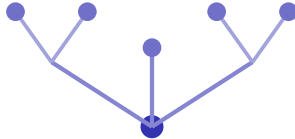


Characteristics & Classification

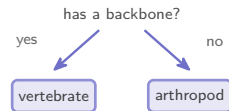
IGCSE Biology ■ Topic 1

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

1

Life and naming

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** 特征 – seven **life processes** 生命过程 that all **organisms** 生物体 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 呼吸作用

the chemical reactions in **cells** 细胞 that break down **nutrient molecules** 营养物质 and **release energy**

sensitivity 应激性

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

excretion 排泄

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

nutrition 营养

taking in materials for energy, growth and development

metabolism 新陈代谢

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** 属 (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 分类

to sort organisms into groups by the features they share

a species 物种

a group that can reproduce to make **fertile offspring** 可育后代 –
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 二歧检索表

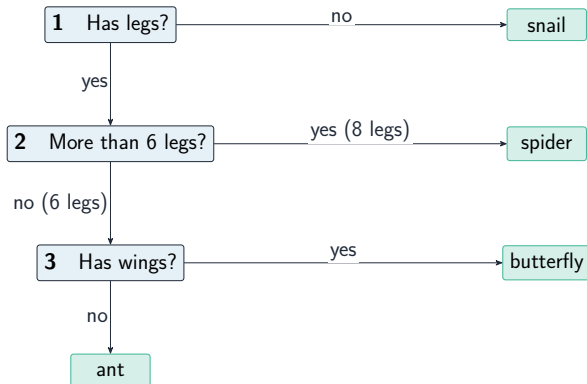
“dichotomous” means splitting into two: each step offers *two*
statements and sends you to the next step or a name

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** 二歧检索表 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** 进化关系:

species A A T G C C T A G G A

species B A T G C C **A** A G G A

species C **T** T G **A** C **A** A **C** G **T**

A-B: **1** difference $\Rightarrow$ **close**
relatives

A-C: **5** differences $\Rightarrow$ **distant**

More recent common ancestor
more similar DNA base sequences

Distant common ancestor
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** 碱基序列 of DNA – the order of the chemical letters making up an organism's **genes** 基因

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.

2

Kingdoms and groups

The five kingdoms

Animal

many cells, **no cell wall**,
feed on other organisms

Plant

cell wall;
photosynthesise
光合作用

Fungus

cell walls; feed on **dead**
or decaying matter

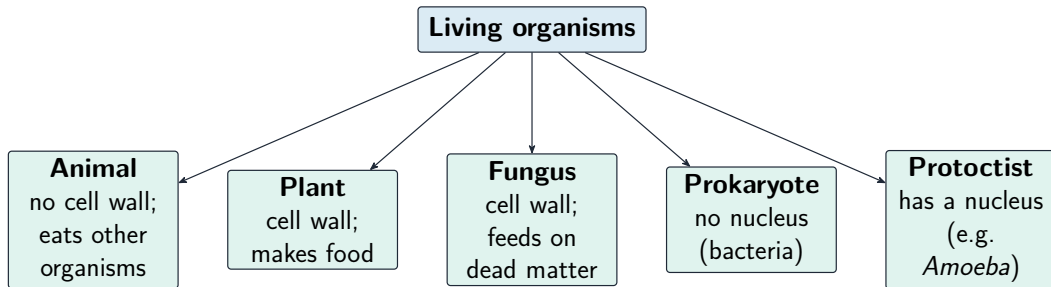
Prokaryote

bacteria: **no nucleus** 细胞核

Protocist

mostly single-celled, **with** a
nucleus: 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** 叶绿体 and make their own food by **photosynthesis** 光合作用.

Fungus

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

Protoctist

Amoeba and the **algae** 藻类: usually **single-celled** 单细胞, 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** 毛发/hair; feed young on milk

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

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

amphibians – moist skin; eggs & young in water

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

Vertebrates 脊椎动物 have a **backbone** 脊柱.

Arthropods

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

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

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

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

Arthropods 节肢动物 have no backbone but a hard **exoskeleton** 外骨骼.

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** 关节, 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).

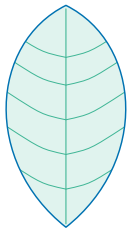
Count legs and body sections first. That single observation separates the four groups on any key.

Plants and viruses



Monocotyledon

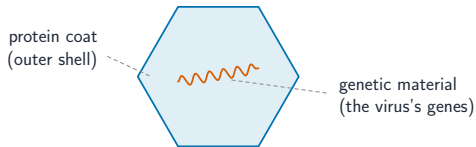
parallel veins, 1 cotyledon



Dicotyledon

net (branching) veins, 2 cotyledons

Monocots 单子叶植物: one **cotyledon** 子叶, parallel veins. **Dicots** 双子叶植物: two, net veins.



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

Grouping the plant kingdom (Supplement)

ferns 蕨类植物

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

flowering plants 开花植物

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

monocotyledons 单子叶植物

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

dicotyledons 双子叶植物

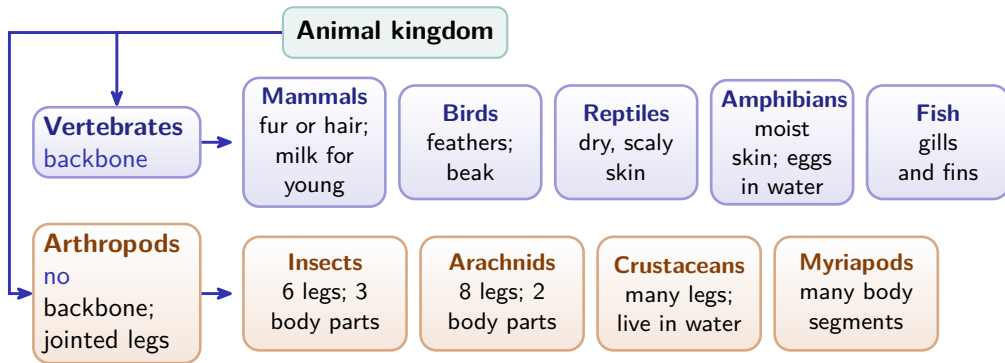
two cotyledons; broad leaves; veins form a **branching net**

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

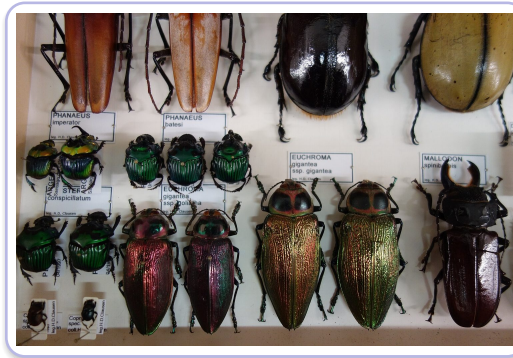


The seven characteristics, as a picture

M	Movement
R	Respiration
S	Sensitivity
G	Growth
R	Reproduction
E	Excretion
N	Nutrition

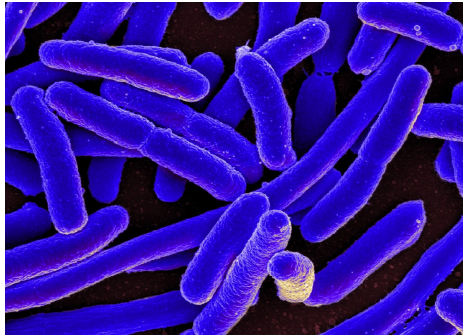
The seven life processes spell MRS GREN

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

A fungus: the fly agaric



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** 消化 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).

3

Recap

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** 双名法: *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

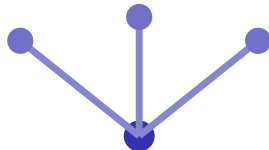
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Groups

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