AQA Biology A-level

2.3 - Transport across membranes

Flashcards

Describe the fluid mosaic model of membranes.

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Fluid: phospholipid bilayer in which individual phospholipids can move = membrane has flexible shape.

Mosaic: extrinsic & intrinsic proteins of different sizes and shapes are embedded.

Explain the role of cholesterol & glycolipids in membranes.

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- **Cholesterol**: steroid molecule in some plasma membranes; connects phospholipids & reduces fluidity to make bilayer more stable.
- **Glycolipids**: cell signalling & cell recognition.

Explain the functions of extrinsic and transmembrane proteins in membranes.

Explain the functions of extrinsic and intrinsic proteins in membranes.

extrinsic:

- binding sites/ receptors e.g. for hormones
- antigens (glycoproteins)
- bind cells together
- involved in cell signalling

intrinsic:

- electron carriers (respiration/photosynthesis)
- channel proteins (facilitated diffusion)
- carrier proteins (facilitated diffusion/ active transport)

Explain the functions of membranes within cells.

Explain the functions of membranes within cells.

- Provide internal transport system.
- Selectively permeable to regulate passage of molecules into / out of organelles.
- Provide reaction surface.
- Isolate organelles from cytoplasm for specific metabolic reactions.

Explain the functions of the cell-surface membrane.

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

Name and explain 3 factors that affect membrane permeability.

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- **Temperature**: high temperature denatures membrane proteins / phospholipid molecules have more kinetic energy & move further apart.
- **pH**: changes tertiary structure of membrane proteins.
- Use of a **solvent**: may dissolve membrane.

Outline how colorimetry could be used to investigate membrane permeability.

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1. Use plant tissue with soluble pigment in vacuole. Tonoplast & cell-surface membrane disrupted = ↑ permeability = pigment diffuses into solution.
2. Select colorimeter filter with complementary colour.
3. Use distilled water to set colorimeter to 0. Measure absorbance/ % transmission value of solution.
4. high absorbance/ low transmission = more pigment in solution.

Define osmosis.

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Water diffuses across **semi-permeable membranes** from an area of higher **water potential** to an area of lower water potential until a dynamic equilibrium is established.

What is water potential (ψ)?

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- pressure created by water molecules measured in kPa
- Ψ of pure water at 25℃ & 100 kPa: 0
- more solute = ψ more negative

How does osmosis affect plant and animal cells?

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- osmosis **INTO cell**:

plant: protoplast swells = cell turgid

animal: lysis

- osmosis **OUT of cell**:

plant: protoplast shrinks = cell flaccid

animal: crenation

Suggest how a student could produce a desired concentration of solution from a stock solution.

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- volume of stock solution = required concentration x final volume needed / concentration of stock solution.
- volume of distilled water = final volume needed - volume of stock solution.

Define simple diffusion.

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- **Passive process** requires no energy from ATP hydrolysis.
- **Net movement** of **small, lipid-soluble** molecules directly through the bilayer from an area of high concentration to an area of lower concentration (i.e. **down a concentration gradient**).

Define facilitated diffusion.

Define facilitated diffusion.

Passive process

Specific **channel or carrier proteins** with complementary binding sites transport **large and/ or polar molecules/ ions** (not soluble in hydrophobic phospholipid tail) **down concentration gradient**

Explain how channel and carrier proteins work.

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Channel: hydrophilic channels bind to specific ions = one side of the protein closes & the other opens

Carrier: binds to complementary molecule = conformational change releases molecule on other side of membrane; in facilitated diffusion, passive process; in active transport, requires energy from ATP hydrolysis

Name 5 factors that affect the rate of diffusion.

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- Temperature
- Diffusion distance
- Surface area
- Size of molecule
- Difference in concentration (how steep the concentration gradient is)

State Fick's law.

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surface area x difference in concentration / diffusion distance

How are cells adapted to maximise the rate of transport across their membranes?

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- many carrier/ channel proteins
- folded membrane increases surface area

Explain the difference between the shape of a graph of concentration (x-axis) against rate (y-axis) for simple vs facilitated diffusion.

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Simple diffusion: straight diagonal line; rate of diffusion increases proportionally as concentration increases.

Facilitated diffusion: straight diagonal line later levels off when all channel/ carrier proteins are saturated.

Define active transport.

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Active process: ATP hydrolysis releases phosphate group that binds to carrier protein, causing it to change shape.

Specific carrier protein transports molecules/ ions from area of low concentration to area of higher concentration (i.e. **against concentration gradient**).

Compare and contrast active transport and facilitated diffusion.

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- Both may involve carrier proteins.
- Active transport requires energy from ATP hydrolysis; facilitated diffusion is a passive process.
- Facilitated diffusion may also involve channel proteins.

Define co-transport.

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Movement of a substance **against** its concentration gradient is **coupled** with the movement of another substance **down** its concentration/ electrochemical gradient.

Substances bind to complementary intrinsic protein:
symport: transports substances in same direction
antiport: transports substances in opposite direction e.g. sodium-potassium pump.

Explain how co-transport is involved in the absorption of glucose / amino acids in the small intestine.

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1. Na^+ actively transported out of epithelial cells & into bloodstream.
2. Na^+ concentration lower in epithelial cells than lumen of gut.
3. Transport of glucose/ amino acids from lumen to epithelial cells is 'coupled' to facilitated diffusion of Na^+ down electrochemical gradient.