6.6 Hormones, Homeostasis & Reproduction

Homeostasis

Define homeostasis

Homeostasis is the maintenance of a constant internal environment within physiological tolerance limits

Outline the role of negative feedback in homeostatic regulation

Feedback mechanisms involve a change being detected by a receptor and a response initiated by an effector

In negative feedback, the effect is antagonistic (opposite) to the stimulus

This means the detected change is reversed

List four conditions under homeostatic regulation

1. Body temperature (thermoregulation)
2. Blood glucose concentration
3. Carbon dioxide levels and blood pH
4. Water balance (osmoregulation)

Endocrine System

Define hormone

Chemical messengers released from endocrine glands into the bloodstream to act on specific target cells

Outline the role of thyroxin in body temperature regulation

Thermoreceptors (in skin) send signals to the hypothalamus and thyroxin is released from the thyroid gland

Thyroxin increases the basal metabolic rate (which generates heat)

When body temperature is low, thyroxin is released, and when temperature is high, thyroxin is not released

Outline the role of melatonin in controlling circadian rhythms

Photoreceptors detect light and send signals to the hypothalamus

Melatonin secretion from the pineal gland is inhibited by light exposure (hence, ⬆ melatonin levels at night)

High levels of melatonin promote sleep in diurnal animals (e.g. humans)

Outline the role of leptin in the control of appetite

Appetite suppression is regulated by the hormone leptin (secreted by adipose tissue)

Leptin binds to receptors in the hypothalamus to inhibit / suppress appetite (⬇ food intake = ⬇ weight gain)

Over-eating causes more adipose cells to be produced, so more leptin is released, leading to desensitisation

Outline the role of insulin and glucagon in the regulation of blood sugar levels

Blood glucose levels are regulated by pancreatic hormones: insulin (from β cells) and glucagon (from α cells)

Insulin lowers blood sugar levels by stimulating glycogen synthesis and increasing rate of glucose breakdown

Glucagon raises blood sugar levels by stimulating glycogen breakdown and decreasing glucose breakdown

Compare type I and type II diabetes

	Type I	**Type II**
Onset	Early onset (childhood)	Late onset (adulthood)
Effect	Body does not produce insulin	Body does not respond to insulin
Cause	β cells destroyed (autoimmune?)	Insulin receptors down-regulated
Treatment	Insulin injections	Dietary management

Reproduction

Outline the conclusions drawn from William Harvey's investigation into the sexual reproduction of deer

Understanding <u>before</u> Harvey:

According to the 'soil and seed' theory: A male 'seed' mixes with menstrual blood (soil) to form an egg that develops into a foetus

Understanding <u>after</u> Harvey:

According to Harvey: Menstrual blood does not contribute to the development of a foetus, but he was unable to detect the correct mechanism (viable light microscopes had not yet been invented)

Describe the genetic and hormonal factors responsible for sex development

Genetic Factors:

The sex chromosomes will determine sex: Females have XX, males have XY

Y chromosome contains SRY gene that causes gonads to develop into testes (in its absence, ovaries develop)

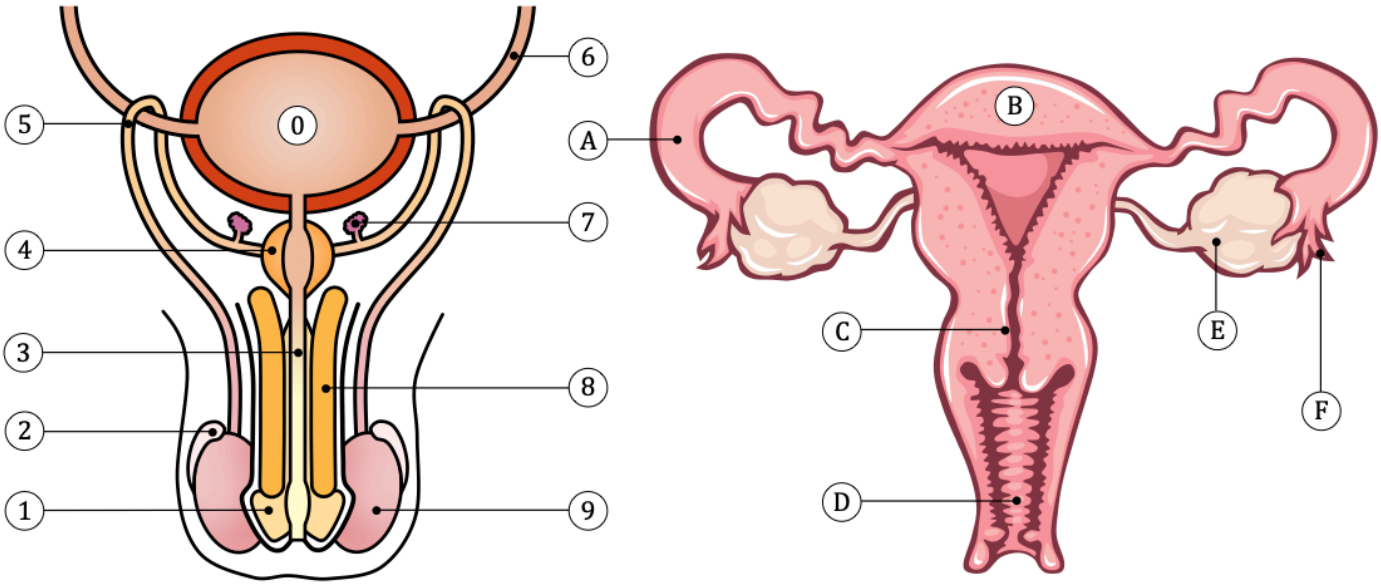
Hormonal Factors (Male):

The testes produce testosterone in order to develop the male sex characteristics (pre-natal development of male genitalia, production of sperm at onset of puberty and development of secondary sex characteristics)

Hormonal Factors (Female):

Ovaries make estrogen & progesterone to develop the female sex characteristics (pre-natal development of reproductive organs, development of secondary sex characteristics and maintenance of menstrual cycle)

Label the male and female reproductive systems



0. Bladder
1. Penis
2. Epididymis
3. Urethra
4. Prostate gland
5. Vas deferens
6. Ureter
7. Seminal vesicle
8. Erectile tissue
9. Testis

A. Oviduct / fallopian tube
B. Uterus
C. Endometrium
D. Vagina
E. Ovary
F. Fimbriae

Outline the roles of the menstrual hormones

Anterior Pituitary

FSH acts on ovaries to stimulates follicular growth and stimulates estrogen secretion (from follicles)

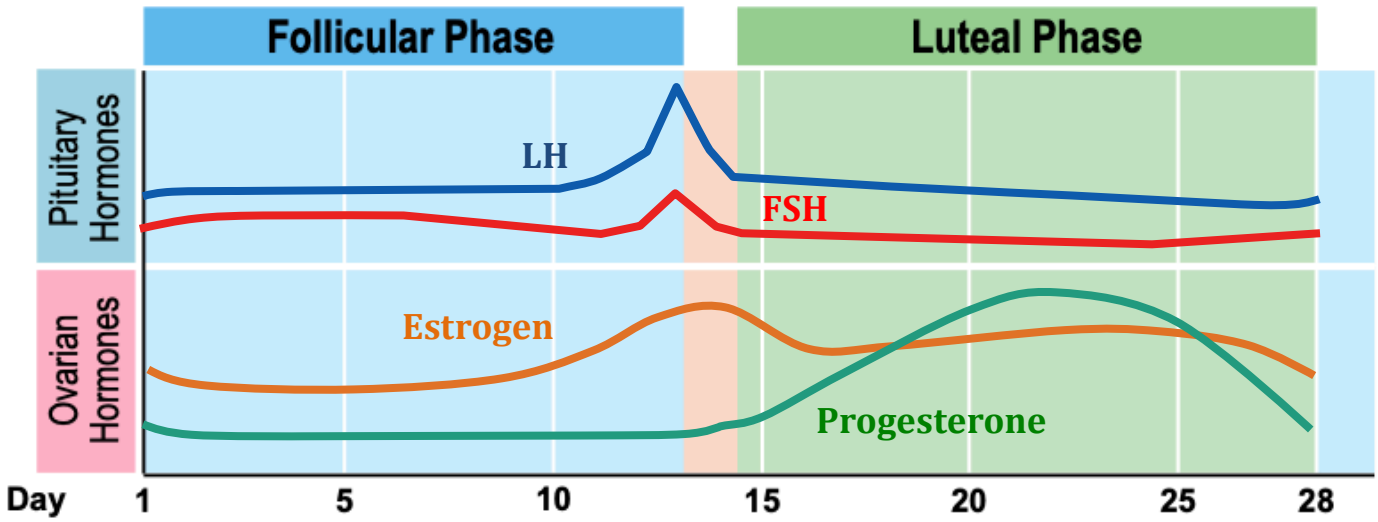
LH acts on ovaries to trigger ovulation, which results in a corpus luteum that produces progesterone

Ovaries

Estrogen and progesterone promote development and thickening of the endometrium

They stimulate FSH/LH secretion in the follicular phase and inhibit FSH/LH secretion in the luteal phase

Complete the diagram to show the changes in hormonal levels over the course of a menstrual cycle



Describe the key events of the menstrual cycle

1. Follicular Phase:

FSH stimulates growth of several follicles, the dominant follicle secretes estrogen which stops the growth of other follicles (⬇ FSH) and also stimulates endometrial development

2. Ovulation:

A surge in LH causes ovulation (egg release) and the rupturing of the follicle creates a corpus luteum

3. Luteal Phase:

Corpus luteum makes estrogen / progesterone, which stimulates endometrial growth and inhibits FSH / LH

Corpus luteum degrades over time, so estrogen /progesterone levels drop and endometrium is sloughed away

Outline the role of negative and positive feedback in the menstrual cycle

Negative Feedback

In the follicular and luteal phase, estrogen / progesterone inhibits FSH / LH production

This is an example of negative feedback as the response (estrogen production) is antagonistic to the stimulus (FSH / LH production)

Positive Feedback

During ovulation, estrogen stimulates LH / FSH production (leading to a surge)

This is an example of positive feedback as the response (estrogen production) promotes the stimulus (FSH / LH production) - positive feedback will cease when the follicle ruptures (ovulation)

Summarise the key steps required for in vitro fertilisation

S Stop menstrual cycle with drugs

H Hormone treatments (FSH triggers superovulation)

E Extract multiple eggs

S Sperm selection

F Fertilisation (in vitro)

I Implantation of embryos

T Test for pregnancy

Discuss the ethical issues regarding the use of IVF

Arguments <u>For</u> IVF

Chance for infertile couples to have children ; Screening of embryos could decrease suffering from genetic diseases ; Spare embryos can be stored for future pregnancies or used for research

Arguments <u>Against</u> IVF

IVF is expensive (access issues) and success rate is low (stressful) ; It could lead to eugenics ; Often leads to multiple pregnancies (extra risks) ; Issues concerning disposal of unused embryos (right to life concerns) ; Inherited forms of infertility may be passed on to children