The Endocrine System

A Level

Part A Endocrine glands

The endocrine system is composed of endocrine glands (glands that release [ ] directly into the [ ]). These glands are found all over the body.

- Head/brain: the [ ], the pituitary gland, and the pineal gland
- Neck: the thryoid gland
- Chest: the thymus
- Abdomen: the [ ], the adrenal glands, and the gonads ([ ] in males, [ ] in females).

Items:

hormones **pancreas** **hypothalamus** **bloodstream** **gastrointestinal tract** **ovaries** **testes** **enzymes**

Part B Hormones

Which of the following statements about hormones are true? Select all that apply.

- [ ] hormones are proteins that catalyse biological reactions
- [ ] hormones are substances that are released by one part of the organism and act on another part of the organism
- [ ] hormones are substances that are released by one neuron into the space between it and another neuron
- [ ] all hormones are proteins
- [ ] all hormones are steroids
- [ ] some hormones are steroids and some hormones are proteins

Part C Endocrine vs nervous system

Both the endocrine system and the nervous system help an organism respond to external changes. In many contexts, the two systems work together and are sometimes collectively referred to as the neuroendocrine system. However, there are some differences between the two systems. Fill in the table below to identify these differences.

	Endocrine system	Nervous system
signal type(s)		
signal carried by...		
speed of response		
duration of response		

Items:

hormones **neurons** **long duration** **electrical impulses and neurotransmitters** **slower (seconds to days)** **blood** **short duration** **very fast (milliseconds)**

Hormones

A Level

Part A Types of hormones

In animals, the two most common types of hormones are steroid hormones and peptide/protein hormones. The table below gives some examples of animal hormones.

Identify which type each hormone is.

Hormone	Type
insulin	
glucagon	
testosterone	
oestrogen	
follicle-stimulating hormone (FSH)	
luteinizing hormone (LH)	
cortisol	
antidiuretic hormone (ADH)	

Items:

steroid **peptide/protein**

Part B Steroid precursor

What is the precursor molecule that most steroid hormones are synthesised from?

Part C Hormone action

Which of the following statements are correct? Select all that apply.

- [ ] steroid hormones pass through the membrane of target cells and bind to receptor molecules inside the cell
- [ ] the binding of a hormone to a receptor on the outside of the target cell membrane can trigger a series of chemical reactions inside the cell
- [ ] steroid hormones cannot pass through the membrane of target cells and so they bind to receptor molecules on the outside of the cell membrane
- [ ] peptide/protein hormones cannot pass through the membrane of target cells and so they bind to receptor molecules on the outside of the cell membrane
- [ ] the binding of a hormone to a receptor inside the target cell forms a complex that can acts as a transcription factor, causing specific genes to be expressed
- [ ] peptide/protein hormones pass through the membrane of target cells and bind to receptor molecules inside the cell

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Homeostasis

A Level

Part A Defining homeostasis

Which of the following is the definition of homeostasis?

- the maintenance of body temperature within restricted limits
- the maintenance of blood water potential within restricted limits
- when the response produced by the control system leads to a **decrease** in the stimulus detected by the receptor and turns the system off
- when a response produced by the control system leads to an **increase** in the stimulus detected by the receptor
- the maintenance of an internal environment within restricted limits

Part B Negative feedback

Negative feedback is an important mechanism in homeostasis.

Drag the steps below into the correct order on the right to show how negative feedback helps ensure homeostasis.

Available items

- the change from the normal state is detected by sensory cells
- the sensory cells stop responding
- the state returns to the normal state
- the response of the endocrine system/nervous system stops
- the endocrine system/nervous system produces a signal in response
- a change from the normal state occurs

Part C Examples of negative feedback

Which of the following things are regulated by negative feedback in mammals? Select all that apply.

- [ ] blood pH
- [ ] blood pressure
- [ ] blood clotting
- [ ] blood water potential
- [ ] uterine contractions during childbirth
- [ ] internal body temperature
- [ ] blood glucose levels

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The Hypothalamus and the Pituitary Gland

A Level

The hypothalamus is sometimes called the "control centre" of the brain. It receives signals from other parts of the nervous system and sends signals to other endocrine glands via the pituitary gland. The pituitary gland is sometimes called the "master gland" because it secretes hormones that regulate almost all of the other endocrine glands.

There are various subsystems within the endocrine system called "axes" that all involve the hypothalamus and the pituitary gland. These include:

- HPA axis (hypothalamic-pituitary-adrenal axis)
- HPG axis (hypothalamic-pituitary-gonadal axis)
- HPT axis (hypothalamic-pituitary-thyroid axis)

The hypothalamus connects to the pituitary gland in two different ways. It connects to the anterior pituitary gland via blood vessels, and it connects to the posterior pituitary gland via neurons.

Part A HPA axis

The HPA axis (hypothalamic-pituitary-adrenal axis) is responsible for releasing cortisol, one of the main "stress hormones" which is involved in increasing blood glucose levels and increasing blood pressure.

When a stressful stimulus is detected, corticotropin-releasing hormone (CRH) is released, which stimulates the release of adrenocorticotropic hormone (ACTH), which stimulates the release of cortisol.

Match the hormone to the endocrine gland in the table below.

Hormone	Endocrine gland
adrenocorticotropic hormone (ACTH)	
corticotropin-releasing hormone (CRH)	
cortisol	

Items:

adrenal glands **hypothalamus** **ovaries** **pancreas** **pituitary gland** **testes** **thymus** **thyroid gland**

Part B HPG axis

The HPG axis (hypothalamic-pituitary-gonadal axis) is responsible for releasing oestrogen and testosterone, two major "sex hormones" which are involved in the development of the reproductive systems during puberty, among other things.

In males, the release of gonadotropin-releasing hormone (GnRH) stimulates the release of luteinizing hormone (LH) and follicle-stimulating hormone (FSH), which stimulate the release of testosterone and the production of sperm cells.

Match the hormone to the endocrine gland in the table below for males.

Hormone	Endocrine gland
follicle-stimulating hormone (FSH)	
gonadotropin-releasing hormone (GnRH)	
luteinizing hormone (LH)	
testosterone	

Items:

adrenal glands **hypothalamus** **ovaries** **pancreas** **pituitary gland** **testes** **thymus** **thyroid gland**

Part C HPT axis

The HPT axis (hypothalamic-pituitary-thyroid axis) is responsible for releasing thyroid hormones (T3 and T4) which are involved in regulating the body's metabolism.

The release of thyrotropin-releasing hormone (TRH) stimulates the release of thyroid-stimulating hormone (TSH), which stimulates the release of thyroid hormones (T3 and T4).

Match the hormone to the endocrine gland in the table below.

Hormone	Endocrine gland
thyroid hormones (T3 and T4)	
thyroid-stimulating hormone (TSH)	
thyrotropin-releasing hormone (TRH)	

Items:

adrenal glands | hypothalamus | ovaries | pancreas | pituitary gland | testes | thymus | thyroid gland

Part D Regulation

In the examples given above, the hormones released by the adrenal glands/gonads/thyroid gland inhibit the release of the hormones released by the hypothalamus.

What is the name given to this mechanism which ensures that hormone levels will not keep increasing?

Part E Pituitary parts

In the examples given above, the hormones released by the hypothalamus travel to the pituitary gland via the bloodstream.

Which part of the pituitary gland will release hormones in response to this?

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Adrenaline

A Level

Adrenaline is one of the hormones involved in an animal's "fight or flight" response. When an animal detects a threat, the hypothalamus sends a signal through the sympathetic nervous system to trigger the release of adrenaline into the bloodstream.

Part A Source

Name the endocrine gland in humans that releases adrenaline into the bloodstream.

Part B Responses

Which of the following physiological responses are triggered by the binding of adrenaline to target cells? Select all that apply.

- [ ] decreased heart rate
- [ ] glycogenolysis in the liver
- [ ] smooth muscle relaxation in the lungs
- [ ] glycogenesis in the liver
- [ ] smooth muscle contraction in the lungs
- [ ] increased heart rate

Part C Functions

How do the physiological responses triggered by adrenaline help the organism respond to a threat? Select all that apply.

- [ ] the digestive system works faster
- [ ] aerobic respiration rates can increase
- [ ] oxygen uptake is increased
- [ ] skeletal muscles can contract more frequently, allowing the organism to move quickly for a longer period of time
- [ ] blood glucose levels are increased
- [ ] more water is reabsorbed into the blood

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The Menstrual Cycle

A Level

The menstrual cycle is the series of changes that occur in the ovaries and uterus of female humans and a few other mammal species. These changes include menstruation, and are controlled by changes in hormone levels during the cycle.

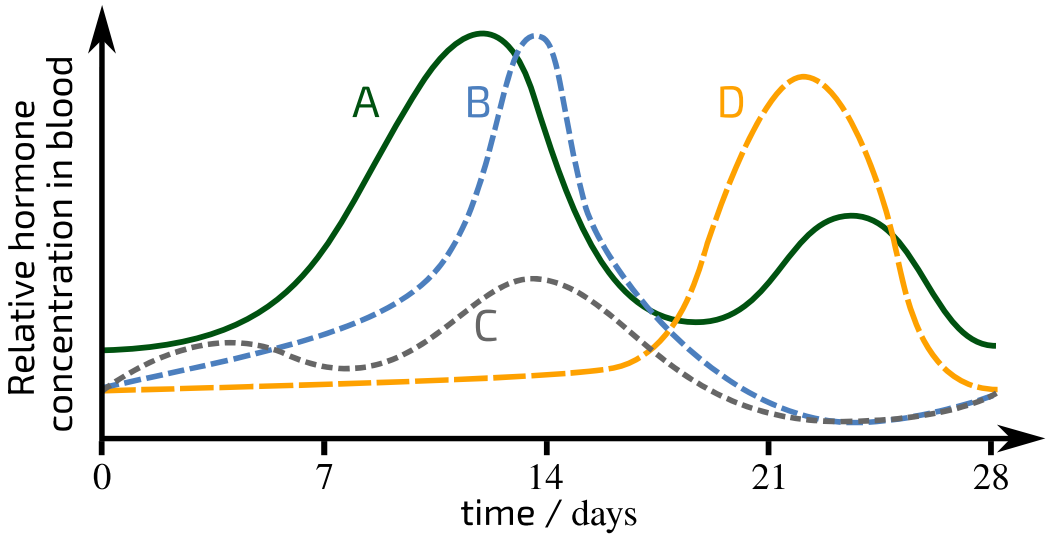

Figure 1: Menstrual cycle hormone levels in female humans. Day 0 corresponds to the beginning of menstruation, when the endometrium (uterine lining) is shed. Day 14 corresponds to ovulation, when the egg is released from the ovary.

Part A Hormones

Match the hormone to the graph line in **Figure 1**.

Figure label	Hormone
A	
B	
C	
D	

Items:

luteinizing hormone (LH) | oestrogen | follicle-stimulating hormone (FSH) | progesterone

Part B Locations and functions

Complete the table below.

Hormone	Released from...	Function
		causes the pituitary gland to release hormones
		causes the endometrium to thicken before ovulation
		causes the ovarian follicle to release the egg, stimulates the production of progesterone and oestrogen
		helps maintain the thickness of the endometrium after ovulation and inhibits FSH and LH production
		causes maturation of the follicle, which increases oestrogen levels

Items:

ovaries **Follicle-stimulating hormone (FSH)** **pituitary gland** **Luteinizing hormone (LH)** **progesterone** **hypothalamus** **oestrogen** **Gonadotropin-releasing hormone (GnRH)**

Part C Fertilisation & implantation

If fertilisation and implantation occur, the embryo produces a hormone called human chorionic gonadotropin (hCG). This hormone is structurally very similar to luteinizing hormone (LH) and so it carries out some of the same functions.

Which of the following things would you expect as a result of fertilisation & implantation that are **different** from the events shown in **Figure 1**? Select all that apply.

- [ ] FSH levels would increase after ovulation
- [ ] the endometrium would be **maintained** instead of being shed
- [ ] the endometrium would be **shed** instead of being maintained
- [ ] LH levels would increase after ovulation
- [ ] oestrogen levels would remain high/increase instead of decreasing after the second peak
- [ ] progesterone levels would remain high/increase instead of decreasing after the peak

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Part D Types of hormones

Gonadotropin releasing hormone (GnRH), Luteinizing hormone (LH) and Follicle-stimulating hormone (FSH) bind to receptors on the membranes of their target cells. Oestrogen and progesterone pass through the membranes of their target cells and bind to receptors inside those cells.

What type of hormones are oestrogen and progesterone?

Adapted with permission from OCR A Level January 2003, Biology Growth, Development and Reproduction, Question 3