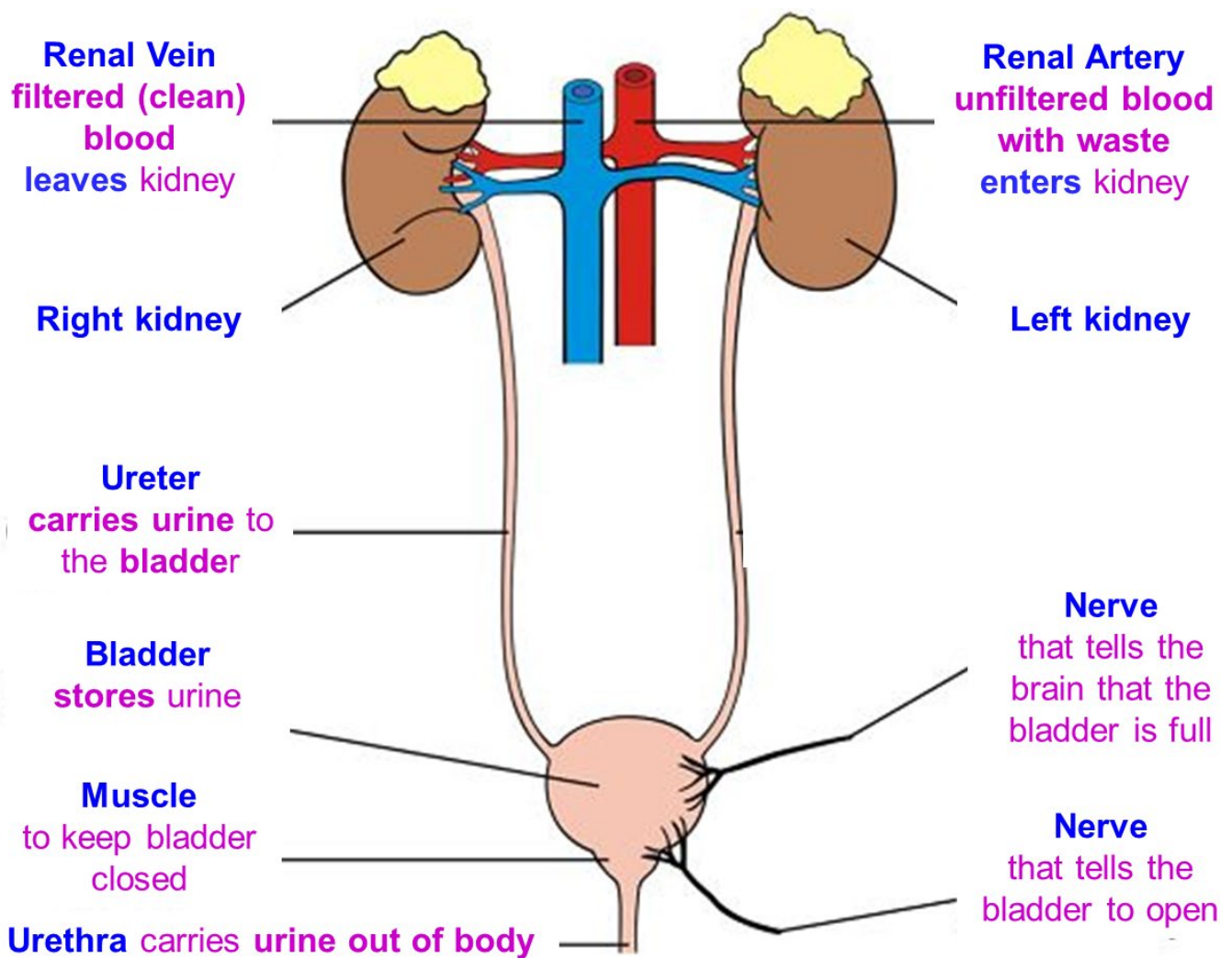


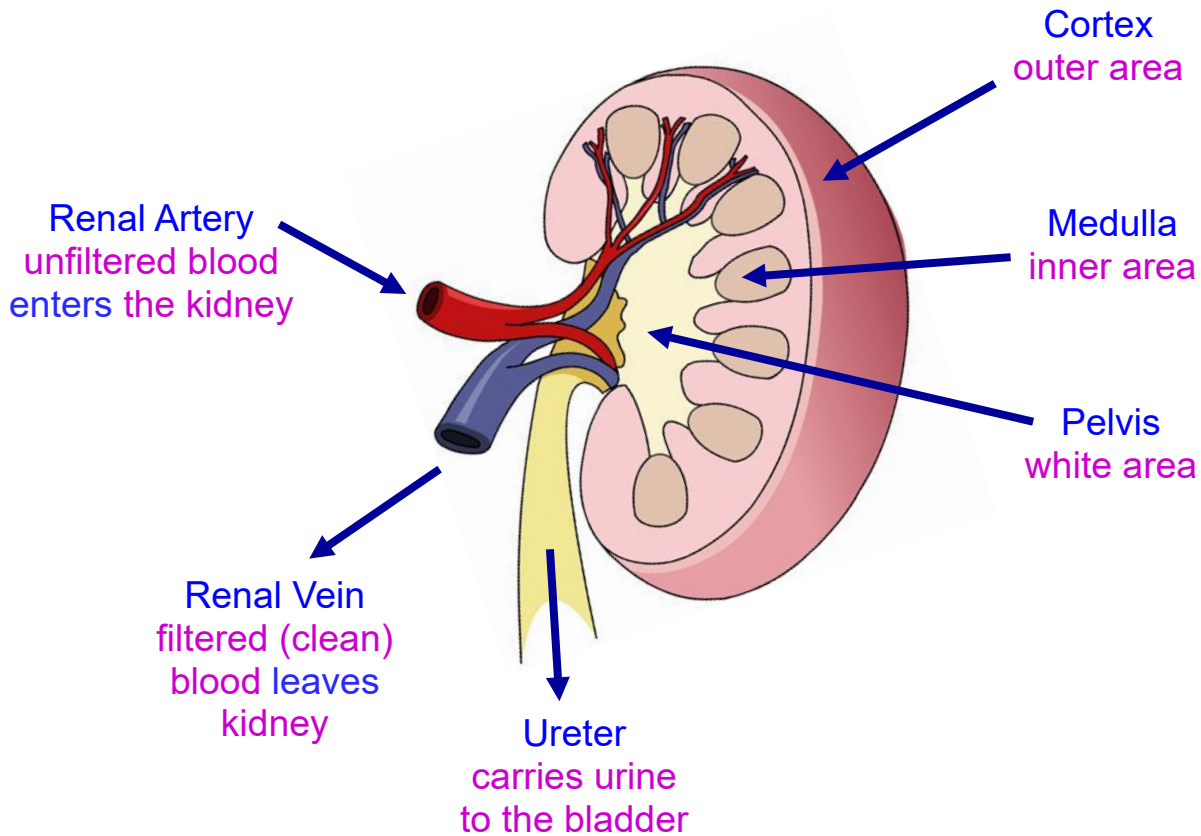
A. THE THREE ROLES OF THE KIDNEYS

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

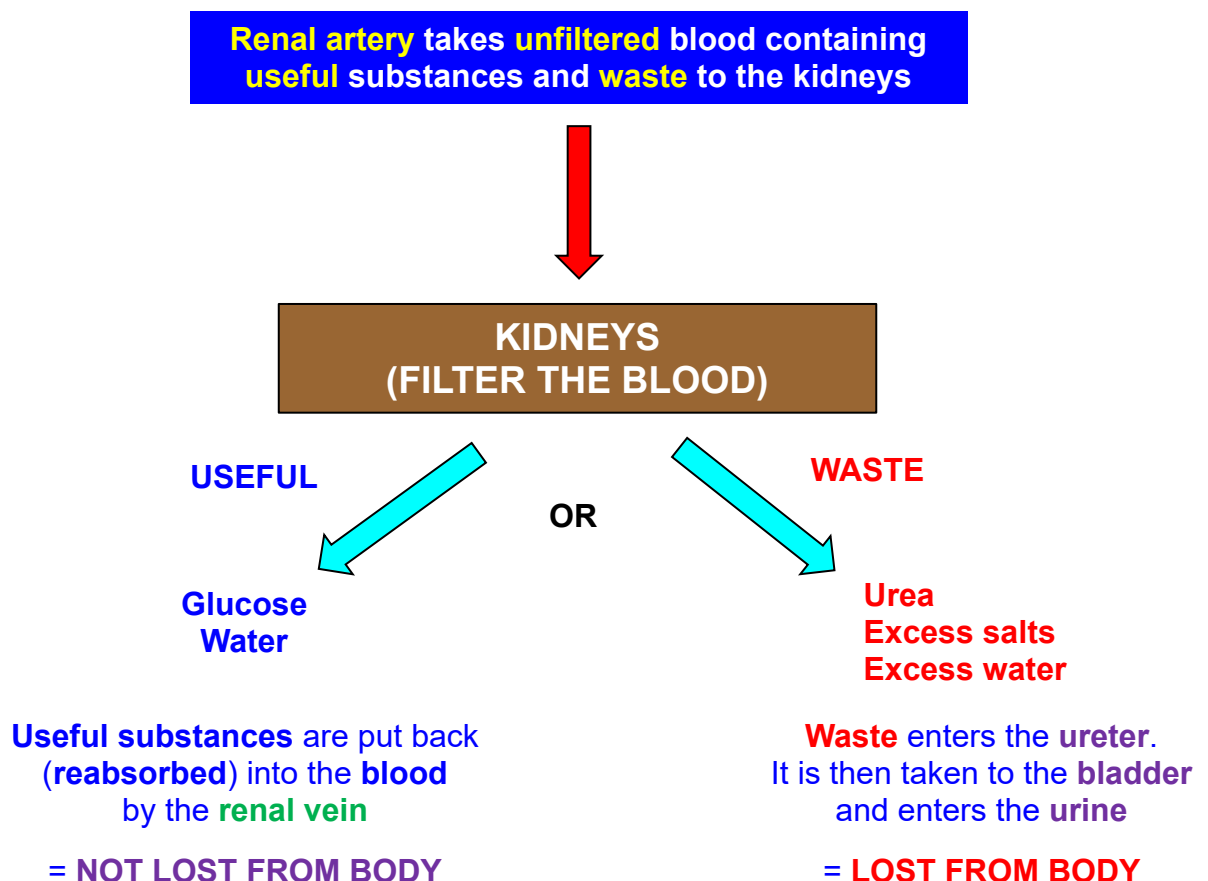


C. KIDNEY STRUCTURE



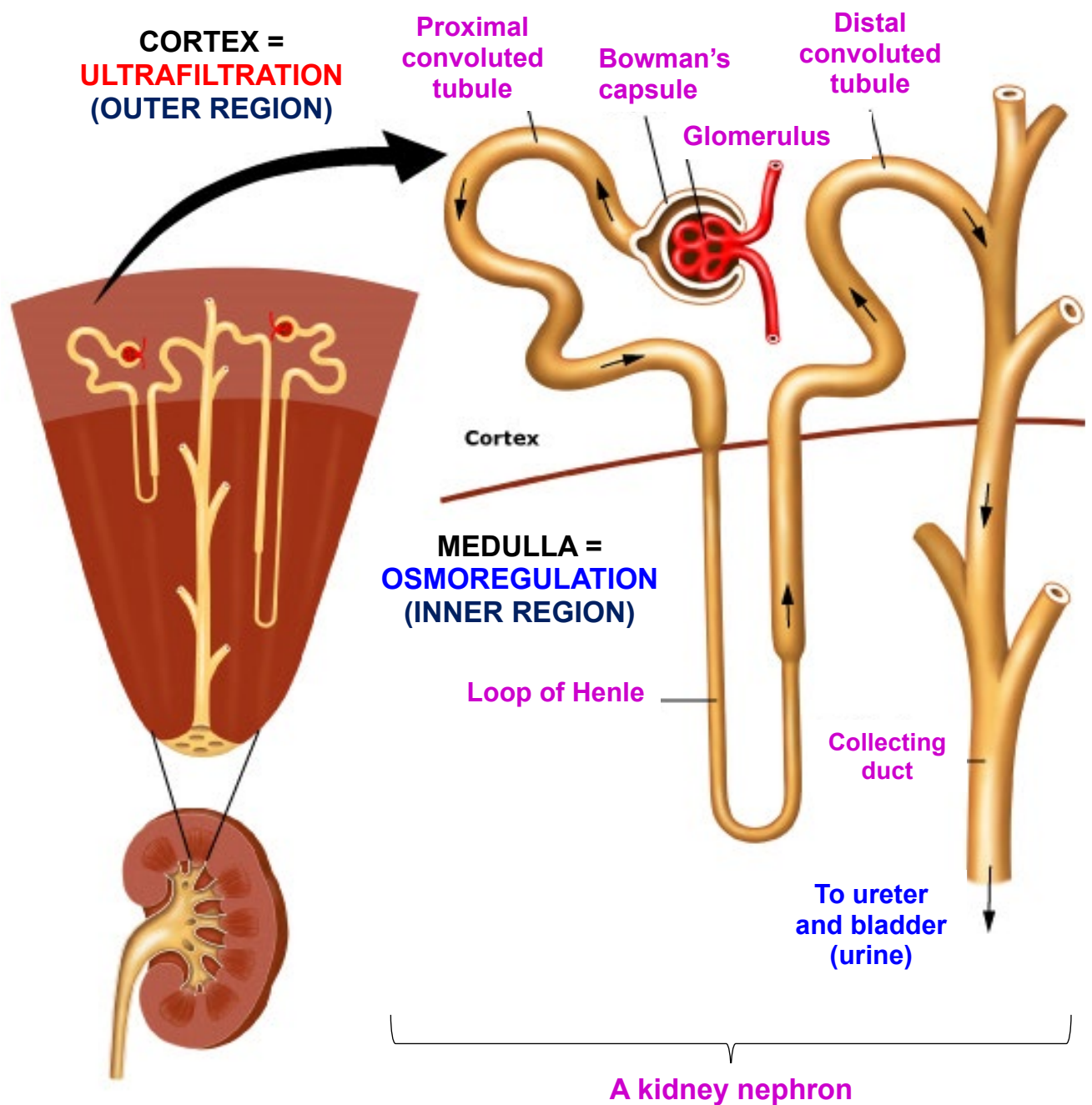
D. TWO CHOICES

- 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.



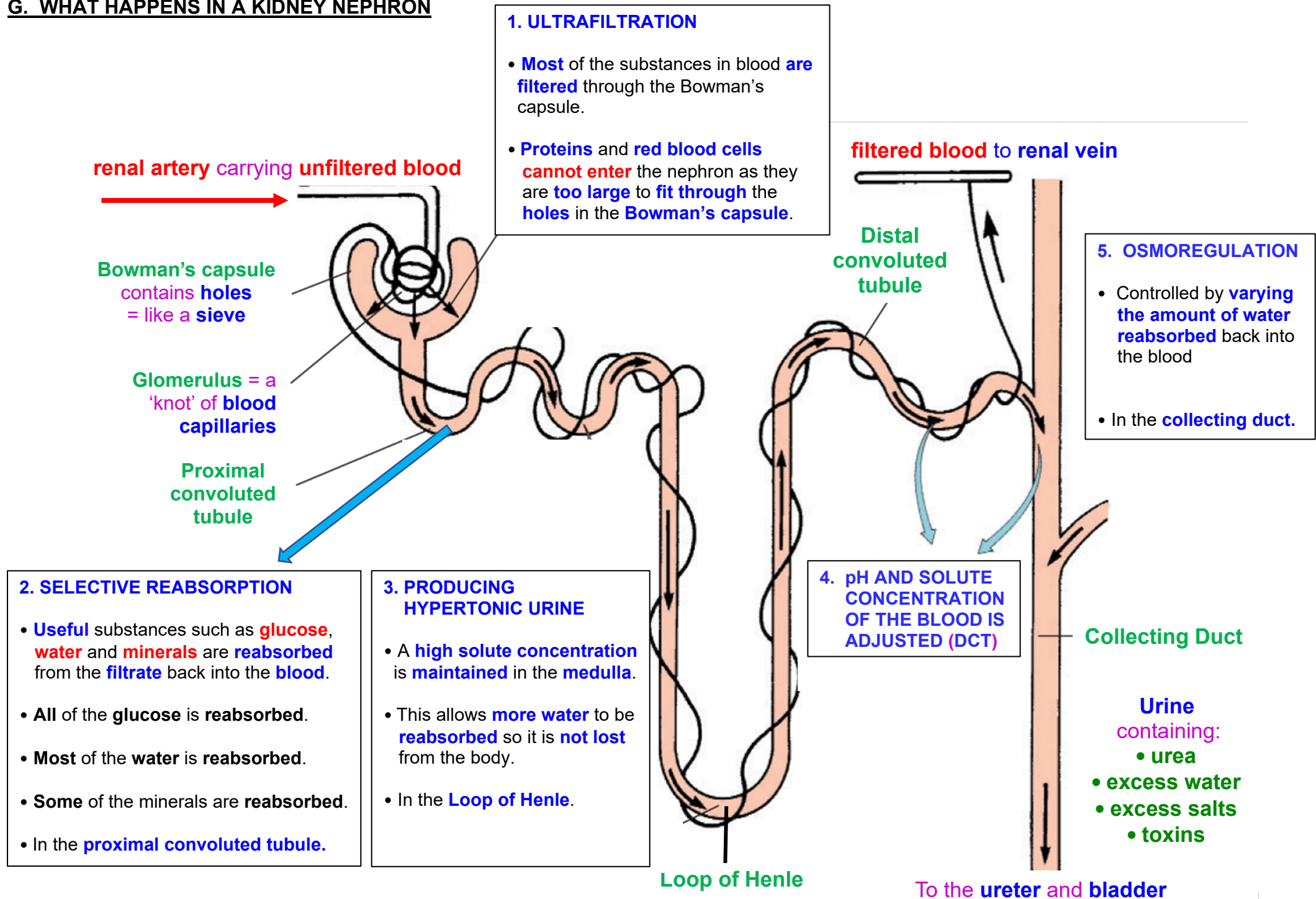
F. THE “TAKE HOME MESSAGE”: REABSORB IT OR LOSE IT!

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



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:

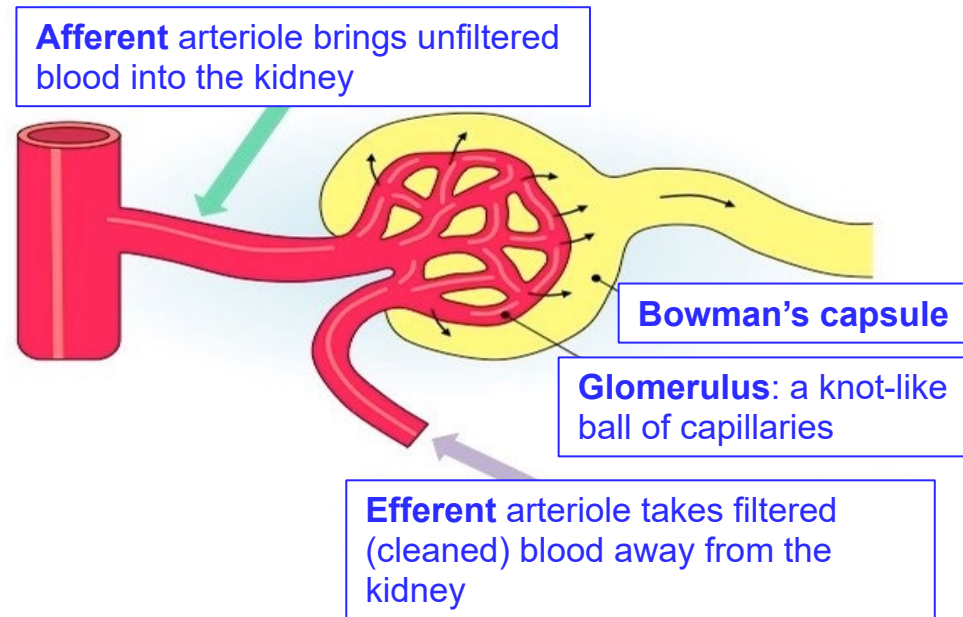
	Filtered through Bowman's capsule? (small enough)	How much is reabsorbed in proximal convoluted tubule?	Should it appear in urine?
GLUCOSE	YES	ALL	NO
WATER	YES	MOST	YES – EXCESS
SALTS/MINERALS	YES	SOME	YES - EXCESS
PROTEIN	NO	NONE	NO
RED BLOOD CELLS	NO	NONE	NO
UREA	YES	NONE	YES

I. APPLYING WHAT YOU KNOW

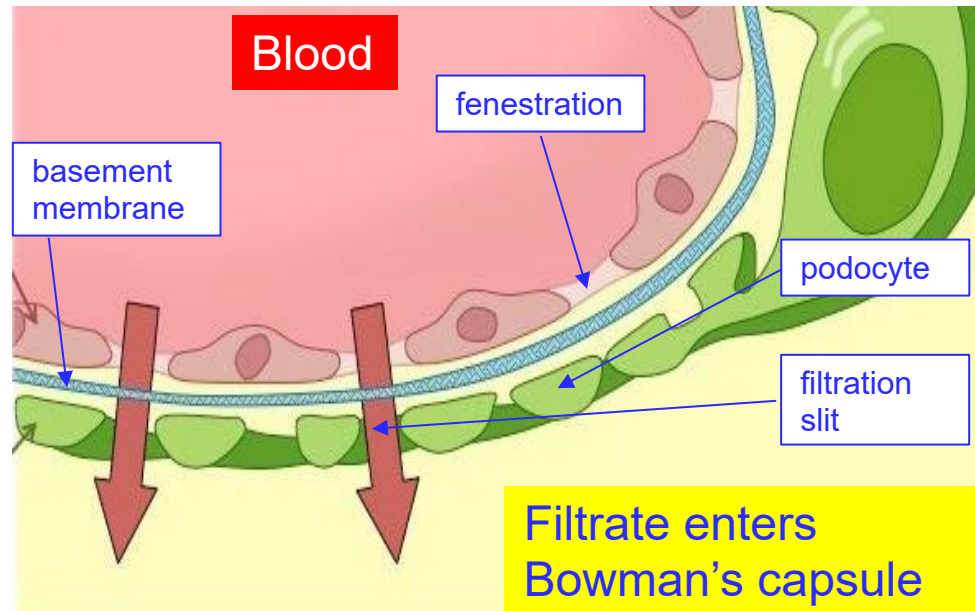
Why is urea more concentrated in urine than in the filtrate? [2 marks]

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

J. ULTRAFILTRATION (= IN THE GLOMERULUS)

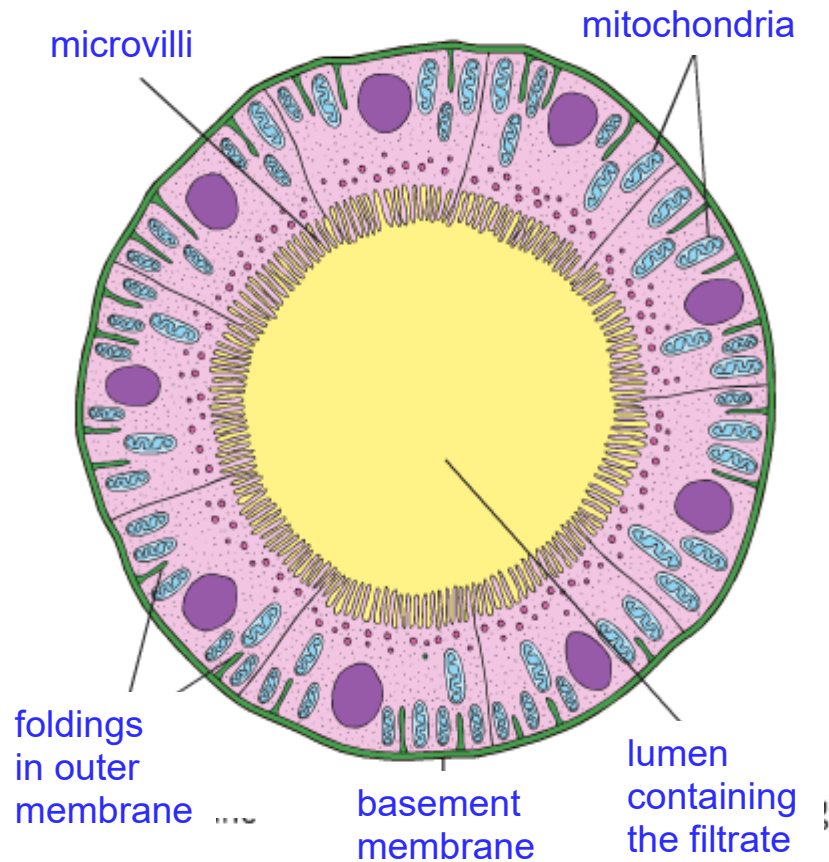


- **Efferent** arteriole is narrower than the **afferent** arteriole so a **high blood pressure** is created in the **glomerulus**.
- There are **many pores (fenestrations)** in the capillary walls.
- These **large pores** allow **all** molecules through.



- 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.

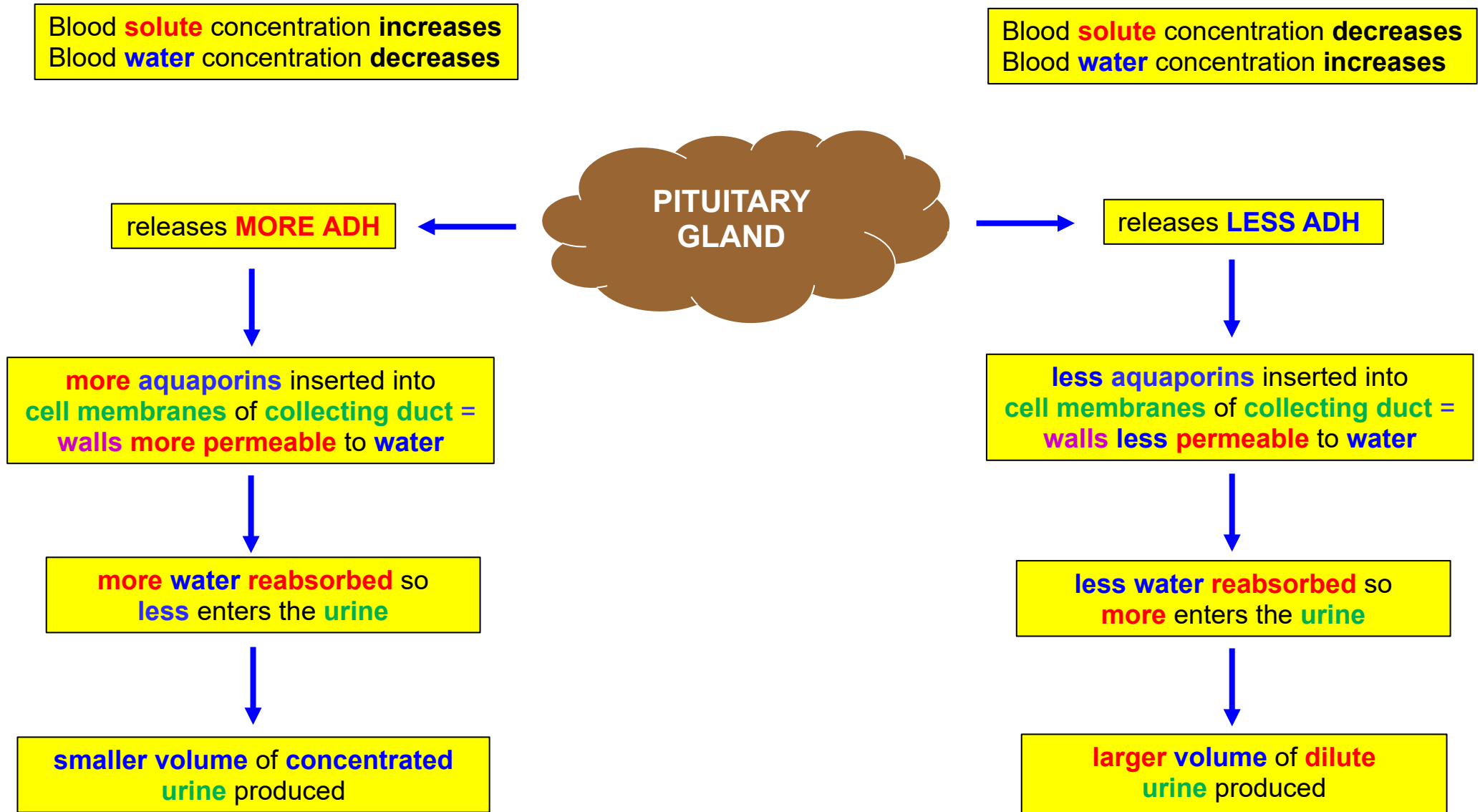
Only **red blood cells** and **large blood proteins** are not in this.

- **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 go 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