

Chapter: 1 - Characteristics and classification of living organisms

Book/PDF: Chapter-1-pdf.pdf

Pages: 1–52

Exam level: Cambridge IGCSE (0610)

1) Big-picture overview (100–150 words)

This chapter introduces the fundamental concepts of what it means to be alive and how scientists organize the vast diversity of life on Earth. First, you'll learn the seven essential characteristics that all living organisms share, easily remembered by the mnemonic **MRS GREN**. Understanding these helps distinguish living from non-living things. The chapter then explains why a universal classification system is necessary, focusing on the **binomial system** (two-part scientific name) for unique identification. You'll learn how classification reflects evolutionary relationships, a concept supported by evidence from anatomy (like the pentadactyl limb) and modern DNA analysis. Finally, the chapter details the key features of the five main kingdoms of life—Animals, Plants, Fungi, Protocists, and Prokaryotes—plus the unique nature of viruses, providing the foundational knowledge for studying any organism.

2) Syllabus mapping

Syllabus outcome codes are not provided in this chapter. The table below maps the key learning outcomes covered to their location in the text.

| Outcome description | Where covered (page) |
|---|-------------------------|
| Describe the seven characteristics of living organisms. | 1-2 |
| Define the terms: movement, respiration, sensitivity, growth, reproduction, excretion, nutrition. | 2 |
| Define and understand the concept of a species. | 2-3, 35 |
| Explain the binomial system of naming species. | 3, 4-5 |
| Understand that classification systems aim to reflect evolutionary relationships. | 3, 10-11 |
| Explain how DNA sequencing is used in classification. | 16-17 |
| Construct and use dichotomous keys to identify organisms. | 6-9 |
| List the main features of the five kingdoms: Animal, Plant, Fungus, Prokaryote, Protocist. | 18, 35-36, 37-38, 43-46 |

| Outcome description | Where covered (page) |
|--|-----------------------------|
| List the main features of the major groups within the animal kingdom (vertebrates and arthropods). | 18-35 |
| List the main features of flowering plants (monocotyledons and dicotyledons) and ferns. | 38-42 |
| Describe the main features of viruses. | 36, 47-48 |

3) Key terms and definitions

| Term | One-sentence definition | First appears (page) | Example/application |
|---------------------|---|-----------------------------|---|
| Movement | An action by an organism or part of an organism causing a change of position or place. | 2 | A plant turning towards sunlight; an animal running. |
| Respiration | Chemical reactions in cells that break down nutrients to release energy for metabolism. | 2 | Releasing energy from glucose to power muscle contraction. |
| Sensitivity | The ability to detect and respond to changes in the internal or external environment. | 2 | A human pulling their hand away from a hot object. |
| Growth | A permanent increase in size and dry mass. | 2 | A seedling developing into a mature tree. |
| Reproduction | The processes that make more of the same kind of organism. | 2 | A bacterium dividing; a cat giving birth to kittens. |
| Excretion | The removal of waste products of metabolism and substances in excess of requirements. | 2 | The lungs removing carbon dioxide; the kidneys producing urine. |
| Nutrition | The taking in of materials for energy, growth, and development. | 2 | A plant photosynthesizing; an animal eating food. |

| Term | One-sentence definition | First appears (page) | Example/application |
|------------------------|--|----------------------|---|
| Species | A group of organisms that can reproduce to produce fertile offspring. | 2 | All domestic dogs belong to the species <i>Canis familiaris</i> . |
| Binomial system | An internationally agreed system where an organism's scientific name has two parts: genus and species. | 3 | The scientific name for humans is <i>Homo sapiens</i> . |
| Kingdom | The largest category used by biologists to classify living organisms. | 18 | The animal kingdom, the plant kingdom. |
| Phylum | A major group within a kingdom (plural: phyla). | 23 | Arthropods are a phylum within the animal kingdom. |
| Parasite | An organism that lives on or in another organism (the host), gaining food and shelter from it. | 44 | The fungus that causes mildew on wheat is a parasite. |

4) Core concepts explained

Characteristics of Living Organisms (p. 1)

All living things, from bacteria to blue whales, share seven key characteristics. These can be remembered using the mnemonic **MRS GREN**.

- **M**ovement: Changing position or place.
- **R**espiration: Releasing energy from food.
- **S**ensitivity: Detecting and responding to stimuli.
- **G**rowth: A permanent increase in size.
- **R**eproduction: Producing offspring.
- **E**xcretion: Removing metabolic waste.
- **N**utrition: Obtaining materials for energy and growth.

Classification and Naming (p. 2-5)

With millions of species, a logical system is needed to organize them. This process is called **classification**.

- **Artificial systems**, like grouping animals by colour, are not very useful because they don't reflect true biological relationships (p. 3).
- Biologists use **natural systems** based on shared features that suggest a common ancestor (p. 3).
- The basic unit of classification is the **species**, a group of organisms that can interbreed to produce fertile offspring (p. 3).
- The **binomial system**, an international standard, gives every species a unique two-part Latin name (p. 4).
 - The first part is the **Genus** (always capitalized).
 - The second part is the **species** (always lowercase).
 - Example: *Panthera leo* (lion) and *Panthera tigris* (tiger) are different species in the same genus.

Dichotomous Keys (p. 6-9)

A **dichotomous key** is a tool used to identify unfamiliar organisms.

- "Dichotomous" means 'two branches', as the key is made of pairs of contrasting statements (p. 6).
- You start at the first pair and choose the statement that best describes your organism.
- This choice directs you to the next pair of statements or to the name of the organism.
- The process continues, narrowing down the possibilities until a final identification is made.
- Example from the book (p. 7):
 - i. Animal is cold-blooded → Go to 2
 - ii. Animal is warm-blooded → Go to 4

Classification and Evolution (p. 10-17)

Modern classification aims to reflect evolutionary relationships.

- **Comparative Anatomy:** Studying anatomical structures can reveal common ancestry. The **pentadactyl limb** (five-fingered limb) is a classic example. The same basic bone structure is found in the forelimbs of humans, lizards, whales, and bats, despite having different functions (holding, walking, swimming, flying). This suggests they all evolved from a common ancestor with that limb structure (p. 11-13).

- **DNA Sequencing:** The sequence of bases in an organism's DNA is a blueprint for its proteins. Closely related species share a more recent common ancestor and therefore have more similar DNA base sequences (p. 16).
- DNA evidence has clarified relationships, such as showing that humans are more closely related to chimpanzees (1.2% genome difference) than to gorillas (1.6% difference) (p. 16-17).

The Five Kingdoms (p. 35-48)

Life is broadly classified into five kingdoms.

| Feature | Animals | Plants | Fungi | Protoctists | Prokaryotes |
|------------------------|-----------------------------------|------------------------------|--|--------------------------------|-------------------------|
| Number of cells | Multicellular | Multicellular | Mostly multicellular (hyphae) or unicellular (yeast) | Mostly unicellular | Unicellular |
| Cell wall | Absent | Present (cellulose) | Present (chitin) | Some have cell walls | Present (not cellulose) |
| Nutrition | Ingest solid food (heterotrophic) | Photosynthesis (autotrophic) | Absorb food (saprotrophic or parasitic) | Photosynthesis or ingestion | Various methods |
| Chloroplasts | Absent | Present | Absent | Some have chloroplasts | Absent |
| Nucleus | Present (eukaryotic) | Present (eukaryotic) | Present (eukaryotic) | Present (eukaryotic) | Absent (prokaryotic) |
| Example | Human, insect | Fern, flowering plant | Mushroom, yeast | <i>Amoeba</i> , <i>Euglena</i> | Bacteria |

Major Animal Groups (p. 18-35)

The Animal Kingdom is divided into many phyla. Two major groups are arthropods and vertebrates.

- **Arthropods** (p. 24): Have a hard exoskeleton, a segmented body, and jointed legs.

| Feature | Insects | Arachnids | Crustaceans | Myriapods |
|----------------------|-----------------------|------------------------|------------------------|----------------------|
| Body parts | Head, thorax, abdomen | Cephalothorax, abdomen | Cephalothorax, abdomen | Head, segmented body |
| Pairs of legs | 3 | 4 | 5 or more | 10 or more |
| Antennae | 1 pair | None | 2 pairs | 1 pair |
| Example | Wasp, butterfly | Spider, mite | Crab, woodlouse | Centipede, millipede |

- **Vertebrates** (p. 28): Have a vertebral column (spine).

| Feature | Fish | Amphibians | Reptiles | Birds | Mammals |
|-----------------------|--|---|--|--|--|
| Body covering | Wet scales | Moist skin | Dry scales | Feathers & scales on legs | Hair/fur |
| Breathing | Gills | Lungs & skin | Lungs | Lungs | Lungs with diaphragm |
| Reproduction | External fertilization (eggs in water) | External fertilization (eggs in water) | Internal fertilization (leathery eggs on land) | Internal fertilization (hard-shelled eggs on land) | Internal fertilization (live birth) |
| Temperature | Cold-blooded | Cold-blooded | Cold-blooded | Warm-blooded | Warm-blooded |
| Unique Feature | Fins, lateral line | 'Double life' (larva in water, adult on land) | Dry, scaly skin | Forelimbs modified into wings, have a beak | Mammary glands, external ears (pinnae) |

Major Plant Groups (p. 37-42)

The Plant Kingdom includes ferns and flowering plants.

- **Ferns** (p. 38): Have roots, stems, and leaves (fronds). They do not produce flowers or seeds, but reproduce via **spores** found in sporangia on the underside of their leaves (p. 39).

- **Flowering Plants** (p. 41): Reproduce using seeds formed in flowers. They are divided into two groups:

| Feature | Monocotyledons (Monocots) | Dicotyledons (Dicots) |
|---------------------|---------------------------|------------------------|
| Cotyledons | One cotyledon in seed | Two cotyledons in seed |
| Leaf shape | Long and narrow | Broad |
| Leaf veins | Parallel | Branching network |
| Flower parts | In multiples of three | In multiples of five |
| Example | Grass, daffodil | Geranium, oak tree |

Viruses (p. 36, 47-48)

Viruses are not classified in any of the five kingdoms.

- They are not considered truly living because they do not show all seven life characteristics (e.g., they don't respire, excrete, or grow) (p. 36).
- They are not made of cells. A virus particle consists of a central core of genetic material (DNA or RNA) surrounded by a protein coat called a **capsid** (p. 47).
- They can only reproduce inside a living host cell, using the host's machinery and materials to make more viruses (p. 47).

5) Diagrams and micrographs (figures)

- **Pentadactyl limb of vertebrates** (p. 12-13, Figure 1.9)
 - **What it shows:** The basic bone structure of the forelimb in a human, lizard, bird, whale, and bat, demonstrating a shared anatomical plan despite different functions.
 - **Labels & Functions:**
 - **Humerus:** Single upper arm bone.
 - **Radius & Ulna:** Two forearm bones.
 - **Wrist bones (carpals):** Group of small bones allowing flexibility.
 - **Hand/finger bones (metacarpals & phalanges):** Five groups of bones forming the hand structure.
- **External features of an insect** (p. 26, Figure 1.16)
 - **What it shows:** The typical body plan of an insect (a greenbottle fly).
 - **Labels & Functions:**
 - **Head:** Contains compound eyes, one pair of antennae (for sensing).

- **Thorax:** Middle section where the three pairs of legs and wings are attached.
- **Abdomen:** Segmented rear section.
- **Compound eye:** For vision, very sensitive to movement.
- **Monocot vs. Dicot leaves** (p. 42, Figure 1.30)
 - **What it shows:** The difference in leaf vein patterns between the two major groups of flowering plants.
 - **Labels & Functions:**
 - **Monocot leaf:** Shows **parallel veins** running the length of the narrow leaf.
 - **Dicot leaf:** Shows a **main vein** with a **branching network of veins** across a broad leaf.
- **Generalised structure of a virus** (p. 47, Figure 1.36)
 - **What it shows:** The basic, non-cellular structure of a virus particle.
 - **Labels & Functions:**
 - **RNA/DNA strand:** The genetic material at the core.
 - **Protein coat (capsid):** Surrounds and protects the genetic material.

6) Processes and cycles

Process: Using a Dichotomous Key (p. 6)

This is a step-by-step process for identifying an organism.

1. **Start at the beginning:** Always begin at the first pair of statements (numbered '1').
 2. **Observe the organism:** Carefully examine the features of the organism you are trying to identify.
 3. **Make a choice:** Read both statements in the pair. Choose the one that accurately describes your organism.
 4. **Follow the direction:** At the end of the chosen statement, there will be either a number or the name of a group.
 - If it's a **number**, go to that numbered pair of statements and repeat the process.
 - If it's a **name**, you have successfully identified the organism.
 5. **Continue until identified:** Repeat steps 3 and 4 until you reach a final identification.
- **Inputs:** An unknown organism and a dichotomous key.
 - **Outputs:** The correct name/classification of the organism.
 - **Common Error:** Misinterpreting a feature (e.g., mistaking a cephalothorax for just a head) or choosing the wrong statement. Always double-check features before moving on.

7) Formulae and calculations

The chapter requires basic data interpretation, including calculating percentages from tables.

| Quantity | Formula | Units | Worked example (from p. 51 data) |
|-----------------------|--|-------|--|
| Percentage of a total | $\left(\frac{\text{part}}{\text{total}} \right) \times 100$ | % | <p>Calculate the percentage of arthropods that are arachnids. 1. Find the total percentage for all arthropods: 56.3% (insects) + 4.5% (arachnids) + 2.4% (crustaceans) + 1.2% (other arthropods) = 64.4%. 2. The part is arachnids: 4.5%. 3. Formula: $\left(\frac{4.5}{64.4} \right) \times 100$ 4. Answer: ParseError: KaTeX parse error: Expected '}', got 'EOF' at end of input: ...prox \bf{7.0%} (to 2 significant figures).</p> |

8) Required practicals / experiments

Activity: Constructing a Dichotomous Key for Laboratory Glassware (p. 8-9)

- **Aim:** To create a simple dichotomous key to identify five different items of laboratory glassware.
- **Apparatus:** Conical flask, beaker, measuring cylinder, boiling tube, round-bottomed flask (as shown in Figure 1.6, p. 9).
- **Method:**
 - Observe all items:** Study the five pieces of glassware and identify features that some have but others don't (e.g., pouring spout, flat base, straight sides, graduations, sloping sides).
 - Create the first question:** Write a 'yes/no' question based on a feature that divides the group into two smaller, roughly equal subgroups. For example: "Does it have a pouring spout?"
 - Divide and conquer:** For the 'yes' group and the 'no' group, write a new question for each that further divides them. For example, for the items with a spout: "Does it have a broad base?"
 - Continue branching:** Keep writing paired questions for each new subgroup until every item can be uniquely identified.
 - Test the key:** Take each item of glassware and follow your key from the start to ensure it leads to the correct identification.
- **Variables:** Not applicable in this identification task.
- **Expected results:** A branching key that successfully distinguishes between all five items. The example key is shown in Figure 1.7 (p. 9).

9) Data handling and graphing

- **Tables:** The chapter uses tables extensively to compare features of different groups (e.g., arthropod classes on p. 28, vertebrate classes on p. 35, monocots vs. dicots on p. 42). Exam prompts often require you to extract information from or complete such tables.
- **Evolutionary Trees (Phylogenetic Trees):** Figure 1.12 (p. 17) is an evolutionary tree showing relationships between primates.
 - **How to read it:** The vertical axis represents time (past at the bottom, present at the top). Branching points represent a **common ancestor**. Organisms on branches that split more recently (higher up the tree) are more closely related.
 - **Typical prompt:** "According to the diagram, which two species share the most recent common ancestor?" (Answer: The two whose lines join closest to the top, e.g., Chimpanzee and Bonobo).

10) Common misconceptions and exam tips

- **Misconception:** "Cold-blooded" means an animal's blood is always cold.
 - **Correct understanding:** It means the animal's body temperature is **variable** and depends on the external environment. A lizard basking in the sun can have very warm blood (p. 29).
 - **Quick tip:** Use the term "**variable body temperature**" instead of "cold-blooded" in exams.
- **Misconception:** Fungi are a type of plant.
 - **Correct understanding:** Fungi are in their own kingdom. They do not have chloroplasts and cannot photosynthesize. Their cell walls are made of **chitin**, not cellulose (p. 43, 51).
 - **Quick tip:** Remember: **F**ungi **f**eed, **P**lants **p**hotosynthesize.
- **Misconception:** Spiders, crabs, and centipedes are all "bugs" or insects.
 - **Correct understanding:** They are all arthropods, but belong to different classes with distinct features (e.g., number of legs, body parts) (p. 24).
 - **Quick tip:** Count the legs! Insects = 3 pairs. Arachnids = 4 pairs. Myriapods = many pairs.
- **Exam Tip:** For the binomial system, always remember **Genus** is capitalized, **species** is lowercase. *Homo sapiens*.
- **Exam Tip:** When asked for characteristics of living things, use the **MRS GREN** mnemonic to ensure you list all seven.

11) Exam-style practice

Multiple Choice Questions (MCQs)

1. Which characteristic of life involves chemical reactions in cells to release energy?
 - A. Excretion
 - B. Nutrition
 - C. Respiration

D. Sensitivity

Answer: C. Respiration is the process that releases energy from nutrient molecules (p. 2).

2. The scientific name for the Indian robin is *Copsychus fulicatus*. What does *Copsychus* represent?

- A. The species
- B. The genus
- C. The kingdom
- D. The class

Answer: B. In the binomial system, the first name is the genus (p. 5).

3. An animal has a segmented body, a hard exoskeleton, and three pairs of jointed legs. To which class does it belong?

- A. Arachnida
- B. Crustacea
- C. Insecta
- D. Myriapoda

Answer: C. Three pairs of legs is a key feature of insects (p. 25).

4. Which feature distinguishes mammals from all other vertebrates?

- A. They are warm-blooded.
- B. They have four limbs.
- C. They produce milk from mammary glands.
- D. They have lungs for breathing.

Answer: C. Only mammals have mammary glands to suckle their young (p. 33).

5. A plant has leaves with parallel veins and its flower parts are in multiples of three. How would it be classified?

- A. Fern
- B. Dicotyledon
- C. Fungus
- D. Monocotyledon

Answer: D. Parallel veins and flower parts in threes are characteristic of monocots (p. 42).

6. Why are viruses not placed in any of the five kingdoms?

- A. They are too small to be seen.
- B. They cause diseases.
- C. They do not have a cellular structure.
- D. They contain DNA instead of RNA.

Answer: C. Viruses are not made of cells; they lack a cytoplasm, cell membrane, and organelles (p. 36, 47).

7. A key asks: "Does the animal have feathers?" If the answer is 'yes', which class have you identified?

- A. Reptilia
- B. Mammalia
- C. Amphibia

D. Aves (Birds)

Answer: D. Feathers are a unique characteristic of birds (p. 33).

8. What is the definition of a species?

A. A group of organisms that look identical.

B. A group of organisms living in the same habitat.

C. A group of organisms that can reproduce to produce fertile offspring.

D. A group of organisms that share the same genus name.

Answer: C. The ability to produce fertile offspring is the key definition of a species (p. 2).

9. The pentadactyl limb in vertebrates is evidence for...

A. The binomial system

B. Dichotomous keys

C. Evolutionary relationships

D. The five-kingdom system

Answer: C. The similar structure suggests a common ancestor, which is a key concept in evolutionary relationships (p. 11).

10. Which kingdom contains organisms with cell walls made of chitin and which feed by absorbing nutrients?

A. Fungi

B. Plantae

C. Animalia

D. Prokaryotae

Answer: A. These are the key features of the Fungi kingdom (p. 43, not explicitly stated in this chapter but standard knowledge).

Short-Answer Questions

1. **State two features that are common to all arthropods.**

- Hard, external skeleton (cuticle/exoskeleton). (p. 24)
- Segmented body and jointed limbs. (p. 24)

2. **Explain why the binomial system is important for international scientists.**

- It provides a single, universally agreed name for each species, avoiding confusion caused by common names (p. 4).
- Common names can vary by language or region (e.g., the 'robin' in Britain vs. India), but the scientific name is the same worldwide (p. 4).

3. **Distinguish between amphibians and reptiles, giving two differences.**

- **Skin:** Amphibians have moist, permeable skin, while reptiles have dry, scaly skin (p. 30, 31).
- **Reproduction:** Amphibians lay jelly-coated eggs in water (external fertilization), while reptiles lay leathery-shelled eggs on land (internal fertilization) (p. 31, 32).

4. **A student discovers a new organism. It is unicellular and has a nucleus, but no cell wall or chloroplasts. Which kingdom should it be placed in? Explain your answer.**
- **Kingdom:** Protocista (p. 46).
 - **Explanation:** It is unicellular with a nucleus, which fits the Protocist kingdom. Being animal-like (no cell wall, no chloroplasts) means it is a protozoan, a subgroup of Protocista (p. 46).
5. **Explain how DNA base sequences can be used to show how closely related two species are.**
- Organisms that share a more recent common ancestor have had less time for their DNA to mutate and change (p. 16).
 - Therefore, more closely related species will have more similar DNA base sequences than distantly related species (p. 16).

Structured Questions

1. The table below shows some features of four different vertebrates: A, B, C, and D.

| Feature | Animal A | Animal B | Animal C | Animal D |
|---------------|--------------|--------------|--------------|----------------|
| Body covering | Hair | Dry scales | Feathers | Moist skin |
| Fertilisation | Internal | Internal | Internal | External |
| Breathing | Lungs | Lungs | Lungs | Lungs and skin |
| Temp. Control | Warm-blooded | Cold-blooded | Warm-blooded | Cold-blooded |

- a) **Identify** the vertebrate class for each of animals A, B, C and D. [4 marks]
- b) Animal B lays eggs with a leathery, waterproof shell. **Explain** the importance of this feature. [2 marks]
- c) **State** two features, other than those in the table, that are characteristic of Animal C's class. [2 marks]
- **Model Answers:**

a) **Animal A:** Mammal; **Animal B:** Reptile; **Animal C:** Bird; **Animal D:** Amphibian. [4]

b) The waterproof shell **prevents** the egg from drying out. [1] This allows the animal to lay its eggs on land, away from water. [1]

c) Forelimbs are modified into wings. [1] The jaws are extended to form a beak. [1] (Also accept: hard-shelled eggs, scales on legs).

2. **Figure 1.13 (p. 19) shows four classes of arthropods.**

- a) The dragonfly and the spider both belong to the phylum Arthropoda. **State** three features they have in common because they are arthropods. [3 marks]

b) **Construct** a simple dichotomous key that could be used to separate the four classes of arthropod shown in Table 1.1 (p. 28): Insects, Arachnids, Crustacea, and Myriapods. [4 marks]

- **Model Answers:**

a) Segmented body. [1] Jointed limbs. [1] Hard exoskeleton. [1]

b)

i. Has three or four pairs of legs.....Go to 2

Has more than four pairs of legs.....Go to 3 [1]

ii. Has three pairs of legs.....**Insecta**

Has four pairs of legs.....**Arachnida** [1]

iii. Has two pairs of antennae.....**Crustacea**

Has one pair of antennae.....**Myriapoda** [2]

12) Quick revision checklist

- [] I can list and define the 7 characteristics of living organisms (MRS GREN).
- [] I can define a species as a group of organisms that can reproduce to produce fertile offspring.
- [] I can explain the binomial system of naming (Genus species) and why it is used.
- [] I can use a simple dichotomous key to identify an organism.
- [] I understand that classification reflects evolutionary relationships shown by anatomy and DNA.
- [] I can state the main features of the five kingdoms (Animal, Plant, Fungi, Protocist, Prokaryote).
- [] I can list the key differences between the five classes of vertebrates (fish, amphibians, reptiles, birds, mammals).
- [] I can list the key differences between the four main classes of arthropods (insects, arachnids, crustaceans, myriapods).
- [] I can distinguish between ferns (reproduce by spores) and flowering plants (reproduce by seeds).
- [] I can state the key differences between monocots and dicots (leaves, flowers, cotyledons).
- [] I know that viruses are not cells and can only reproduce inside a host.

13) Flashcards (ready-to-use)

| Question | Answer |
|--|---|
| What does MRS GREN stand for? | M ovement, R espiration, S ensitivity, G rowth, R eproduction, E xcretion, N utrition. |
| What is a species? | A group of organisms that can reproduce to produce fertile offspring. |
| What are the two parts of a binomial name? | The first part is the Genus (capitalized), the second is the species (lowercase). |

| Question | Answer |
|--|--|
| What is a dichotomous key? | A tool with pairs of contrasting statements used to identify organisms. |
| What is the pentadactyl limb? | The five-fingered limb structure common to many vertebrates, showing evidence of a common ancestor. |
| How does DNA help in classification? | More closely related species have more similar DNA base sequences. |
| What are the five kingdoms of life? | Animal, Plant, Fungi, Protocist, Prokaryote. |
| Key feature of an Animal cell? | No cell wall. |
| Key feature of a Plant cell? | Cellulose cell wall and chloroplasts. |
| Key feature of a Fungal cell? | Chitin cell wall, no chloroplasts. |
| Difference between Prokaryote and Protocist? | Protocists have a nucleus (eukaryotic); Prokaryotes do not. |
| What is the main difference between an insect and an arachnid? | Insects have 3 pairs of legs and 3 body parts; arachnids have 4 pairs of legs and 2 body parts. |
| How do fish breathe? | Using gills. |
| How are mammals unique among vertebrates? | They have hair/fur and produce milk (mammary glands). |
| How do ferns reproduce? | Using spores, not seeds. |
| What is the difference between monocot and dicot leaves? | Monocot leaves are narrow with parallel veins; dicot leaves are broad with a branching network of veins. |
| Are viruses living? Why? | No, because they are not made of cells and cannot carry out all 7 life processes on their own. |
| What is the protein coat of a virus called? | A capsid. |
| What is the main body of a fungus made of? | Thread-like structures called hyphae. |
| Why is a reptile better adapted to a dry environment than an amphibian? | It has dry, scaly skin to reduce water loss and lays waterproof eggs on land. |

14) 60-second recap

This chapter covers the seven characteristics that define life, remembered as MRS GREN. To organize life, scientists use classification, with the species being the basic unit and the binomial system providing a unique two-part name for every organism, like *Homo sapiens*. This classification system reflects evolutionary history, which can be studied by comparing anatomy, like the pentadactyl limb, and by analyzing DNA sequences. All organisms are grouped into five kingdoms: Animals (multicellular, no cell walls), Plants (multicellular, photosynthesize), Fungi (absorb food), Protocists (unicellular with a nucleus), and Prokaryotes (unicellular, no nucleus). Viruses are separate as they are non-cellular particles that can only replicate inside a living host.

15) References to pages

- **Arthropods:** 19, 24-28, 49
- **Binomial System:** 3, 4-5, 52
- **Characteristics of Life (MRS GREN):** 1-2, 48
- **Classification (General):** 1, 3, 10
- **Dichotomous Keys:** 6-9, 49
- **DNA in Classification:** 16-17, 49
- **Evolutionary Relationships:** 10-17, 49
- **Ferns:** 38-40, 50
- **Flowering Plants (Monocots & Dicots):** 38, 41-42, 50
- **Fungi Kingdom:** 36, 43-45, 49
- **Prokaryote Kingdom:** 36, 45, 49
- **Protocist Kingdom:** 36, 46, 49
- **Species:** 2, 3, 35, 48
- **Vertebrates:** 10, 21-23, 28-35, 49
- **Viruses:** 36, 47-48, 50

16) Excluded "Going further" sections (not summarized)

| Section title | Pages |
|-------------------------|----------|
| The three-domain scheme | 36-37 |
| Total excluded: | 1 |