

14.1 Homeostasis in mammals

Name: _____ Class: _____ Date: _____ Total: 14 marks

KEY WORDS glucose • kidney • glucagon • hormone
• cell signalling

Objective

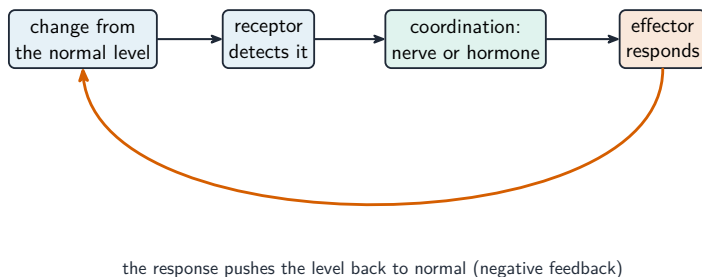
Build the skills to answer exam questions on **homeostasis in mammals – negative feedback**, the **kidney** and urine formation, **osmoregulation**, and **cell signalling** in blood-glucose control.

You must be able to:

- explain homeostasis and the principle of negative feedback
- describe ultrafiltration and selective reabsorption in the nephron
- explain osmoregulation by ADH and the glucagon signalling cascade

1 Key knowledge and worked examples

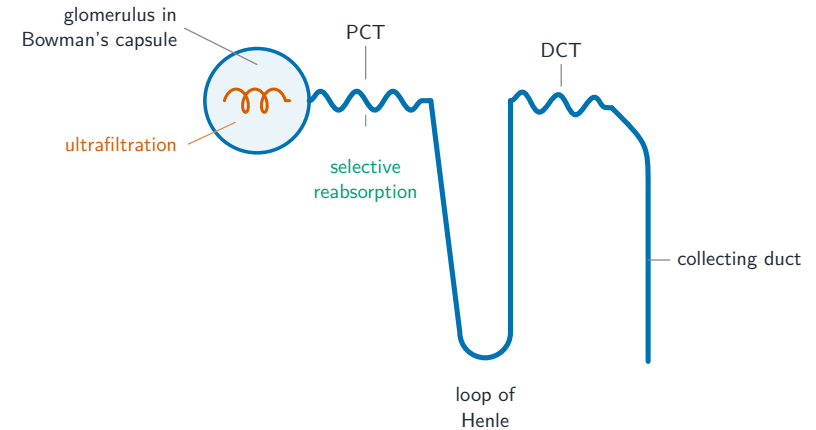
■ Homeostasis and negative feedback



Negative feedback: a receptor detects a change; an effector corrects it, returning to normal

Homeostasis keeps internal conditions steady. A **stimulus** is detected by a **receptor**; a coordination system (nervous or endocrine) signals an **effector** that corrects the change.

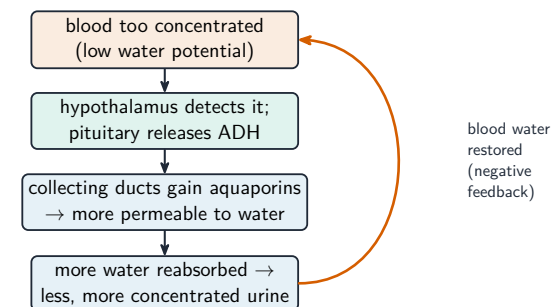
■ The nephron: making urine



Ultrafiltration in the Bowman's capsule; selective reabsorption in the proximal convoluted tubule

- **ultrafiltration** (Bowman's capsule): high glomerular pressure forces water and small molecules (glucose, ions, urea) out; cells and proteins stay in the blood.
- **selective reabsorption** (proximal convoluted tubule): glucose and much water/ions are taken back; the cells have **microvilli** and many **mitochondria** for active transport.

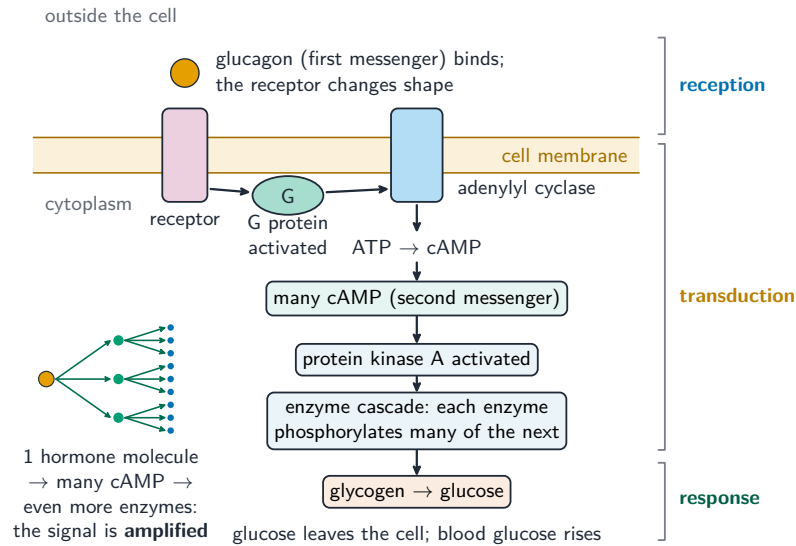
■ Osmoregulation by ADH



When blood is too concentrated, ADH makes the collecting ducts reabsorb more water

The **hypothalamus** detects low water potential; the **pituitary** releases **ADH**; the collecting ducts gain **aquaporins**, so more water is reabsorbed → less, more concentrated urine.

■ Cell signalling: glucagon



A second messenger (cAMP) and an enzyme cascade amplify the signal – each step activates many

2 Practice

2.1 Name the coordination system that uses (a) nerve signals and (b) hormones. [2]

2.2 State **two** substances reabsorbed in the proximal convoluted tubule. [1]

3 Exam-style questions

3.1 Which substance does **not** normally pass into the glomerular filtrate during ultrafiltration? [1]

- ☐ A glucose
☐ B urea
☐ C plasma protein
☐ D water

3.2 When the blood is too concentrated, ADH causes: [1]

- ☐ A less water to be reabsorbed
☐ B the collecting ducts to become more permeable to water
☐ C more dilute urine to be produced
☐ D glycogen to break down

3.3 (a) Explain how the proximal convoluted tubule is adapted for selective reabsorption. [3]

(b) Explain how ADH restores the water potential of the blood when it is too low. [3]

3.4 Glucagon controls blood glucose by an enzyme cascade.

(a) Name the second messenger formed inside the liver cell. [1]

(b) Explain why the use of an enzyme cascade amplifies the signal. [2]

Solutions

Each answer shows the steps, then the **result**.

2.1

(a)

- the nervous system

(b)

- the endocrine system

2.2

- any two of: glucose; water; (named) ions

3.1 C

- Plasma proteins are too large to be filtered; the others pass into the filtrate

3.2 B

- ADH makes the collecting ducts more permeable to water (more aquaporins)

3.3

(a)

- microvilli give a large surface area for reabsorption; many mitochondria release ATP for active transport; carrier proteins reabsorb glucose/ions

(b)

- the hypothalamus detects the low water potential and the pituitary releases ADH; the collecting ducts gain aquaporins and become more permeable; more water is re-absorbed into the blood, raising its water potential

3.4

(a)

- cyclic AMP (cAMP)

(b)

- each enzyme activates many molecules of the next enzyme, so a few hormone molecules trigger a large response