



Cambridge (CIE) IGCSE Biology



Your notes

Characteristics, Classification & Features of Organisms

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Characteristics of Living Organisms

- **Movement:** an action by an organism or part of an organism causing a change of position or place
- **Respiration:** the chemical reactions that break down nutrient molecules in living cells to release energy for metabolism
- **Sensitivity:** the ability to detect or sense stimuli in the internal or external environment and to make appropriate responses
- **Growth:** a permanent increase in size and dry mass by an increase in cell number or cell size or both
- **Reproduction:** the processes that make more of the same kind of organism
- **Excretion:** the removal from organisms of toxic materials, the waste products of metabolism (chemical reactions in cells including respiration) and substances in excess of requirements
- **Nutrition:** the taking in of materials for energy, growth and development; plants require light, carbon dioxide, water and ions; animals need organic compounds, ions and usually need water



Examiner Tips and Tricks

Use this mnemonic to help you remember these processes:

MRS. GREN

- Movement
- Respiration
- Sensitivity
- Growth and development
- Reproduction
- Excretion
- Nutrition



How Organisms are Classified

- There are millions of species of organisms on Earth
- A species is defined as a group of organisms that can **reproduce to produce fertile offspring**
- These species can be classified into groups by the **features that they share** e.g. all mammals have bodies covered in hair, feed young from mammary glands and have external ears (pinnae)

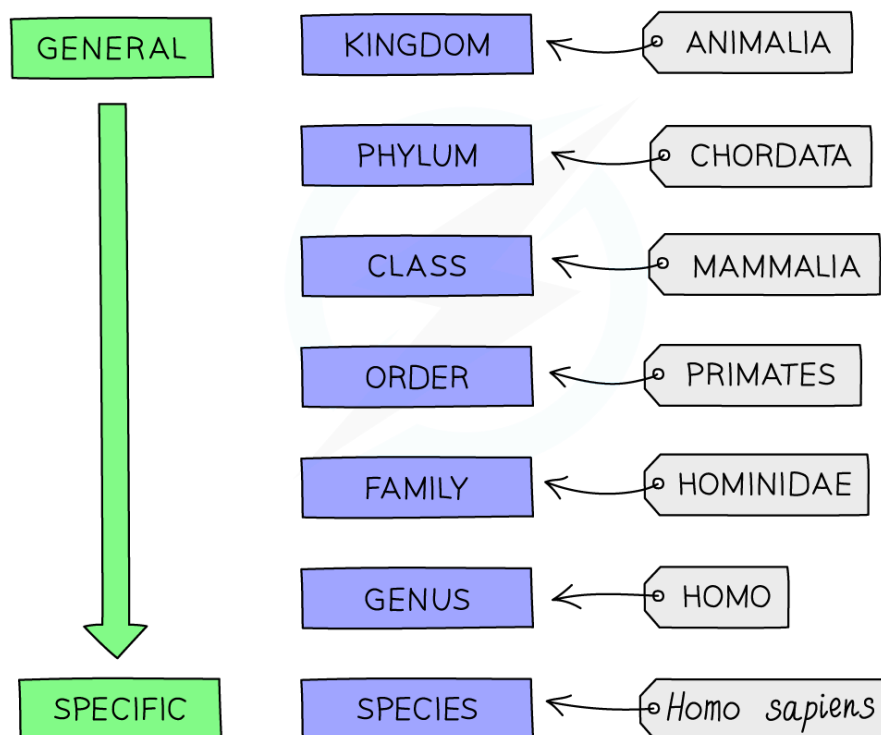
The Binomial System

- Organisms were first classified by a Swedish naturalist called **Linnaeus** in a way that allows the subdivision of living organisms into smaller and more specialised groups
- The species in these groups have more and more features in common the more subdivided they get
- He named organisms in Latin using the **binomial system** where the scientific name of an organism is made up of two parts starting with the **genus** (always given a **capital letter**) and followed by the **species** (starting with a **lower case letter**)
- When typed binomial names are always in **italics** (which indicates they are Latin) e.g. *Homo sapiens*
- The sequence of classification is: **Kingdom, Phylum, Class, Order, Family, Genus, Species**

LINNAEUS'S SYSTEM OF CLASSIFICATION



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Linnaeus's system of classification



Examiner Tips and Tricks

The order of classification can be remembered by using a mnemonic like:

KING PHILIP CAME OVER FOR GRAN'S SPAGHETTI

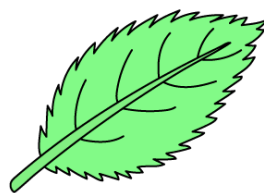
Dichotomous Keys

- Keys are used to identify organisms based on a **series of questions about their features**
- Dichotomous means 'branching into two' and it leads the user through to the name of the organism by giving **two descriptions at a time** and asking them to choose
- Each choice leads the user onto another two descriptions
- In order to successfully navigate a key:

1. You need to pick a single organism to start with, or you may be presented with an unfamiliar one as part of an exam questions
2. **Follow the statements from the beginning.** Each statement or question you should be able to answer using the information provided in the question or an image given as part of the question.
3. Eventually there will be no more statements or questions left and you will have the name of the organism
4. You then pick another organism and **start at the beginning of the key again**, repeating until all organisms are named

THE DIAGRAM SHOWS A LEAF

USE THE KEY TO IDENTIFY THE LEAF



- 1 LEAF WITH SEVERAL SMALL LEAFLETS..... GO TO 2
 LEAF WITH ONE LARGE LEAF BLADE..... GO TO 3
- 2 LEAFLETS ARE BROAD AND FLAT.....A
 LEAFLETS ARE NARROW AND HAIR-LIKE.....B
- 3 LEAF WITH A SMOOTH EDGE.....C
 LEAF WITH A TOOTHED EDGE.....D

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Example of a dichotomous key #1

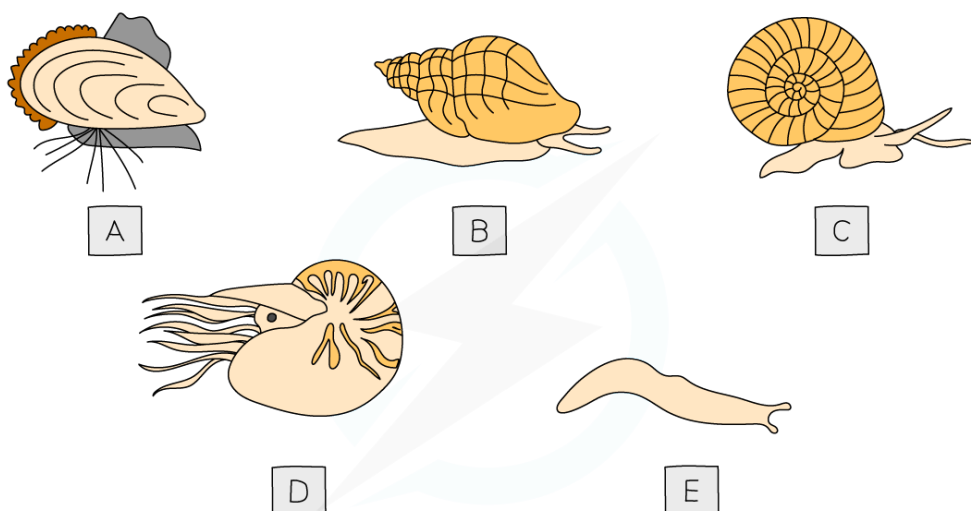


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FIVE SPECIES OF MOLLUSC



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USE THE KEY TO IDENTIFY EACH SPECIES. WRITE THE LETTER OF EACH SPECIES (A TO E) IN THE CORRECT BOX BESIDE THE KEY.

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KEY		
1 (a)	BODY IS COMPLETELY OR PARTLY COVERED IN A SHELL	GO TO 2
(b)	BODY IS NOT COMPLETELY OR PARTLY COVERED IN A SHELL	LIMAX FLAVUS
2 (a)	SHELL IS ATTACHED TO ROCKS BY THIN THREADS	MYTILUS EDULIS
(b)	SHELL IS NOT ATTACHED TO ROCKS BY THIN THREADS	GO TO 3
3 (a)	SHELL IS A SPIRE THAT COMES TO A POINT	BUCCINUM UNDATUM
(b)	SHELL IS NOT A SPIRE THAT COMES TO A POINT	GO TO 4
4 (a)	ANIMAL HAS TENTACLES	NAUTILUS POMPILIUS
(b)	ANIMAL HAS 2 TENTACLES	PLANORBIS PLANORBIS

Example of a dichotomous key #2



Examiner Tips and Tricks

Simple dichotomous keys almost always come up in the multiple choice paper, so make sure you can use one. Very occasionally they show up in the theory paper, and when they do you almost always have to use one instead of constructing one, so focus on this rather than spending hours learning to construct them yourself!



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Reflecting Evolutionary Relationships: Extended

Extended Tier Only

- Classification systems aim to **reflect evolutionary relationships** between species
- Traditional biological classification systems grouped organisms based on the **features** that they **shared**
 - If organisms shared more similar features then they were said to be more closely related
- In the past, scientists have encountered many **difficulties** when trying to determine the **evolutionary relationships** of species based on this method
- Using the physical features of species (such as colour/shape/size) has **many limitations** and can often lead to the **wrong classification** of species

Using DNA to Classify Organisms: Extended

Extended Tier Only

- Organisms share features because they originally descend from a **common ancestor**
- Example: all mammals have bodies covered in hair, feed young from mammary glands and have external ears (pinnae)
- Originally, organisms were classified using **morphology** (the overall form and shape of the organism, e.g. whether it had wings or legs) and **anatomy** (the detailed body structure as determined by dissection)
- As technology advanced, **microscopes**, knowledge of **biochemistry** and eventually **DNA sequencing** allowed us to classify organisms using a more scientific approach
- Studies of DNA sequences of different species show that the **more similar the base sequences in the DNA of two species, the more closely related those two species are** (and the more recent in time their common ancestor is)
- This means that the **base sequences in a mammal's DNA are more closely related to all other mammals** than to any other vertebrate groups



Your notes

PHEROPSOPHUS	C	T	T	A	G	A	T	C	G	T	T	C	C	A	C	—	—	—	A	C	A	T	A	T	A	C
BRACHINUS ARMIGER	A	T	T	A	G	A	T	C	G	T	A	C	C	A	C	—	—	—	A	T	A	T	A	T	T	C
BRACHINUS HIRSUTUS	A	T	T	A	G	A	T	C	G	T	A	C	C	A	C	—	—	—	A	T	A	T	A	T	A	C
APTINUS	C	T	T	A	G	A	T	C	G	T	A	C	C	A	C	—	—	—	A	C	A	A	T	T	A	C
PSEUDOMRPHA	C	T	T	A	G	A	T	C	G	T	A	C	C	—	—	—	—	—	A	C	A	A	A	T	A	C

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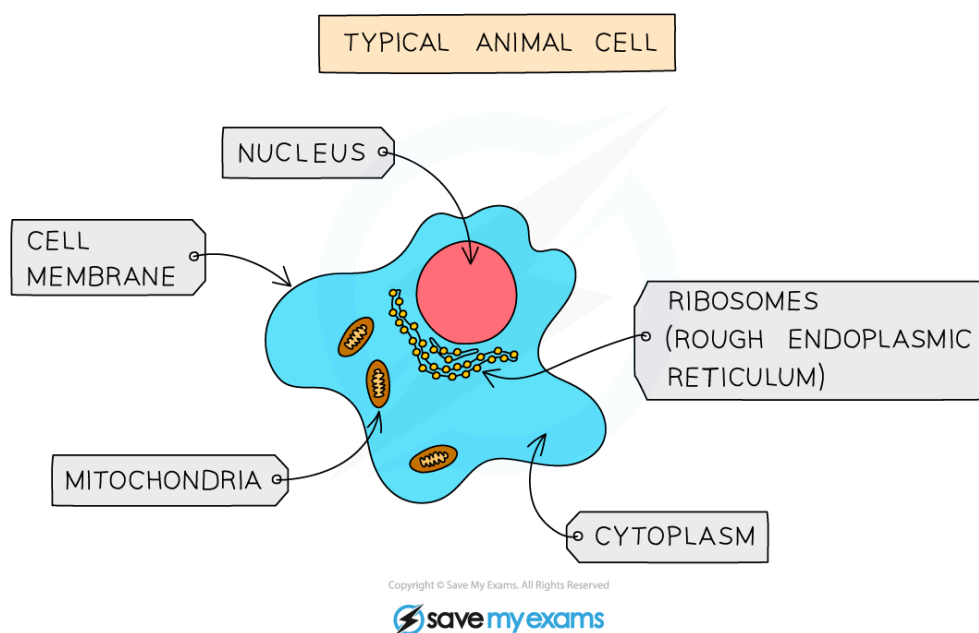
DNA sequences can show how closely related different species are

- The sequences above show that Brachinus armiger and Brachinus hirsutus are **more closely related** than any other species in the list as their DNA sequences are identical except for the last but one base (B.armiger has a T in that position whereas B.hirsutus has an A)
- As DNA base sequences are used to code for **amino acid sequences in proteins**, the similarities in amino acid sequences can also be used to determine how closely related organisms are



The Five Kingdoms

- The first division of living things in the classification system is to put them into one of **five kingdoms**. They are:
 - **Animals**
 - **Plants**
 - **Fungi**
 - **Protoctists**
 - **Prokaryotes**
- **Main features of all animals:**
 - they are multicellular
 - their cells contain a nucleus but no cell walls or chloroplasts
 - they feed on organic substances made by other living things



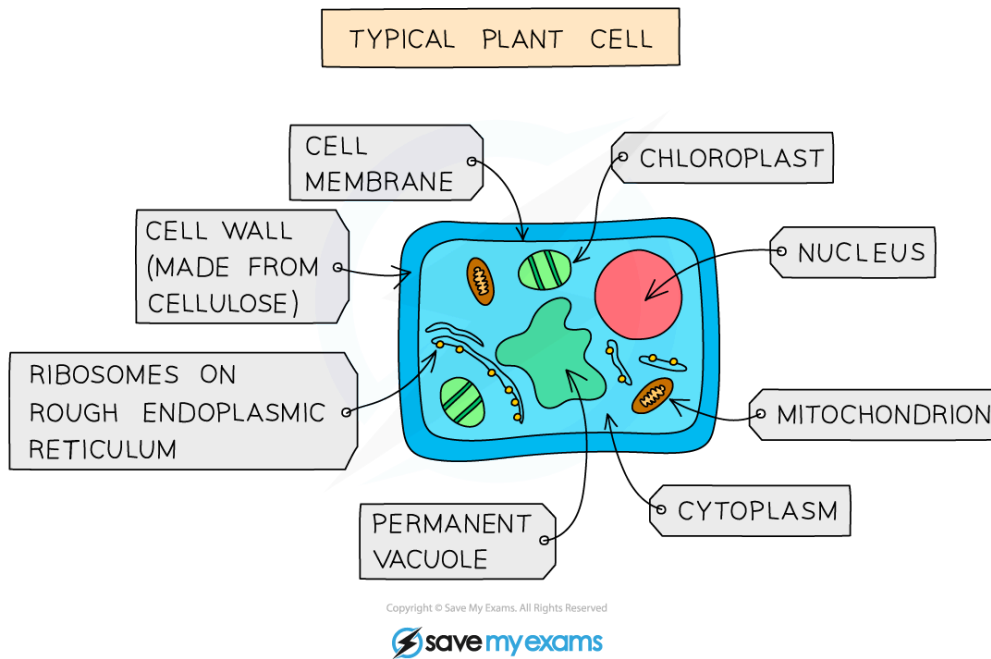
A typical animal cell

- **Main features of all plants:**
 - they are multicellular
 - their cells contain a nucleus, chloroplasts and cellulose cell walls

- they all feed by photosynthesis



Your notes



A typical plant cell

The Animal Kingdom

- Several main features are used to place organisms into groups within the animal kingdom

Vertebrates

- All vertebrates have a **backbone**
 - There are 5 classes of vertebrates

Vertebrate Table

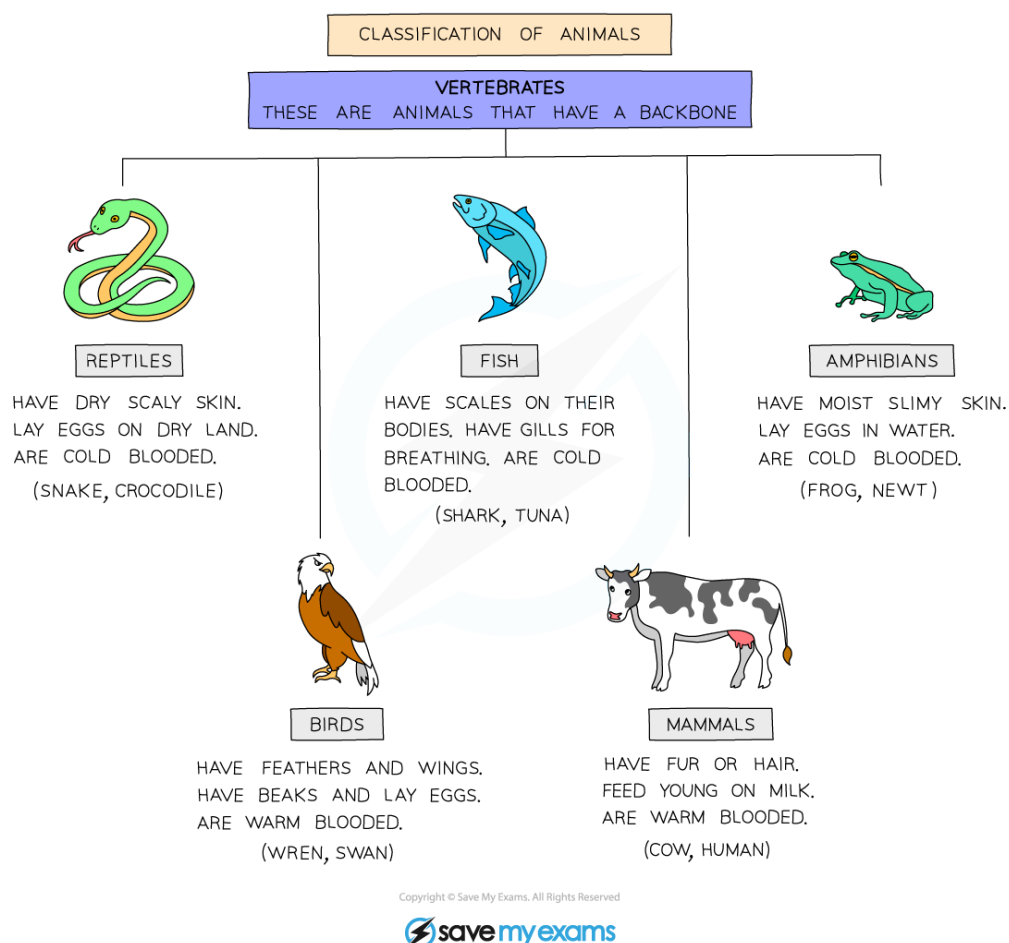


Your notes

CLASS	MAIN FEATURES	EXAMPLES
MAMMALS	<ul style="list-style-type: none">– FUR/HAIR ON SKIN– HAVE A PLACENTA– YOUNG FEED ON MILK FROM MAMMARY GLANDS– EXTERNAL EARS (PINNA) VISIBLE– ENDOTHERMIC	HORSE, DOG, SQUIRREL, HUMAN
BIRDS	<ul style="list-style-type: none">– SKIN COVERED IN FEATHERS– HAVE 2 LEGS AND 2 WINGS INSTEAD OF FORELIMBS– LAY EGGS WITH HARD SHELLS ON LAND– HAVE A BEAK– ENDOTHERMIC	PARROT, BLUE TIT, EAGLE
REPTILES	<ul style="list-style-type: none">– DRY, FIXED SCALES ON SKIN– LAY EGGS WITH RUBBERY SHELLS ON LAND	SNAKE, TURTLE, IGUANA
AMPHIBIANS	<ul style="list-style-type: none">– SMOOTH, MOIST SKIN– ADULTS USUALLY LIVE ON LAND (SO HAVE LUNGS), LARVAE LIVE IN WATER (SO HAVE GILLS)– LAY EGGS WITHOUT SHELLS IN WATER	FROG, TOAD, NEWT
FISH	<ul style="list-style-type: none">– LOOSE, WET SCALES ON SKIN– GILLS TO BREATHE– LAY EGGS WITHOUT SHELLS IN WATER	FLOUNDER, GROUPER



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Vertebrate classification

Invertebrates

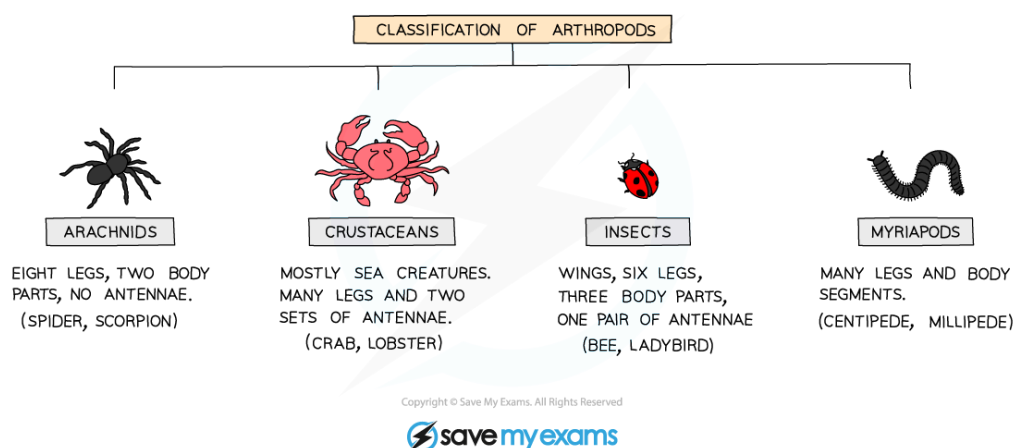
- Invertebrates do not possess a backbone
- One of the morphological characteristics used to classify invertebrates is **whether they have legs or not**
- All invertebrates with **jointed legs** are part of the **arthropod** phylum
- They are classified further into the following groups:

Arthropod groups table



Your notes

	MAIN FEATURES	EXAMPLES
MYRIAPODS	<ul style="list-style-type: none">– BODY CONSISTS OF MANY SEGMENTS– EACH SEGMENT CONTAINS AT LEAST 1 PAIR OF JOINTED LEGS– 1 PAIR OF ANTENNAE	CENTIPEDE
INSECTS	<ul style="list-style-type: none">– 3 PART BODY – HEAD, THORAX AND ABDOMEN– 3 PAIRS OF JOINTED LEGS– 2 PAIRS OF WINGS (1 OR BOTH PAIRS MAY BE VESTIGIAL – MEANING NON-FUNCTIONAL AND UNDEVELOPED)– 1 PAIR OF ANTENNAE	BUTTERFLY
ARACHNIDS	<ul style="list-style-type: none">– 2 PART BODY – CEPHALOTHORAX AND ABDOMEN– 4 PAIRS OF JOINTED LEGS– NO ANTENNAE	SPIDER
CRUSTACEANS	<ul style="list-style-type: none">– MORE THAN 4 PAIRS OF JOINTED LEGS– CHALKY EXOSKELETON FORMED FROM CALCIUM– BREATHE THROUGH GILLS– 2 PAIRS OF ANTENNAE	CRAB



Arthropod classification



Examiner Tips and Tricks

Make sure that you are aware of the distinction between the **main features** of a group of organisms and the **defining features** of a group:

- An exam question might ask you to state the *main* features of a group of organisms; these are given above, and some of these main features are **shared between the groups**, e.g. all of the vertebrates have a backbone, and all of the arthropods have segmented bodies

- It is also possible that an exam question might ask you to give a *defining* feature of one of these groups, i.e. a feature that **sets a group apart from the other groups**, e.g. mammals have fur while the other vertebrates do not, and crustaceans have 2 pairs of antennae while this is not the case for the other groups of arthropods



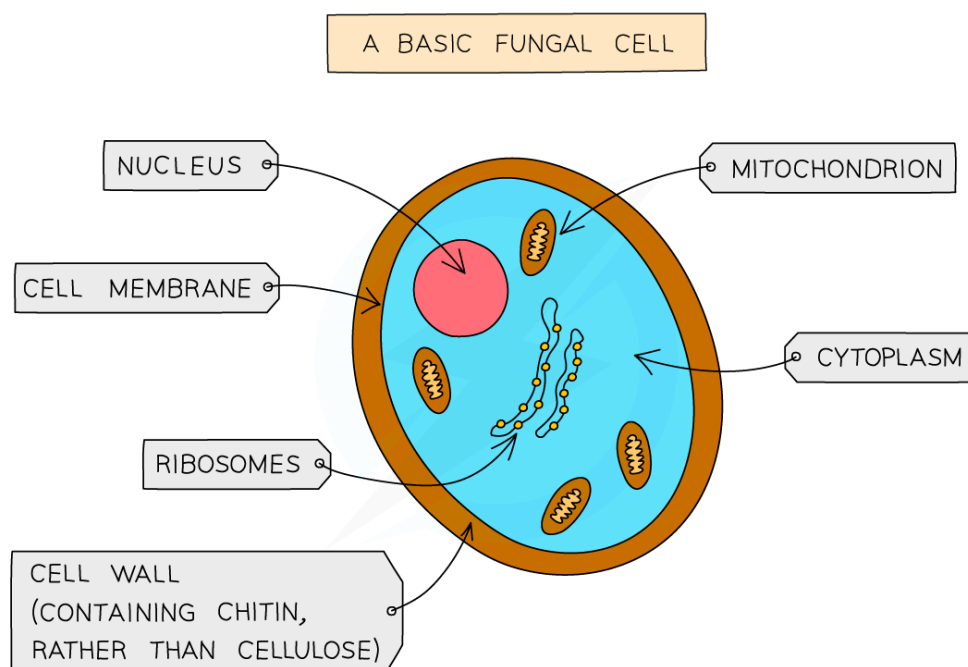
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The Five Kingdoms: Extended

Extended Tier Only

- The first division of living things in the classification system is to put them into one of **five kingdoms**
- They are:
 - Animals
 - Plants
 - Fungi
 - Protoctists
 - Prokaryotes
- **Main features of all fungi (e.g. moulds, mushrooms, yeast)**
 - usually **multicellular**
 - cells have **nuclei** and **cell walls** not made from cellulose
 - do not photosynthesize but **feed by saprophytic** (on dead or decaying material) or **parasitic** (on live material) **nutrition**



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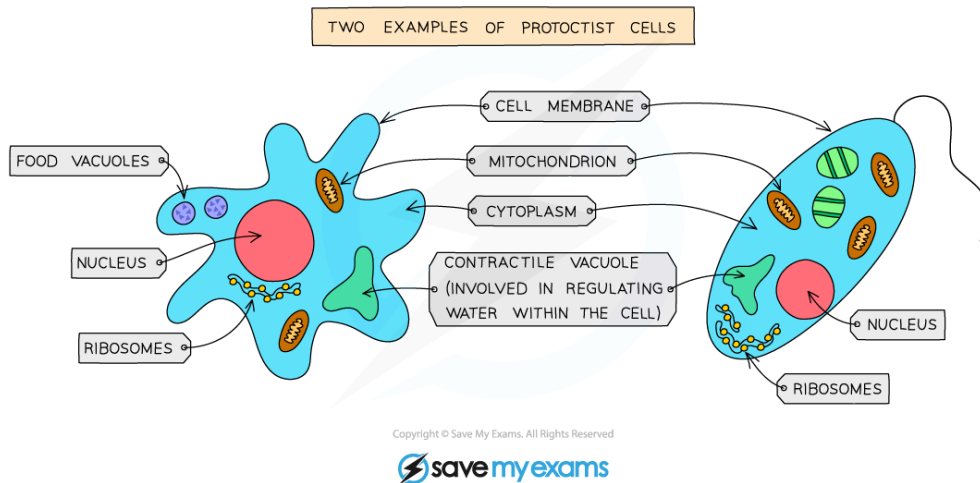
A typical fungal cell



Your notes

■ Main features of all Protoctists (e.g. Amoeba, Paramecium, Plasmodium)

- **most are unicellular** but some are multicellular
- all have a **nucleus**, some may have cell walls and chloroplasts
- meaning **some protoctists photosynthesise** and **some feed on organic substances** made by other living things



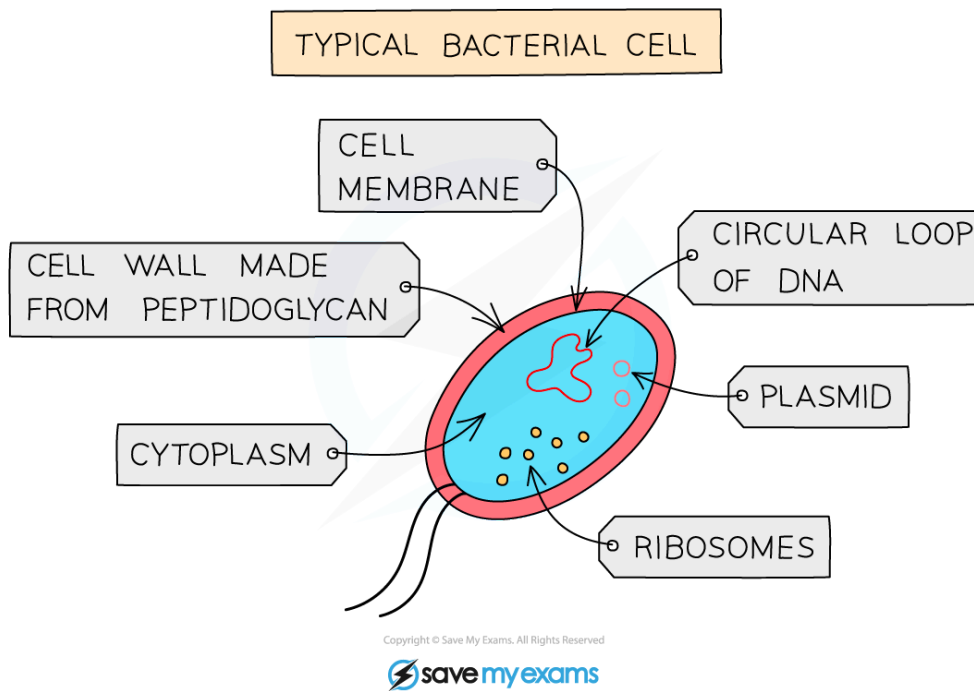
Two examples of protoctist cells

■ Main features of all Prokaryotes (bacteria, blue-green algae)

- often **unicellular**
- cells have **cell walls** (not made of cellulose) and **cytoplasm** but **no nucleus or mitochondria**



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A typical bacterial cell

The Plant Kingdom: Extended

Extended Tier Only

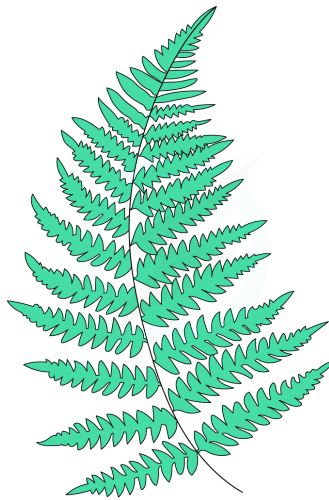
- At least some parts of any plant are green, caused by the presence of the pigment **chlorophyll** which absorbs energy from sunlight for the process of **photosynthesis**
- The plant kingdom includes organisms such as **ferns and flowering plants**

Ferns

- Have leaves called **fronds**
- Do not produce flowers but instead **reproduce by spores** produced on the underside of fronds

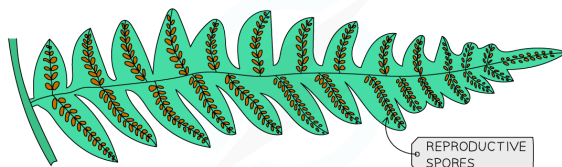


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Ferns



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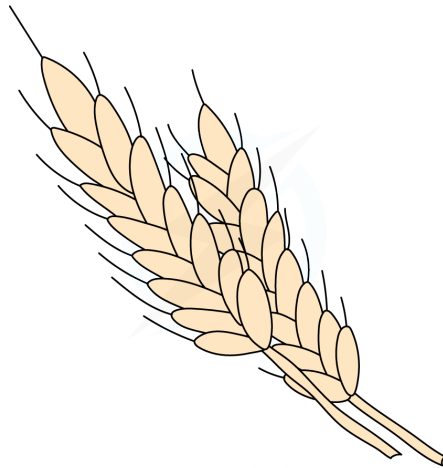
Ferns reproduce by spores found in the underside of their fronds

Flowering plants

- Reproduce sexually by means of **flowers and seeds**
- Seeds are produced inside the ovary found at the base of the flower
- Can be divided into two groups – **monocotyledons** and **dicotyledons**

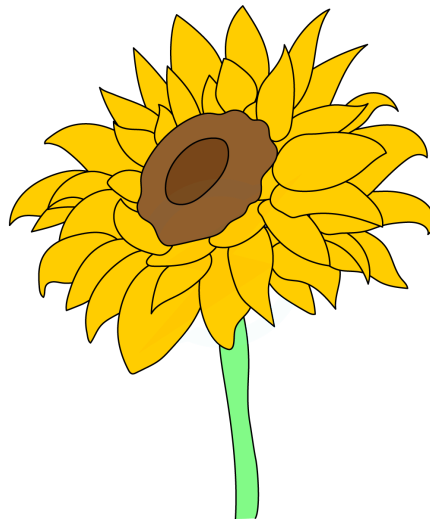


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Wheat plants are monocotyledons



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Sunflowers are dicotyledons

How do you distinguish between monocotyledons and dicotyledons?

■ Flowers

- Flowers from **monocotyledons** contain petals in **multiples of 3** while flowers from dicotyledons contain petals in **multiples of 4 or 5**

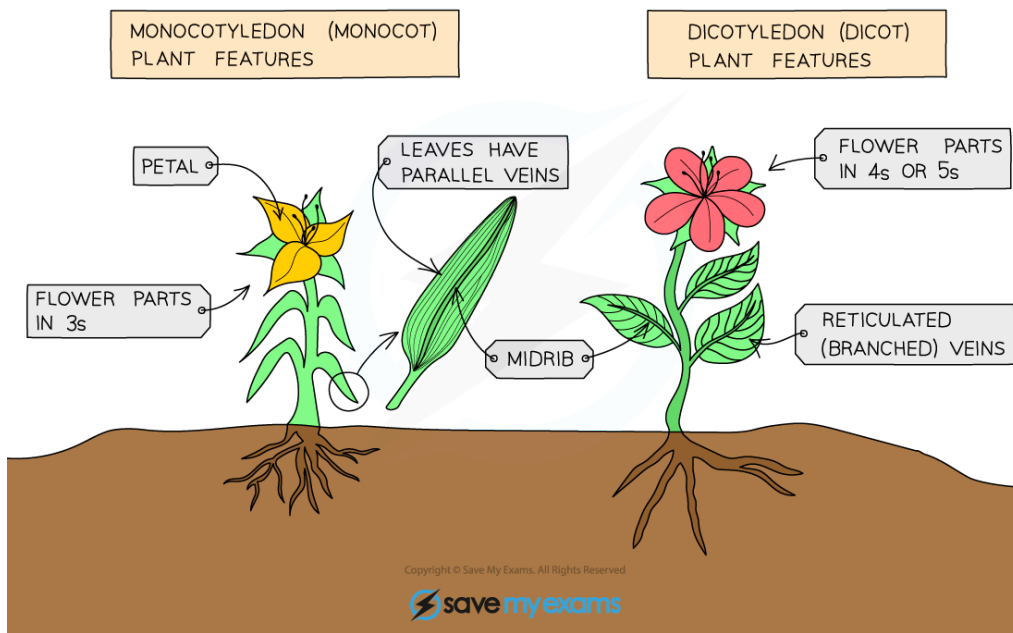
■ Leaves

- Leaves from monocotyledons have **parallel leaf veins** while leaves from dicotyledons have **reticulated leaf veins**
 - Reticulated = form a web-like network throughout the leaf

- Leaves from monocotyledons are **narrow** and grass-like while leaves from dicotyledons tend to have **broad** leaves that come in a wide range of shapes



Your notes



Comparing monocots and dicots



Examiner Tips and Tricks

Identification of monocotyledons and dicotyledons comes up fairly frequently in the multiple choice paper and so it is worth learning the two differences between their flowers and leaves.

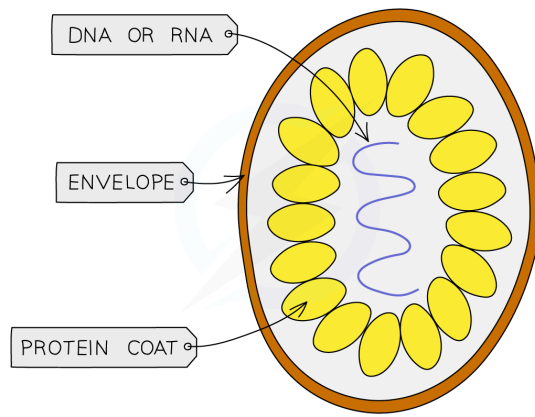
Viruses: Extended

Extended Tier Only

- Viruses are not part of any classification system as they are **not considered living things**
- They **do not carry out the seven life processes** for themselves, instead they **take over a host cell's metabolic pathways** in order to make multiple copies of themselves
- Virus structure is simply **genetic material** (RNA or DNA) inside a protein coat



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Structure of a typical virus