Exercise walk-through

1.3

Transport in cells – diffusion, osmosis, active transport (4.1.3, RP2)

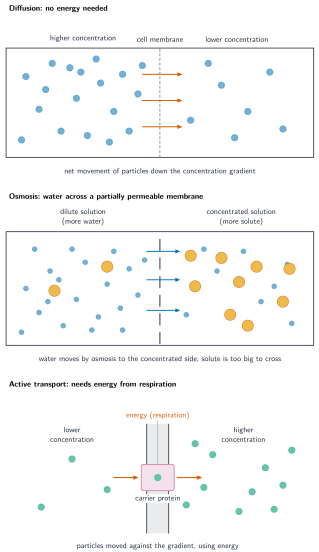
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Diffusion, osmosis and active transport

- **Diffusion** is the net movement of particles from an area of higher concentration to an area of lower concentration.
- Particles move in every direction, but more move down the **concentration gradient** than up it.
- Examples are oxygen and carbon dioxide in **gas exchange**, and urea moving from cells into the **blood plasma** to be taken to the kidneys.
- **Diffusion** is faster with a steeper **concentration gradient**, a higher temperature and a larger membrane surface area.

$$\text{percentage change} = \frac{\text{final mass} - \text{initial mass}}{\text{initial mass}} \times 100$$

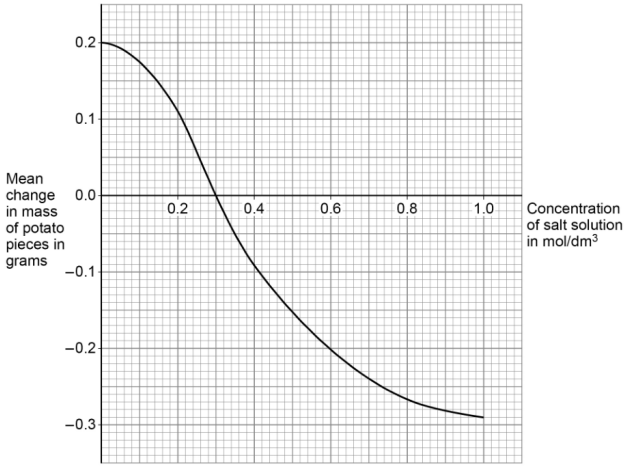
Figure: Diffusion, osmosis and active transport



- **Diffusion**, **osmosis** and **active transport** compared in three panels.
- Match each part of the diagram to the text.

Figure: Diffusion, osmosis and active transport (2)

Figure 4

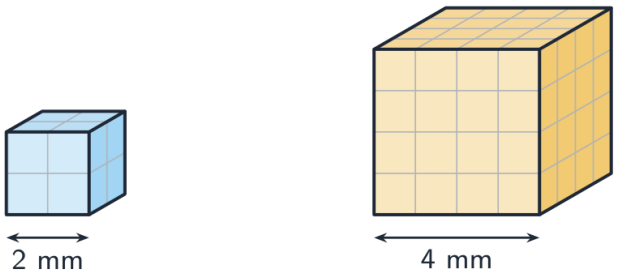


- Mean change in mass of potato in grams against solution concentration (AQA GCSE Biology Paper 1H, June 2024, Figure 4)
- Read the axes and units first.

Exchange surfaces and surface area to volume ratio

- a large surface area, so more substance crosses at once;
- a thin membrane, so the **diffusion** path is short;
- (in animals) a good blood supply, which carries substances away and keeps the gradient steep;
- (for **gas exchange**) **ventilation** , which brings in fresh air or water.

Figure: Exchange surfaces and surface area to volume ratio



surface area $= 6 \times 2^2 = 24$ mm^2
volume $= 2^3 = 8$ mm^3
SA : V = 24 : 8 = 3 : 1

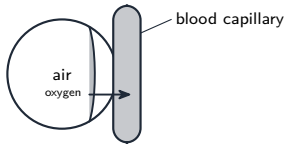
surface area $= 6 \times 4^2 = 96$ mm^2
volume $= 4^3 = 64$ mm^3
SA : V = 96 : 64 = 1.5 : 1

double the side: area $\times 4$, volume $\times 8$, so SA : V halves

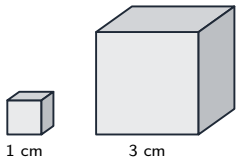
- Two cubes showing how doubling the side halves the surface-area-to-volume ratio.
- Match each part of the diagram to the text.

Exercises 2.1·2.2

2.1 Oxygen diffuses from the air in an alveolus into the blood. Explain why it moves in this direction. [2]

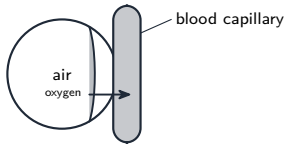


2.2 Calculate the surface area to volume ratio of the 1 cm cube and of the 3 cm cube. [2]



Exercises 2.1·2.2

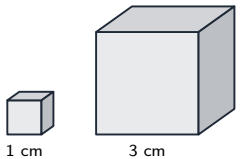
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2.1

- the concentration of oxygen is higher in the alveolus than in the blood; particles diffuse from a higher to a lower concentration

2.2 Calculate the surface area to volume ratio of the 1 cm cube and of the 3 cm cube. [2]



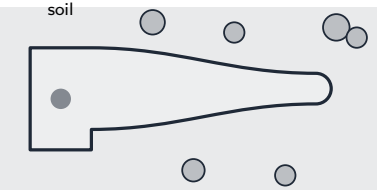
2.2

- 1 cm cube: $6 : 1$; 3 cm cube: $54 : 27 = 2 : 1$

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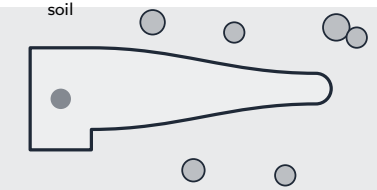
Exercise 2.3

2.3 A root hair cell takes in nitrate ions from the soil. The concentration of nitrate is higher in the cell than in the soil. Name the process and explain why it needs energy. [2]



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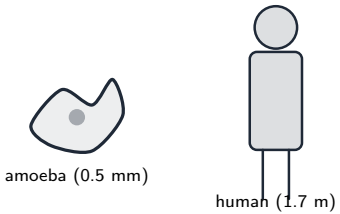


2.3

- **active transport**; the ions move against the concentration gradient (from low to high), so energy from respiration is needed

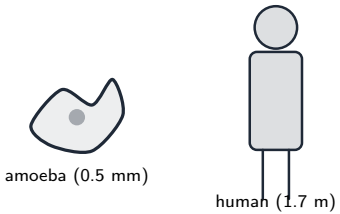
Exercise 3.1

3.1 An amoeba is a single cell. It does not need lungs or a blood system. Explain why a large animal does need them. [3]



Exercise 3.1

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3.1

- a large animal has a small surface area to volume ratio
- diffusion through its surface would be too slow to supply all its cells; the distances are too long
- so it needs exchange surfaces (lungs) and a transport system (blood) to move substances to and from every cell

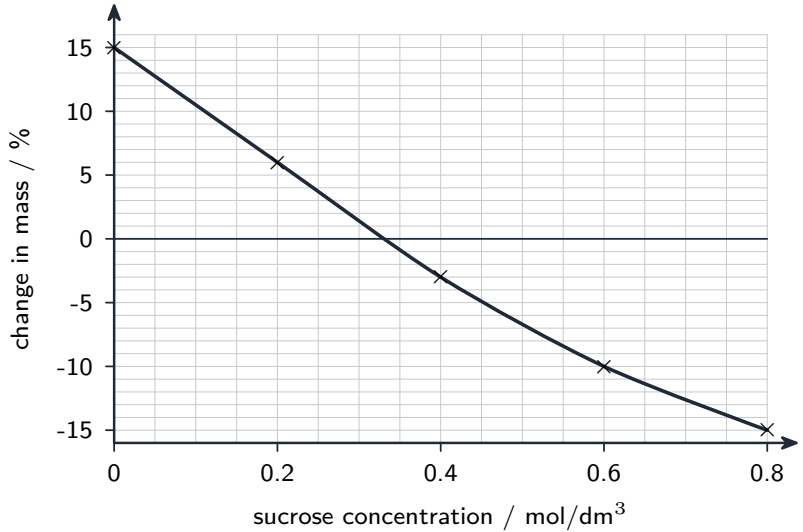
Setup for exercise 3.2

3.2 A student puts cylinders of potato into sucrose solutions of different concentrations. She measures the mass of each cylinder at the start and after 24 hours.

concentration / mol/dm^3	**0.0**	**0.2**	**0.4**	**0.6**	**0.8**
mass at start / g	2.00	2.00	2.00	2.00	2.00
mass after 24 h / g	2.30	2.12	1.94	1.80	1.70

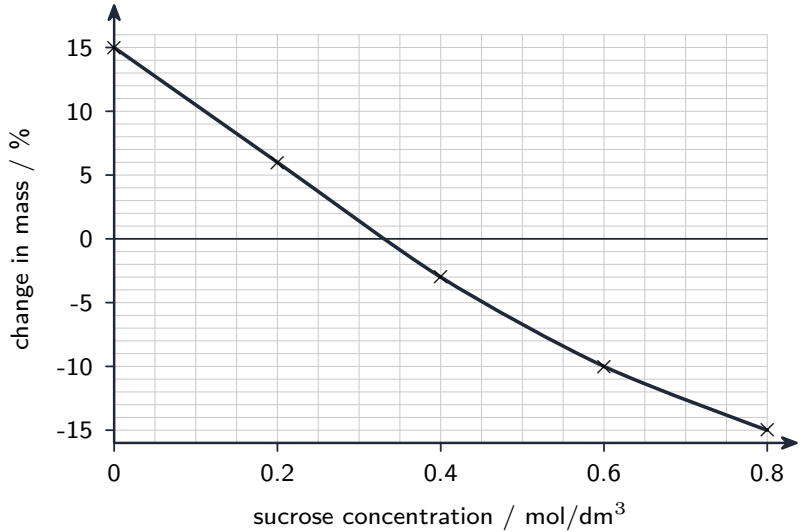
Exercise 3.2 (a)

(a) Calculate the percentage change in mass for 0.2 mol/dm^3. [2]



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(a) Calculate the percentage change in mass for 0.2 mol/dm^3. [2]



(a) $\frac{2.12-2.00}{2.00} \times 100 = +\mathbf{6}\%$

Exercise 3.2 (b)

3.2 A student puts cylinders of potato into sucrose solutions of different concentrations. She measures the mass of each cylinder at the start and after 24 hours.

concentration / mol/dm^3	**0.0**	**0.2**	**0.4**	**0.6**	**0.8**
mass at start / g	2.00	2.00	2.00	2.00	2.00
mass after 24 h / g	2.30	2.12	1.94	1.80	1.70

(b) Use the graph to estimate the concentration of the solution inside the potato cells. Explain your answer. [3]

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(b) Use the graph to estimate the concentration of the solution inside the potato cells. Explain your answer. [3]

(b) where the line crosses 0% change; about **0.33** mol/dm^3 (accept 0.30–0.36); here there is no net movement of water, so the concentrations inside and outside are the same

Exercise 3.2 (c)

3.2 A student puts cylinders of potato into sucrose solutions of different concentrations. She measures the mass of each cylinder at the start and after 24 hours.

concentration / mol/dm^3	**0.0**	**0.2**	**0.4**	**0.6**	**0.8**
mass at start / g	2.00	2.00	2.00	2.00	2.00
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(c) Explain why the cylinder in 0.8 mol/dm^3 lost mass. [2]

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(c) Explain why the cylinder in 0.8 mol/dm^3 lost mass. [2]

(c) the solution is more concentrated than the cell contents; so water moves out of the cells by osmosis through the partially permeable membrane

Exercise 3.2 (d)

3.2 A student puts cylinders of potato into sucrose solutions of different concentrations. She measures the mass of each cylinder at the start and after 24 hours.

concentration / mol/dm^3	**0.0**	**0.2**	**0.4**	**0.6**	**0.8**
mass at start / g	2.00	2.00	2.00	2.00	2.00
mass after 24 h / g	2.30	2.12	1.94	1.80	1.70

(d) Describe how the student did this investigation. Include how she made the results valid. [6]

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mass at start / g	2.00	2.00	2.00	2.00	2.00
mass after 24 h / g	2.30	2.12	1.94	1.80	1.70

(d) Describe how the student did this investigation. Include how she made the results valid. [6]

(d) points to include:

- cut cylinders of potato with a cork borer and trim them to the same length
- blot each one dry and find its mass on a balance
- put each cylinder in the same volume of a different sucrose concentration
- leave them for the same time at the same temperature
- remove, blot dry in the same way and find the mass again
- calculate percentage change, because the starting masses could differ; repeat and find means

Levels: **5–6** a full, logical answer with correct biology and correct terms; **3–4** several correct points, partly linked; **1–2** one or two relevant points.