

Contents

There are four chapters that describe the human circulatory system and disorders relevant to the science curriculum.

- 1 **Structure and function** describes the position of the kidneys and their gross structure. It also shows the blood supply to the kidneys and the location of the ureters, bladder and urethra. Information on the function of these parts is also given.
- 2 **How the kidney works** shows the processes that occur in the kidney nephron. Filtration and reabsorption are described.
- 3 **Problems with kidneys.** Nephritis, kidney stones and kidney failure are described. Dialysis and kidney transplants are briefly mentioned as treatments.
- 4 **What is dialysis?** This section gives considerable detail on kidney dialysis and pays particular attention to osmosis and diffusion across the dialysis membrane.

Curriculum links (using the COL keyword scheme)**Life processes**

Parts of the body
Tissues
Organs

Humans & other animals

Human health: medicines
Circulatory system - blood
Transport of reactants/products

Solids, liquids & gases

Particle theory

Elements, compounds & mixtures

Separation - other

Sound

Ultrasound

Web links**Cancer and cells**

www.schoolscience.co.uk/content/4/biology/abpi/cancer/index.html

Heart - the circulatory system

www.schoolscience.co.uk/content/4/biology/abpi/heart/heart2.html

Using the resource

2 - Filtration and reabsorption

Use chapters 1 and 2 to enable students to develop a greater understanding of the processes involved in urine production.

Structure of the kidney

A dissection, with suitable safety precautions, can be used to look at the internal structures of the kidney. The results of a dissection are shown in chapter 1, figure 2. Have students look at the rollover (figure 3) to identify the kidney cortex, medulla, and pelvis.

Use chapter 2, figure 4 to describe the process of urine production.

Filtration first

Filtration occurs at the Bowman's capsule. Stress that this filtration is due to pressure of blood in the branch of the renal artery.

Kidneys are extremely efficient and approximately 180 litres per day of filtrate is produced.

Problems, such as heart failure, that result in a decrease in blood pressure can prevent sufficient filtration taking place so patients with heart problems can often suffer from oedema (water retention).

Filtration is dependent on molecular size, so useful compounds are filtered out of the blood as well as waste products and toxins.

Reabsorption

Looking at the filtration rate (180 liters per day), not all of the filtrate becomes urine. Depending on conditions, the normal range for urine production in an adult is 1 – 2 litres per day. So, clearly, much has to be reabsorbed.

Use figure 4 to illustrate that all of the glucose and most of the water and salts are absorbed back into the blood in the nearby capillaries.

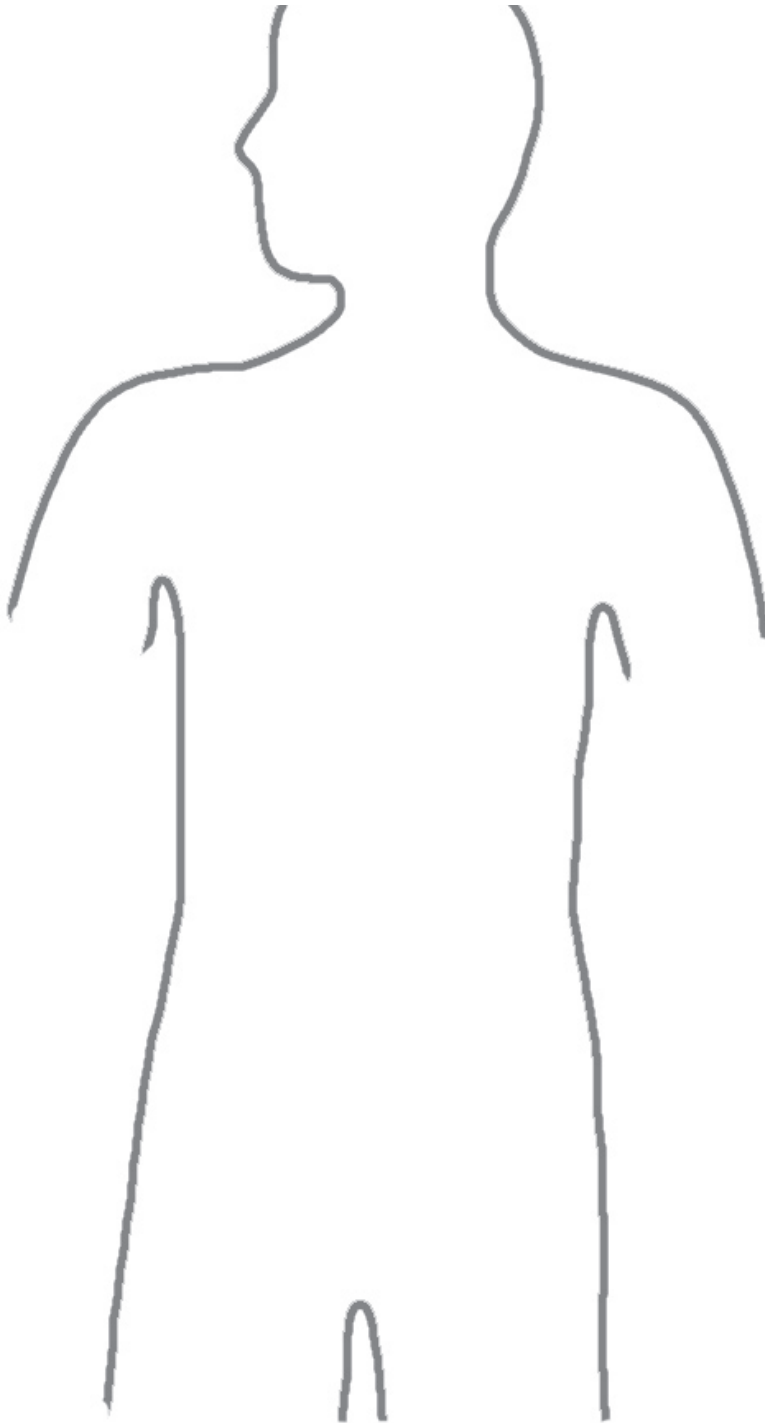
The volume of urine is controlled so that the correct water balance is maintained in the body. This can lead into a description of the role of anti-diuretic hormone and also the effects of excessive perspiration or lack of water intake on urine volume.

To assess students' understanding of the process of filtration and reabsorption, use Student worksheet 2, *Journey through the kidney*, as a homework.

Using the resource

1 - The kidneys and water balance

The first activity can be used to introduce students to the gross structure and function of the urinary system.



Position of the kidneys

As a stimulus activity, have the students mark the position and relative size of the kidneys and bladder on a copy of the body outline shown here.

Students can also be asked what they think is the role of the kidneys. Generally, they will know that they produce urine but will often not link this with the removal of urea and the role of the kidneys in water regulation.

Have the students look at chapter 1, picture 3 of the electronic resource. It describes the position, structure and function of the kidneys. Have them compare their positioning of the kidneys and bladder with the diagram and also use the rollovers to understand the roles played by the kidneys.

Students can then use chapter 1 to complete Student worksheet 1, *Kidneys: where they are and what they do*, as a record of the kidney structure and function.



Age 14-16

ABPI
The kidneys and body balance
Student worksheet 1



SEP



Kidneys: where they are and what they do

Clearly label the following parts on the diagram:

Kidneys

Bladder

Renal Artery

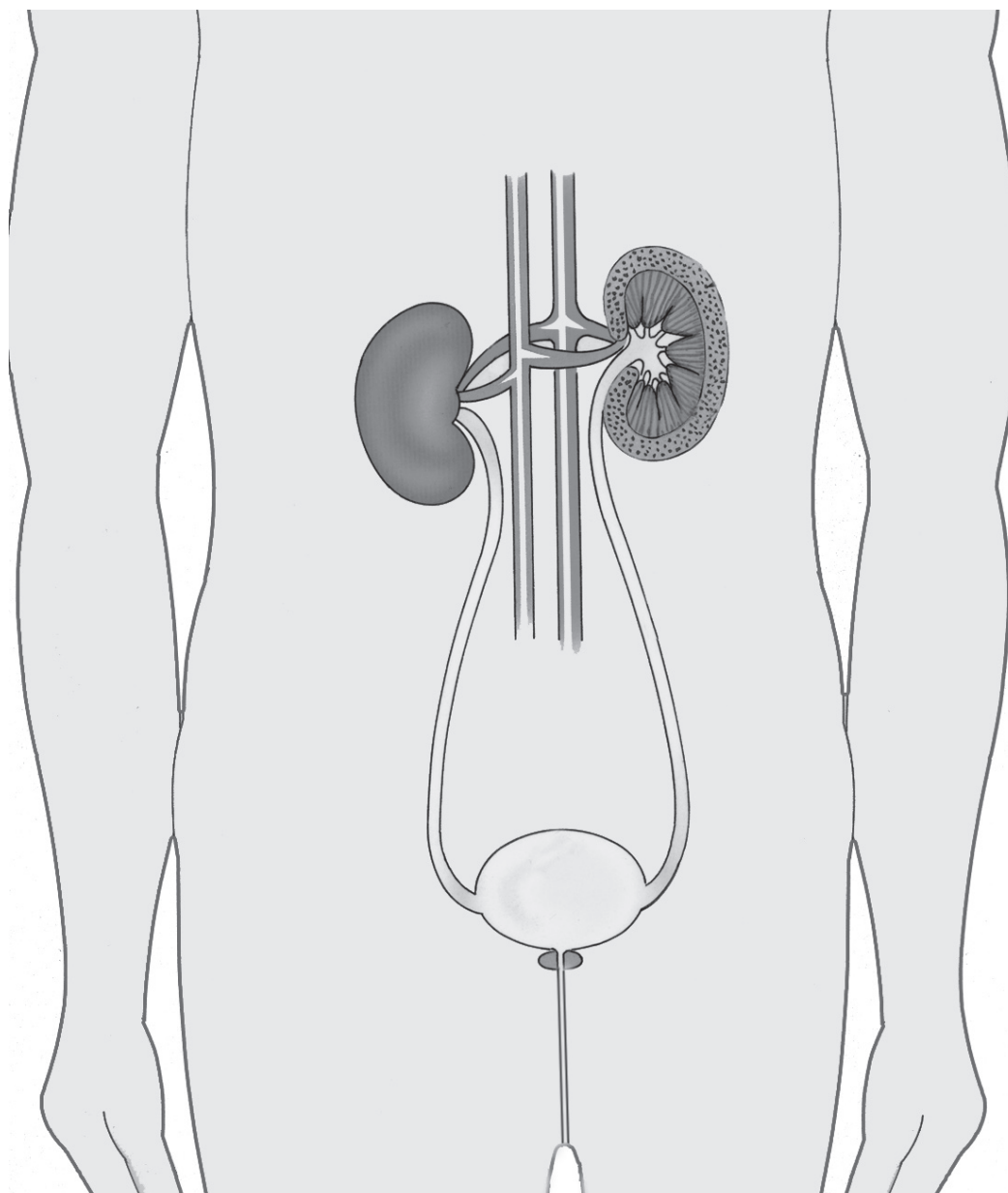
Renal Vein

Ureter

Urethra

Aorta

Vena Cava





Age 14-16

ABPI
The kidneys and body balance
 Student worksheet 1



Use the descriptions below to complete the table. Show the functions of each of the structures.

Structure	Functions
Aorta	
Renal Artery	
Renal Vein	
Vena Cava	
Kidney	
Ureter	
Bladder	
Urethra	

Functions

Collects and stores urine produced by the kidneys.	Filters the blood and removes wastes like urea. Also removes drugs like alcohol and helps to regulate the amount of water in the body.
Collects blood from the kidneys.	Returns filtered blood to the heart for circulation around the body.
Carries urine from the kidneys to the bladder.	Carries urine from the bladder to the outside of the body.
Supplies blood to the kidneys.	Main artery from the heart. Gives kidneys an excellent blood supply.



Age 14-16



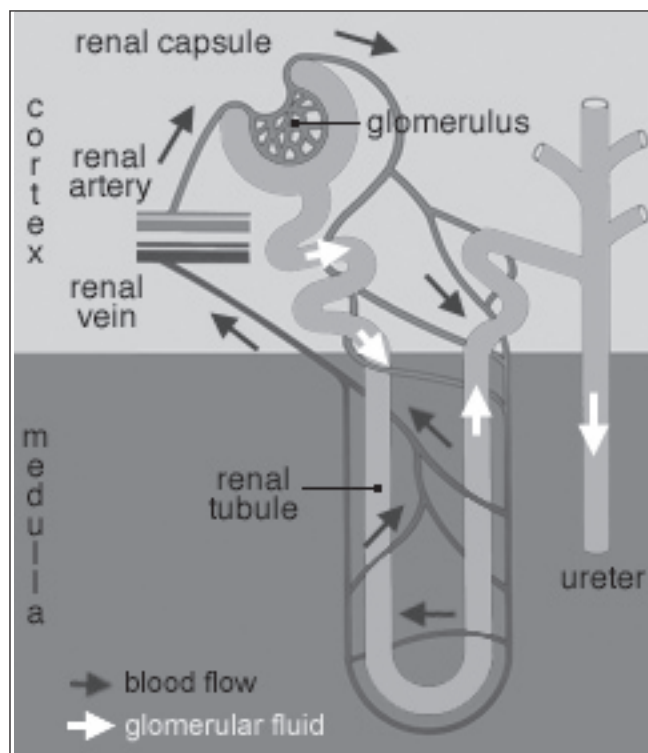
Journey through the kidney

You will imagine that you are in the blood that is travelling through the kidney.

Start your journey at the renal artery and complete it at the renal vein or the bladder. Your final destination will depend on what you are.

Think about the structures that you travel through. Also what happens to you in the different places, like the Bowman's capsule and in the kidney nephron.

This picture may help to remind you about the kidney nephron.



1. Write brief accounts of a journey through a kidney for each of these parts of the blood.

- A red blood cell.
- A large protein.
- A molecule of water that is essential to the body.
- A molecule of urea (a toxic waste).
- A molecule of glucose (sugar).
- A molecule of water that needs to be removed from the body to keep the water balance right.
- A molecule of alcohol.