*This is the **Higher Separate** version — includes all Higher Tier content (marked ★) and all Separate Science content.*

Blood glucose concentration must be maintained within a narrow range to supply cells with energy while preventing damage from high glucose levels.

- Normal blood glucose: ~4–8 mmol/L (varies with meals and exercise).
- The PANCREAS monitors blood glucose and acts as the control centre.
- Blood glucose rises (e.g. after eating): beta cells in pancreas secrete INSULIN → cells take up glucose; liver converts glucose to GLYCOGEN (glycogenesis) → blood glucose falls.
- Blood glucose falls (e.g. during exercise): alpha cells in pancreas secrete GLUCAGON → liver breaks glycogen back to glucose (glycogenolysis) → blood glucose rises.
- This is negative feedback: the response opposes the change, restoring the set point.
- Type 1 diabetes: autoimmune — immune system destroys beta cells → no insulin produced → blood glucose stays high (hyperglycaemia). Treated with insulin injections.
- Type 2 diabetes: body cells become RESISTANT to insulin (do not respond to it) → glucose stays in blood. Linked to obesity/poor diet. Managed with diet, exercise and medication.
- ★ **HT** Hyperglycaemia: blood glucose too high — osmotic damage to cells, nerve damage, kidney damage (long-term).
- ★ **HT** Hypoglycaemia: blood glucose too low — brain cells deprived of glucose → confusion, unconsciousness.

Key Terms

Insulin	Hormone from pancreatic beta cells — lowers blood glucose by stimulating glucose uptake and glycogen synthesis
Glucagon	Hormone from pancreatic alpha cells — raises blood glucose by stimulating glycogen breakdown
Glycogen	The storage form of glucose — insoluble polysaccharide stored in liver and muscles
Glycogenesis	Conversion of glucose to glycogen for storage (when blood glucose is high)
Glycogenolysis	Breakdown of glycogen to glucose (when blood glucose is low)
Type 1 diabetes	No insulin produced — autoimmune destruction of beta cells — requires insulin injections
Type 2 diabetes	Cells resistant to insulin — linked to obesity — managed with lifestyle changes

■ **Exam Tip:** A common mistake: saying insulin "destroys" glucose. Insulin causes glucose to be taken UP by cells and converted to GLYCOGEN — it does not destroy glucose. Similarly, glucagon does not make new glucose — it converts stored glycogen back to glucose.