AQA Biology A-level

2.1 - Cell structure

Flashcards

Define the terms eukaryotic and prokaryotic cell.

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Eukaryotic: DNA is contained in a nucleus, contains membrane-bound specialised organelles.

Prokaryotic: DNA is ‘free’ in cytoplasm, no organelles e.g. bacteria & archaea.

State the relationship between a system and specialised cells.

State the relationship between a system and specialised cells.

Specialised cells → tissues that perform specific function → organs made of several tissue types → organ systems

Describe the structure and function of the cell-surface membrane.

Describe the structure and function of the cell-surface membrane.

‘**Fluid mosaic**’ **phospholipid bilayer** with **extrinsic & intrinsic proteins** embedded

- Isolates cytoplasm from extracellular environment.
- Selectively permeable to regulate transport of substances.
- Involved in cell signalling / cell recognition.

Explain the role of cholesterol, glycoproteins & glycolipids in the cell-surface membrane.

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Cholesterol: steroid molecule connects phospholipids & reduces fluidity.

Glycoproteins: cell signalling, cell recognition (antigens) & binding cells together.

Glycolipids: cell signalling & cell recognition.

Describe the structure of the nucleus.

Describe the structure of the nucleus.

- Surrounded by **nuclear envelope**, a semi-permeable double membrane.
- **Nuclear pores** allow substances to enter/exit.
- Dense **nucleolus** made of RNA & proteins assembles ribosomes.

Describe the function of the nucleus.

Describe the function of the nucleus.

- Contains DNA coiled around chromatin into chromosomes.
- Controls cellular processes: gene expression determines specialisation & site of mRNA transcription, mitosis, semiconservative replication.

Describe the structure of a mitochondrion.

Describe the structure of a mitochondrion.

- Surrounded by double membrane folded inner membrane forms **cristae**: site of electron transport chain
- Fluid **matrix**: contains mitochondrial DNA, respiratory enzymes, lipids, proteins.

Describe the structure of a chloroplast.

Describe the structure of a chloroplast.

- Vesicular plastid with double membrane.
- **Thylakoids:** flattened discs stack to form **grana**; contain photosystems with chlorophyll.
- **Intergranal lamellae:** tubes attach thylakoids in adjacent grana.
- **Stroma:** fluid-filled matrix.

State the function of mitochondria and chloroplasts.

State the function of mitochondria and chloroplasts.

- **Mitochondria**: site of aerobic respiration to produce ATP.
- **Chloroplasts**: site of photosynthesis to convert solar energy to chemical energy.

Describe the structure and function of the Golgi apparatus.

Describe the structure and function of the Golgi apparatus.

Planar **stack of membrane-bound, flattened sacs**

cis face aligns with rER.

Molecules are processed in **cisternae**

vesicles bud off **trans face** via exocytosis:

- modifies & packages proteins for export
- synthesises glycoproteins

Describe the structure and function of a lysosome.

Describe the structure and function of a lysosome.

Sac surrounded by single membrane

embedded **H^+ pump** maintains acidic conditions

contains digestive **hydrolase enzymes**

glycoprotein coat protects cell interior:

- digests contents of phagosome
- exocytosis of digestive enzymes

Describe the structure and function of a ribosome.

Describe the structure and function of a ribosome.

Formed of **protein & rRNA**

free in cytoplasm or attached to ER.

- Site of protein synthesis via translation:

large subunit: joins amino acids

small subunit: contains mRNA binding site

Describe the structure and function of the endoplasmic reticulum (ER).

Describe the structure and function of the endoplasmic reticulum (ER).

Cisternae: network of tubules & flattened sacs extends from cell membrane through cytoplasm & connects to nuclear envelope:

- **Rough ER**: many ribosomes attached for protein synthesis & transport.
- **Smooth ER**: lipid synthesis.

Describe the structure of the cell wall.

Describe the structure of the cell wall.

- **Bacteria**:
  Made of the polysaccharide **murein.**
- **Plants**:
  Made of cellulose **microfibrils**
  plasmodesmata allow molecules to pass between cells, **middle lamella** acts as boundary between adjacent cell walls.

State the functions of the cell wall.

State the functions of the cell wall.

- Mechanical strength and support.
- Physical barrier against pathogens.
- Part of **apoplast pathway** (plants) to enable easy diffusion of water.

Describe the structure and function of the cell vacuole in plants.

Describe the structure and function of the cell vacuole in plants.

Surrounded by single membrane: **tonoplast**

contains **cell sap**: mineral ions, water, enzymes, soluble pigments.

- Controls turgor pressure.
- Absorbs and hydrolyses potentially harmful substances to detoxify cytoplasm.

Explain some common cell adaptations.

Explain some common cell adaptations.

- Folded membrane or microvilli increase surface area e.g. for diffusion.
- Many mitochondria = large amounts of ATP for active transport.
- Walls one cell thick to reduce distance of diffusion pathway.

State the role of plasmids in prokaryotes.

State the role of plasmids in prokaryotes.

- Small ring of DNA that carries non-essential genes.
- Can be exchanged between bacterial cells via conjugation.

State the role of flagella in prokaryotes.

State the role of flagella in prokaryotes.

Rotating tail propels (usually unicellular) organism.

State the role of the capsule in prokaryotes.

State the role of the capsule in prokaryotes

polysaccharide layer:

- Prevents desiccation.
- Acts as food reserve.
- Provides mechanical protection against phagocytosis & external chemicals.
- Sticks cells together.

Compare eukaryotic and prokaryotic cells.

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both have:

- Cell membrane.
- Cytoplasm.
- Ribosomes (don't count as an organelle since not membrane-bound).

Contrast eukaryotic and prokaryotic cells.

Contrast eukaryotic and prokaryotic cells.

Prokaryotic	Eukaryotic
small cells & always unicellular	larger cells & often multicellular
no membrane-bound organelles & no nucleus	always have organelles & nucleus
circular DNA not associated with proteins	linear chromosomes associated with histones
small ribosomes (70S)	larger ribosomes (80S)
binary fission - always asexual reproduction	mitosis & meiosis - sexual and/or asexual
cellulose cell wall (plants)/ chitin (fungi)	murein cell walls
capsule, sometimes plasmids & cytoskeleton	no capsule, no plasmids, always cytoskeleton

Why are viruses referred to as ‘particles’ instead of cells?

Why are viruses referred to as ‘particles’ instead of cells?

Acellular & non-living: no cytoplasm, cannot self-reproduce, no metabolism.

Describe the structure of a viral particle.

Describe the structure of a viral particle.

- **Linear genetic material** (DNA or RNA) & viral enzymes e.g. reverse transcriptase.
- Surrounded by **capsid** (protein coat made of capsomeres).
- No cytoplasm.

Describe the structure of an enveloped virus.

Describe the structure of an enveloped virus.

- Simple virus surrounded by **matrix protein.**
- Matrix protein surrounded by **envelope** derived from cell membrane of host cell.
- **Attachment proteins** on surface.

State the role of the capsid on viral particles.

State the role of the capsid on viral particles.

- Protect nucleic acid from degradation by restriction endonucleases.
- Surface sites enable viral particle to bind to & enter host cells or inject their genetic material.

State the role of attachment proteins on viral particles.

State the role of attachment proteins on viral particles.

Enable viral particle to bind to complementary sites on host cell : entry via endosymbiosis.

Describe how optical microscopes work.

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1. Lenses focus rays of light and magnify the view of a thin slice of specimen.
2. Different structures absorb different amounts and wavelengths of light.
3. Reflected light is transmitted to the observer via the objective lens and eyepiece.

Outline how a student could prepare a temporary mount of tissue for an optical microscope.

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1. Obtain thin section of tissue e.g. using ultratome or by maceration.
2. Place plant tissue in a drop of water.
3. **Stain** tissue on a slide to make structures visible.
4. Add **coverslip** using **mounted needle** at 45° to avoid trapping air bubbles.

Suggest the advantages and limitations of using an optical microscope.

Suggest the advantages and limitations of using an optical microscope.

+ colour image
+ can show living structures
+ affordable apparatus
- 2D image
- lower resolution than electron microscopes = cannot see ultrastructure

Describe how a transmission electron microscope (TEM) works.

Describe how a transmission electron microscope (TEM) works.

1. Pass a high energy **beam of electrons** through thin slice of specimen.
2. More dense structures appear darker since they absorb more electrons.
3. Focus image onto fluorescent screen or photographic plate using magnetic lenses.

Suggest the advantages and limitations of using a TEM.

Suggest the advantages and limitations of using a TEM.

+ electrons have shorter wavelength than light = high resolution, so ultrastructure visible
+ high magnification (x 500000)
- 2D image
- requires a vacuum = cannot show living structures
- extensive preparation may introduce artefacts
- no colour image

Describe how a scanning electron microscope (SEM) works.

Describe how a scanning electron microscope (SEM) works.

1. Focus a beam of electrons onto a specimen's surface using electromagnetic lenses.
2. Reflected electrons hit a collecting device and are amplified to produce an image on a photographic plate.

Suggest the advantages and limitations of using an SEM.

Suggest the advantages and limitations of using an SEM.

+ 3D image
+ electrons have shorter wavelength than light = high resolution
- requires a vacuum = cannot show living structures
- no colour image
- only shows outer surface

Define magnification and resolution.

Define magnification and resolution.

Magnification: factor by which the image is larger than the actual specimen.

Resolution: smallest separation distance at which 2 separate structures can be distinguished from one another.

Explain how to use an eyepiece graticule and stage micrometer to measure the size of a structure.

Explain how to use an eyepiece graticule and stage micrometer to measure the size of a structure.

1. Place micrometer on stage to calibrate eyepiece graticule.
2. Line up scales on graticule and micrometer. Count how many graticule divisions are in 100μm on the micrometer.
3. Length of 1 eyepiece division = 100μm / number of divisions
4. Use calibrated values to calculate actual length of structures.

State an equation to calculate the actual size of a structure from microscopy.

State an equation to calculate the actual size of a structure from microscopy.

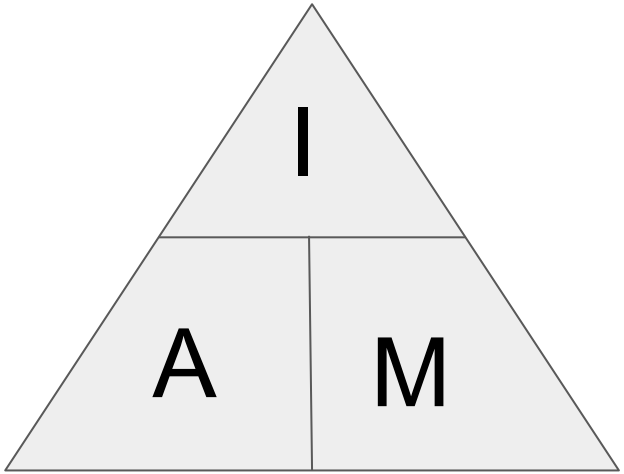
actual size

=

image size

/

magnification



Outline what happens during cell fractionation and ultracentrifugation.

Outline what happens during cell fractionation and ultracentrifugation.

1. Mince and **homogenize** tissue to break open cells & release organelles.
2. Filter homogenate to remove debris.
3. Perform **differential centrifugation**:

a) Spin homogenate in centrifuge.

b) The most dense organelles in the mixture form a **pellet**.

c) Filter off the **supernatant** and spin again at a higher speed.

State the order of sedimentation of organelles during differential centrifugation.

State the order of sedimentation of organelles during differential centrifugation.

most dense → least dense

nucleus → mitochondria → lysosomes → RER → plasma membrane → SER → ribosomes

Explain why fractionated cells are kept in a cold, buffered, isotonic solution.

Explain why fractionated cells are kept in a cold, buffered, isotonic solution.

cold: slow action of hydrolase enzymes.

buffered: maintain constant pH.

isotonic: prevent osmotic lysis/ shrinking of organelles.