7 - Animal coordination, control and homeostasis

Edexcel GCSE Biology Revision Notes

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How to use these notes

These notes cover everything you need to know for this part of the specification. They have been written in question-answer format to make them easier for you to study from.

In order to study successfully, I recommend you do the following for each question and answer:

- Read it carefully and make sure you **understand** it.
- **Memorise** the answer.
- **Practice** applying your understanding to past exam questions.

A good way to memorise information is to use **retrieval practice**. This is when you practise retrieving information from your memory. You could do this by making a flashcard for each question with the question on one side and the answer on the other. Or you could use a flashcard app. Alternatively, use a sheet of paper to cover up the answer so you can only see the question. Try to answer the question and then check how you did.

You should practise retrieving each answer from your memory until you can do it perfectly. Even once you can retrieve the answer perfectly, your ability to retrieve it will probably fade as time passes without practising. Therefore you will need to keep going back to the questions that you have previously mastered and practising them again. However, each time you re-learn the answer, the memory will be stronger and will last longer than the time before.

Hormones in humans

7.1

What is a hormone?
A hormone is a signalling molecule that is released within a multicellular organism and travels to specific locations within the organism where it stimulates changes to take place.

In the human body, where are hormones produced?
In the human body, hormones are produced in a group of glands called the endocrine glands.

What are some of the endocrine glands in the human body?
The endocrine glands in the human body include the pituitary gland, the thyroid gland, the pancreas, the adrenal glands, the ovaries and the testes.

Where is the pituitary gland located?
The pituitary gland is located at the base of the brain.

Name three hormones produced in the pituitary gland.
FSH, LH and TSH are produced in the pituitary gland.

Where is the thyroid gland located?
The thyroid gland is located in the neck.

Name one hormone produced in the thyroid gland.
Thyroxine is produced in the thyroid gland.

Where is the pancreas located?
The pancreas is located in the abdomen, just behind the stomach.

Name two hormones produced in the pancreas.
Insulin and glucagon are produced in the pancreas.

Where are the adrenal glands located?
The adrenal glands are located on top of the kidneys. There are two adrenal glands - one on top of each kidney.

Name one hormone produced in the adrenal glands.
Adrenaline is produced in the adrenal glands.

Where are the ovaries located?
The ovaries are located within the female reproductive system. There are two ovaries - one on each side of the uterus.

Name two hormones produced in the ovaries.
Oestrogen and progesterone are produced in the ovaries.

Where are the testes located?
The testes are located within the male reproductive system. There are two testes and they are both located within the scrotum.

Name one hormone produced in the testes.
Testosterone is produced in the testes.

What is the name for the organs that a hormone has its effects on?
The organs that a hormone has its effects on are referred to as the target organs of that hormone.

How do hormones get from the endocrine glands that produce them to their target organs?
Endocrine glands secrete hormones into the bloodstream. The hormones then travel around the body in the bloodstream, passing through all the different organs. The target organs of a particular hormone have receptors for that hormone. Once a hormone reaches one of its target organs, some of the hormone molecules bind to the receptors, which stimulates changes to take place in the target organ.

Beyond the syllabus: Oestrogen, Progesterone and Testosterone

Most GCSE Biology textbooks state that females have oestrogen and progesterone and males have testosterone. However, this is very misleading. In fact, all humans have all three of these hormones.

I have not included this information in the questions and answers above since it is unlikely to come up in a GCSE exam, but I am explaining it here for anyone who wants to get a more accurate understanding of these three hormones.

Both ovaries and testes produce all three of the hormones. Therefore, every human has all of them, regardless of whether they have ovaries or testes - or both, or combined ovaries and testes called ovotestes, as is the case for some some intersex people (people whose bodies cannot be easily classified as male or female).

Oestrogen, progesterone and testosterone all play important roles in every human body. However, the relative concentrations of the three hormones and the roles they play do differ depending on sex.

7.2

What is adrenaline?
Adrenaline is a hormone produced by the adrenal glands and is released in response to dangerous or stressful situations. It prepares the body for ‘fight or flight’ (fighting another organism or running away).

What changes does adrenaline stimulate in the body?
Adrenaline stimulates the following changes in the body:

- Increased heart rate
- Increased blood pressure
- Increased blood flow to the muscles
- An increased rate at which the liver converts glycogen to glucose, resulting in an increased blood glucose concentration.

7.3

What is metabolic rate?
Metabolic rate is the rate at which the body uses energy. It depends on the rate at which energy-transferring reactions take place within the body.

What is thyroxine?
Thyroxine is a hormone released from the thyroid gland. It causes the metabolic rate to increase.

What stimulates the thyroid gland to produce thyroxine?
The hypothalamus (part of the brain) produces and releases a hormone called TRH. TRH stimulates the pituitary gland to release a hormone called TSH. TSH stimulates the thyroid gland to produce thyroxine.

What happens when there is a high concentration of thyroxine in the blood?
A high concentration of thyroxine in the blood inhibits (prevents) the release of TRH from the hypothalamus and the production of TSH in the pituitary gland. This then leads to a reduction in the amount of thyroxine produced, so the concentration of thyroxine in the blood falls.

What happens when there is a low concentration of thyroxine in the blood?
A low concentration of thyroxine in the blood stimulates the production of TRH in the hypothalamus. This leads to more TSH being released from the pituitary gland, which then leads to more thyroxine being produced by the thyroid gland. Therefore, the concentration of thyroxine in the blood rises.

What is negative feedback?
Negative feedback is when a change in a system causes further changes that reverse the original change. For example, if an increase in the concentration of a substance causes changes which decrease the concentration of the substance. Negative feedback is used within organisms to keep conditions within certain limits.

In what way is the control of the concentration of thyroxine in the blood an example of negative feedback?
The control of the concentration of thyroxine in the blood is an example of negative feedback because an increase in the concentration of thyroxine causes changes which reduce the concentration of thyroxine, and a decrease in the concentration of thyroxine causes changes which increase the concentration of thyroxine. This keeps the concentration of thyroxine within certain limits.

The menstrual cycle and reproduction in humans

7.4

What is the menstrual cycle?
The menstrual cycle is a repeating series of changes that take place within the female reproductive system, beginning at puberty and continuing until around the age of 50.

What are the two main parts of the female reproductive system that are involved in the menstrual cycle?
The ovaries and the uterus (womb) are the two main parts of the female reproductive system involved in the menstrual cycle.

What are ovaries?
Ovaries are structures within the female reproductive system that produce egg cells. There are two ovaries - one on each side of the uterus. Each ovary is connected to the uterus by a tube called a fallopian tube.

What happens to the egg cells that are produced in the ovaries?
Once in every menstrual cycle, one of the two ovaries releases an egg cell. This process is called ovulation. The egg cell then begins travelling along the fallopian tube towards the uterus. If sperm cells are present (e.g. as a result of having vaginal sex), one of the sperm cells may fertilise the egg cell. If the egg cell is not fertilised, it will pass out of the body during menstruation.

What happens to a fertilised egg cell?
When an egg cell and a sperm cell fuse during fertilisation, they form a cell called a zygote. The menstrual cycle stops and pregnancy begins. The zygote develops into an embryo, which then implants into the lining of the uterus. The embryo then develops into a foetus, which then continues to develop until it is born, at which point it becomes a baby.

What is the uterus?
The uterus (also known as the womb) is a structure within the female reproductive system. It is where an embryo develops into a foetus and then continues developing until it is born.

How long does the menstrual cycle last?
The length of the menstrual cycle varies but the average length is around 28 days.

What is menstruation?
Menstruation (also known as a period) is a process which takes place at the beginning of each menstrual cycle. During menstruation, the lining of the uterus breaks down. Blood and other tissue from the broken down uterus lining then passes out of the body through the vagina, along with the unfertilised egg from the previous ovulation.

How long does menstruation typically last?
Menstruation varies in length, but it typically lasts about 5 days.

What happens in the menstrual cycle after menstruation?
After menstruation (on around day 6 of the menstrual cycle), the uterus lining starts to thicken again. On around day 14, ovulation takes place - this is when an egg cell is released from one of the ovaries. The uterus lining then continues to thicken and the egg cell travels through the fallopian tube towards the uterus. If the egg cell is not fertilised, the cycle will begin again with menstruation after about day 28.

What part of the menstrual cycle does oestrogen stimulate?
Oestrogen stimulates the uterus lining to build up.

What part of the menstrual cycle does progesterone stimulate?
Progesterone stimulates the growth of blood vessels within the uterus lining.

7.5

What are FSH and LH?
FSH and LH are hormones produced by the pituitary gland which have roles in controlling the menstrual cycle.

What part of the menstrual cycle does FSH stimulate?
FSH stimulates egg cells to develop within the ovaries.

What part of the menstrual cycle does LH stimulate?
LH stimulates ovulation (the release of an egg cell from one of the ovaries).

How do oestrogen, progesterone, FSH and LH interact with each other?
FSH stimulates the ovaries to produce oestrogen.
LH stimulates the ovaries to produce progesterone.
Oestrogen stimulates the pituitary gland to produce less FSH and more LH.

How do oestrogen, progesterone, FSH and LH work together to control the menstrual cycle?
At the beginning of the menstrual cycle, levels of all four hormones are low.

Then levels of FSH begin to rise.

This stimulates egg cells to develop within the ovaries and causes an increase in the level of oestrogen.

Increasing oestrogen levels stimulate the lining of the uterus to build up and lead to a decrease in the level of FHS and an increase in the level of LH.

Increased levels of LH stimulate ovulation to take place and lead to an increase in the level or progesterone.

The increased level of progesterone stimulates the growth of blood vessels within the uterus lining.

7.6

What is contraception?
Contraception is any method used to prevent pregnancy from occurring during sex.

What is hormonal contraception?
Hormonal contraception is contraception that works by taking hormones into the body which prevent pregnancy from occurring. At the moment, hormonal contraception is only available for women, but there are forms of hormonal contraception being developed for men.

Which hormones are used in hormonal contraception?
Some types of hormonal contraception contain just a progesterone-like hormone.
Other types of hormonal contraception contain a progesterone-like hormone and oestrogen.

What forms can hormonal contraception come in?
Hormonal contraception can come in several different forms including pills, implants under the skin, injections, patches, vaginal rings and IUDs (devices inserted into the uterus).

How does hormonal contraception work?
Hormonal contraception works in the following ways:

- Preventing ovulation so that there is no egg for sperm cells to fuse with.
- Preventing the uterus lining from building up, so that any embryos that are formed are unable to implant into the uterus lining.
- Causing the mucus at the entrance of the uterus (the cervix) to become thicker and stickier, so it is harder for sperm to enter the uterus.

7.7

What is barrier contraception?
Barrier contraception is contraception that prevents pregnancy by using a physical barrier to prevent sperm from entering the uterus.

What are some common types of barrier contraception?
Common types of barrier contraception include male condoms, female condoms and diaphragms.

What is a male condom?
A male condom is a barrier placed over the penis during sex. It prevents pregnancy by preventing sperm from entering the uterus. It also prevents the spread of sexually transmitted infections (STIs).

What is a female condom?
A female condom is a barrier inserted into the vagina during sex. The open end of the female condom stays outside the vagina and covers the external female genitals (the vulva). It prevents pregnancy by preventing sperm from entering the uterus. It also prevents the spread of STIs.

What is a diaphragm?
A diaphragm is a barrier inserted into the vagina and positioned so that it covers the cervix (the entrance to the uterus) during sex. It prevents pregnancy by preventing sperm from entering the uterus. It also provides some protection against STIs, although not as much as male and female condoms.

What are some of the advantages of barrier contraception over hormonal contraception?
Some advantages of barrier contraception over hormonal contraception are:

- Barrier contraception helps to prevent STIs and pregnancy, whereas hormonal contraception only helps to prevent pregnancy.
- Barrier contraception only has to be used when having sex, whereas hormonal contraception requires the hormones to be in the body all the time.
- Barrier contraception has a much lower risk of having side-effects on the body, whereas hormonal contraception has a higher risk of side-effects.

What is the main advantage of hormonal contraception over barrier contraception?
The main advantage of hormonal contraception over barrier contraception is that it has a higher success rate at preventing pregnancy.

7.8

What is assisted reproductive technology (ART)?
Assisted reproductive technology (ART) is a set of medical procedures used to help people become pregnant.

What are some forms of ART?
Forms of ART include IVF and clomifene therapy.

What is IVF?
IVF (in vitro fertilisation) is a form of ART that involves creating an embryo outside of the body (in a laboratory) and then inserting it into the uterus. The steps are as follows:

- Hormones are given to the woman to stimulate egg cells to mature.
- Once egg cells are released, they are collected from the woman's body.
- Sperm cells are collected from a man.
- The egg cells and sperm cells are fused in a laboratory to create embryos.
- One or more embryos are placed in the woman's uterus.

What is clomifene therapy?
Clomifene therapy is a form of ART used with women who do not ovulate. It involves giving them a drug called clomifene which causes increased concentrations of FSH and LH in their blood, which causes ovulation, allowing them to get pregnant.

Homeostasis

7.9

What is a constant internal environment?
A constant internal environment is when the conditions within an organism are kept within narrow limits.

What are some aspects of the internal environment that are kept constant in the human body?
Some aspects of the internal environment that are kept constant in the human body are:

- Body temperature
- Blood glucose concentration
- Blood solute concentration

Why is it important for organisms to maintain a constant internal environment?
A constant internal environment allows processes within the body to take place normally.

What does the body need to monitor in order to maintain a constant internal environment?
In order to maintain a constant internal environment, the body needs to monitor any changes in internal or external conditions (conditions inside or outside the body). If any changes take place, the body will need to respond to them.

7.10B

What is homeostasis?
Homeostasis is the process of maintaining a constant internal environment in response to internal and external change.

Give two examples of homeostasis.
Two examples of homeostasis are thermoregulation and osmoregulation.

What is thermoregulation?
Thermoregulation is the process of maintaining a constant body temperature.

Why is thermoregulation important?
Thermoregulation is important because body temperature must be kept within narrow limits in order for enzyme-controlled chemical reactions within the body to function properly. If the temperature is too low, the reactions will happen too slowly. If the temperature is too high, the enzymes will become denatured which will prevent the reactions from happening.

What is osmoregulation?
Osmoregulation is the process of maintaining a constant blood solute concentration (in other words, it is the process of keeping the concentration of substances dissolved in the blood constant).

Why is osmoregulation important?
Osmoregulation is important because the concentration of solutes (dissolved substances) in the blood affects the amount of water that moves by osmosis from the blood into the cells or from the cells into the blood.

If the concentration of solutes in the blood is too low, then too much water will move into the cells from the blood by osmosis, causing the cells to swell up.

If the concentration of solutes in the blood is too high, then too much water will move out of the cells into the blood by osmosis, causing the cells to shrink.

Extra explanation: Osmosis

Osmosis is a very complicated concept which most GCSE students find difficult to understand. Therefore, I am including a little extra explanation here to help you understand the information above.

For a much more detailed explanation with diagrams, see the Mooramo GCSE Biology course: https://www.mooramo.com/courses/5f85db1d28a3180017d6e5ff

First, a quick reminder of some key terms:

Solution
A mixture made up of one or more substances dissolved in another substance. Blood is an example of a solution. The cytoplasm of cells is another example.

Solute
One of the dissolved substances in a solution.

Solvent
The substance that the solutes are dissolved in. In biology, this is usually water.

Partially permeable membrane
A partially permeable membrane is one which allows the solvent (e.g. water) to pass through it but does not allow all of the solutes dissolved in it to pass through. Cell membranes are usually partially permeable.

Osmosis happens when two solutions with different solute concentrations are separated by a partially permeable membrane.

Water always moves by osmosis from the side with the lower solute concentration to the side with the higher solute concentration.

Therefore, if the blood has a very low solute concentration, the solute concentration in the blood will be lower than the solute concentration in the cytoplasm of the cells. This will cause water to move by osmosis from the blood into the cells.

If the blood has a very high solute concentration, the solute concentration in the cytoplasm of the cells will be lower than the solute concentration in the blood. This will cause water to move by osmosis from the cells into the blood.

Thermoregulation

7.11B

At what temperature is the inside of the human body usually maintained?
The inside of the human body is usually maintained at a temperature of approximately 37°C.

What are the two main layers of human skin?
The two main layers of human skin are the dermis and the epidermis.

How are the dermis and the epidermis arranged?
The dermis is the much thicker inner layer of the skin. The epidermis is the thinner outer layer which covers the dermis.

What is the hypothalamus?
The hypothalamus is a structure within the brain which coordinates many processes of homeostasis, including thermoregulation.

How does the body monitor the external temperature (the temperature of the surroundings)?
The dermis contains temperature receptors which measure the temperature of the skin, which gives an indication of the temperature of the surroundings. This information is sent (along sensory neurones) to the hypothalamus.

How does the body monitor the internal temperature (the temperature of the inside of the body)?
The hypothalamus measures the temperature of the blood passing through it. This allows it to monitor the internal temperature of the body.

What is sweating?
Sweating is one of the processes that the body uses to cool down when it is too hot. Sweating involves secreting a solution called sweat onto the epidermis. The sweat evaporates from the epidermis, carrying heat away from the body as it leaves. This helps to cool the body down.

How are hairs in the skin involved in thermoregulation?
The skin is covered in hairs. There are muscles within the dermis called erector muscles, which are attached to these hairs. When the body is too cold, the erector muscles contract, causing the hairs to stand erect. When the body is too warm, the erector muscles relax, causing the hairs to lie flat. When the hairs stand erect, they trap a layer of air, which insulates the body. However, the size of this effect is much smaller in humans than in many other mammals because humans are not very hairy.

How does the hypothalamus coordinate thermoregulation?
The hypothalamus uses the information about internal and external temperature to determine whether the body is becoming too hot or too cold. It then sends out signals to other parts of the body to stimulate processes that prevent the temperature from falling too low or rising too high.

What kinds of processes does the hypothalamus stimulate if the body temperature is falling too low?
If the hypothalamus detects that body temperature is falling too low, it sends out signals that cause changes in the body including:

- Starting shivering [Note: this is explained below]
- Contraction of erector muscles, causing hairs to stand erect
- Vasoconstriction [Note: this is explained below]
- Stopping sweating

What kinds of processes does the hypothalamus stimulate if the body temperature is rising too high?
If the hypothalamus detects that the body temperature is rising too high, it sends out signals that cause changes in the body including:

- Starting sweating
- Vasodilation [Note: this is explained below]
- Relaxation of erector muscles, causing hairs to lie flat
- Stopping shivering [Note: this is explained below]

7.12B

What is shivering?
Shivering is a rapid contraction of the muscles in order to generate heat.

What is vasoconstriction?
Vasoconstriction is when blood vessels close to the skin constrict (get narrower), reducing the volume of blood flowing close to the surface of the body. This reduces heat loss from the body to the surroundings.

What is vasodilation?
Vasoconstriction is when blood vessels close to the skin dilate (get wider), increasing the volume of blood flowing close to the surface of the body. This increases heat loss from the body to the surroundings.

Control of blood glucose concentration and diabetes

7.13

What is glucose?
Glucose is a sugar.

What is blood glucose concentration?
Blood glucose concentration is the concentration of glucose in the blood.

How does glucose enter the body?
Glucose enters the body through food. Many foods contain glucose. Many foods also contain other sugars or complex carbohydrates which the body breaks down in the process to digestion to produce glucose. Glucose is absorbed from the small intestine into the bloodstream.

What does the body use glucose for?
The body uses glucose in two ways:

- Some glucose is used in respiration as a source of energy.
- Some glucose is used as a building block for making other molecules that the body needs.

Why does the body need to keep blood glucose concentration within narrow limits?
If blood glucose concentration is not kept within narrow limits, a wide range of health problems can result.

What happens to excess glucose that the body does not need?
The body converts excess glucose that it does not need into a complex carbohydrate called glycogen. Glycogen is stored in the liver and muscles. It can be broken down into glucose when the body needs it.

What is insulin?
Insulin is a hormone which the pancreas produces and secretes into the bloodstream. It plays an important role in controlling blood glucose concentration.

Under what conditions does the pancreas release insulin?
The pancreas releases insulin when the blood glucose concentration is too high (e.g. after a large meal is eaten).

What are insulin's target organs?
Insulin's target organs are the liver and the muscles.

What changes does insulin stimulate in its target organs?
Insulin stimulates the liver and muscles to absorb more glucose from the bloodstream and convert it to glycogen. This causes the blood glucose concentration to decrease.

7.14

What is glucagon?
Glucagon is a hormone which the pancreas produces and secretes into the bloodstream. It plays an important role in controlling blood glucose concentration.

Under what conditions does the pancreas release glucagon?
The pancreas releases glucagon when the blood glucose concentration is too low (e.g. after several hours without eating).

What is glucagon's target organ?
Glucagon's target organ is the liver.

What changes does glucagon stimulate in its target organ?
Glucagon stimulates the liver to break glycogen down into glucose and release it into the bloodstream. This causes the blood glucose concentration to increase.

7.15

What is diabetes?
Diabetes is a medical condition in which the body is unable to properly regulate the blood glucose concentration.

What are the different types of diabetes?
There are two types of diabetes. They are called type 1 diabetes and type 2 diabetes.

What is type 1 diabetes?
Type 1 diabetes is caused by the body's immune system attacking and destroying the cells in the pancreas that produce insulin. This means that the body can no longer produce enough insulin, which results in the blood glucose concentration becoming dangerously high.

How is type 1 diabetes treated?
Type 1 diabetes is treated with regular injections of insulin into the body. A carefully controlled diet can also help to regulate blood glucose concentration.

7.16

What is type 2 diabetes?
Type 2 diabetes is when the cells in the pancreas stop producing enough insulin, or the target tissues (liver and muscles) become less responsive to insulin, or a combination of both of these.

How is type 2 diabetes treated?
Type 2 diabetes is treated by eating a carefully controlled diet (e.g. avoiding sugary foods and drinks) and by exercising. Some people with type 2 diabetes eventually also require insulin injections.

7.17

What are the main ways of assessing a person's body mass?
The two main ways of assessing a person's body mass are:

- Calculating their body mass index (BMI)
- Calculating their waist:hip ratio

How is body mass index calculated?
Body mass index (BMI) is calculated using the following formula:

$$BMI = \frac{mass\ (kg)}{(height\ (m))^2}$$

How is waist:hip ratio calculated?
Waist:hip ratio (pronounced 'waist to hip ratio') is calculated by dividing the distance around the person's waist by the distance around their hips.

Waist:hip ratio = distance around waist (cm) ÷ distance around hips (cm)

How are BMI and waist:hip ratio related to type 2 diabetes?
BMI and waist:hip ratio are both correlated with type 2 diabetes.

In other words, type 2 diabetes is more common among people with high BMIs than it is among people with low BMIs, and it is also more common among people with high waist:hip ratios than it is among people with low waist:hip ratios.

The urinary system

7.18B

What is urine?
Urine is a solution produced within the bodies of humans and many other animals. It is made up of water with various other substances dissolved in it. It is removed from the body through the process of urination - which is an example of excretion.

What are some of the purposes of urination?
The purposes of urination include:

- Removing excess water from the body
- Removing excess salts from the body
- Removing urea, a toxic waste product, from the body
- Regulating the concentration of solutes in the blood (osmoregulation)

What is the urinary system?
The urinary system is the organ system that produces urine and removes it from the body.

Which organs and other structures make up the urinary system?
The urinary system is made up of the kidneys, the ureters, the bladder and the urethra.

What are the kidneys?
The kidneys are a pair of organs that filter the blood, removing some water and other substances from it. The mixture of substances that the kidneys remove from the blood forms the urine. The urine then leaves the kidneys through the ureters.

What are the ureters?
The ureters are a pair of tubes that carry urine from the kidneys to the bladder. There is one ureter connected to each kidney.

What is the bladder?
The bladder is the organ that stores urine before it is removed from the body through the process of urination. The ureters bring urine to the bladder from the kidneys. Urine leaves the bladder through the urethra.

What is the urethra?
The urethra is the tube that carries urine from the bladder out of the body during urination.

What structures within the kidneys produce urine?
The kidney contains tiny structures called nephrons. It is the nephrons that filter the blood to produce urine.

How many nephrons are in a typical human kidney?
A typical human kidney contains over a million nephrons.

7.19B

What are the main parts of a nephron?
The main parts of a nephron are:

- The Bowman's capsule
- The glomerulus
- The proximal convoluted tubule
- The loop of Henle
- The distal convoluted tubule
- The collecting duct

What is the Bowman's capsule?
The Bowman's capsule is a hollow, cup-shaped structure located at the start of the nephron. It contains the glomerulus. The Bowman's capsule drains into the proximal convoluted tubule.

What is the glomerulus?
The glomerulus is a bundle of capillaries within the nephron. It is surrounded by the Bowman's capsule.

Extra Explanation: the meanings of the words 'tubule', 'convoluted', 'proximal' and 'distal'

The words 'tubule', 'convoluted', 'proximal' and 'distal' are used a lot in the answers to the next few questions. Knowing the meanings of these words will make the answers easier to remember.

Tubule
A narrow tube.

Convoluted
Highly folded.

Proximal
Nearby

Distal
Far away

The proximal convoluted tubule gets its name because it is the highly folded narrow tube which is closest to the start of the nephron.

The distal convoluted tubule gets its name because it is the highly folded narrow tube which is furthest from the start of the nephron.

What is the proximal convoluted tubule?
The proximal convoluted tubule (PCT) is a narrow, highly-folded tube within the nephron. Fluid from the Bowman's capsule drains into the PCT. The fluid flows through the PCT and then into the loop of Henle.

What is the loop of Henle?
The loop of Henle is a narrow tube within the nephron. It is a U-shaped loop. Fluid from the PCT flows through the loop of Henle and then into the distal convoluted tubule.

What is the distal convoluted tubule?
The distal convoluted tubule (DCT) is a narrow, highly folded tube within the nephron. Fluid from the loop of Henle flows through the DCT and then into the collecting duct.

What is the collecting duct?
The collecting duct is a narrow tube within the nephron. Fluid from the DCT flows into the collecting duct. All of the collecting ducts in the kidney flow into the ureter that is attached to that kidney.

What are the two main stages in the process of forming urine?
The two main stages in the process of forming urine are filtration and selective reabsorption.

What happens in the filtration stage of forming urine?
During the filtration stage of forming urine, the following things happen:

- As the blood flows through the glomerulus, some of the water from the blood and some of the substances dissolved in the water are squeezed out of the glomerulus into the Bowman's capsule.
- This fluid then flows into the proximal convoluted tubule.

What substances are filtered out of the blood in the glomerulus and into the Bowman's capsule?
The following substances are filtered out of the blood in the glomerulus and into the Bowman's capsule:

- Some of the water from the blood
- Some of the glucose from the blood
- Some of the urea from the blood
- Some of the salts from the blood

What happens during the selective reabsorption stage of forming urine?
During the selective reabsorption stage of forming urine, the following things happen:

- The fluid that has been filtered into the Bowman's capsule flows into the PCT.
- As the fluid flows through the PCT, all of the glucose that is in the fluid is reabsorbed from the fluid into the blood.
- The fluid then flows into the loop of Henle.
- As the fluid flows through the loop of Henle, some of the water from the fluid is reabsorbed into the blood.
- The fluid then flows through the DCT and then into the collecting duct.
- As the fluid flows through the collecting duct, some more of the water is reabsorbed into the blood.
- The fluid in the collecting duct now contains no glucose and much less water than was originally filtered out of the blood. This fluid is now urine.

Why is it important that all of the glucose is reabsorbed?
Glucose is useful to the body. If there was glucose in the urine, this glucose would be lost from the body during urination. Therefore, it is important that all of the glucose that was originally filtered out of the blood is reabsorbed back into the blood, leaving no glucose in the urine.

What is it important that most of the water is reabsorbed?
During the filtration stage of urine production, a large amount of water is filtered out of the blood. If all of this water was lost as urine during urination, the body would quickly become dehydrated. Therefore, it is important that most of the water is reabsorbed, so that only a much smaller amount of water is lost as urine.

7.20B

What is ADH?
ADH is a hormone that is produced in the hypothalamus in the brain and then transported to the pituitary gland. The pituitary gland releases ADH into the bloodstream in response to dehydration.

What is the effect of ADH?
ADH stimulates the walls of the collecting ducts to become more permeable to water. This allows more water to be reabsorbed from the collecting ducts into the bloodstream. This means that there is less water in the urine (in other words, the urine is more concentrated), and therefore a smaller volume of water is lost during urination. Therefore, ADH helps to protect the body from further dehydration.

7.21B

What is kidney failure?
Kidney failure is when a person's kidneys are unable to carry out their function properly. This leads to a range of different medical problems.

What are the main treatments for kidney failure?
The main treatments for kidney failure are kidney dialysis and kidney transplants.

What is kidney dialysis?
Kidney dialysis is when a person's bloodstream is connected to a machine called a dialysis machine.

The person's blood flows through a series of tubes within the dialysis machine and then back into the person's body.

The dialysis machine contains a fluid called dialysis fluid which contains the correct proportions of substances that should be in the blood.

The blood flowing through the dialysis machine is separated from the dialysis fluid by a partially permeable membrane. Substances are exchanged between the blood and the dialysis fluid. This results in waste products like urea, as well as any excess water and salts, being removed from the blood.

What is a kidney transplant?
A kidney transplant is when a healthy kidney from another person is put into a patient's body in order to replace a kidney that is not working properly.

7.22B

What is urea?
Urea is a toxic waste product that is produced from the breakdown of excess amino acids in the liver. It must be removed from the body.