

Cells and levels of organisation

Revision notes · Levels of organisation, plant and animal cell structures and functions, cell differentiation and stem cells.

For Pearson Edexcel International GCSE Biology 4BI1 and Science (Double Award) 4SD0. **Biology only** is not in the Double Award and is only examined on Paper 2.

Cells and levels of organisation Spec 2.1-2.6B

Levels of organisation Spec 2.1

Living things are built up in levels. Each level is made from the one below it. The smallest level you need to know is the **organelle**.

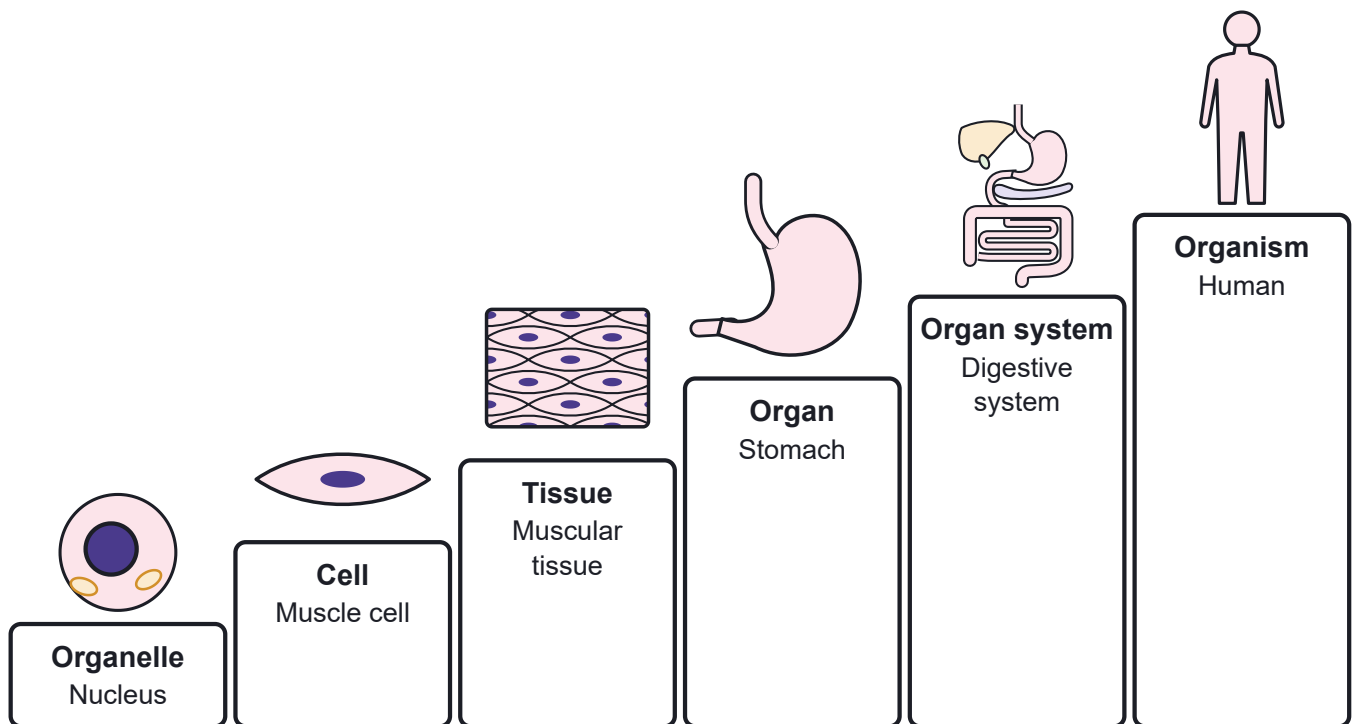
Organelle	A structure inside a cell that has a particular job, such as the nucleus or a mitochondrion.
Cell	The basic building block of all living organisms.
Tissue	A group of cells with a similar structure and function.
Organ	A group of different tissues that work together to perform a specific function.
Organ system	A group of organs that work together to carry out a major job in the body.

The stomach is a good example of an **organ**. It is made of several tissues that work together. Muscular tissue churns the food, glandular tissue makes digestive juices (enzymes and acid), and epithelial tissue covers the inside and outside surfaces.

The stomach is one of the organs in the **digestive system**. This is an **organ system**: several organs working together to digest and absorb food.

Levels of organisation		
Level	Animal example	Plant example
Organelle	A nucleus or a mitochondrion	A chloroplast
Cell	A muscle cell	A palisade mesophyll cell
Tissue	Muscular tissue	Palisade mesophyll
Organ	The stomach or the heart	A leaf
Organ system	The digestive system or the circulatory system	Roots, stem and leaves (transport system)
Organism	A human	A tree

Exam tip: An organ contains more than one tissue. To explain why something is an organ, say it is made of several tissues that work together to do a specific job.

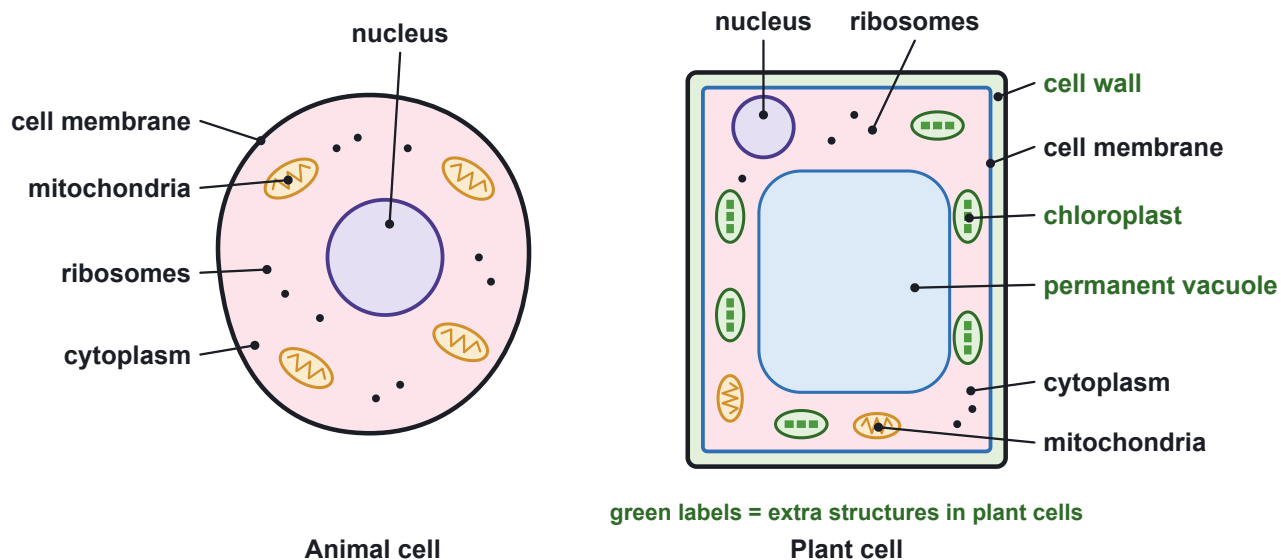


Levels of organisation: **organelle → cell → tissue → organ → organ system → organism**.

Animal and plant cell structure Spec 2.2, 2.3, 2.4

Most animal cells have a nucleus, cytoplasm, a cell membrane, mitochondria and ribosomes. Plant cells have all of these as well, and they often also have **chloroplasts**, a **vacuole** filled with cell sap and a **cell wall**.

Cell structures and their functions			
Structure	Function	Animal cell	Plant cell
Nucleus	Contains the genetic material (DNA) and controls the activities of the cell	Yes	Yes
Cytoplasm	Where most chemical reactions happen	Yes	Yes
Cell membrane	Controls the movement of substances into and out of the cell	Yes	Yes
Mitochondria	Where aerobic respiration takes place, releasing energy for the cell	Yes	Yes
Ribosomes	Where proteins are made (protein synthesis)	Yes	Yes
Cell wall	Made of cellulose; strengthens the cell and supports it	No	Yes
Chloroplasts	Contain chlorophyll, which absorbs light energy for photosynthesis	No	Yes (in cells exposed to light)
Vacuole	Filled with cell sap (a solution of sugars and salts); helps to keep the cell firm	No (or only small, temporary ones)	Yes (large, permanent)



Plant cells have the same structures as animal cells, plus a cell wall, chloroplasts and a large vacuole.

Similarities and differences

Comparing plant and animal cells		
	Animal cell	Plant cell
Similarities	Nucleus, cytoplasm, cell membrane, mitochondria, ribosomes	Nucleus, cytoplasm, cell membrane, mitochondria, ribosomes
Cell wall	Absent	Present, made of cellulose
Chloroplasts	Absent	Often present
Vacuole	Absent or small	Large vacuole with cell sap

Exam tip: When asked to explain how a structure is related to its function, name the structure, state what it does, then link that to the job of the cell. Chloroplasts absorb light for photosynthesis, so they are found in cells that make food.

Cell differentiation and specialised cells Spec 2.5B Biology only

Differentiation is the process by which a cell becomes specialised for a particular job. The cell gains the structures it needs to carry out its function. For example, a nerve cell has a long axon, and a root hair cell has a long projection that gives it a large surface area.

Differentiation is important in the development of specialised cells because a multicellular organism needs many different cell types doing different jobs. Specialised cells form tissues, which make up organs. Each type of **specialised cell** can then carry out its job efficiently.

Examples of specialised cells		
Cell	Special feature	How it helps
Root hair cell	Long projection from the cell	Large surface area for absorbing water and mineral ions
Nerve cell	Long axon	Carries electrical impulses over long distances
Red blood cell	No nucleus, and full of haemoglobin	No nucleus leaves more room for haemoglobin, which carries oxygen
Palisade mesophyll cell	Many chloroplasts	Absorbs a lot of light for photosynthesis

Exam tip: Link structure to function. 'The cell has become specialised' earns less than saying what structure it gained and what job that structure helps with.

Stem cells in medicine Spec 2.6B Biology only

Stem cells are cells that have not yet differentiated, so they can develop into different types of cell. They may be able to replace damaged or diseased cells. Possible uses include treating conditions such as diabetes and paralysis, and replacing damaged tissue.

Embryonic stem cells come from early embryos and can develop into almost any type of cell. **Adult stem cells**, for example from bone marrow, can develop into only a few types of cell.

Advantages and disadvantages of using stem cells in medicine	
Advantages	Disadvantages
Could treat conditions that are currently hard to treat, such as diabetes or paralysis.	Stem cells can divide out of control and form a tumour.
Could replace damaged cells with new healthy cells.	Viruses in donated stem cells could be passed to the patient and cause disease.
Could be used to grow replacement tissues.	The patient's immune system may reject cells from another person.
	Some people object to using embryos for ethical or religious reasons.

Exam tip: In a 'discuss' question, include at least one advantage and one disadvantage, and finish by weighing them up.

Quick check

- Put these in order, smallest first: organ, cell, organelle, tissue, organ system.
- What is the function of the mitochondria?
- Name three structures found in plant cells but not animal cells.
- Biology only What is differentiation?
- Biology only Give one disadvantage of using stem cells in medicine.

Quick check answers

Cells and levels of organisation

1. Organelle, cell, tissue, organ, organ system.
2. They are where aerobic respiration takes place, releasing energy for the cell.
3. Cell wall, chloroplasts and a large permanent vacuole.
4. The process by which a cell becomes specialised for a particular job.
5. They can divide out of control and form a tumour (or viruses could be passed on, or the immune system may reject them).