

Characteristics & Classification

IGCSE Biology ■ Topic 1

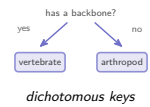
IGCSE Biology



Characteristics & Classification

What we will cover

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



1

Life and naming

Characteristics & Classification

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).

Characteristics & Classification

Life and naming

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 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.

Characteristics & Classification

Life and naming

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.

Characteristics & Classification

Life and naming

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.

Characteristics & Classification

Life and naming

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 namegenus 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 keystart 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.

Characteristics & Classification

Life and naming

Dichotomous keys

1 Has legs?

no

snail

yes

2 More than 6 legs?

yes (8 legs)

spider

no (6 legs)

3 Has wings?

yes

butterfly

no

ant

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.

Characteristics & Classification

Life and naming

Classification and DNA (Supplement)

Modern classification tries to show **evolutionary relationships** 进化关系 – 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.

Characteristics & Classification

Life and naming

DNA sequences give a better classification

the older methodgrouping by **visible features** – which can mislead when unrelated species evolve similar shapes

the modern methodcompare the **base sequence** 碱基序列 of DNA – the order of the chemical letters making up an organism's **genes** 基因

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

also usedthe amino acid sequence of the proteins those genes code for

why it is betterit 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

Characteristics & Classification

Kingdoms and groups

The five kingdoms

Animal

many cells, no cell wall, feed

Plant

cell wall, **photosynthesis** 光合作用

Fungus

cell walls, feed on matter

Prokaryote

bacteria, no **nucleus** 细胞核

Protocist

e.g. *Amoeba*

Characteristics & Classification

Kingdoms and groups

The five kingdoms, in detail

Living organisms

Animal

no cell wall;
eats other organisms

Plant

cell wall;
makes food

Fungus

cell wall;
feeds on dead matter

Prokaryote

no nucleus
(bacteria)

Protocist

has a nucleus
(e.g. *Amoeba*)

Living organisms are sorted into five kingdoms by their main features

Characteristics & Classification

Kingdoms and groups

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.

Protocist

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?

Characteristics & Classification

Kingdoms and groups

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.

Characteristics & Classification

Kingdoms and groups

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.

Characteristics & Classification

Kingdoms and groups

Why arthropods need joints

The exoskeleton

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

So: joints

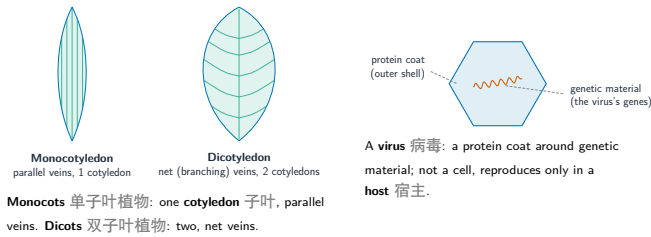
Legs bend at **joints** 关节, and the animal moults to grow. Every arthropod feature follows from a skeleton on the outside.

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

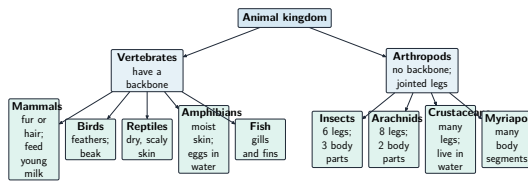


Grouping the plant kingdom (Supplement)

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

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** 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 ⇒ 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.

Arthropods split on **legs**:
insect 6, arachnid 8, crustacean >10, myriapod many. Count legs first, every time.

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