

AQA Biology A-Level

Required Practical 4

Investigation into the effect of a named variable on the permeability of cell-surface membranes.



Cell-surface membranes are made up of a **phospholipid bilayer** which makes them **selectively permeable**. This permeability can be changed by different variables, such as **temperature** and **concentration of solvents**, like ethanol.

The permeability of a membrane can be measured by using beetroot cells, which contain a purple **pigment** called **betalain**. When the cell-surface membrane has a higher permeability, more pigment leaks out of cells. The permeability can therefore be measured by the **amount of pigment leaked** from beetroot cells into an aqueous solution using a **colorimeter**.

Equipment list

- Beetroot
- Scalpel
- Forceps
- Cutting board
- Ruler
- Tongs
- Distilled water
- Boiling tubes
- Boiling tube rack
- Colorimeter
- Cuvettes
- Filter paper
- Timer
- Water bath
- Thermometer
- Ethanol

Method

1. Cut beetroot into 6-10 **identical cubes** using a scalpel.
2. Wipe/rinse to **clean off any pigment** released as a result.
3. **If investigating temperature**: place each of the cubes of beetroot in an equal volume of distilled water (**5-15ml**).
4. Place each test tube in a **water bath** at a **range of temperatures** (30-80°C).



5. **If investigating concentration of solvents:** create a **dilution series** of ethanol using distilled water. Ethanol concentrations should range from **0-100%** ethanol.
6. Leave the samples for **20 minutes** - the pigment will leak out of the beetroot.
7. Set the colorimeter to a **blue filter** and **zero** using a cuvette with **distilled water**.
8. **Filter** each sample into a cuvette using **filter paper**.
9. Measure the **absorbance** for each solution. A **higher absorbance** indicates **higher pigment concentration**, and hence a **more permeable membrane**.

Risk Assessment

Hazard	Risk	Safety Precaution	In emergency	Risk Level
Scalpel	Cuts from sharp object	Cut away from fingers; use forceps to hold sample whilst cutting, keep scalpel away from the edge of the desk	Elevate cuts; apply pressure; seek medical assistance	Low
Broken glass	Cuts from sharp object	Take care when handling glassware; keep away from edge of desk	Elevate cuts; apply pressure; do not remove glass from wound; seek medical assistance	Low
Ethanol	Irritant/flammable	Wear eye protection; keep away from naked flames	Wash eyes and skin with cold water	Low
Hot liquids	Scalding	Handle with care; use tongs to remove boiling tubes from water bath; wear eye protection, keep away from the edge of the desk	Run burn under cold water; seek medical assistance	Low





Graph

- Plot a graph of **absorbance against ethanol concentration/temperature**.

Conclusion

Temperature

- As the temperature increases, the permeability of the cell-surface membrane also **increases**. This is because the proteins in the membrane **denature** as the **heat damages the bonds** in their **tertiary structure**. This **creates gaps** in the membrane, so it is easier for molecules to pass through it.
- At low temperatures, phospholipids have **little energy** and are **packed closely together** to make the membrane **rigid**. This causes a **decrease** in permeability and restricts molecules from crossing the membrane.

NB: At **very low** temperatures, **ice crystals** can form which **pierce the cell membrane** and **increase** the permeability.

Concentration of ethanol

- Ethanol causes the cell-surface membrane to **rupture**, releasing the betalain pigment from the cell. **Higher concentrations** of ethanol will cause **more disruption** to the membrane and **more gaps will form**. Thus, as concentration of ethanol **increases**, the permeability of the cell-surface membrane also **increases**.

