

Edexcel IAL Biology A Level

Core Practical 3

Investigate membrane properties including the effect of alcohol and temperature on membrane permeability.



Beetroot can be used to investigate the **permeability** of cell membranes, since when its cell membranes are damaged a **coloured pigment**, that gives beetroot its purple colour, **leaks out**. The higher the permeability of the membrane, the more pigment is released outside of cells. The permeability of cell membranes is affected by a number of factors including **temperature, alcohol and solvent concentration**.

Independent variable: Temperature or alcohol concentration

Dependent variable: Absorbance reading of liquid

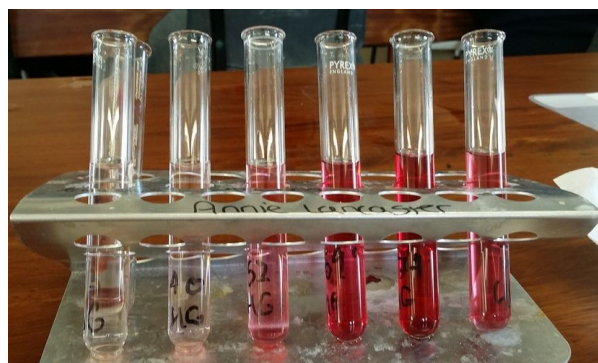
Equipment list

- Beetroot
- Scalpel
- 4 test tubes
- Colorimeter
- Cuvettes
- Stopwatch
- Water baths
- Pipette

Method

The following method describes how to investigate how cell membrane permeability changes with temperature; the effect of alcohol can also be investigated by placing the beetroot cubes in solutions containing **differing concentrations of ethanol** instead, and then following the same colorimetry technique.

1. Use the scalpel to cut 4 equal pieces of beetroot from the same beetroot and **rinse each piece with water** to remove any pigment already released from the cutting.
2. Use a pipette to fill 4 test tubes with 5 cm³ of water and place a cube of beetroot in each test tube.
3. Place each of the test tubes in a **water bath** at the following temperatures - 0°C, 20°C, 40°C, and 60°C. Remove the test tubes from the water baths after **exactly 5 minutes** and remove the beetroot pieces **leaving only the coloured liquid**.
4. Set up a colorimeter by giving it 5 minutes to **stabilise** and by first measuring its absorbance with **pure water in a cuvette**. Then use a pipette to fill a cuvette with liquid from each of the 4 test tubes to measure and **record their absorbance with the colorimeter**.
5. Plot a graph of temperature against absorbance.



Risk assessment

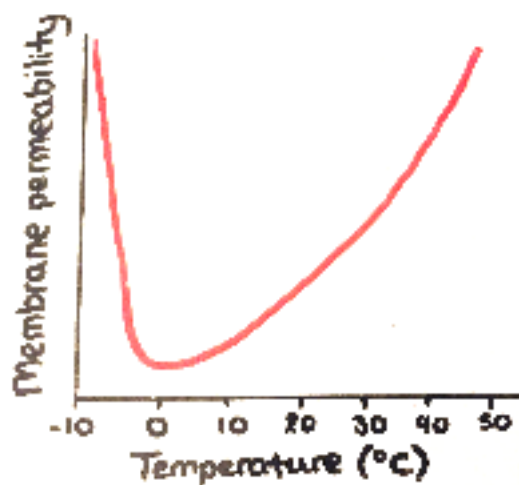
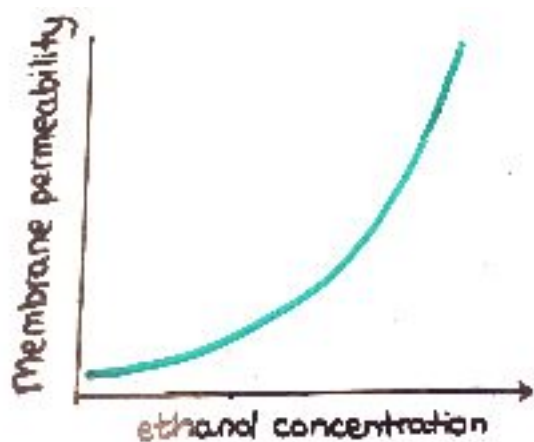
Hazard	Risk	Precaution
Broken glass	Cuts from sharp object	Take care when handling glass objects Keep away from edge of desk
Ethanol	Highly flammable and volatile	Keep away from naked flames and extreme heat Put the lid on once used Keep away from edge of desk

Results table

Temperature (°C)	Colorimeter absorbance
0	
20	
40	
60	

Alcohol concentration (mol/dm ³)	Colorimeter absorbance

Graph



Conclusion

Temperature

- Below 0 °C - **Ice crystals** form in the membrane, **piercing it** and allowing molecules including beetroot pigment to leak out.
- 0°C - 40°C - As temperature increases the **phospholipids** in the membrane **gain kinetic energy** and **move more**, increasing the permeability.
- Over 40°C - **Proteins** in the membrane **deform at high temperatures** meaning they cannot control what goes in and out of the cell - increase membrane permeability. Furthermore, the **phospholipids** start to **melt** and **expanding water inside the cell** puts **increasing pressure** on the membrane.

Alcohol

Both **ethanol** and the **phospholipid bilayer** that makes up the cell membrane are **non-polar**. This means the **lipids dissolve in solutions containing ethanol**, thus disrupting the membrane. The higher the concentration of lipids the more the membrane will be disrupted allowing more pigment to leak out.

