Passive transport through cellulose tubing: starch molecules and chloride ions

Student worksheet

Principle

Cellulose tubing is a partially permeable membrane. It may be used to model passive transport through cell membranes. Passive diffusion through membranes is driven by concentration differences and does not require an input of energy.

In this activity you will compare the passive transport of starch molecules and chloride ions through a cellulose membrane.

Equipment and materials

- 15 cm length of cellulose tubing knotted at one end
- Sawn-off plastic syringe barrel to support the cellulose tubing (Figure 1)
- Boiling tube
- 2 x 10 cm^3 measuring cylinders
- Elastic band
- 0.01 mol dm^{-3} iodine solution, in a dropper bottle
- 0.01 mol dm^{-3} silver nitrate solution, in a dropper bottle
- Starch suspension
- Sodium chloride solution
- 2 x teat pipettes
- White spotting tile
- 4 x test tubes
- 100 cm^3 beaker

Method

Care. At the concentrations used all solutions are low hazards. However, silver nitrate is corrosive so goggles should be worn for preparation. Iodine solution may stain skin or clothing

1. If it has not been done for you, tie a knot in the end of the cellulose tubing. Soak the tubing in water and use an elastic band to fasten it to the sawn-off syringe barrel (Figure 1).
2. Set up a boiling tube, four test tubes in a rack, a spotting tile, with dropper bottles of iodine solution and silver nitrate solution.
3. Use measuring cylinders to put 5 cm^3 of starch suspension and 5 cm^3 of sodium chloride solution into the cellulose tubing. Rinse the outside of the cellulose tubing under the tap then suspend it in the boiling tube. Make sure there is room to put a teat pipette in the water surrounding the tubing.

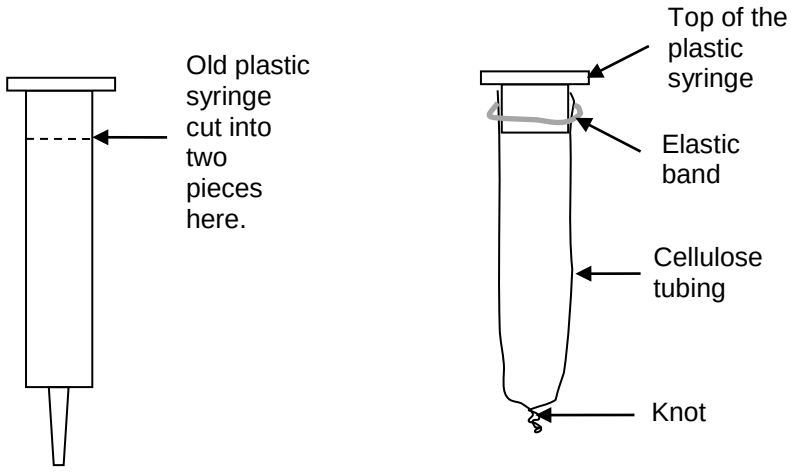

Figure 1 Preparing the cellulose tubing for diffusion experiments.

4. Use a teat pipette to remove about 1 cm^3 of the cellulose tubing contents. Put one drop on the spotting tile, and the rest in a test tube. Then put the teat pipette back into the cellulose tubing.
5. Use a second teat pipette to put water into the boiling tube until its level is the same as the cellulose tubing contents.
6. Start a stopclock and immediately use the second teat pipette to remove about 1 cm^3 of the water surrounding the tubing. Put one drop on the spotting tile, and the rest in a test tube. Then put the teat pipette back in the water outside the cellulose tubing.
7. Add one drop of iodine solution to each of the drops on the spotting tile. If they turn blue-black, the liquid contains starch.

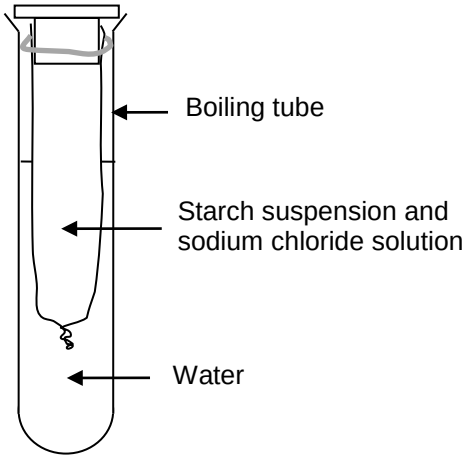

Figure 2 Set up to monitor diffusion.

8. Add 2-3 drops of silver nitrate solution to the solution in each test tube. If a white precipitate forms, the liquid contains chloride ions.
9. After 15 minutes, sample the liquids inside and outside the tubing again. Ensure that you have a fresh sample by squeezing the pipette a couple of times to expel the remnants of any earlier sample and to mix the liquids well before sampling.
10. Test the samples as in 7 and 8.

Recording and interpreting data

1. Record data in a table similar to this:

	Result of test with iodine	Result of test with silver nitrate solution	Does the liquid contain starch?	Does the liquid contain chloride ions?
Cellulose tubing contents at beginning				
Water around the tubing at beginning				
Cellulose tubing contents after 15 minutes				
Water around the tubing after 15 minutes				

2. Describe how chloride ions and starch molecules differ.
3. Explain the observations made in the experiment.
4. Suggest the significance of your observations to the cells in the roots of plants.