

Exercise walk-through

14.1

Homeostasis in mammals

A-Level Biology

One hormone, an amplified answer

1. Binding

Glucagon binds a receptor on the liver cell surface, causing a **conformational change** – a change in the receptor's shape.

2. G-protein

That activates a **G-protein G**, which switches on the enzyme **adenylyl cyclase**.

3. Second messenger

Adenylyl cyclase makes a **second messenger AMP** (cAMP). inside the cell: **cyclic**

4. Enzyme cascade

cAMP activates **protein kinase A**, which starts an **enzyme cascade** – each enzyme switching on the next by **phosphorylation**.

The point of the cascade is **amplification**: a few hormone molecules outside end in millions of glucose molecules released.

Along one nephron, in order

Glomerulus and capsule

Each kidney holds about a million **nephrons**. Blood in the **glomerulus** is under high pressure, so water and small molecules – glucose, ions, urea – are pushed into the **Bowman's capsule** as the **filtrate**.

Proximal tubule

The **proximal convoluted tubule** reabsorbs all the glucose and most of the ions and water.

Loop of Henle

The **loop of Henle** builds a salt gradient in the medulla – the pump that makes concentrated urine possible.

Distal tubule and duct

The **distal convoluted tubule** fine-tunes ions and pH; the **collecting duct** sets the final water content.

The tubule wall is built for the job: **microvilli** for surface area, and many **mitochondria** to power the **active transport**.

What homeostasis is, and the parts it needs

homeostasis

keeping conditions inside the body **steady** even when the outside changes

what is held steady

temperature, blood glucose, water potential, pH and ion **concentration**

a receptor

detects the change from the set point

a coordination system

carries the message – either the **nervous system** nerve signals, or the **endocrine system** in the blood

using
using hormones

an effector

brings about the correction – a muscle or a gland

negative feedback

the correction *reverses* the change, so the value returns toward the set point

Positive feedback amplifies instead, which is why it is rare in the body and used only for events that must run to completion – childbirth, the action potential.

Exercises 2.1·2.2

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]

Exercises 2.1-2.2

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

2.1

(a)

- the nervous system

(b)

- the endocrine system

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

2.2

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

Exercises 3.1·3.2

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

Exercises 3.1·3.2

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

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

3.1 C

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

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

3.2 B

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

Exercise 3.3

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]

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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 reabsorbed into the blood, raising its water potential

Exercise 3.4 (a)

3.4 Glucagon controls blood glucose by an enzyme cascade.

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

[1]

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[1]

(a)

- cyclic AMP (cAMP)

Exercise 3.4 (b)

3.4 Glucagon controls blood glucose by an enzyme cascade.

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

[2]

Exercise 3.4 (b)

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

(b)

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