# Edexcel A Biology A-Level

## Core Practical 3

Investigate membrane structure, including the effect of alcohol concentration or temperature on membrane permeability.

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

- Water baths
- Thermometer
- Distilled water
- Syringe
- Beetroot
- Cork borer
- White tile
- Knife
- Syringe
- Pipette
- Test tubes
- Colorimeter
- Cuvettes
- Forceps

## Method

1. Cut beetroot into 8 **identical cylinders** using a cork borer and wipe/rinse to **clean off any pigment** released as a result.
1. Place each of the cylinders of beetroot in 10 ml of distilled water. Place each test tube in a **water bath** at a **range of temperatures** between 0 and 70°C.
2. Leave the samples for **15 minutes**- pigment will leak out of the beetroot.
3. Record the exact temperature of the **water bath** using the thermometer.
4. Remove the test tubes from the water baths and remove the cylinders of beetroot from them. Decant the liquid into clean test tubes.
5. Set the colorimeter to a **blue filter** and **zero** using a cuvette with **distilled water**. Filter each sample into a cuvette using **filter paper**.

6. 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 away from edge of 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 |
| Hot liquids | Scalding | Handle with care; use tongs to remove boiling tubes from water bath; wear eye protection, keep away from edge of desk | Run burn under cold water; seek medical assistance | Low |
| Ethanol | Irritant/ flammable | Wear eye protection; keep away from naked flames | Wash eyes and skin with cold water | Low |

## Graph

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

## Conclusion

- 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.

## Modification

The method can be modified to investigate the effect of **ethanol** on membrane permeability by having concentration of ethanol as the independent variable. 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, so does the permeability of the cell-surface membrane.