Year 12 Science: Cells, organelles and membrane transport

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

Practice

1. A cube-shaped cell has sides of 3 µm. What is its SA:V?

2. A potato cylinder goes from 4.00 g to 3.70 g in a salt solution. What is its percentage change in mass?

3. Glucose enters a cell down its concentration gradient through a carrier protein, without ATP. Which transport method is this?

4. A red blood cell is put into pure water. What happens to it, and why?

5. Sperm cells swim using a tail that needs a lot of ATP. Which organelle would you expect to find in large numbers near the tail?

Exam-style question: seawater on a paddock

A storm surge floods a coastal paddock with seawater. A day later the ryegrass is wilting, even though the soil is soaking wet. Seawater is a much more concentrated salt solution than the sap inside the grass's root hair cells.

6. Describe osmosis.

7. Explain why the grass wilts after the seawater flood.

8. Before the flood, the root hair cells took in nitrate ions by active transport. Explain why this process needs mitochondria.

9. Discuss how the structure of a root hair cell suits it to taking in both water and mineral ions, and compare how the two cross the membrane.

Fix the mistake

10. Correct this statement: "In osmosis, the salt moves out of the cell into the water."

11. Correct this statement: "Water moves from a high concentration of solute to a low concentration of solute."

12. Correct this statement: "Facilitated diffusion uses energy because it uses a protein."

13. Correct this statement: "A bigger cell has a bigger SA:V because it has more surface area."

Answer key (for parents and tutors)

1. A cube-shaped cell has sides of 3 µm. What is its SA:V?
   SA = 6 × 3 × 3 = 54 µm², V = 3 × 3 × 3 = 27 µm³, so SA:V = 54 ÷ 27 = 2:1 (2 µm⁻¹).
2. A potato cylinder goes from 4.00 g to 3.70 g in a salt solution. What is its percentage change in mass?
   (3.70 − 4.00) ÷ 4.00 × 100 = −7.5%, a 7.5% decrease.
3. Glucose enters a cell down its concentration gradient through a carrier protein, without ATP. Which transport method is this?
   Facilitated diffusion.
4. A red blood cell is put into pure water. What happens to it, and why?
   It swells and bursts, because water moves in by osmosis from the more dilute water and it has no cell wall to stop it.
5. Sperm cells swim using a tail that needs a lot of ATP. Which organelle would you expect to find in large numbers near the tail?
   Mitochondria, which make ATP in aerobic respiration.
6. Describe osmosis.
   Osmosis is the net movement of water across a partially permeable membrane from a dilute solution to a more concentrated one; it is passive (Achieved).
7. Explain why the grass wilts after the seawater flood.
   The soil water is now more concentrated than the cell sap, so water leaves the root hair cells by osmosis instead of entering; the cells lose turgor, water is no longer supplied to the leaves, and the grass wilts (Merit, because it gives the reason using the gradient).
8. Before the flood, the root hair cells took in nitrate ions by active transport. Explain why this process needs mitochondria.
   Nitrate is pumped in against its concentration gradient by carrier proteins, which change shape using ATP; ATP comes from aerobic respiration in mitochondria, so the cell needs many of them (Merit).
9. Discuss how the structure of a root hair cell suits it to taking in both water and mineral ions, and compare how the two cross the membrane.
   Excellence links the ideas: the long thin hair gives a large surface area to volume ratio, so more water and ions cross the membrane each second; water enters passively by osmosis while the sap is more concentrated than the soil water, so it needs no ATP, while nitrate is taken in against its gradient by active transport, which needs carrier proteins and ATP from the many mitochondria; the ions pumped in keep the sap concentrated, which keeps water flowing in, so the seawater flood reverses the gradient and both processes suffer.
10. Correct this statement: "In osmosis, the salt moves out of the cell into the water."
    In osmosis only water moves across the membrane; the dissolved particles cannot cross it.
11. Correct this statement: "Water moves from a high concentration of solute to a low concentration of solute."
    Water moves towards the more concentrated solution, from where there is more free water to where there is less.
12. Correct this statement: "Facilitated diffusion uses energy because it uses a protein."
    Facilitated diffusion is passive: it goes down the gradient and needs no ATP; only active transport pumps against the gradient.
13. Correct this statement: "A bigger cell has a bigger SA:V because it has more surface area."
    A bigger cell has more surface area, but its volume grows faster, so its SA:V is smaller.