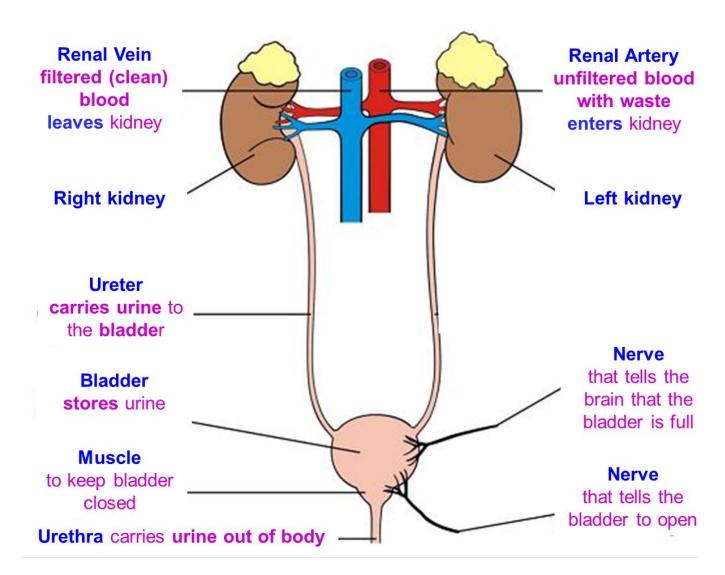
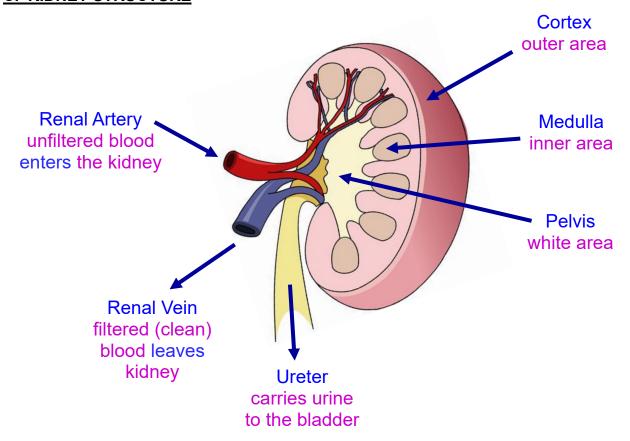
## A. THE THREE ROLES OF THE KIDNEYS

- 1. PRODUCE URINE to get rid of waste from the blood (urea, excess water, excess salts)
- 2. REABSORB useful substances such as glucose back into the blood
- 3. CONTROL the amount of water and salt in the blood

## **B. THE URINARY SYSTEM**

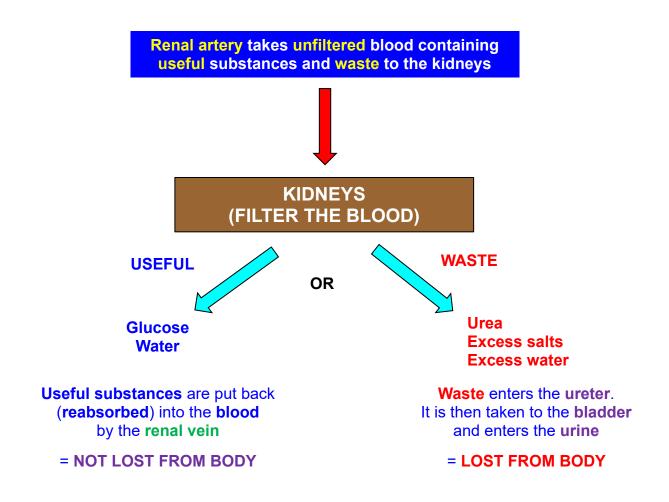


## **C. KIDNEY STRUCTURE**



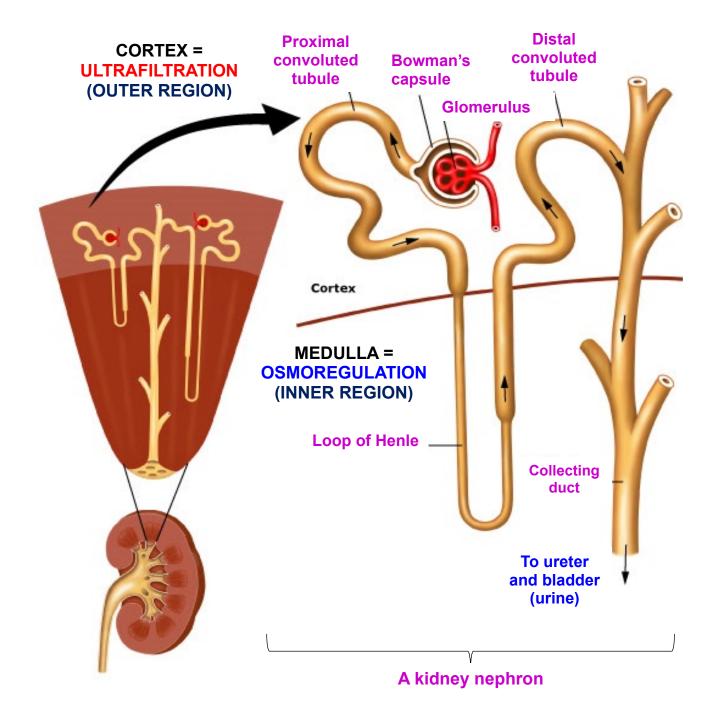
# **D. TWO CHOICES**

• The kidney can do **two** things to substances that are taken to it in the **renal artery**.



## **E. KIDNEY NEPHRONS**

The kidneys contain nephrons, which act as 'filter boxes' to clean the blood.



## F. THE "TAKE HOME MESSAGE": REABSORB IT OR LOSE IT!

Unfiltered blood enters the tubule at the glomerulus and Bowman's capsule

If a substance makes the full journey, right through the tubule and passes out of the collecting duct, it will be lost from the body

Useful substances must be reabsorbed during this journey, so they are put back into the blood and not lost

#### G. WHAT HAPPENS IN A KIDNEY NEPHRON 1. ULTRAFILTRATION • Most of the substances in blood are filtered through the Bowman's capsule. Proteins and red blood cells filtered blood to renal vein renal artery carrying unfiltered blood cannot enter the nephron as they are too large to fit through the holes in the Bowman's capsule. Distal 5. OSMOREGULATION convoluted Bowman's capsule tubule contains holes Controlled by varying = like a sieve the amount of water reabsorbed back into the blood Glomerulus = a 'knot' of blood • In the collecting duct. capillaries **Proximal** convoluted tubule 4. pH AND SOLUTE 3. PRODUCING 2. SELECTIVE REABSORPTION CONCENTRATION **HYPERTONIC URINE** OF THE BLOOD IS • Useful substances such as glucose, **Collecting Duct ADJUSTED (DCT)** water and minerals are reabsorbed • A high solute concentration is maintained in the medulla. from the filtrate back into the blood. **Urine** • This allows more water to be • All of the glucose is reabsorbed. containing: reabsorbed so it is not lost from the body. urea Most of the water is reabsorbed. excess water • In the **Loop of Henle**. • Some of the minerals are reabsorbed. excess salts toxins • In the proximal convoluted tubule. **Loop of Henle** To the ureter and bladder

## **H. WHAT URINE SHOULD NOT CONTAIN**

Urine should **NOT** contain:

- Red blood cells as they are too large to fit through the holes in the Bowman's capsule.
- Protein as they are too large to fit through the holes in the Bowman's capsule.
- Glucose as this is fully reabsorbed back into the blood in the proximal convoluted tubule.

Study this table carefully:

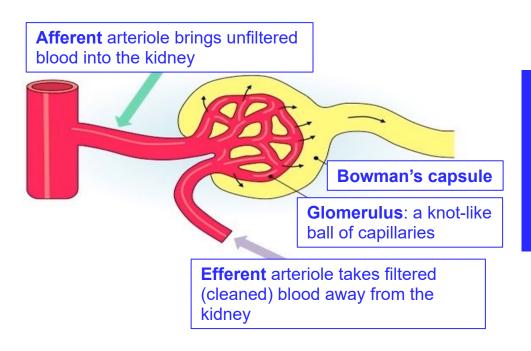
	Filtered through Bowman's capsule? (small enough)	How much is reabsorbed in proximal convoluted tubule?	Should it appear in urine?
GLUCOSE	YES	ALL	NO
WATER	YES	MOST	YES – EXCESS
SALTS/MINERALS	YES	SOME	YES - EXCESS
PROTEIN	NO	NONE	NO
RED BLOOD CELLS	NO	NONE	NO
UREA	YES	NONE	YES

## I. APPLYING WHAT YOU KNOW

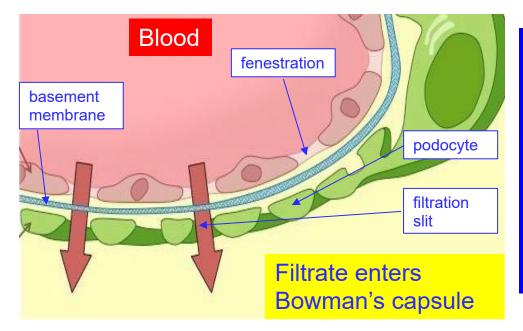
Why is urea more concentrated in urine than in the filtrate? [2 marks]

- Water has been reabsorbed/entered the blood (before producing urine);
- (So) less water in urine;

## J. ULTRAFILTRATION (= IN THE GLOMERULUS)

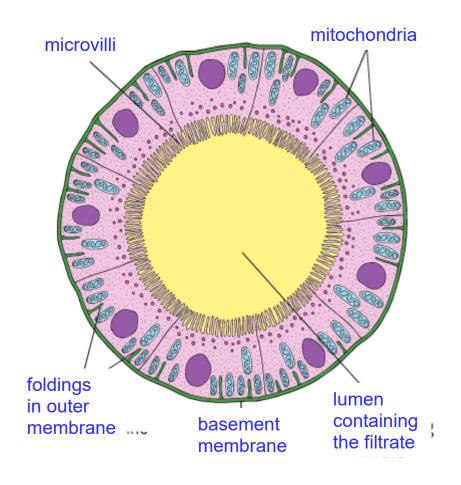


- Efferent arteriole is narrower than the afferent arteriole so a high blood pressure is created in the glomerulus.
- There are many pores (fenestrations) in the capillary walls.
- These large pores allow all molecules through.



- Only medium and small molecules can fit through the next two filter layers.
- Large red blood cells and large blood proteins cannot fit through.
  - basement membrane = a gel on the outside of a capillary
  - filtration slits = narrow gaps between podocytes
  - podocytes = form the inner wall of the Bowman's capsule

## K. SELECTIVE REABSORPTION (= IN THE PROXIMAL CONVOLUTED TUBULE)



Happens in the **proximal convoluted tubule**.

The filtrate contains useful substances and waste.

Only red blood cells and large blood proteins are not in this.

- Many microvilli = large surface area for reabsorption
- Many mitochondria = lots of ATP made for active transport
- Membrane pumps = for active transport

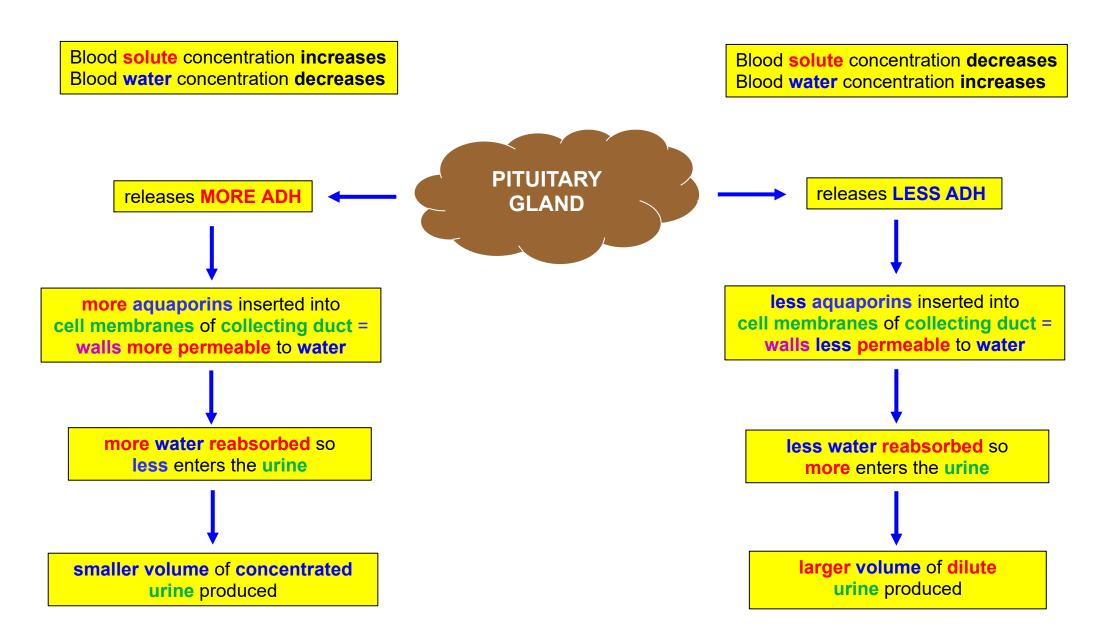
ALL of the glucose is reabsorbed

MOST of the water is reabsorbed

MOST of the minerals are reabsorbed

#### L. OSMOREGULATION (= CONTROL OF THE WATER CONCENTRATION OF THE BLOOD)

- Involves the hormone ADH (anti-diuretic hormone), which is released by the pituitary gland.
- ADH acts on the collecting duct.



## M. APPLYING YOUR KNOWLEDGE

Alcohol causes a person to got to the toilet more often. It also causes their urine to change from yellow to colourless.

Use your knowledge of ADH to suggest and explain how alcohol causes these effects.

[5 marks]

- Alcohol inhibits/prevents ADH (release)
- (So) less aquaporins in cell membranes of collecting duct
- (So) less permeable to water
- (So) less water reabsorbed/enters blood / more water enters urine
- (So) larger volume of dilute urine