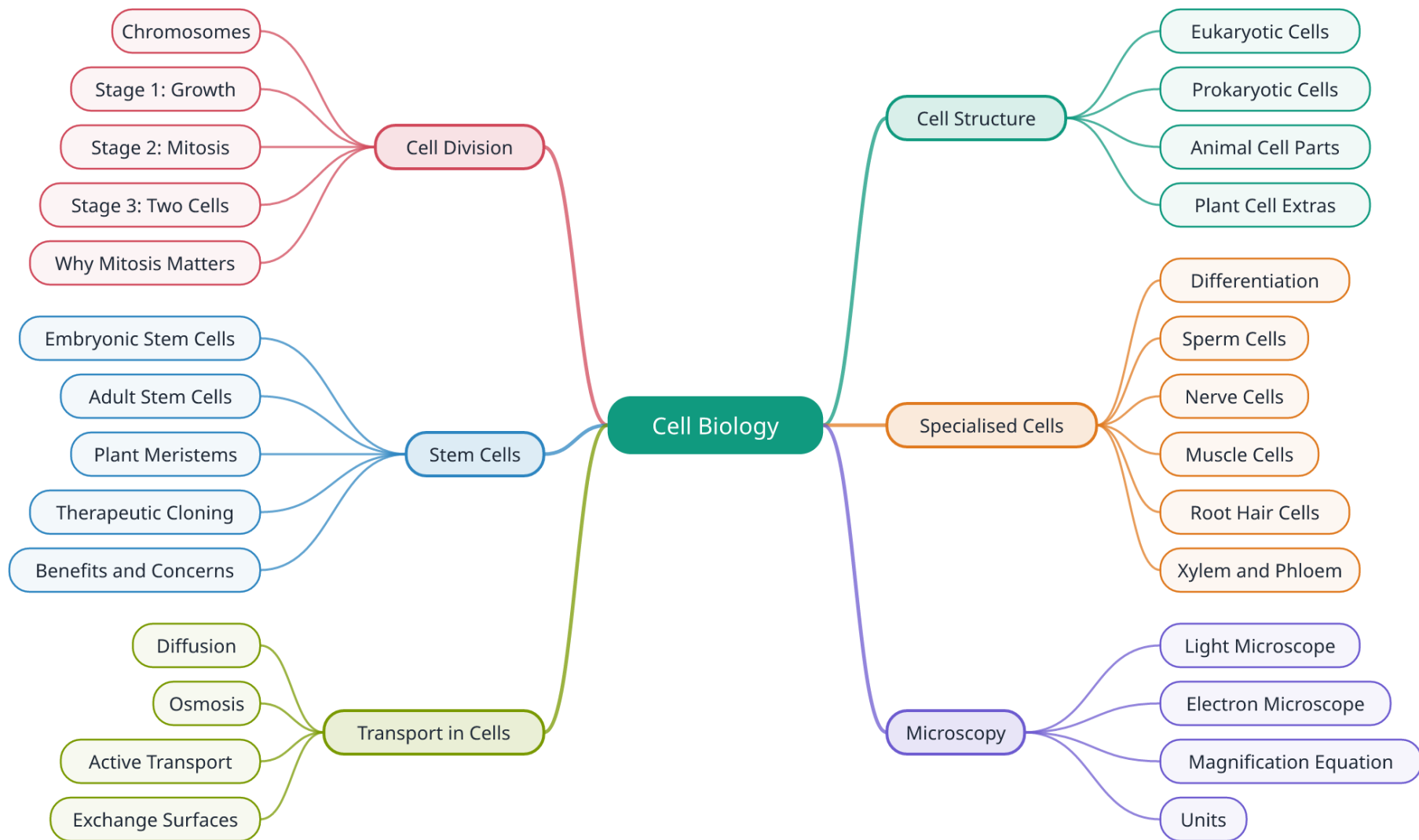


Cell Biology Mind Map (GCSE)

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Cell Biology mind map explained

Cell Structure

All living things are made of cells. The key split is between eukaryotic cells, which have a nucleus, and prokaryotic cells, which do not.

Eukaryotic Cells

Animal and plant cells. Their genetic material is enclosed in a nucleus.

Prokaryotic Cells

Bacterial cells. Much smaller than eukaryotic cells, with no nucleus. Their genetic material is a single loop of DNA, and they may also have small rings of DNA called plasmids. They have a cell wall, cell membrane and cytoplasm.

Animal Cell Parts

- Nucleus: contains genetic material and controls the cell's activities
- Cytoplasm: where most chemical reactions happen, controlled by enzymes
- Cell membrane: controls what enters and leaves the cell
- Mitochondria: where aerobic respiration happens
- Ribosomes: where proteins are made

Plant Cell Extras

Plant cells have everything an animal cell has, plus:

- Chloroplasts: absorb light for photosynthesis
- Permanent vacuole: filled with cell sap
- Cell wall: made of cellulose, strengthens the cell

Specialised Cells

Each specialised cell has structures that suit its job. Exam questions usually ask you to link a feature to its function.

Differentiation

As an organism develops, cells become specialised for a particular job. Most animal cells differentiate early in life, while many plant cells can differentiate throughout life.

Sperm Cells

A tail to swim, many mitochondria to release energy, and enzymes in the head to get into the egg.

Nerve Cells

Long, with branched connections, to carry electrical impulses around the body.

Muscle Cells

Can contract, and contain many mitochondria to release the energy needed.

Root Hair Cells

A large surface area to absorb water and mineral ions from the soil.

Xylem and Phloem

Xylem cells form hollow tubes, strengthened with lignin, that carry water and mineral ions. Phloem cells carry dissolved sugars, and have end walls called sieve plates.

Microscopy

Required practical: use a light microscope to observe, draw and label plant and animal cells, including a magnification scale.

Light Microscope

Uses light, is cheap, and can be used to view living cells, but has limited magnification and resolution.

Electron Microscope

Much higher magnification and resolution, so it shows sub-cellular structures such as ribosomes and the inside of mitochondria. It helped scientists understand cells in far more detail.

Magnification Equation

magnification = size of image / size of real object

Rearrange it to find the real size: real size = image size / magnification. For example, an image 10 mm wide at x100 magnification shows an object 0.1 mm (100 μm) wide.

Units

- 1 millimetre (mm) = 1000 micrometres (μm)
- 1 micrometre (μm) = 1000 nanometres (nm)

Cells are usually measured in micrometres. Convert both sizes to the same unit before using the equation.

Cell Division

Body cells divide by mitosis as part of the cell cycle, producing two genetically identical cells.

Chromosomes

Found in the nucleus, made of DNA, and each carries many genes. Body cells have chromosomes in pairs: human body cells have 23 pairs.

Stage 1: Growth

The cell grows, the number of sub-cellular structures such as ribosomes and mitochondria increases, and the DNA replicates so there are two copies of each chromosome.

Stage 2: Mitosis

One set of chromosomes is pulled to each end of the cell, and the nucleus divides.

Stage 3: Two Cells

The cytoplasm and cell membrane divide, forming two genetically identical cells.

Why Mitosis Matters

Mitosis is used for growth, for repair, and for asexual reproduction.

Stem Cells

A stem cell is an undifferentiated cell that can divide to make more cells like itself, or differentiate into other types of cell.

Embryonic Stem Cells

Can differentiate into almost any type of cell.

Adult Stem Cells

Found in places such as bone marrow. They can form many types of cell, including blood cells, but not as many as embryonic stem cells.

Plant Meristems

Tissue at the tips of roots and shoots that can differentiate into any type of plant cell throughout the plant's life. Used to clone rare plants, and crops with useful features such as disease resistance.

Therapeutic Cloning

An embryo is made with the same genes as the patient, so stem cells from it would not be rejected by the patient's body.

Benefits and Concerns

Stem cells may treat conditions such as diabetes and paralysis. Against that, there are ethical and religious objections to using embryos, and a risk of transferring viral infections.

Transport in Cells

Substances move into and out of cells by diffusion, osmosis and active transport. Learn each definition exactly: mark schemes look for the key words.

Diffusion

The net movement of particles from an area of higher concentration to an area of lower concentration. Examples: oxygen and carbon dioxide in gas exchange, and urea moving from cells into the blood. It is faster with a steeper concentration gradient, a higher temperature and a larger membrane surface area.

Osmosis

The diffusion of water from a dilute solution to a more concentrated solution through a partially permeable membrane.

Required practical: measure the change in mass of plant tissue, such as potato, in different concentrations of salt or sugar solution.

Active Transport

The movement of substances from a more dilute solution to a more concentrated solution, against the concentration gradient. It needs energy from respiration. Examples: root hair cells absorbing mineral ions from the soil, and sugar being absorbed from the gut into the blood.

Exchange Surfaces

Single-celled organisms have a large surface area to volume ratio, so diffusion is enough. Larger organisms need exchange surfaces adapted with a large surface area, a thin membrane, a good blood supply and, in animals, ventilation.

How to revise with this mind map

1. Learn definitions word for word. Diffusion, osmosis and active transport each have a definition with key words, such as "partially permeable membrane" or "against the concentration gradient", that mark schemes look for.
2. Practise the calculations. Use the magnification equation in all three arrangements, and practise converting between mm, μm and nm until it is automatic.
3. Know the practicals. AQA calls them required practicals and Edexcel calls them core practicals. For microscopy and osmosis, be ready to describe the method, name the variables, and explain the results.
4. Revise in pairs. Many questions ask for differences: eukaryotic and prokaryotic cells, light and electron microscopes, diffusion and active transport, embryonic and adult stem cells. Make a quick comparison for each pair from the map.
5. Make it yours. Build your own cell biology map in Mindmapi from your class notes, and ask the AI about any branch you are unsure of. The answer is saved into that branch's notes for next time.