

Section 2

Biology

- Genes, Alleles & Natural Selection
- Hormones
- The Nervous System

HORMONES

This is quite an easy section. It literally just involves learning the functions of a few hormones, and vaguely understanding the menstrual cycle. If you get a question on hormones or the menstrual cycle in the exam, it will be quick and easy marks because they won't involve any thinking on your part – just recalling a few facts.

GENERAL HORMONES

Hormones are chemical messengers secreted by glands and transported in the blood to act on a general or specific area.

Adrenaline: Released from the **adrenal glands** located just above the kidneys. It is responsible for the “fight or flight” response, and increases heart rate, stroke volume and breathing rate. It also triggers glycolysis in the liver and in muscles to produce glucose from glycogen stores, and also redirects blood flow to muscles.

Insulin: Released from beta cells in the Islets of Langerhans in the **pancreas**. It reduces blood glucose levels by encouraging cells to take up glucose from the blood.

Glucagon: The opposite of insulin. It is released from alpha cells in the Islets of Langerhans in the **pancreas**. It increases blood glucose levels.

Testosterone: Released from the **testes**. It causes hair follicles to grow during puberty, and to be lost in later life. It enlarges the voice box (larynx), has effects on reproductive organs and brain development, and causes muscle hypertrophy (growth).

ADH (Anti-Diuretic Hormone): Released from the **posterior pituitary gland** (in the brain). Diuresis is when you produce dilute urine (ie: urine with a lot of water in it, ie: the process by which water is lost from the body). ADH, being anti-diuretic, inhibits the loss of water and causes the production of concentrated urine. It acts on the distal (lower) parts of the nephron (the functional unit in the kidney). It also increases blood pressure.

MENSTRUAL CYCLE HORMONES

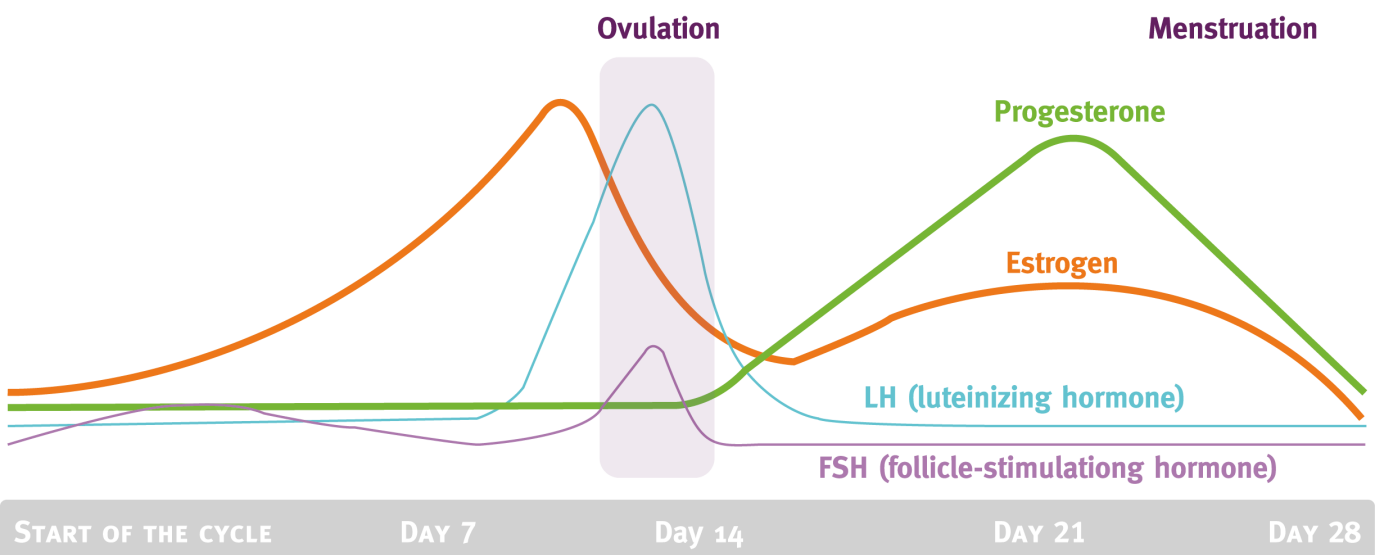
Oestrogen: Produced in the **ovaries** by developing follicles. It stimulates the buildup of the uterus wall. It inhibits FSH production via negative feedback loops. It also overrides progesterone at the end of pregnancy, allowing contractions to take place.

Progesterone: Produced by the corpus luteum (the bit the egg leaves behind after being fired into the ovarian ducts) in the **ovaries**. It maintains the lining of the uterus, and inhibits FSH and LH production. It causes breast development and inhibits uterus contractions during pregnancy.

FSH (Follicle Stimulating Hormone): Released by the (anterior) **pituitary gland** in the brain at the start of the menstrual cycle. It stimulates development of the primary follicle, which in turn secretes oestrogen.

LH (Leuteinising Hormone): Produced by the (anterior) **pituitary gland** in the brain around day 12 of the menstrual cycle. It causes the release of the secondary oocyte (the egg cell) from the primary follicle, and helps the remaining follicle develop into the corpus luteum.

(Yes, this is slightly more information than you strictly “need to know”, but in fairness, it’s only a page of definitions and learning it isn’t that difficult. If you are desperate to learn only what might come up in the exam however, just learn the basic function and production site of these hormones, and you’ll probably be okay).



The graph above shows the changes in the concentration of hormones during the menstrual cycle. As you can see, oestrogen rises before ovulation, and then falls to a lower concentration afterwards. This makes sense because oestrogen causes a buildup in the lining of the uterus, which we want to happen before ovulation takes place.

Progesterone isn’t produced until after ovulation (when the corpus luteum is formed), and it maintains the lining of the uterus. Hence, it makes sense for it to only increase in concentration once the lining has already been built up by oestrogen. When progesterone levels decrease towards the end of the cycle, that causes the lining of the uterus to break down (as it’s no longer being maintained), and menstruation occurs.

LH is fairly useless generally, but around day 12, there is a surge in LH concentration and that causes ovulation to happen. If you didn’t know, ovulation is when the egg (the secondary oocyte) bursts free from the primary follicle and makes its way into the fallopian tubes (ovarian ducts).

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FSH increases a little at the start of the cycle to stimulate production of the primary follicle (which is what produces oestrogen) but does little else apart from that. Around day 12, there is a surge in FSH levels and this helps LH get released around that time. Because progesterone inhibits FSH release (we don't want another primary follicle developing while we already have an egg in the uterus), FSH levels become very low after the surge on day 12.

(Again, you probably don't "need to know" all of this, but it's relatively simple, and helps understanding of what the hormones do. Besides, questions have come up in the past about the menstrual cycle and we'd rather be safe than sorry).

QUESTIONS

The following statements are about hormone levels and their effect:

- 1 Increasing levels of insulin cause an increase in blood glucose levels.
- 2 Increasing levels of oestrogen increases the thickness of the inner lining of the uterus.
- 3 Increasing levels of adrenaline increases the heart rate.

Which of the statements are true?

- A 1 and 2
- B 1 and 3
- C 2 and 3
- D all of the above
- E none of the above

1 – Insulin causes a **decrease in blood glucose levels**, so this is false.

2 – Yes, this is precisely what oestrogen does.

3 – Yes, this is one of the many things adrenaline does.

1

Gland	Hormone	One function
Adrenal	Adrenaline	
	Oestrogen	Female secondary sexual characteristics
	Antidiuretic hormone (ADH)	
Testes		Male secondary sexual characteristics
Pancreas		Regulates blood glucose level

Which word or statement does **not** correctly fit into one of the gaps left in the table?

- A Insulin
- B Increases heartbeat rate
- C Pituitary
- D Testosterone
- E Ovary
- F Carbohydase
- G Regulates water level in blood

This is too easy. Adrenaline obviously increases heartbeat rate (B), oestrogen is released in the ovaries (E), ADH is released from the pituitary gland (C) and regulates water level in the blood (G). The testes release testosterone (D), and the hormone that regulates blood glucose, released from the pancreas, is obviously insulin (A). The only thing missing is **F – Carbohydase**. (Incidentally, carbohydrases are enzymes that break down carbohydrates and are found throughout the digestive tract).

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Consumption of alcohol leads to an increase in dilute urine production by reducing the level of the hormone ADH.

Which of the following are correct statements about alcohol and/or ADH?

- 1 ADH travels in the bloodstream.
- 2 There is a positive correlation between the level of ADH and the production of dilute urine.
- 3 Increased ADH leads to increased formation of dilute urine.
- 4 A reduced level of ADH could lead to dehydration.

- A 1 and 2 only
- B 1 and 3 only
- C 1 and 4 only
- D 2 and 3 only
- E 2 and 4 only
- F 3 and 4 only

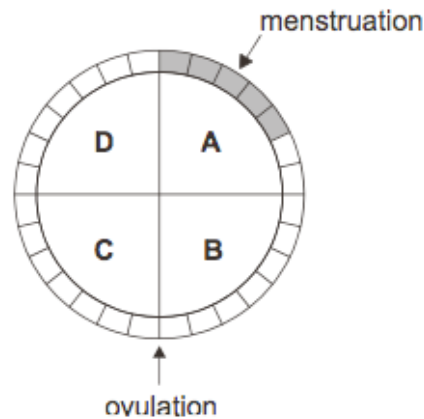
1 – ADH is a hormone and is released from the pituitary gland (brain) to act on the kidneys, so of course it travels in the bloodstream.

2 – ADH is **anti-diuretic**, and diuresis is the production of dilute urine. Therefore, an increase in ADH levels actually **decreases** the production of dilute urine and increases production of concentrated urine, so this is false.

3 – This is (2) reworded. ADH levels lead to increased formation of concentrated urine, not dilute urine, so this is false.

4 – If you had a reduced level of ADH, that means that more dilute urine would be produced, so more water would be lost in the urine. So yes, this could potentially lead to dehydration. True.

- 26 The diagram shows the menstrual (oestrus) cycle for a human female who is not pregnant.



During which period, **A**, **B**, **C** or **D**, will the concentration of oestrogen reach its highest level?

Because we are clever people and we now know what the concentrations of hormones throughout the menstrual cycle, this question is very easy. The cycle starts after the shaded “menstruation” bit and from the start until ovulation, oestrogen concentration increases. It will reach its highest point during **B**. After ovulation, as can be easily shown from the graph in the notes above, oestrogen concentration stays at a level lower than what it was before ovulation.

- 26 Which row of the table shows the roles of the female sex hormones in controlling the menstrual cycle?

	causes thickening of lining of uterus	maintains lining of uterus	causes break down of lining of uterus
A	fall in oestrogen concentration	low oestrogen concentration	rise in progesterone concentration
B	fall in progesterone concentration	low progesterone concentration	rise in oestrogen concentration
C	rise in oestrogen concentration	high progesterone concentration	fall in progesterone concentration
D	rise in progesterone concentration	high oestrogen concentration	fall in progesterone concentration
E	rise in oestrogen concentration	low progesterone concentration	rise in progesterone concentration
F	fall in progesterone concentration	high progesterone concentration	fall in oestrogen concentration

- Causes thickening of lining of uterus** – We know from the notes above, that an increase in oestrogen concentration during days 1-12 causes a thickening of the lining of the uterus.
- Maintains lining of the uterus** – Again, because we took a few minutes to learn what the menstrual hormones do, we know for a fact that high progesterone concentration (like after ovulation) is what maintains the lining of the uterus.

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- 3. Causes break down of lining of uterus** – Progesterone concentration falls towards the end of the cycle, and because the lining is no longer being maintained by it, the lining breaks down and menstruation occurs.

The answer is therefore **C**.
