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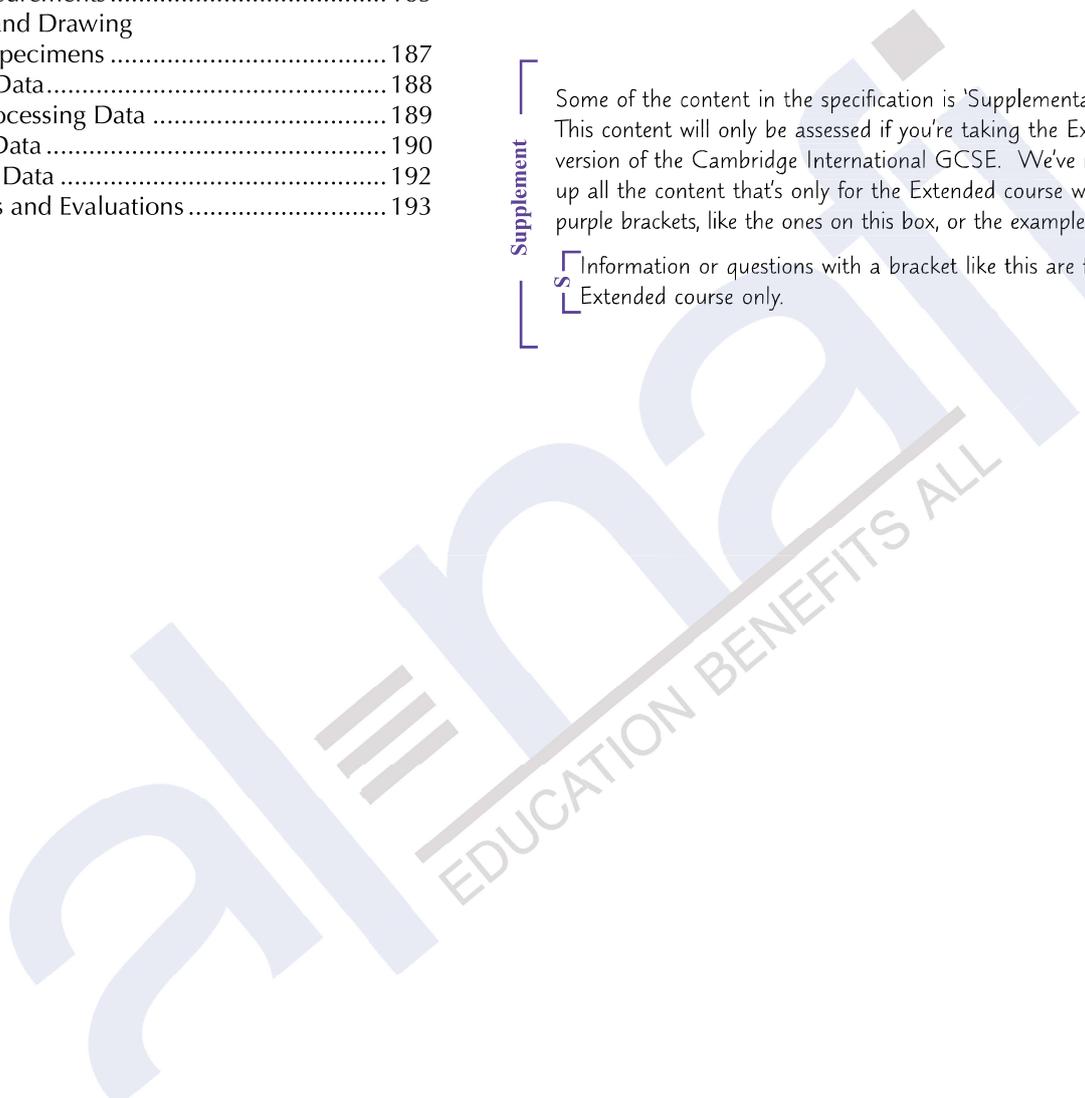
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Supplement

Some of the content in the specification is 'Supplemental'. This content will only be assessed if you're taking the Extended version of the Cambridge International GCSE. We've marked up all the content that's only for the Extended course with purple brackets, like the ones on this box, or the example below:

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Characteristics of Living Organisms

Welcome to the wonderful world of Biology. It's wonderful because it's all about **living organisms** — which includes you. And **all living organisms** share the same **seven basic characteristics**...

The Seven Basic Characteristics Are...

The table below shows the **seven characteristics** in the **left-hand** column, with their **definitions** in the **right-hand** column. You need to make sure you know them all:



Characteristic	Definition
Movement	An action by organisms or parts of organisms causing a change of place or position. 
Respiration	The chemical reactions that happen in cells to break down nutrient molecules and release energy for metabolism (see p.78).
Sensitivity	The ability of an organism to detect and respond to changes in the environment (see p.87).
Growth	A permanent increase in the size of an organism.
Reproduction	The processes that make more of the same kind of organism (see p.105). 
Excretion	The removal of the waste products of metabolism, toxic materials and substances that are in excess of what the organism needs (see p.83).
Nutrition	The taking in of materials for energy, growth and development. 

This could be to move towards things like **water** and **food**, or **away** from things like **predators** and **poisons**. Even plants can move a bit.

These changes are called **stimuli** and they can be **internal** or **external**.

An increase in **size** can be by an increase in **cell number**, **cell size**, or both. Growth can also be an increase in the **dry mass** of an organism.

Metabolism is the **chemical reactions** that happen in cells, including respiration.

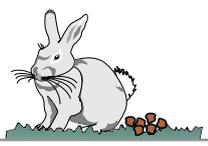
Plants and animals require slightly different materials. **Plants** need light, carbon dioxide, water and ions. **Animals** require ions and organic compounds, and usually need water.

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Remember “Mrs Gren”

It's important you learn all seven characteristics and their definitions. Use the first letter of each characteristic to help you remember them — they spell out “Mrs Gren”.

Classification

I hope you like **organising** things, because it's time to put millions of **organisms** into **groups**...

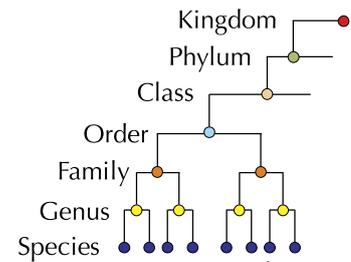
Classification is Organising Living Organisms into Groups

- 1) There are **millions** of **different organisms** living on Earth and they come in a **huge range** of **shapes** and **sizes** — from **small** and **simple** (like bacteria) to **large** and **complex** (like blue whales). They also have a **wide variety** of **physical features** — e.g. wings, beaks, claws, teeth, leaves, branches, etc.
- 2) All of these organisms can be **organised** into **groups**. For example:

- **Plants** can be divided into **two major groups** — **flowering plants** (e.g. daisies) and **non-flowering plants** (such as ferns and mosses).
- **Animals** can also be divided into two major groups — **invertebrates** (which lack a backbone, e.g. insects) and **vertebrates** (which have a backbone, e.g. mammals).

- 3) There are **different ways** of classifying organisms, e.g. they can be grouped based on the **features** that they share.
- 4) One way of classifying organisms is the **five kingdom system**. In this system, living things are first divided into five groups, called kingdoms:

- **Animals** — fish, mammals, reptiles, etc.
- **Plants** — grasses, trees, etc.
- **Fungi** — mushrooms and toadstools, yeasts, mould.
- **Prokaryotes** — **single-celled** organisms **without** a nucleus.
- **Protocists** — **eukaryotic single-celled** or **simple multicellular** organisms, e.g. algae.



- 5) These are then **subdivided** into smaller and **smaller** groups that have **common features**.
- 6) The **smallest group** in this system is called a **species**.



A **species** is a group of similar organisms that can reproduce to give fertile offspring.

Each Organism has its Own Two-Part Scientific Name in Latin

Organisms are named according to the **binomial system**.



The **binomial system** is an internationally agreed system to scientifically name organisms using their **genus** and **species**.

- 1) The **first** part of a binomial name refers to the **genus** that the organism belongs to. This gives you information on the organism's **ancestry**. The **second** part refers to the **species**. E.g. humans are known as *Homo sapiens*. '*Homo*' is the genus and '*sapiens*' is the species.
- 2) The binomial system is used **worldwide** and means that scientists in **different countries** or who speak **different languages** all refer to a particular species by the **same name** — avoiding potential confusion.

Classification

Here's some more information about **classification systems**, and a diagram of an **odd-looking tree**.

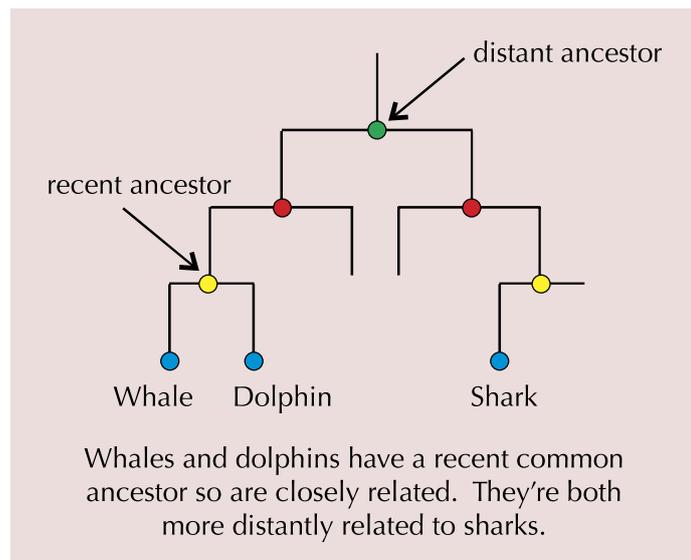
Classification Systems have Changed Over Time

- 1) Traditionally, organisms were **classified** according to similarities and differences in their **morphological** and **anatomical characteristics** (features of their **internal** and **external** structure).
- 2) As **technology improved**, this included things you can see with a **microscope**, e.g. **cell structure**.
- 3) These characteristics were used to classify organisms in the **five kingdom classification system**.
- 4) The **five kingdom** classification system is still used, but it's now a bit **out of date**.
- 5) This is because over time **technology** has developed further and our understanding of things like **biochemical processes** and **genetics** has increased.
- 6) For example, we are now able to determine the **sequence** (order) of **DNA bases** in different organisms' **genes** and **compare them** — the more **similar** the sequence of a gene, the more **closely related** the organisms.
- 7) Scientists are also able to compare **amino acid sequences** in **proteins** in a similar way. **DNA base** sequencing and **amino acid** sequencing are more **accurate** methods of **classification**.

There's more on DNA on pages 30 and 126.

Classification Systems Reflect Evolutionary Relationships

- 1) Evolutionary trees show how scientists think **different species** are **related** to each other.
- 2) They show **common ancestors** and relationships between species. The more **recent** the common ancestor, the more **closely related** the two species — and the more **characteristics** they're likely to share.
- 3) Scientists analyse lots of different types of **data** to work out evolutionary relationships. For **living** organisms, they use the **current classification data** (e.g. DNA analysis and structural similarities).
- 4) Organisms which share a more **recent ancestor** have more **similar DNA** base sequences than organisms that only share a distant ancestor.



Classification systems have been around for thousands of years

The more scientists find out about organisms, the more information they have to be able to classify them into different groups. New technology has made this even easier. Clever stuff.

Features of Organisms

As you saw on page 2, living organisms can be arranged into **groups** called kingdoms, according to the **features** they **have in common**. Two of the kingdoms are **plants** and **animals**.

Different Components Make Up Cells

- 1) **Cells** make up all **living** organisms. There are a few different **features** of cells, each with its own **role**. These features can be used to help **classify** organisms into different **kingdoms**. These are the cell features you need to know:

- **Cytoplasm** — contains smaller structures and is where reactions happen
- **Cell membrane** — holds the cell together, responsible for what comes in and out of the cell
- **DNA** — genetic material responsible for the proteins made within the cell

- **Ribosomes** — involved in protein synthesis
- **Enzymes** — involved in respiration

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- 2) There are **two** different types of cell. **Eukaryotic** cells have their genetic material in a structure called a **nucleus**. **Prokaryotic** cells do not have a nucleus — their genetic material is in the cytoplasm.

Learn the Features of Plants and Animals

Plant and animals are **eukaryotic** organisms — they are made up of eukaryotic cells. If you've ever wondered what **features** you share with a housefly, then this section is for you. Read on to find out more...

For more on the structure of plant and animal cells, see page 11.

Plants

- 1) Plants are **multicellular**.
- 2) They have **chloroplasts** (see p.11), which means they can **photosynthesise** and so produce their own **food** (see p.36).
- 3) Their cells have **cell walls** (see p.11), which are made of **cellulose**.
- 4) Plants **store carbohydrates** as **sucrose** or **starch**.
- 5) Plants can **reproduce sexually** or **asexually** (see p.105).



Animals

- 1) Animals are also **multicellular**.
- 2) They **don't have chloroplasts** and they **can't photosynthesise** — they have to eat **other organisms** to get food.
- 3) Their cells **don't have cell walls**.
- 4) Most have some kind of **nervous coordination** (see p.87). This means that they can respond rapidly to changes in their environment.
- 5) They can usually **move around** from one place to another.
- 6) They often **store carbohydrate** in the form of **glycogen**.
- 7) Most animals **reproduce sexually**.

