

Edexcel Biology GCSE

Topics 7.9 to 7.17 - Homeostasis

Flashcards



What is homeostasis?



What is homeostasis?

The maintenance of a stable internal environment in the body despite fluctuations in internal and external conditions.



Why is homeostasis important?



Why is homeostasis important?

To ensure optimum conditions for enzymes and cellular processes in the body



State three conditions within the body that must be controlled by homeostasis



State three conditions within the body that must be controlled by homeostasis

- Temperature
- Blood glucose concentration
- Water levels



What is thermoregulation? (biology only)



What is thermoregulation? (biology only)

The maintenance of core body temperature



Why must body temperature be controlled? (biology only)



Why must body temperature be controlled?
(biology only)

Enzymes work best at their optimum temperature. Deviations from this optimum temperature decrease the rate of enzyme-controlled reactions.



What is the optimum temperature for
enzymes in the human body?
(biology only)



What is the optimum temperature for enzymes in the human body? (biology only)

37°C



What does the maintenance of an ideal
body temperature depend on?
(biology only)



What does the maintenance of an ideal body temperature depend on? (biology only)

A negative feedback system involving:

- Receptors
- Hypothalamus
- Effectors e.g. sweat glands, hair erector muscles



Where are temperature-sensitive receptors located? (biology only)



Where are temperature-sensitive receptors located?
(biology only)

- **Skin** - epidermis (outer layer) and dermis (below epidermis)
- **Hypothalamus**



What is the function of receptors in the skin and in the hypothalamus?
(biology only)



What is the function of receptors in the skin and in the hypothalamus? (biology only)

They detect changes in blood temperature and send information to the hypothalamus.



What is the function of the
hypothalamus? (biology only)



What is the function of the hypothalamus?
(biology only)

It coordinates information from the receptors and sends instructions to the effectors.



What is the function of the effectors?
(biology only)



What is the function of the effectors? (biology only)

They produce a response to counteract the change in blood temperature and return it to the set point.



Outline the responses of the body to an increase in temperature above 37°C (3)
(biology only)



Outline the responses of the body to an increase in temperature above 37°C (3) (biology only)

- Vasodilation
- Sweating
- Erector muscles relax, hairs lie flat



What structure produces sweat?
(biology only)



What structure produces sweat? (biology only)

Sweat glands found in the dermis



How is sweat released from the skin? (biology only)



How is sweat released from the skin? (biology only)

Pores in the epidermis release sweat onto the skin's surface which then evaporates.



How does sweating help to reduce body temperature? **(biology only)**



How does sweating help to reduce body temperature? (biology only)

Heat energy is used to evaporate sweat.
Increased heat transfer from the skin to the environment decreases body temperature.



What is vasodilation? (biology only/higher)



What is vasodilation? (biology only/higher)

- Dilation of blood vessels near the skin surface
- Blood flows closer to the skin surface
- Greater heat loss to the surroundings



Outline the responses of the body to a decrease in temperature below 37°C (4)
(biology only)



Outline the responses of the body to a decrease in temperature below 37°C (4) (biology only)

- Vasoconstriction
- Shivering
- Hair erector muscles contract
- Little sweat is produced



How does shivering help to increase body temperature? (biology only)



How does shivering help to increase body temperature? (biology only)

Involuntary contraction of muscles generates heat energy from respiration



How does the contraction of hair erector muscles help to increase body temperature? (biology only)



How does the contraction of hair erector muscles help to increase body temperature? **(biology only)**

Hairs stand on end creating pockets of air between hairs and a layer of insulation.



What is vasoconstriction? (biology only/higher)



What is vasoconstriction? (biology only/higher)

- Constriction of blood vessels near skin surface
- Less blood flows close to the skin surface
- Less heat loss to the surroundings



Which organ is responsible for the maintenance of blood glucose concentrations?



Which organ is responsible for the maintenance of blood glucose concentrations?

Pancreas



How are blood glucose concentrations controlled?



How are blood glucose concentrations controlled?

Controlled by the hormones insulin and glucagon which are secreted by the pancreas



Insulin and glucagon are antagonistic hormones. What does this mean?



Insulin and glucagon are antagonistic hormones.
What does this mean?

They have opposite effects which
counteract one another.



Describe the role of insulin in the regulation of blood sugar levels



Describe the role of insulin in the regulation of blood sugar levels

- Causes liver and muscle cells to increase their uptake of glucose from the blood
- Glucose is converted into glycogen, a storage molecule



Describe the role of glucagon in the regulation of blood sugar levels (**higher**)



Describe the role of glucagon in the regulation of blood sugar levels (**higher**)

- Causes the breakdown of glycogen to glucose in the liver
- Glucose is released into the blood



What is the control of blood glucose concentration an example of?



What is the control of blood glucose concentration an example of?

Negative feedback



Describe what happens when blood
glucose concentrations become too high
(higher)



Describe what happens when blood glucose concentrations become too high (**higher**)

- Blood glucose concentration increases above a set point
- Pancreas secretes **insulin** and stops producing glucagon
- Liver and muscle cells increase uptake of glucose
- Glucose is converted to glycogen and stored
- Some glucose may be stored as lipid in tissues
- Blood glucose concentration decreases, returning to normal level



Describe what happens when blood
glucose concentrations become too low
(higher)



Describe what happens when blood glucose concentrations become too low (**higher**)

- Blood glucose concentration decreases below a set point
- Pancreas secretes **glucagon** and stops producing insulin
- Liver cells convert glycogen into glucose which is released into blood
- Blood glucose concentration increases, returning to normal level



What is diabetes?



What is diabetes?

A condition where the homeostatic control of blood glucose levels stops working.



What is the cause of type 1 diabetes?



What is the cause of type 1 diabetes?

Pancreas does not produce enough
insulin



How is type 1 diabetes treated? (3)



How is type 1 diabetes treated? (3)

- Daily insulin injections at meal times
- Limiting intake of refined sugars
- Regular exercise



What is the cause of type 2 diabetes?



What is the cause of type 2 diabetes?

Person develops insulin resistance or doesn't produce enough insulin (often due to obesity)



How is type 2 diabetes treated? (3)



How is type 2 diabetes treated? (3)

- **Balanced diet**
(eating fewer simple sugars and replacing them with more complex carbohydrates)
- **Exercise**
- **Medication or insulin injections** (however, these are less effective)



How does exercise help to control diabetes?



How does exercise help to control diabetes?

Exercise increases respiration in muscle cells. Excess glucose is removed from the blood to produce energy in the form of ATP.



Why are type 2 diabetics advised to replace simple carbohydrates with more complex carbohydrates?



Why are type 2 diabetics advised to replace simple carbohydrates with more complex carbohydrates?

- Simple carbohydrates are broken down quickly so can raise blood glucose levels rapidly.
- Complex carbohydrates take longer to break down so have a reduced effect on blood glucose levels.



What is the Body Mass Index (BMI)?



What is the Body Mass Index (BMI)?

A value based on height and mass used to categorise an individual as underweight, normal weight, overweight or obese.



How is BMI calculated?



How is BMI calculated?

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



What BMI values indicate obesity and an increased risk of type 2 diabetes?



What BMI values indicate obesity and an increased risk of type 2 diabetes?

BMI value larger than 30



How is an individual's waist-to-hip ratio calculated?



How is an individual's waist-to-hip ratio calculated?

$$\text{waist-to-hip ratio} = \frac{\text{waist circumference (cm)}}{\text{hip circumference (cm)}}$$



What does a waist-to-hip ratio higher than 1.0 in males or 0.85 in females indicate?



What does a waist-to-hip ratio higher than 1.0 in males or 0.85 in females indicate?

- Abdominal obesity
- Increased risk of developing type 2 diabetes



What is osmoregulation?



What is osmoregulation?

The maintenance of constant water levels in the body fluids of an organism



Why is osmoregulation important? (biology only)



Why is osmoregulation important? (biology only)

Prevents cells bursting or shrinking when water enters or leaves by osmosis



Describe what happens to an animal cell if it is placed into a solution with a higher water concentration **(biology only)**



Describe what happens to an animal cell if it is placed into a solution with a higher water concentration (biology only)

- Higher concentration of water in surrounding solution
- Water molecules move down their water concentration gradient into the cell by osmosis
- Pressure inside the cell increases, cell bursts (lysis)



Describe what happens to an animal cell if it is placed into a solution with a lower water concentration (biology only)



Describe what happens to an animal cell if it is placed into a solution with a lower water concentration **(biology only)**

- Lower concentration of water in surrounding solution
- Water molecules move down their water concentration gradient out of the cell by osmosis
- Pressure inside the cell decreases, cell shrinks (crenation)



Describe what happens to an animal cell if it is placed into a solution with an equal water concentration (biology only)



Describe what happens to an animal cell if it is placed into a solution with an equal water concentration (biology only)

No net movement of water molecules into or out of the cell



Describe the function of the kidneys (biology only)



Describe the function of the kidneys (biology only)

- Removes toxic waste substances from the body
- Alters blood water levels
- Alters blood ion levels



What is urine? (biology only)



What is urine? (biology only)

Waste product of the kidney that contains urea, excess water and excess ions



How is urea produced? (biology only)

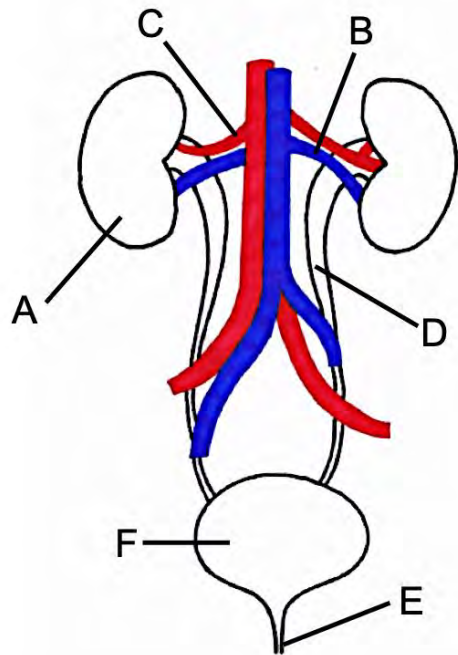


How is urea produced? (biology only)

In the liver, urea is produced from the breakdown of excess amino acids.



Identify the structures of
the urinary system
labelled in the diagram
(biology only)



Identify the structures of the urinary system labelled in the diagram (**biology only**)

A = kidney

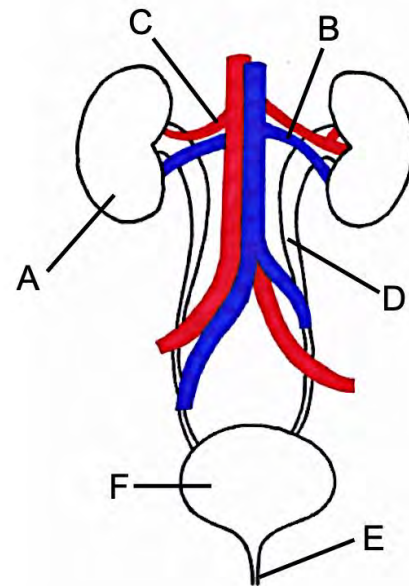
B = renal vein

C = renal artery

D = ureter

E = urethra

F = bladder



What is the function of the renal artery?
(biology only)



What is the function of the renal artery?
(biology only)

Supplies blood to the kidneys



What is the function of the renal vein?
(biology only)



What is the function of the renal vein? (biology only)

Drains blood from the kidneys



What is the function of the ureter?
(biology only)



What is the function of the ureter? (biology only)

Takes urine to the bladder from the kidneys



What is the function of the urethra?
(biology only)



What is the function of the urethra? (biology only)

Releases urine from the bladder, out of the body



What is a nephron? (biology only)



What is a nephron? (biology only)

Functional unit of the kidney where filtration and selective reabsorption takes place



Describe filtration in the kidneys (biology only)



Describe filtration in the kidneys (biology only)

- Blood flows through the glomerulus under high pressure
- Small molecules (e.g. urea, glucose), water and ions are filtered out of the blood and into the Bowman's capsule of the nephron



Why do large molecules (e.g. red blood cells, proteins) remain in the blood?
(biology only)



Why do large molecules (e.g. red blood cells, proteins) remain in the blood? **(biology only)**

They are too large to fit through the pores in the capillary walls.



Which substances are selectively reabsorbed from the nephron tubule?
(biology only)



Which substances are selectively reabsorbed from the nephron tubule? (biology only)

- All sugars
- Some water
- Some ions



What happens to the molecules not selectively reabsorbed? (biology only)



What happens to the molecules not selectively reabsorbed? (biology only)

They travel down the kidney tubule as urine and are transported to the bladder via the ureter. Here they are stored and eventually excreted.



How is the concentration and volume of urine controlled? (biology only/higher)



How is the concentration and volume of urine controlled? (biology only/higher)

Controlled by the secretion of anti-diuretic hormone (ADH)



What produces ADHD? (biology only/higher)



What produces ADH? (biology only/higher)

Pituitary gland



Describe how ADH affects the reabsorption of water from the kidney tubules (biology only/higher)



Describe how ADH affects the reabsorption of water from the kidney tubules (biology only/higher)

ADH increases the permeability of the collecting ducts, enabling more water to be reabsorbed into the blood.



What is required to maintain the ideal
water content of blood?
(biology only/higher)



What is required to maintain the ideal water content of blood? (biology only/higher)

A negative feedback system involving:

- Receptors in the hypothalamus
- Hypothalamus
- Effector i.e. pituitary gland



Describe the negative feedback loop
which occurs when low blood water
concentration is detected
(biology only/higher)



Describe the negative feedback loop which occurs when low blood water concentration is detected

(biology only/higher)

- Receptors detect low blood water content and send information to the hypothalamus. This coordinates the information and sends instructions to the pituitary gland.
- Pituitary gland increases ADH secretion. ADH increases collecting duct permeability so more water is reabsorbed.
- Blood water content increases. More concentrated urine is produced.



Describe the negative feedback loop
which occurs when high blood water
concentration is detected
(biology only/higher)



Describe the negative feedback loop which occurs when high blood water concentration is detected (biology only/higher)

- Receptors detect high blood water content and send information to the hypothalamus. This coordinates the information and sends instructions to the pituitary gland.
- Pituitary gland secretes less ADH. Collecting duct becomes less permeable so less water is reabsorbed.
- Blood water content decreases. More dilute urine is produced.



How can kidney failure be treated? (biology only)



How can kidney failure be treated? (biology only)

- Kidney dialysis
- Kidney transplant



What is kidney dialysis? (biology only)



What is kidney dialysis? (biology only)

A machine artificially filters a patient's
blood



How does kidney dialysis work? (biology only)



How does kidney dialysis work? (biology only)

- Selectively permeable barrier separates patient's blood from dialysis fluid
- Materials are exchanged across the barrier e.g. urea, excess ions and water move out of the blood and into the dialysis fluid
- Large cells and proteins remain in the blood



Describe the composition of dialysis fluid
(biology only)



Describe the composition of dialysis fluid (biology only)

- Same concentration of glucose and ions as in normal blood plasma
- No urea



What does a kidney transplant involve?
(biology only)



What does a kidney transplant involve? (biology only)

Taking a kidney from a living donor or someone recently deceased and implanting it into the patient.



What is the risk associated with kidney transplants? (biology only)



What is the risk associated with kidney transplants?
(biology only)

Risk of the body rejecting the
transplanted kidney



What precautions are taken to minimise the risk of rejection? **(biology only)**



What precautions are taken to minimise the risk of rejection? (biology only)

- Tissue typing ensures that the transplanted organ is 'compatible' with the recipient
- Immunosuppressant drugs help prevent the immune system from rejecting the organ

