

# 5.3.3 Maintaining water and nitrogen balance in the body

## AQA GCSE Biology (Higher) Question and answer 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.

### What are the functions of the kidneys?

The functions of the kidneys are:

- To maintain water balance in the body by removing excess water.
- To remove urea (a toxic waste product) from the body.

The kidneys achieve both of these functions by filtering the blood to form urine, which is then removed from the body.

**Why must the level of water in the body be kept within certain limits?**

If the level of water in the body gets too high, too much water will enter the cells by osmosis, causing them to swell up, which prevents them from functioning properly.

If the level of water in the body gets too low, too much water will leave the cells by osmosis, causing them to shrink, which prevents them from functioning properly.

Therefore, the level of water within the body must be kept within certain limits.

**How does water enter the body?**

Water enters the body through eating and drinking.

**How does water leave the body? Which of these processes are controlled and which are uncontrolled?**

Water is lost from the lungs during exhalation.

Water is lost from the skin in sweat.

Water loss through the lungs and skin is uncontrolled.

Water is lost from the body through urination.

Water loss through urination is controlled. The kidneys adjust the volume of water lost in the urine in order to maintain water balance.

**Besides water, what else is lost from the skin in sweat?**

As well as water, ions and urea are lost from the skin in sweat.

**How is urea produced in the body?**

Protein in food is digested into amino acids. If there are too many amino acids in the body, the excess amino acids are broken down through a process called deamination. The deamination of amino acids produces the waste product ammonia which is highly toxic. Because ammonia is so toxic it is immediately converted to urea, which is a less toxic waste product. However, urea is still toxic so it needs to be removed from the body.

**What are the stages in the production of urine?**

The kidneys produce urine in two stages. First, they filter the blood to form a mixture of substances called filtrate, which contains many of the substances from the blood. Then, they carry out a process called selective reabsorption in which many of the substances in the filtrate are absorbed back into the blood, leaving behind a new mixture which is the urine.

**What happens during the filtration stage of urine production?**

During filtration, the blood passing through the kidneys is filtered. Many substances are removed from the blood and form the filtrate. This includes water, urea, glucose and ions. Some things remain in the blood, including blood cells and proteins.

**What happens during selective reabsorption?**

During selective reabsorption, all of the glucose and some of the water and ions in the filtrate are absorbed back into the blood. The mixture that is left behind is called urine. It is made up of water, urea and ions.

**Why is selective reabsorption necessary?**

Without selective reabsorption, useful substances would be lost in the urine. Glucose is a useful substance and there is no need to remove it from the body. Therefore, all of the glucose is reabsorbed. Some water and ions do need to be removed from the body in order to maintain water and ion balance. However, without selective reabsorption, far too much water and far too many ions would be lost.

**What is ADH?**

ADH is a hormone which is released into the bloodstream by the pituitary gland when the level of water in the body is too low (in other words, when the blood is too concentrated).

**What does ADH do?**

ADH binds to cells in the kidney tubules (small tubes that the filtrate travels through). This stimulates the kidney tubules to become more permeable to water, which results in more water being reabsorbed from the filtrate into the blood. This reduces the amount of water in the urine (in other words, it makes the urine more concentrated), so less water is lost from the body through urination. This is an example of negative feedback.

**What is kidney failure?**

Kidney failure is when the kidneys do not function properly.

**How can kidney failure be treated?**

Kidney failure can be treated by kidney transplant or by using dialysis.

**What is dialysis?**

Dialysis is a medical procedure in which a person's bloodstream is connected to a machine called a dialysis machine, which artificially carries out the function of the kidneys. In the dialysis machine, the blood passes through a fluid called dialysis fluid, which contains the substances found in a healthy person's blood (the right concentration of ions, no urea, etc.). The blood and the dialysis fluid are separated by a partially permeable membrane. Substances diffuse down their concentration gradients, meaning that urea and any excess ions diffuse out of the blood and into the dialysis fluid. This process must be repeated regularly to keep the person healthy.