Highsted Knowledge Organiser, Biology, Term 5, Year 10: Hormonal coordination 1

What I need to know

Principles of hormonal control
Control of blood glucose levels
Treating diabetes

Key Vocabulary:

adrenal gland, adrenaline, diabetes, endocrine system, glucagon, hormone, insulin, metabolic rate, negative feedback, pancreas, pituitary gland, thyroid gland, thyroxine

Challenge question: What is the difference between a nervous system response and a reflex arc

Suggested reading:

www.kerboodle.com
https://www.bbc.co.uk/bitesize/guides/zq4mk2p/revision/4

Human endocrine system

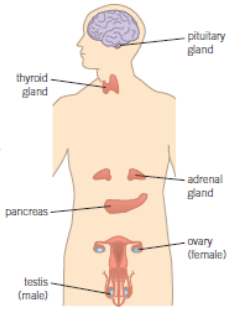
The **endocrine system** is composed of glands that secrete chemicals called **hormones** into the bloodstream.

The blood carries hormones to a target organ, where an effect is produced.

Compared to the nervous system, the effects caused by the endocrine system are slower but act for longer.

The **pituitary gland**, located in the brain, is known as a 'master gland', because it secretes several hormones into the blood.

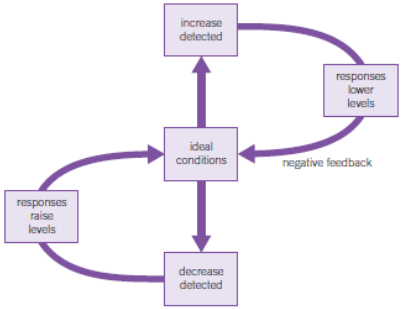
These hormones then act on other glands to stimulate the release of other hormones, and bring about effects.



Endocrine gland	Role of the hormones
Pituitary	• controls growth in children • stimulates the thyroid gland to make thyroxine to control the rate of metabolism • in females – stimulates the ovaries to produce and release eggs, and make oestrogen • in males – stimulates the testes to make sperm and testosterone
Thyroid	• controls the rate of metabolism in the body
Pancreas	• controls blood glucose levels
Adrenal	• prepares the body for stress • involved in the 'fight or flight' response
Ovaries	• controls the development of female secondary sexual characteristics • controls the menstrual cycle
Testes	• controls the development of male secondary sexual characteristics • involved in the production of sperm

Negative feedback (HT only)

Negative feedback systems work to maintain a steady state. For example, blood glucose, water, and **thyroxine** levels are all controlled in the body by negative feedback.



Adrenaline

- produced by **adrenal glands** in times of fear or stress
- increases heart rate
- boosts delivery of oxygen and glucose to brain and muscles
- prepares the body for 'fight or flight' response
- does not involve negative feedback, as adrenal glands stop producing **adrenaline**

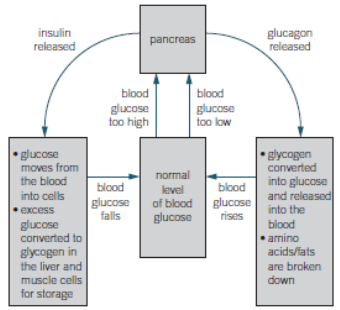
Thyroxine

- produced by the **thyroid gland**
- regulates how quickly your body uses energy and makes proteins (**metabolic rate**)
- important for growth and development
- levels controlled by negative feedback

Control of blood glucose levels

Blood glucose (sugar) concentration is monitored and controlled by the **pancreas**.

This is an example of negative feedback control, as the pancreas switches production between the hormones **insulin** and **glucagon** to control blood glucose levels.



Diabetes

Diabetes is a non-communicable disease where the body either cannot produce or cannot respond to insulin, leading to uncontrolled blood glucose concentrations.

Type 1 diabetes	Type 2 diabetes
early onset	usually later onset, obesity is a risk factor
pancreas stops producing sufficient insulin	body doesn't respond to the insulin produced
commonly treated through insulin injections, also diet control and exercise	commonly treated through a carbohydrate-controlled diet and exercise

Highsted Knowledge Organiser, Biology, Term 6, Year 10: Plant systems

What I need to know
Tissues and organs in plant
Transport systems in plants
Evaporation and transpiration
Factors affecting transpiration

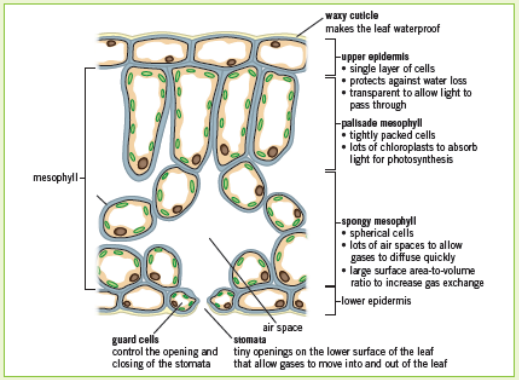
Key Vocabulary:
Photosynthesis
Stomata
Guard cells
Transpiration
Translocation
Light intensity
Temperature
Humidity
Wind speed
Phloem
Xylem

Challenge question:
How are transpiration and translocation processes connected to photosynthesis?

Suggested reading:
www.kerboodle.com
https://www.bbc.co.uk/bitesize/guides/zyk8msg/revision/1

Tissues in leaves

Leaves are organs because they contain many tissues that work together to perform photosynthesis.



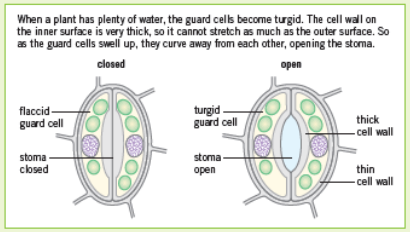
Stomata

Stomata are tiny openings in the undersides of leaves – this placement reduces water loss through evaporation.

They control gas exchange and water loss from leaves by:

- allowing diffusion of carbon dioxide into the plant for photosynthesis
- allowing diffusion of oxygen out of the plant.

Guard cells are used to open and close the stomata.

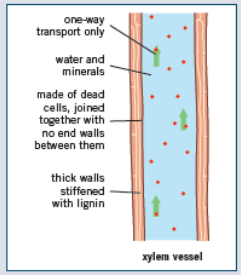


Transpiration

Description
Water is lost through the stomata by evaporation. This pulls water up from the roots through the **xylem** and is called transpiration. The constant movement of water up the plant is called the **transpiration stream**.

Importance
- provides water to cells to keep them **turgid**
- provides water to cells for photosynthesis
- transports mineral ions to leaves

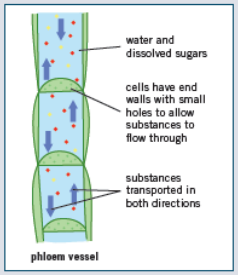
Specialised tissues



Translocation

The movement of dissolved sugars from the leaves to the rest of the plant through the **phloem**.

- moves dissolved sugars made in the leaves during photosynthesis to other parts of the plant
- this allows for respiration, growth, and glucose storage



Factors affecting the rate of transpiration

Factor	Effect on transpiration	Because...
temperature	higher temperatures *increase* the rate of transpiration	water evaporates faster in higher temperatures
humidity	lower humidity *increases* the rate of transpiration	the drier the air, the steeper the concentration gradient of water molecules between the air and leaf
wind speed	more wind *increases* the rate of transpiration	wind removes the water vapour quickly, maintaining a steeper concentration gradient
light intensity	higher light intensity *increases* the rate of transpiration	stomata open wider to let more carbon dioxide into the leaf for photosynthesis

Key terms

Make sure you can write a definition for these key terms.

photosynthesis stomata guard cells transpiration translocation
light intensity temperature humidity wind speed phloem xylem

Highsted Knowledge Organiser, Biology, Term 6, Year 10: Homeostasis in action

What I need to know

Controlling body temperature
Removing waste products
The human kidney
Dialysis- an artificial kidney
Kidney transplants

Key Vocabulary:

ADH, adrenal gland, adrenaline, coordination centres, dialysis, effectors, endocrine system, homeostasis, hormone, kidney tubule, metabolic rate, negative feedback, stimuli, thermoregulatory centre, urea, urine, vasoconstriction, vasodilation

Challenge question: Why is important to control temperature and water levels?

Suggested reading:

www.kerboodle.com

https://www.bbc.co.uk/bitesize/guides/zxgmfcw/revision/1

Homeostasis

Homeostasis is the regulation of internal conditions (of a cell or whole organism) in response to internal and external changes, to constantly maintain optimum conditions for functioning.

This maintains optimum conditions for all cell functions and enzyme action.

In the human body, this includes control of

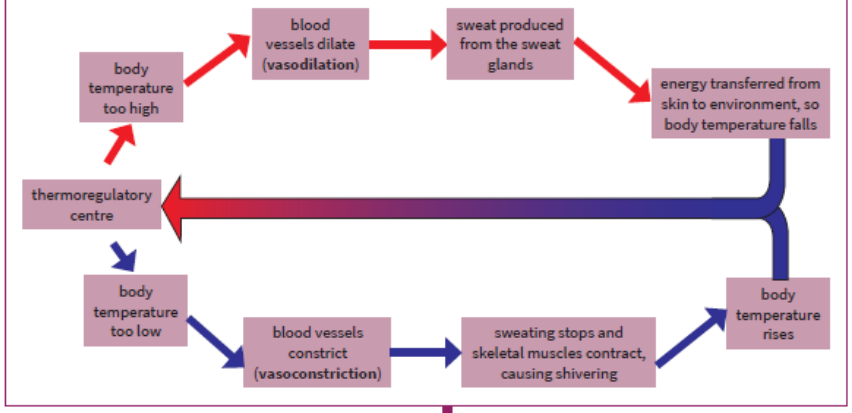
- blood glucose concentration
- body temperature
- water levels.

The automatic control systems of homeostasis may involve nervous responses or chemical responses.

All control systems involve

- receptor cells, which detect **stimuli** (changes in the environment)
- **coordination centres** (such as the brain, spinal cord, and pancreas), which receive and process information from receptors
- **effectors** (muscles or glands), which produce responses to restore optimum conditions.

Control of body temperature



Body temperature is monitored and controlled by the **thermoregulatory centre** in the brain. The centre contains receptors sensitive to the blood temperature.

The skin also contains temperature receptors and sends nervous impulses to the thermoregulatory centre.

Maintaining water and nitrogen balance

Water leaves the body through the lungs during exhalation, and water, ions, and **urea** are lost from the skin in sweat. The body has no control over these losses.

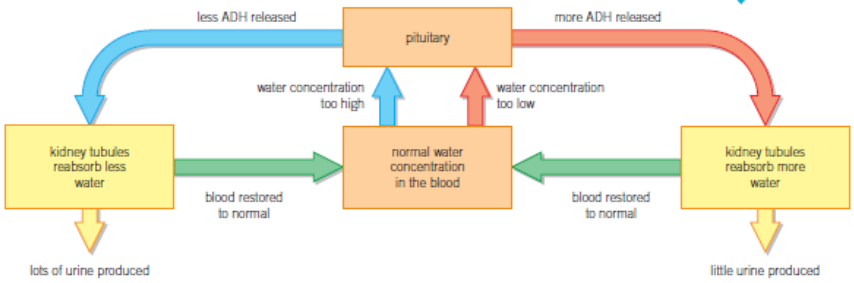
Excess water, ions, and urea are removed by the kidneys in **urine**.

Levels of water in the body must be balanced because cells do not function efficiently if they lose or gain too much water.

The kidneys produce urine by filtration of the blood and selective reabsorption of useful substances such as water, glucose, and some ions.

The water level in the blood is controlled through this process by the hormone **ADH**, which affects the amount of water absorbed by the **kidney tubules**.

This is a **negative feedback cycle**.



People who suffer from kidney failure may be treated by organ transplants or kidney **dialysis**.

Process of kidney dialysis

- blood temporarily removed from patient's body
- filtered through a dialysis machine
- patient's blood passes over dialysis fluid
- dialysis fluid has no urea
- urea and waste products diffuse from high concentration in patient's blood to low concentration in dialysis fluid
- patient's blood then returned to their body

Waste products

The digestion of proteins from food results in excess amino acids, which need to be excreted safely.

These amino acids are deaminated in the liver to form ammonia.

Ammonia is toxic, so it is immediately converted to urea for safe excretion.

Highsted Knowledge Organiser, Biology, Term 6, Year 10: Hormonal coordination 2

What I need to know

Human reproduction
Hormones and the menstrual cycle
Artificial control of fertility
Infertility treatments
Plant hormones and responses
Using plant hormones

Key Vocabulary:

Auxin, contraception, follicle stimulating hormone, gravitropism, infertility, in vitro fertilisation, oestrogen, ovary, luteinising hormone, menstrual cycle, ovulation, phototropism, progesterone, testes, uterus

Challenge question: How are specific fertility treatments designed to address specific issues in the menstrual cycle?

Suggested reading:

www.kerboodle.com

https://www.bbc.co.uk/bitesize/guides/zcnp7p3/revision/2

https://www.bbc.co.uk/bitesize/guides/zc6cqhv/revision/5

Hormones in human reproduction

During puberty, reproductive hormones cause the secondary sex characteristics to develop:

Oestrogen

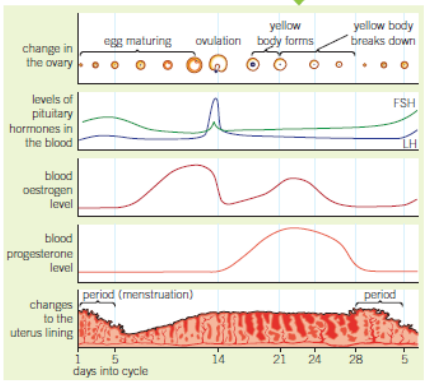
- main female reproductive hormone
- produced in the **ovary**
- at puberty, eggs begin to mature and one is released every ~28 days

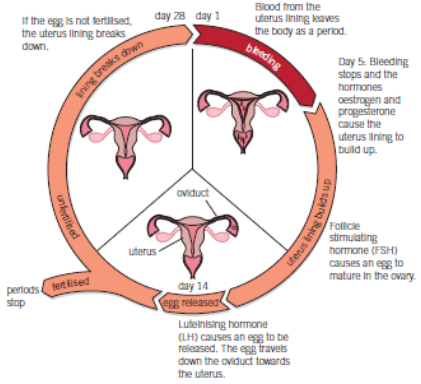
Testosterone

- main male reproductive hormone
- produced by the **testes**
- stimulates sperm production

The menstrual cycle

Hormone	Released by	Function
follicle stimulating hormone (FSH)	pituitary gland	• causes eggs to mature in the ovaries • stimulates ovaries to produce oestrogen
luteinising hormone (LH)	pituitary gland	• stimulates the release of mature eggs from the ovaries (**ovulation**)
oestrogen	ovaries	• causes lining of uterus wall to thicken • inhibits release of FSH • stimulates release of LH
progesterone	ovaries	• maintains thick uterus lining • inhibits release of FSH and LH





Treating infertility with hormones (HT only)

Hormones are used in modern reproductive technologies to treat **infertility**.

FSH and LH can be given as a drug to treat infertility, or **in vitro fertilisation** (IVF) treatment may be used.

IVF treatment

1. mother given FSH and LH to stimulate the maturation of several eggs
2. eggs collected from the mother and fertilised by sperm from the father in a laboratory
3. fertilised eggs develop into embryos
4. one or two embryos are inserted into the mother's **uterus** (womb) when the embryos are still tiny balls of cells

Fertility treatment has some disadvantages:

- it is emotionally and physically stressful
- it has a low success rate
- it can lead to multiple births, which are a risk to both the babies and the mother.

Contraception

Fertility can be controlled by a variety of hormonal and non-hormonal methods of **contraception**.

Hormonal contraception

- oral contraceptives – contain hormones to inhibit FSH production so no eggs mature
- injection, implant, skin patch, or intrauterine devices (IUD) – slowly release progesterone to inhibit maturation and release of eggs; can last months or years

Non-hormonal contraception

- barrier methods, for example, condoms and diaphragms – prevent sperm reaching the egg
- copper IUD – prevents the implantation of an embryo
- surgical methods of male and female sterilisation
- spermicidal agents – kill or disable sperm
- abstaining from intercourse when an egg may be in the oviduct

Plant hormones

A plant's response can be known as **phototropism**, when the shoots bend towards light, and **gravitropism** when the root moves towards gravity. The responses are controlled by the hormone **auxin**. In phototropism, auxin moves from the side of the shoot with light to the unlit side, meaning the cells on that side will grow more. In gravitropism, high levels of auxin means that the growth of root cells in inhibited.

(HT only) **Gibberellins** are also plant hormones which begin the process of seed germination by breaking down the food stores in the seeds and stimulate the growth of stems. Ethene is another hormone which controls cell division.