Answers to Workbook exercises Chapter 3

Exercise 3.1 Diffusion experiment

a

Dish	Temperature / °C	Distance red colour diffused into jelly / mm				
		Hole 1	Hole 2	Hole 3	Hole 4	Mean (average)
A	10	2	3	2	3	3
B	20	5	5	6	4	5
C	40	9	11	8	10	10
D	80	19	21	18	23	20

b Yes. As temperature increased, the distance the red colour diffused through the jelly increased. As the dishes were all left for the same period of time, this must mean the colour was moving faster in the warmer dishes. A doubling of the temperature caused the distance diffused by the colour to roughly double.

c The four most important variables to be controlled are: concentration of the solution of red pigment; size of hole in the jelly; depth of jelly in the dish; volume of solution placed in the hole.

d This allowed for a mean to be calculated. It improves the reliability of the results.

e Measurement of the distance diffused, because the 'edge' between the colour and the uncoloured jelly will not be very distinct. Some dye may have got into the jelly before the dishes are transferred to their final temperatures (especially as they were carried). Time taken for the dye and jelly in each dish to reach their final temperature – the dye won't have been at the correct temperature for the entire duration of the experiment.

Exercise 3.2 How plants take up water

a cell wall, large vacuole

b Label line to the cell surface membrane, or to the membrane around the vacuole.

c Water molecules move randomly. There is a greater concentration of them outside the cell than inside, so more will (by chance) move into the cell than out of it, through the partially permeable cell surface membrane. The solutes in the cell cannot get out through the partially permeable membrane. (Some students may answer in terms of water potential. The water potential of the solution outside the cell is higher than that inside, so water moves down its water potential gradient.)

d This provides a large surface area, so more water can pass across the surface at any one time.

Exercise 3.3 Osmosis and potatoes

a The table should have rows or columns for the percentage concentration of the solution, and rows or columns for the mass of potato pieces, with the unit g in the heading. Students should also calculate the change in mass. The following is an example of a suitable results table.

Percentage concentration of solution	mass / g		
	Before soaking	After soaking	Change
0.0	5.2	5.5	+0.3
0.1	5.1	5.2	+0.1
0.2	4.9	4.9	0
0.5	5.0	5.3	+0.3
0.8	5.1	5.0	–0.1
1.0	5.2	5.0	–0.2

b The mass of the potato piece soaking in 0.5% solution has increased, but it would be expected to decrease. This does not follow the pattern of the other results and so is anomalous.

c Look for the following features on the graph:
- 'percentage concentration of solution' on the *x*-axis, and 'change in mass / g' on the *y*-axis
- suitable scales
- all points plotted correctly (allow 0.5 mm tolerance) as crosses or as encircled dots
- either a best-fit line, drawn as a smooth curve with equal numbers of points above and below the line, or points joined with straight lines drawn with a ruler; the anomalous result should be ignored.

d The 0 and 0.1% solutions had a higher water potential than inside the potato cells, so water moved in by osmosis and made the cells increase in mass. The 0.2% solution had a water potential equal to that of the potato cells, so there was no net movement of water into or out of the cells (the same amount went in as came out) so there was no change in mass. The solutions with higher concentrations than this had water potentials lower than that of the potato cells, so water moved out of the cells by osmosis and their mass therefore decreased.

e Have several pieces of potato in each solution, and calculate a mean change in mass for each.

f Yes, this would have been better because the original masses of the potato pieces were not identical. Calculating percentage change would give a fairer comparison between the pieces – it would avoid discrepancies caused by this uncontrolled variable. S

Exercise 3.4 Diffusion and active transport S

a A, because the concentration is the same inside and outside.

b B, because the concentration inside the root cell is greater than outside, so it must have been moved in against its concentration gradient.

c C, because the concentration outside the cell is greater than inside, so it must have been moved out against its concentration gradient.

d The roots would not be able to respire, so they would not be able to release energy to use in active transport. This would have no effect on the concentration of A, as these ions are moving passively by diffusion. Active transport of B and C would stop, so they would now move by diffusion alone and their concentrations in the soil and cells would become equal. For ion B, this would mean that the concentration inside the cells would decrease and for ion C, it would increase. There would probably be no measurable effect in the soil water, because this is a huge volume compared with that of the root cells.