

IGCSE · Biology (0610) · Chapter 1

Characteristics and Classification of Living Organisms



Syllabus topics 1.1 Characteristics of living organisms · 1.2 Classification systems · 1.3 Features of organisms

For the Cambridge IGCSE Biology 0610 syllabus, exams in 2026, 2027 and 2028 (Core and Extended)

Syllabus statements covered in this chapter

Syllabus ref.	What you must be able to do	Level
1.1	The seven characteristics of living organisms C	C
1.2	Grouping by shared features; species; binomial system; dichotomous keys C . Classification reflects evolutionary relationships; DNA base sequences S	C S
1.3	Features of the animal and plant kingdoms; vertebrate and arthropod groups C . The five kingdoms; ferns and flowering plants (monocots, dicots); viruses S	C S

What is inside

1. Concept notes, feature tables, organism drawings, 8 worked examples
2. Practical skills (Paper 5 / 6); common mistakes
3. 20 MCQs (Paper 1/2 style), explained
4. 4 Extended (Paper 4) + 2 Core (Paper 3) theory questions and 1 Alternative to Practical (Paper 6), all with full mark schemes
5. Quick-reference sheet, "I can" checklist

How to read these notes

C = Core · **S** = Supplement (Extended only)

red = key term green = definition

1 = one mark in the mark scheme

★ **Exam tip:** Learn the seven characteristics with **MRS GREN**: Movement, Respiration, Sensitivity, Growth, Reproduction, Excretion, Nutrition, and learn each definition word for word.

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1.1 Characteristics of living organisms

characteristic	definition
movement	an action by an organism or part of an organism causing a change of position or place
respiration	the chemical reactions in cells that break down nutrient molecules and release energy for metabolism
sensitivity	the ability to detect and respond to changes in the internal or external environment
growth	a permanent increase in size and dry mass
reproduction	the processes that make more of the same kind of organism
excretion	the removal of the waste products of metabolism and substances in excess of requirements
nutrition	the taking in of materials for energy, growth and development

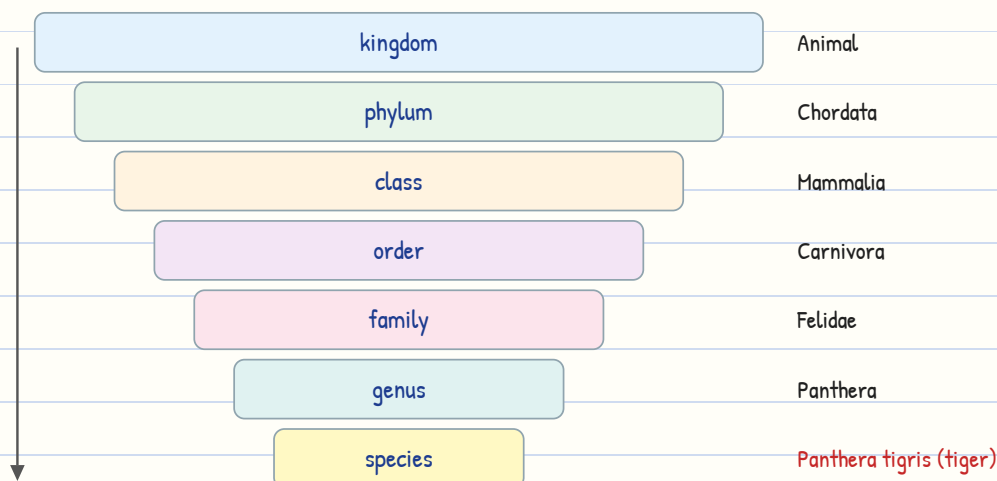
Worked example 1: is it alive?

A car moves, uses fuel and gives out waste gases. Explain why it is not a living organism.

It does not show **all seven** characteristics: it does not grow, reproduce or show sensitivity, and its "fuel use" is not respiration in cells.

1.2 Classification systems

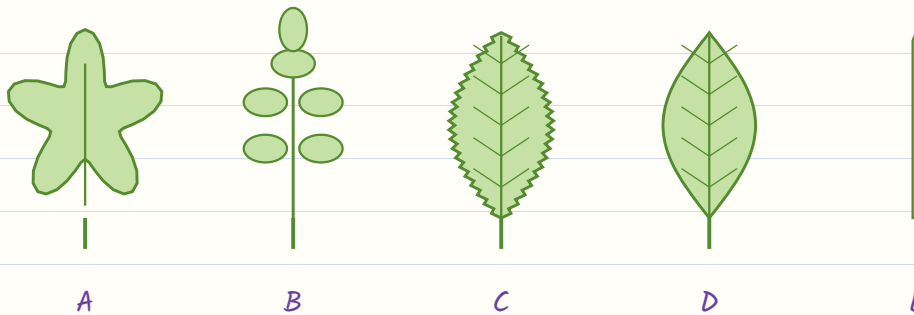
- Organisms are **classified** into groups by the **features they share**.
- A **species** is a group of organisms that can **reproduce to produce fertile offspring**.
- The **binomial system** is an internationally agreed system in which the scientific name of an organism has **two parts**: the **genus** and the **species**, e.g. *Panthera tigris* (tiger), *Homo sapiens* (human). The genus starts with a capital letter; the name is written in italics (or underlined).



The levels of classification, from kingdom to species.

Dichotomous keys

- A dichotomous key uses **pairs of contrasting statements** about **identifiable features** (things you can see or count, e.g. number of legs, leaf shape) to identify organisms step by step.
- Each step should split the remaining organisms into two groups; each organism is reached by one route. Avoid features like size or colour that vary, unless they are clear.



Five leaves (not to scale).

1	leaf divided into separate leaflets	B
	leaf not divided into leaflets	go to 2
2	leaf long and very narrow (needle-shaped)	E
	leaf broad	go to 3
3	leaf has deep lobes	A
	leaf has no lobes	go to 4
4	leaf edge has small teeth (serrated)	C
	leaf edge smooth	D

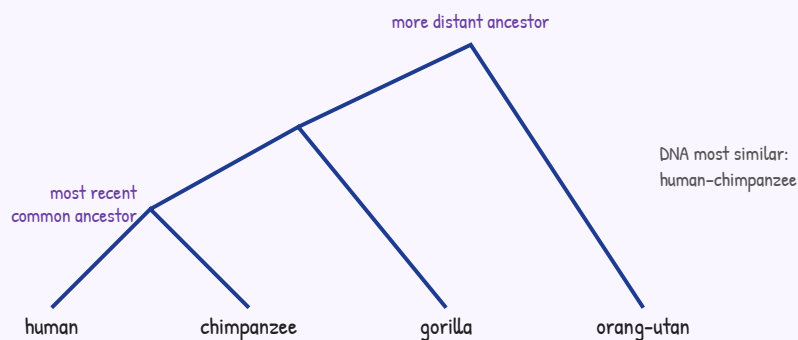
Worked example 2: binomial names

The lion is *Panthera leo* and the leopard is *Panthera pardus*. What do the names show?

They are in the **same genus** (*Panthera*) but are **different species** (*leo*, *pardus*), so they are closely related.

Extended (Supplement) only

- Classification systems aim to reflect **evolutionary relationships**: organisms in the same group share a common ancestor.
- The **sequences of bases in DNA** are used to classify organisms. Groups that share a **more recent ancestor** (are more closely related) have DNA base sequences that are **more similar** than those that share only a distant ancestor.



An evolutionary tree; DNA similarity matches the branching.

Worked example 3: DNA evidence S

Species P and Q differ at 2% of DNA bases; P and R differ at 9%. Which is more closely related to P? Explain.

Q: its DNA is more similar to P's, so P and Q share a more recent common ancestor.

1.3 Features of organisms

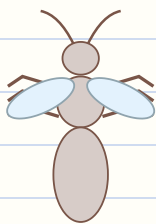
kingdom	main features
animal	multicellular; cells with no cell wall and no chloroplasts; feed on organic substances made by other organisms (heterotrophic); usually move
plant	multicellular; cells with a cellulose cell wall, chloroplasts and a large permanent vacuole; make their own food by photosynthesis; store starch

Groups of vertebrates (animals with a backbone)

group	skin covering	other key features
mammals	fur / hair	external ears (pinna); mammary glands produce milk; young develop in the uterus (placenta); whiskers
birds	feathers	beak; wings (front limbs); lay hard-shelled eggs
reptiles	dry, scaly skin	lay leathery-shelled eggs on land
amphibians	moist, smooth skin (no scales)	lay eggs in water (jelly); larvae (tadpoles) live in water with gills; adults have lungs
fish	scales	fins; gills; lay eggs in water; lateral line

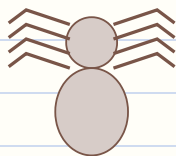
Groups of arthropods

Arthropods have a hard **exoskeleton**, **jointed legs** and a **segmented body**.



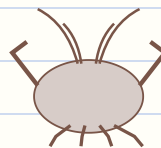
insects

3 pairs of legs, 3 body parts,
1 pair of antennae, wings



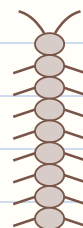
arachnids

4 pairs of legs, 2 body parts,
no antennae



crustaceans

more than 4 pairs of legs,
2 pairs of antennae



myriapods

many segments, 1-2 pairs of
legs per segment, 1 pair of antennae

The four groups of arthropods (schematic).

Worked example 4: classifying

An animal has 8 legs, 2 body sections and no antennae. Another has scales, fins and gills. Classify each. The first is an **arachnid** (arthropod). The second is a **fish** (vertebrate).

Worked example 5: bird or mammal?

State two features that would separate a bat (mammal) from a bird, although both fly.

A bat has **fur** and **external ears** (and feeds its young on milk); a bird has **feathers** and a **beak**.

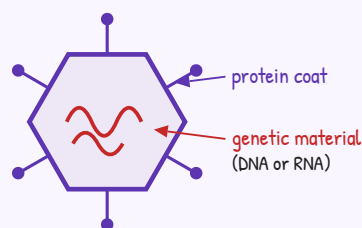
Extended (Supplement) only

The five kingdoms

kingdom	main features
animal	multicellular; no cell walls; no chloroplasts; feed on other organisms
plant	multicellular; cellulose cell walls; chloroplasts; photosynthesis
fungus	usually multicellular (hyphae) – yeast is single-celled; cell walls of chitin ; no chloroplasts; feed by extracellular digestion (saprotrophic)
prokaryote	single-celled; no nucleus (circular DNA and plasmids); cell wall (not cellulose); e.g. bacteria
protocist	mostly single-celled with a nucleus; some are plant-like (with chloroplasts, e.g. algae), some animal-like (e.g. Amoeba)

Groups within the plant kingdom

group	features
ferns	leaves called fronds; reproduce by spores (on the underside of fronds); no flowers or seeds
flowering plants	produce flowers and seeds (in fruits)
– monocotyledons	one cotyledon in the seed; long narrow leaves with parallel veins ; flower parts in threes (e.g. grasses, maize)
– dicotyledons	two cotyledons; broad leaves with a network of veins ; flower parts in fours or fives (e.g. beans, roses)

Viruses

A virus: a protein coat around genetic material.

- Viruses are **not** placed in any kingdom. They consist only of a **protein coat** and **genetic material** (DNA or RNA). They can only reproduce inside the living cells of another organism.

Worked example 6: kingdoms

An organism is made of thread-like hyphae with cell walls of chitin and no chloroplasts. Name its kingdom.

Fungus.

Worked example 7: monocot or dicot? S

A plant has long narrow leaves with parallel veins and flower parts in threes. Classify it.

A flowering plant: a **monocotyledon**.

Worked example 8: plant or animal cell?

A multicellular organism has cells with cellulose walls and chloroplasts. Which kingdom is it in?

The **plant** kingdom.

Practical skills for Paper 5 and Paper 6**Constructing a dichotomous key**

- Look at all the specimens and list clear, visible features (number of legs, wings present, leaf divided, leaf edge, vein pattern).
- Choose a feature that divides the group into two; write it as a pair of opposite statements (e.g. "has wings" / "has no wings"). Continue until each specimen is alone.
- Number the steps; end each line either with a name or "go to n". A key for n organisms has n – 1 steps.
- Do not use comparative words ("large", "small") unless a measurement is given.

Biological drawings

Use a sharp pencil; a single, clear, continuous outline (no sketching or shading); draw large (use most of the space); proportions correct; label lines drawn with a ruler, not crossing; include detail such as veins or the midrib (double line).

Common mistakes that lose marks

- **Definitions.** Growth needs "permanent increase in size and **dry mass**"; excretion is removal of **waste products of metabolism** (not faeces/egestion).
- **Respiration $\neq$ breathing.** Respiration is chemical reactions in cells releasing energy.
- **Binomial names.** Genus first (capital), then species (lower case).
- **Keys.** Use paired, opposite statements; each organism must be reachable.
- **Vertebrate features.** Amphibians: moist skin, no scales. Reptiles: dry scales. Learn one feature unique to each group.
- **Arthropod legs.** Insects 3 pairs; arachnids 4 pairs; crustaceans more than 4 pairs; myriapods many.
- **Viruses (S).** Not in a kingdom; only protein coat + genetic material.
- **Photosynthesis is not a characteristic** of all living things; it is a form of plant nutrition.

Exam-style multiple-choice questions (Paper 1/2 style)

20 questions, 1 mark each. Choose one answer, A, B, C or D. Questions marked **S** are Extended only. Answers with full explanations follow the questions.

1. Which is the definition of growth?
 - A a permanent increase in size and dry mass
 - B an increase in height
 - C taking in food
 - D producing more cells
2. Which characteristic is the removal of waste products of metabolism?
 - A nutrition
 - B respiration
 - C excretion
 - D egestion
3. What is a species?
 - A organisms that live in the same place
 - B a group of organisms that can reproduce to produce fertile offspring
 - C organisms in the same genus
 - D organisms that look the same
4. In the binomial name *Canis lupus*, what is *Canis*?
 - A species
 - B kingdom
 - C family
 - D genus
5. Which feature is found only in mammals?
 - A scales
 - B fur and mammary glands
 - C lungs
 - D a backbone
6. An animal has dry scaly skin and lays leathery eggs on land. Which group is it in?
 - A reptiles
 - B amphibians
 - C fish
 - D birds
7. How many pairs of legs does an insect have?
 - A 2
 - B 4
 - C many
 - D 3
8. Which arthropod group has two pairs of antennae?
 - A insects
 - B arachnids
 - C crustaceans
 - D myriapods
9. What is respiration?
 - A chemical reactions in cells that break down nutrient molecules and release energy
 - B breathing in and out
 - C gas exchange in the lungs
 - D making glucose

10. Which feature places an organism in the plant kingdom?
- A it moves towards light
 - B cells with chloroplasts and cellulose cell walls
 - C it is green
 - D it has no nervous system
11. Which group has moist skin and lays eggs in water?
- A reptiles
 - B fish
 - C amphibians
 - D mammals
12. What is sensitivity?
- A moving from place to place
 - B making more organisms
 - C releasing energy
 - D the ability to detect and respond to changes in the environment
13. Which is true of a dichotomous key?
- A it uses pairs of contrasting statements
 - B it lists organisms alphabetically
 - C it uses DNA sequences only
 - D each step has three choices
14. A spider is an arachnid. How many pairs of legs does it have?
- A 3
 - B 4
 - C 5
 - D 2
15. **S** Which kingdom contains organisms with no nucleus?
- A protocist
 - B fungus
 - C plant
 - D prokaryote
16. **S** What are fungal cell walls made of?
- A cellulose
 - B protein
 - C chitin
 - D starch
17. **S** What are viruses made of?
- A a protein coat and genetic material
 - B a cell wall and cytoplasm
 - C a nucleus and membrane
 - D chitin and DNA
18. **S** Which is a feature of monocotyledons?
- A broad leaves with net veins
 - B two cotyledons
 - C spores
 - D narrow leaves with parallel veins

19. **S** Why are DNA base sequences used in classification?
- A they are the same in all species
 - B closely related organisms have more similar base sequences
 - C they show what organisms eat
 - D they show the size of organisms
20. **S** How do ferns reproduce?
- A seeds
 - B flowers
 - C spores
 - D fruits

Answers and explanations

1 A · 2 C · 3 B · 4 D · 5 B · 6 A · 7 D · 8 C · 9 A · 10 B · 11 C · 12 D · 13 A · 14 B · 15 D · 16 C · 17 A · 18 D · 19 B · 20 C

1. **A**. Definition.
2. **C**. Excretion (egestion removes undigested food).
3. **B**. Fertile offspring.
4. **D**. First part = genus.
5. **B**. Fur and mammary glands.
6. **A**. Reptiles.
7. **D**. Three pairs.
8. **C**. Crustaceans.
9. **A**. Definition.
10. **B**. Chloroplasts and cellulose walls.
11. **C**. Amphibians.
12. **D**. Definition.
13. **A**. Pairs of statements.
14. **B**. Four pairs.
15. **D**. Prokaryotes.
16. **C**. Chitin.
17. **A**. Protein coat + genetic material.
18. **D**. Parallel veins.
19. **B**. More similar = more related.
20. **C**. Spores.

Exam-style Extended theory questions (Paper 4 style)

Answer all parts. Total: 38 marks. Full mark schemes follow each question.

Question 1 [10 marks]

- (a) Define (i) excretion, (ii) nutrition, (iii) movement. [3]
- (b) Bacteria show the characteristics of living organisms. Give two characteristics, with an example of how bacteria show each. [4]
- (c) Explain why viruses are not classified as living organisms in any kingdom. [3]

Mark scheme

- (a)(i) removal of the waste products of metabolism and substances in excess of requirements **1**;
(ii) taking in of materials for energy, growth and development **1**; (iii) an action causing a change of position or place **1**
- (b) any two characteristics **2** with matching examples, e.g. reproduction: divide into two; respiration: release energy from nutrients; nutrition: absorb nutrients; growth: increase in size before dividing **2**
- (c) only a protein coat and genetic material **1**; no cells / cytoplasm **1**; reproduce only inside living cells (do not show all characteristics alone) **1**

Question 2 [10 marks]

- (a) Describe the binomial system of naming species. **[2]**
- (b) Define species. **[1]**
- (c) Explain why scientists use binomial names rather than common names. **[2]**
- (d) Explain how DNA base sequences can show how closely related two species are. **[3]**
- (e) State what classification systems aim to reflect. **[2]**

Mark scheme

- (a) internationally agreed system; name in two parts **1**; genus then species **1**
- (b) a group of organisms that can reproduce to produce fertile offspring **1**
- (c) common names differ between languages / regions **1**; binomial names are the same worldwide, avoiding confusion **1**
- (d) compare the base sequences **1**; more similar sequences **1**; mean a more recent common ancestor / more closely related **1**
- (e) evolutionary relationships **1**; organisms grouped by common ancestry **1**

Question 3 [9 marks]

- (a) Complete for each of the five kingdoms one feature that distinguishes it. **[5]**
- (b) Give two differences between monocotyledons and dicotyledons. **[2]**
- (c) State two features of ferns. **[2]**

Mark scheme

- (a) animal: no cell wall / feed on other organisms **1**; plant: chloroplasts, cellulose wall **1**; fungus: chitin walls / hyphae / saprotrophic **1**; prokaryote: no nucleus **1**; protist: mostly single-celled with a nucleus **1**
- (b) any two: one vs two cotyledons; parallel vs net veins; flower parts in threes vs fours/fives; narrow vs broad leaves **2**
- (c) fronds **1**; reproduce by spores / no flowers or seeds **1**

Question 4 [9 marks]

The table describes four vertebrates.

	skin	eggs	other
P	feathers	hard shell, on land	beak
Q	moist, no scales	jelly, in water	larvae with gills
R	fur	none (live young)	external ears
S	scales	in water	fins, gills

- (a) Name the group of each vertebrate. [4]
- (b) Give one feature shared by all four. [1]
- (c) State two features shared by all arthropods. [2]
- (d) An arthropod has a body of many segments, each with two pairs of legs. Name its group. [1]
- (e) State why "colour" is a poor feature to use in a key. [1]

Mark scheme

- (a) P bird 1; Q amphibian 1; R mammal 1; S fish 1
- (b) backbone / vertebral column 1
- (c) any two: exoskeleton; jointed legs; segmented body 2
- (d) myriapod 1
- (e) colour can vary between individuals / with age / is subjective 1

Exam-style Core theory questions (Paper 3 style)

Total: 16 marks. Full mark schemes follow each question.

Question 5 [8 marks]

- (a) Name the seven characteristics of living organisms. [4]
- (b) Define respiration and sensitivity. [2]
- (c) A plant grows towards light. Name the characteristic shown. [1]
- (d) Define growth. [1]

Mark scheme

- (a) movement, respiration, sensitivity, growth, reproduction, excretion, nutrition: 7 correct 4 (6: 3; 4-5: 2; 2-3: 1)
- (b) respiration: chemical reactions in cells breaking down nutrient molecules to release energy 1; sensitivity: detecting and responding to changes in the environment 1
- (c) sensitivity 1
- (d) a permanent increase in size and dry mass 1

Question 6 [8 marks]

- (a) State two features of the animal kingdom and two of the plant kingdom. [4]
- (b) Name the arthropod group: (i) 3 pairs of legs and wings, (ii) 4 pairs of legs, (iii) more than 4 pairs of legs and 2 pairs of antennae. [3]
- (c) Name the genus of *Homo sapiens*. [1]

Mark scheme

- (a) animal: no cell wall; no chloroplasts / feed on other organisms **2**; plant: cellulose cell wall; chloroplasts / photosynthesis **2**
- (b)(i) insects **1**; (ii) arachnids **1**; (iii) crustaceans **1**
- (c) *Homo* **1**

Exam-style Alternative to Practical question (Paper 6 style)**Question 7** [11 marks]

The figure in section 1.2 shows leaves A–E from five different trees.

- (a) Construct a dichotomous key to identify the five leaves. Use only features you can see. **[4]**
- (b) Make a large, labelled drawing of leaf C. **[4]**
- (c) State one feature that would show leaf E belongs to a conifer rather than a flowering plant. **[1]**
- (d) Suggest why a student should look at several leaves from each tree before writing the key. **[2]**

Mark scheme

- (a) four steps (n – 1) **1**; each step a pair of opposite statements about a visible feature **1**; each leaf reached once **1**; key works (e.g. leaflets → B; needle → E; lobes → A; serrated → C / smooth → D) **1**
- (b) clear continuous outline **1**; large (fills most of the space) and in proportion **1**; serrated edge and midrib (double line) with veins **1**; label lines with a ruler, e.g. "midrib", "serrated edge", "vein" **1**
- (c) needle-shaped / bears cones (no flowers) **1**
- (d) leaves vary within one tree **1**; so features chosen must be typical / reliable **1**

Quick-reference sheet

Item	Statement	Level
characteristics	movement, respiration, sensitivity, growth, reproduction, excretion, nutrition	C
species	can reproduce to produce fertile offspring	C
binomial	genus + species, e.g. <i>Homo sapiens</i>	C
keys	paired contrasting statements on visible features	C
vertebrates	mammals fur; birds feathers; reptiles dry scales; amphibians moist skin; fish scales, fins, gills	C
arthropods	insects 3 pairs legs; arachnids 4; crustaceans >4, 2 pairs antennae; myriapods many	C
five kingdoms	animal, plant, fungus (chitin), prokaryote (no nucleus), protocist	S
plants	ferns (spores); flowering: monocot (parallel veins) / dicot (net veins)	S
evolution, DNA	more similar DNA = more recent common ancestor; viruses: protein coat + genetic material	S

"I can" checklist

- ☐ define the seven characteristics of living organisms
- ☐ define species, use binomial names, construct and use dichotomous keys
- ☐ classify animals into vertebrate and arthropod groups
- ☐  use the five kingdoms, plant groups and features of viruses; explain DNA evidence for classification