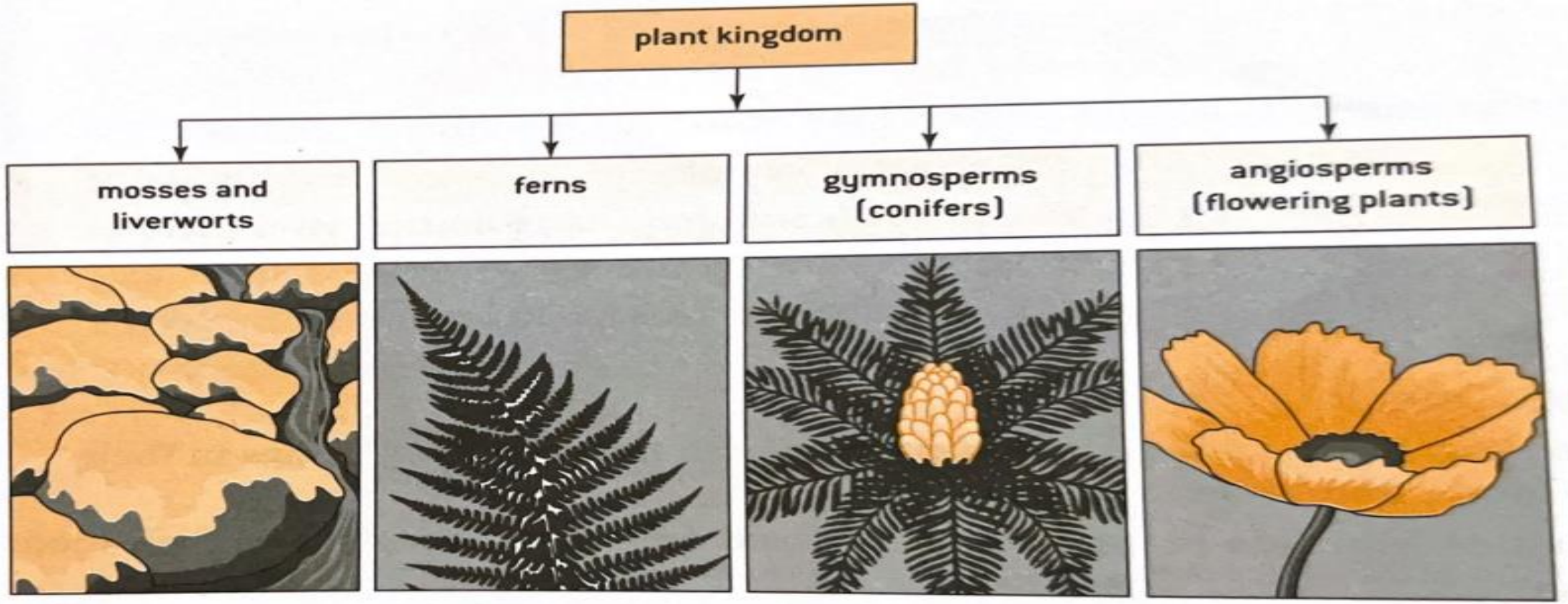


Figure 25. The plant kingdom

Plant Phyla Recognition Features:

	Structures	Vascularisation	Reproduction	Other Features	Examples
Bryophyta	No 'true' leaves, roots or stems	None	Spores	Anchored by rhizoids	Mosses
Filicinophyta	Have leaves, roots and stems	Present	Spores	Leaves are pinnate	Ferns
Coniferophyta	Have leaves, roots and stems	Present	Seeds (in cones)	Woody stems	Conifers
Angiospermophyta	Have leaves, roots and stems	Present	Seeds (in fruits)	Have flowers & fruits	Flowers

Dichotomous keys

The dichotomous key is a tool that allows you to determine the features of a living organism. The term "dichotomous" means "divided into two". This is because the dichotomous key always gives you two choices in each step. You will always start at the first stage and then answer the question to move to the following stage.

Worked example: Using dichotomous keys

5. Use the dichotomous key below to identify the organism in figure 26.

Figure 26. What is this organism?

1. Has legs..... Go to 2
   Has no legs ..... Go to 3
2. Has 6 legs ..... Insect
   Has 8 legs ..... Spider
3. Has a shell ..... Mollusc
   Has no shell .....Go to 4
4. Has a segmented body ..... Earthworm
   Has no segmented body ..... Tapeworm

Solution

The living organism in the picture has no legs, so go to 3. Since it has a shell, it is a mollusc.

Question

7 Use the dichotomous key in the worked example to identify the organism in figure 27.

Figure 27. Clue: This is not a chicken

Earthworm