*This is the **Higher Combined** version — includes Higher Tier content. Some Separate-only details are omitted.*

Active transport moves substances against the concentration gradient — from low to high concentration. Unlike diffusion, it requires energy.

- Active transport moves substances from LOW concentration to HIGH concentration — AGAINST the concentration gradient.
- It requires ENERGY in the form of ATP, produced by respiration.
- It uses carrier proteins in the cell membrane.
- Example 1: Root hair cells absorb mineral ions (e.g. nitrates) from soil water. Even when soil concentration is lower than inside the root, minerals must still be absorbed.
- Example 2: Glucose is absorbed from the small intestine into the blood even when blood glucose is already high (e.g. after a meal).

★ **HT** Example 3: Sodium-potassium pumps in nerve and muscle cells maintain ion gradients needed for electrical signals.

- Comparison: Diffusion is passive (no energy, high→low), osmosis is passive water diffusion, active transport uses energy (ATP, low→high).

★ **HT** Inhibiting respiration (e.g. with cyanide) stops ATP production → stops active transport → shows that active transport requires respiration.

Key Terms

Active transport	Movement of substances from LOW to HIGH concentration using energy (ATP) and carrier proteins
ATP	Adenosine triphosphate — the energy currency of the cell, produced by respiration
Carrier protein	Protein in the cell membrane that transports specific substances by active transport

■ **Exam Tip:** The key difference from diffusion: active transport moves substances AGAINST the gradient and REQUIRES ENERGY. Always mention both facts. If a question asks why active transport is needed in a specific situation, always explain that the substance needs to move against its concentration gradient.