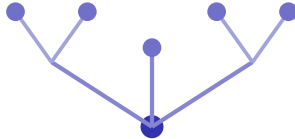


# Characteristics & Classification

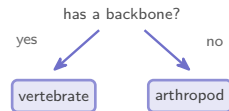
IGCSE Biology ■ Topic 1

IGCSE Biology



# What we will cover

- 1 The seven characteristics
- 2 Species & naming
- 3 Dichotomous keys
- 4 The five kingdoms
- 5 Vertebrates & arthropods
- 6 Plants & viruses



*dichotomous keys*



# The seven characteristics of a living organism



**MRS GREN** – and the two that lose marks are **growth** (a permanent increase in *dry mass*, not just size) and **excretion** (metabolic waste, not faeces).

## Seven life processes, one definition each

### MRS GREN

Every living thing shares the same seven **characteristics** – seven **life processes** that all **organisms** carry out.

### Movement and respiration

An action changing position or place; and the chemical reactions that release energy from nutrient molecules.

### Sensitivity and growth

Detecting and responding to changes; and a permanent increase in size and dry mass.

### Reproduction, excretion, nutrition

Making more of the same kind; removing the waste products of metabolism; and taking in the materials for energy, growth and development.

IGCSE wants the *definitions*, not the initials. Learn the seven sentences, and MRS GREN is only the reminder.

## Four of the seven, defined the way the mark scheme wants

**respiration**

the chemical reactions in **cells** that break down **nutrient molecules** and **release energy**

**sensitivity**

the ability to **detect and respond** to changes in the internal or external **environment**

**excretion**

the removal of the **waste products** of metabolism, and of substances the body has **in excess**

**nutrition**

taking in materials for energy, growth and development

**metabolism**

**all** the chemical reactions happening inside an organism's cells

These are **learned definitions**, not descriptions to invent. Excretion is not egestion: excretion removes what the body *made*, egestion removes what it never absorbed.

## Species and naming

genus  
(capital letter)



*Homo sapiens*



species  
(small letter)

- The **first** part is the **genus** (a larger group that the species belongs to). It starts with a capital letter.
- The **second** part is the species. It starts with a small letter.

# Species, the binomial system, and dichotomous keys

## to classify

to sort organisms into groups by the features they share

## a species

a group that can reproduce to make **fertile offspring** – fertile is the word that matters

## the binomial name

genus then species, in **italics**: *Homo sapiens*. *Rattus norvegicus* and *Rattus rattus* share a genus, not a species

## a dichotomous key

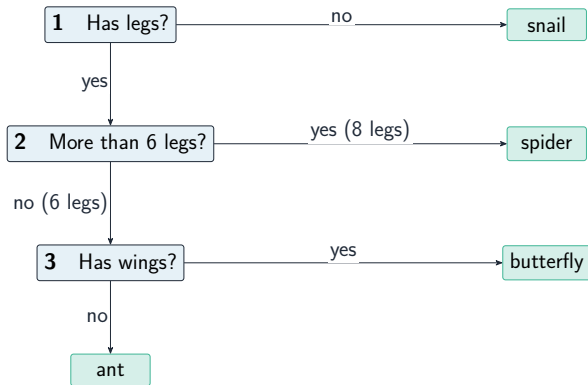
“dichotomous” means splitting into two: each step offers **two** statements and sends you to the next step or a name

## using a key

start at step 1 every time, and follow only the branch your organism matches

A key's questions must be about **visible, unambiguous** features. “Is it large?” is a bad step; “does it have six legs?” is a good one.

# Dichotomous keys



A **dichotomous key** identifies an organism by a series of **two-way** choices. Use clear, visible features (wings / no wings), not size.

## Classification and DNA (Supplement)

Modern classification tries to show **evolutionary relationships** – how closely different organisms are related.

- Organisms that share a **more recent** ancestor (more closely related) have **more similar** DNA base sequences.
- Organisms that share only a **distant** ancestor have **less similar** base sequences.

# DNA sequences give a better classification

## the older method

grouping by **visible features** – which can mislead when unrelated species evolve similar shapes

## the modern method

compare the **base sequence** of DNA – the order of the chemical letters making up an organism's **genes**

## the rule

the **more similar** the base sequences, the more **closely related** the species

## also used

the amino acid sequence of the proteins those genes code for

## why it is better

it measures actual shared ancestry rather than appearance

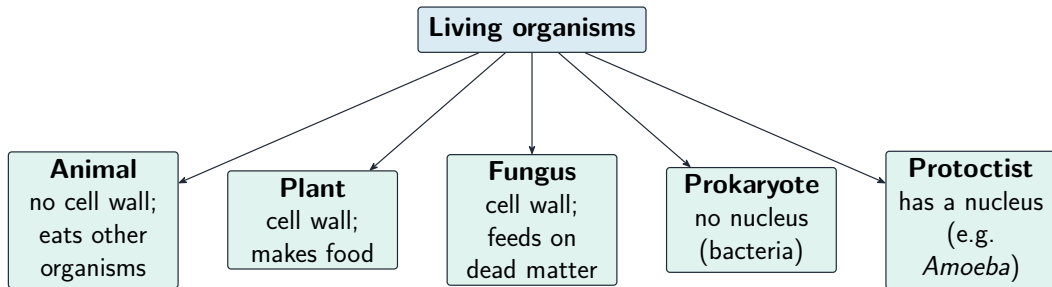
A dolphin looks like a fish and its DNA does not. That mismatch is exactly why sequence data reorganised the classification of many groups.



# The five kingdoms

- **Animal** – many cells, no cell wall, feed
- **Plant** – cell wall, **photosynthesise**
- **Fungus** – cell walls, feed on matter
- **Prokaryote** – bacteria, no **nucleus**
- **Protocist** – e.g. *Amoeba*

# The five kingdoms, in detail



Living organisms are sorted into five kingdoms by their main features

# The five kingdoms, with an example each

## Animal

Many cells, no cell wall, feed on other organisms, and most can move about.

## Plant

Many cells with a cell wall; many contain **chloroplasts** and make their own food by **photosynthesis** .

## Fungus

**Moulds** , **mushrooms** and **yeast** : cell walls, cannot photosynthesise, feed on dead or living matter.

## Protoctist

*Amoeba* and the **algae** : usually **single-celled** , and the cells **do** have a nucleus.

## Prokaryote

Bacteria: single-celled, and the cells have **no** nucleus.

Ask three questions in order: many cells or one? A nucleus or none? Makes its own food or takes it?

# Vertebrates

**mammals** – **fur** /hair; feed young on milk

**birds** – **feathers** & a beak; hard-shelled eggs

**reptiles** – dry **scales** ; leathery eggs on land

**amphibians** – moist skin; eggs & young in water

**fish** – wet scales & **fins** ; breathe with **gills**

**Vertebrates** have a **backbone** .

# Arthropods

**insects** – 3 body parts; 3 pairs of legs; **antennae**

**arachnids** – 2 body parts; 4 pairs of legs; no wings

**crustaceans** – many legs; 2 pairs of antennae; mostly aquatic

**myriapods** – many **segments** , legs on each

**Arthropods** have no backbone but a hard **exoskeleton** .

# Why arthropods need joints

## The exoskeleton

A hard outer skeleton supports the body and keeps water in – but it cannot stretch.

## So: joints

Legs bend at **joints**, and the animal moults to grow. Every arthropod feature follows from a skeleton on the outside.

## The four groups

Insects (six legs, three body parts), arachnids (eight legs, two), crustaceans (two pairs of antennae), myriapods (many similar segments).

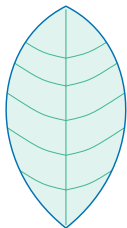
Count legs and body sections first. That single observation separates the four groups on any key.

## Plants and viruses



**Monocotyledon**

parallel veins, 1 cotyledon

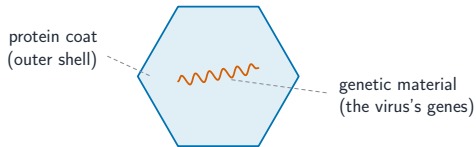


**Dicotyledon**

net (branching) veins, 2 cotyledons

**Monocots** : one **cotyledon** , parallel veins. **Dicots** :

two, net veins.



A **virus** : a protein coat around genetic material;  
not a cell, reproduces only in a **host** .

## Grouping the plant kingdom (Supplement)

### ferns

roots, stems and leaves – but **no** flowers and **no** seeds; they reproduce using **spores**

### flowering plants

make flowers and form **seeds** inside them; split by their **cotyledons** (seed leaves)

### monocotyledons

**one** cotyledon; long narrow leaves; **veins** run **parallel**

### dicotyledons

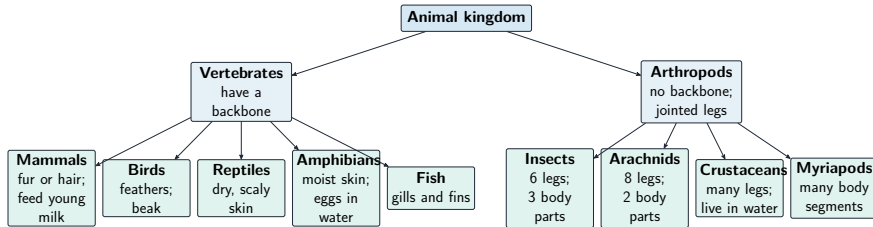
**two** cotyledons; broad leaves; veins form a **branching net**

### the quick test

grass and cereals are monocots; a rose or an oak leaf is a dicot

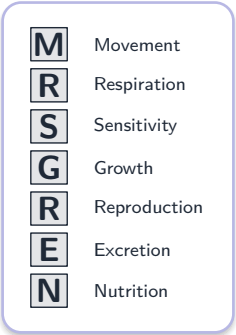
Cotyledon number, leaf shape and vein pattern all agree, so any one of the three identifies the group in an exam picture.

# Grouping the animal kingdom



The animal kingdom splits into vertebrates (with a backbone) and arthropods (no backbone), each with its main groups

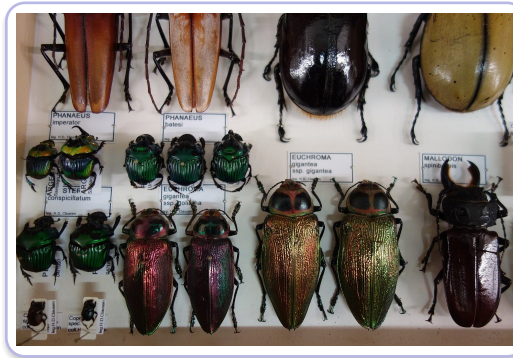
## The seven characteristics, as a picture



|          |              |
|----------|--------------|
| <b>M</b> | Movement     |
| <b>R</b> | Respiration  |
| <b>S</b> | Sensitivity  |
| <b>G</b> | Growth       |
| <b>R</b> | Reproduction |
| <b>E</b> | Excretion    |
| <b>N</b> | Nutrition    |

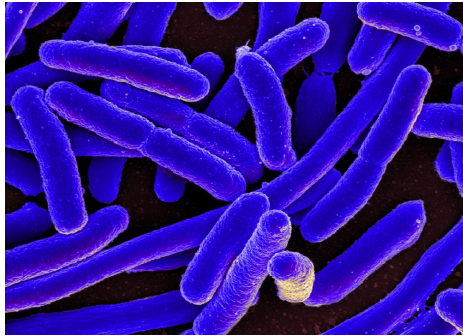
The seven life processes spell MRS GREN

## Classification: sorting living things into groups



A museum insect drawer: classification groups organisms by the features they share

# Kingdoms



A prokaryote (bacterium): *E. coli* seen under an electron microscope

## Kingdoms, continued



A fungus: the fly agaric, a mushroom

## Exam tips

- Learn the **seven characteristics** by heart, with their exact definitions. Write them as clear, full sentences.
- **Digestion** is *not* one of the seven characteristics – it is just one part of nutrition. “Breathing” is not one of the seven either.
- In a scientific name, the genus starts with a capital letter and the species with a small letter, and both are in italics.
- To use a dichotomous key, start at the first pair of choices and follow the route step by step. Do not jump ahead.
- More similar DNA base sequence → the organisms are more closely related (they share a more recent ancestor).



## Worked example – using a key

A student finds a small animal with six legs and two pairs of wings. Which group is it in, and how do you write its name?

- Six legs  $\Rightarrow$  an **insect** (arthropods are grouped by **leg number**).
- Insects: 6 legs, 3 body parts, usually 2 pairs of wings.
- Names use the **binomial system** : *Genus species*.
- *Apis mellifera* – genus with a capital, species lower case, both in italics.

Count **legs and body parts** first: insect 6 legs / 3 parts, arachnid 8 / 2. A crustacean is then named by its **two pairs of antennae**, a myriapod by its many similar segments.

# Topic 1 – key takeaways

1

## MRS GREN

the seven characteristics of living things

2

## Naming

binomial: capital genus, small species, italics

3

## Kingdoms

animal, plant, fungus, prokaryote, protocist

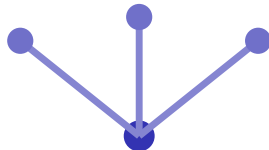
4

## Groups

vertebrates (backbone),  
arthropods (exoskeleton)

## Check yourself

- 1 What does the R in MRS GREN stand for?
- 2 Which part of a scientific name has a capital letter?
- 3 What feature do all arthropods share?
- 4 Why are viruses not placed in a kingdom?



**Answers** 1. Respiration 2. the genus (first part) 3. a hard exoskeleton & jointed legs 4. they are not made of cells