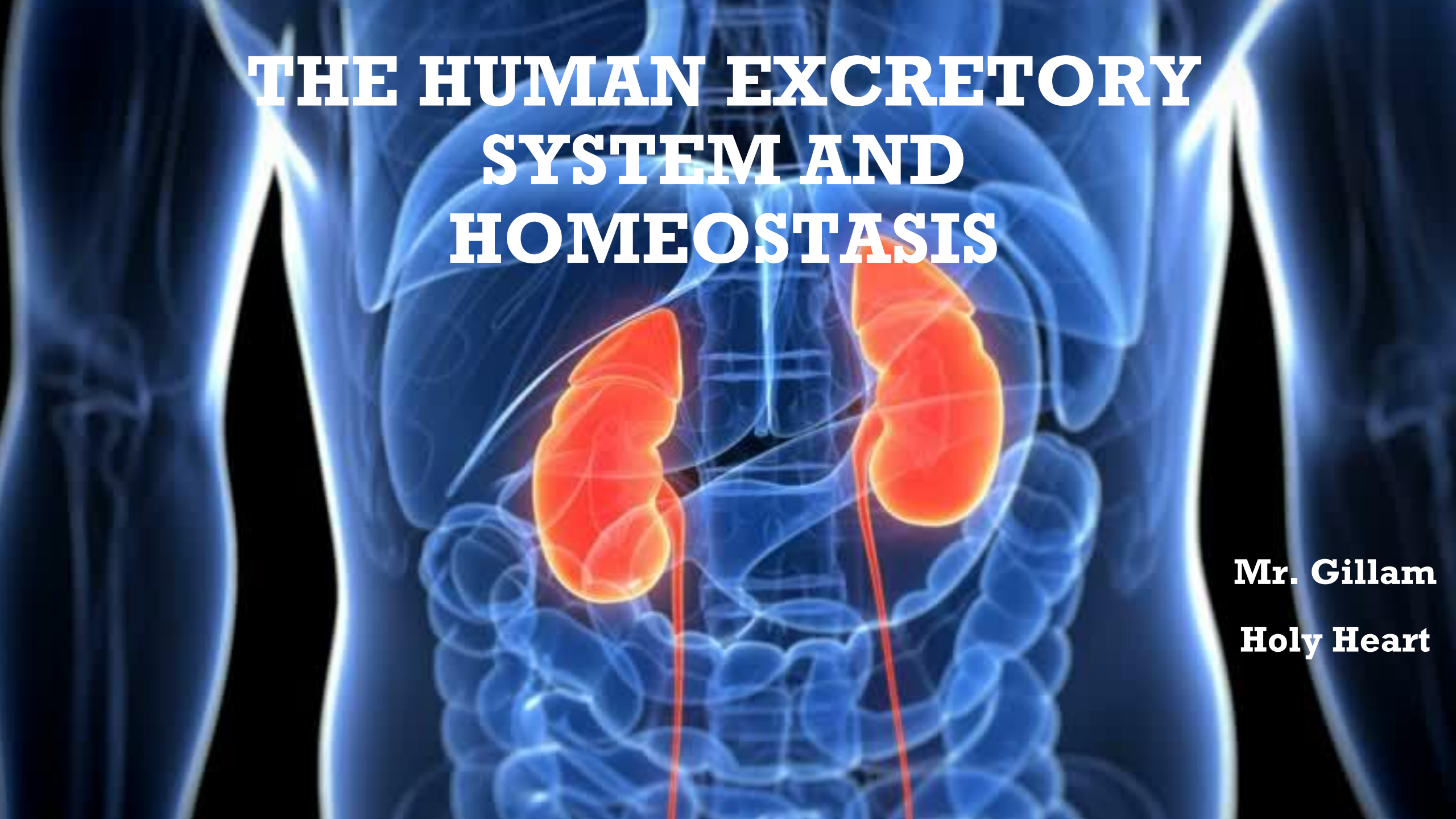
THE HUMAN EXCRETORY SYSTEM AND HOMEOSTASIS



Mr. Gillam

Holy Heart

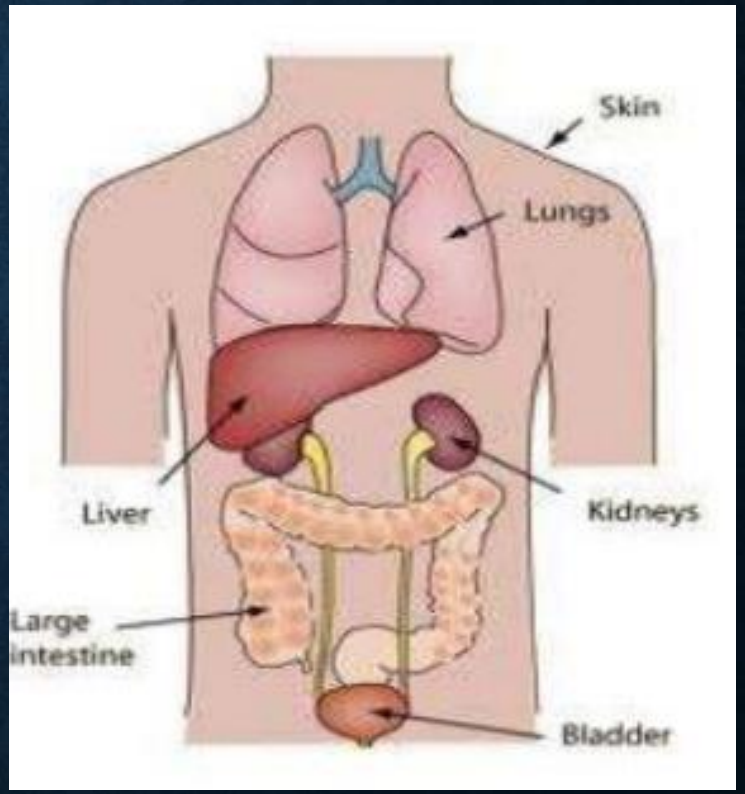
THE EXCRETORY SYSTEM

- excretory system the system that regulates the volume and composition of body fluids by excreting metabolic wastes and recycling some substances for re-use

- excretion process of separating wastes from body fluids and eliminating them from the body; performed by several body systems, including respiratory, skin, digestive, and excretory systems

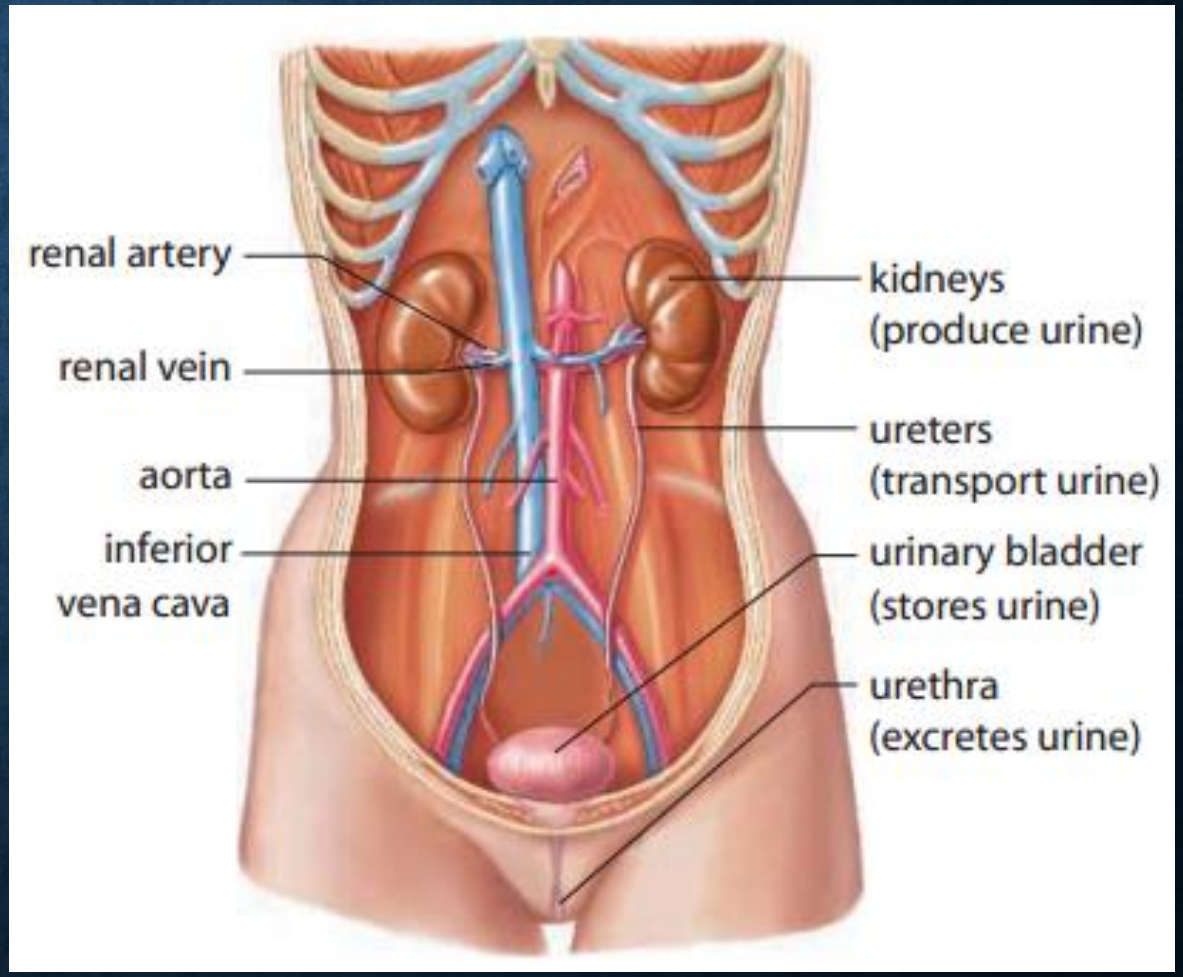
THE EXCRETORY SYSTEM

- The respiratory system excretes carbon dioxide (Lungs)
- The skin excretes water and salts in perspiration
- The digestive system excretes water, salts, and lipids.
- The urinary system filters blood and produces urine.
- Ammonia is highly toxic but is quickly converted to the less toxic compound, urea, in the liver.



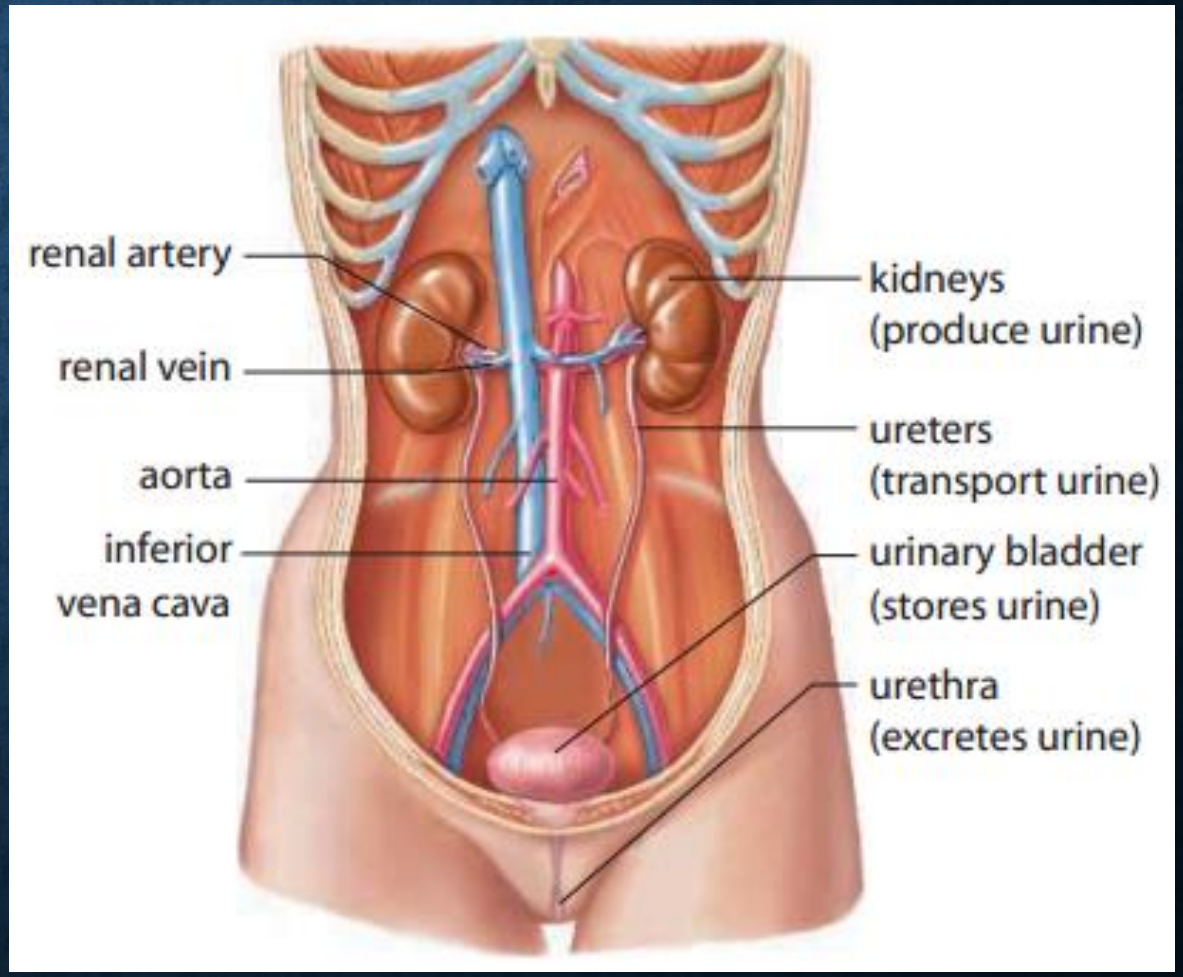
EXCRETORY STRUCTURES AND FUNCTIONS

- ureters a pair of muscular tubes that carry urine from the kidneys to the bladder



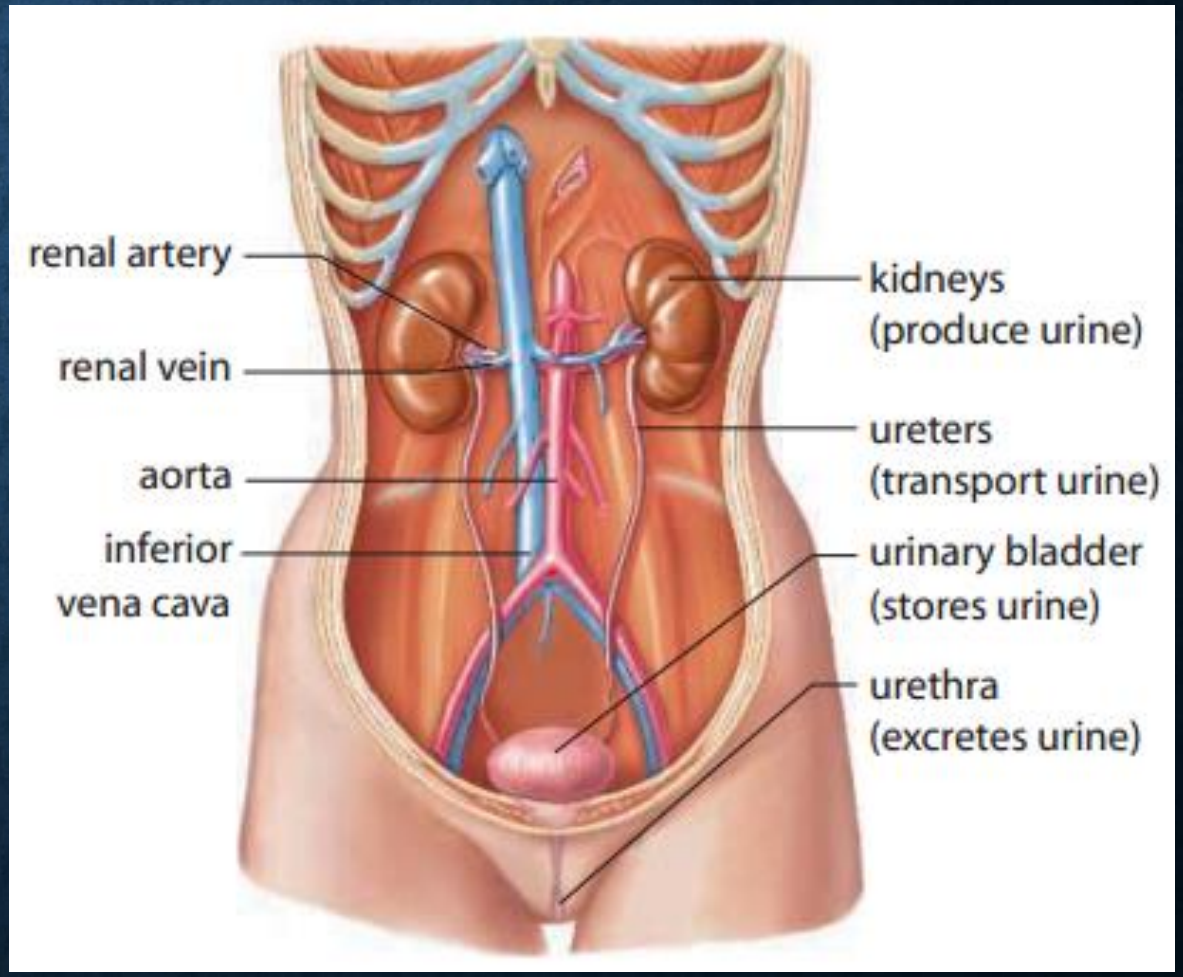
EXCRETORY STRUCTURES AND FUNCTIONS

- urinary bladder
  organ where urine is stored before being discharged by way of the urethra



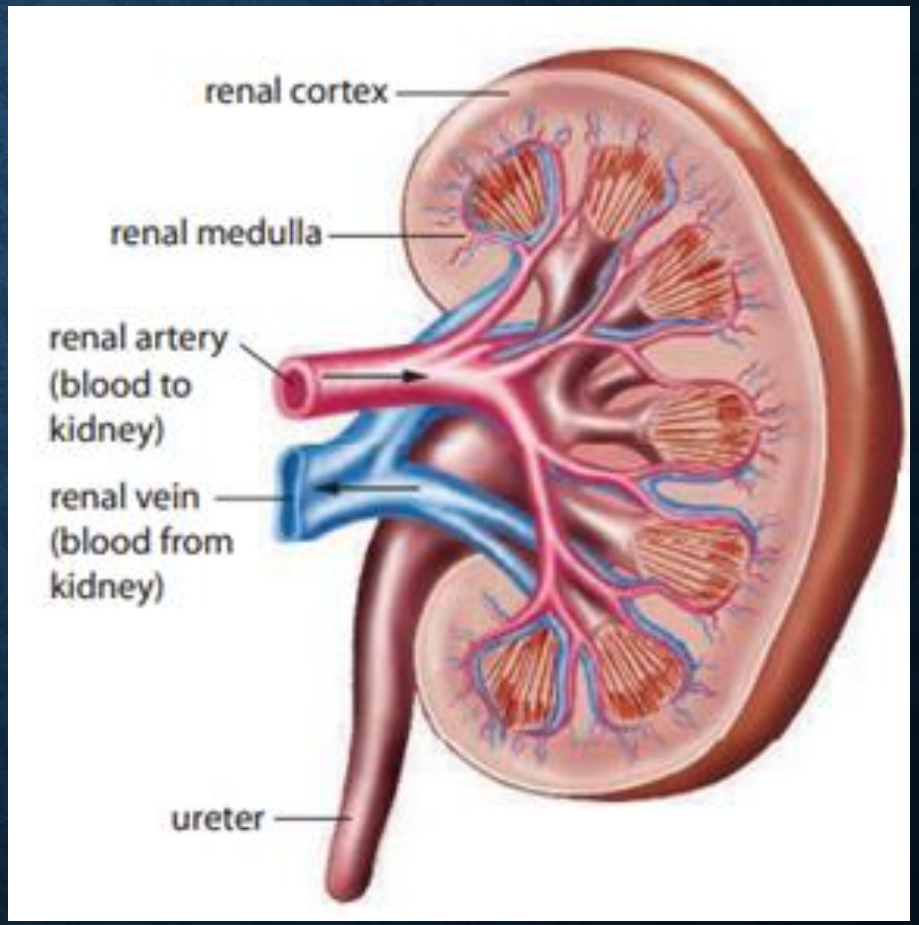
EXCRETORY STRUCTURES AND FUNCTIONS

- urethra the tube through which urine exits the bladder and the body



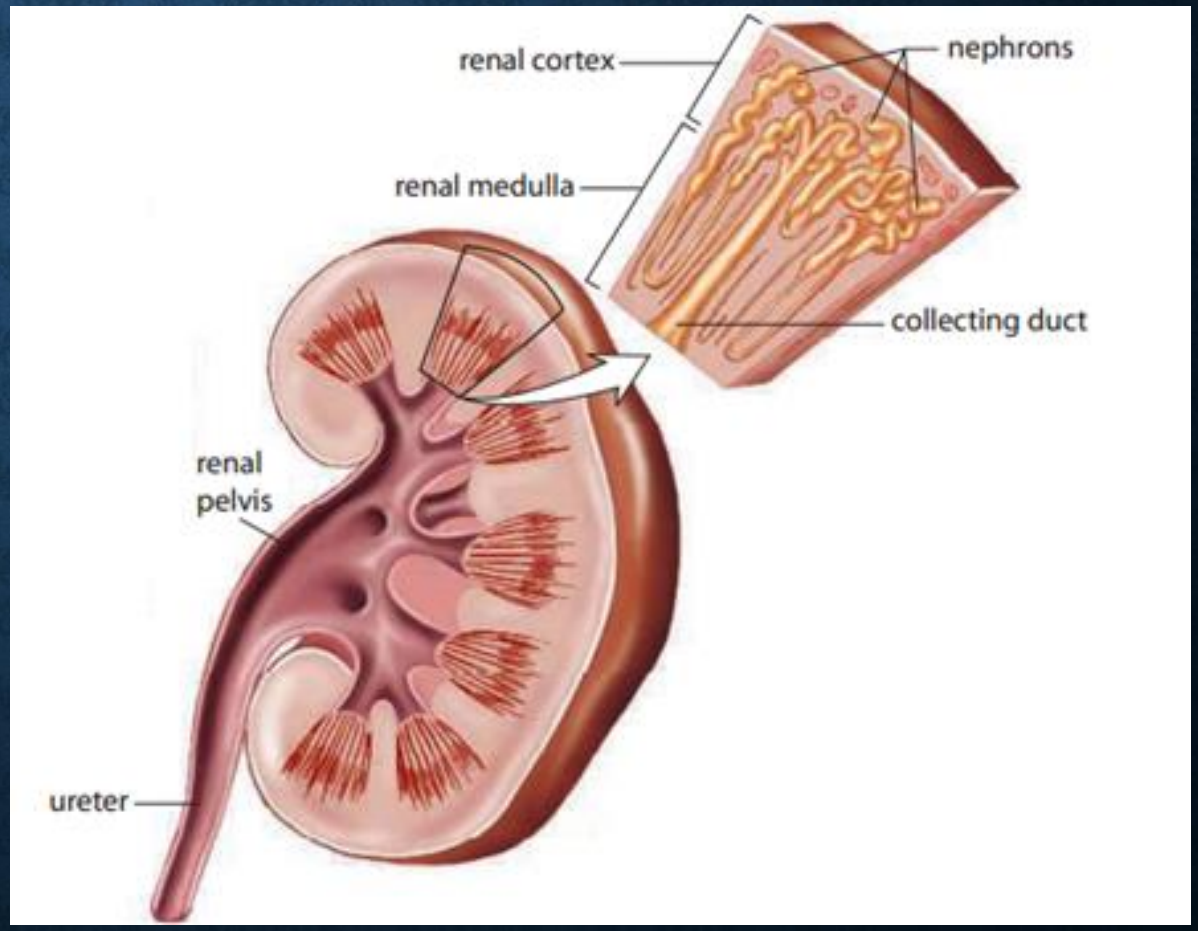
EXCRETORY STRUCTURES AND FUNCTIONS

- kidney one of a pair of organs that filters waste from the blood and adjusts the concentrations of salts in the blood



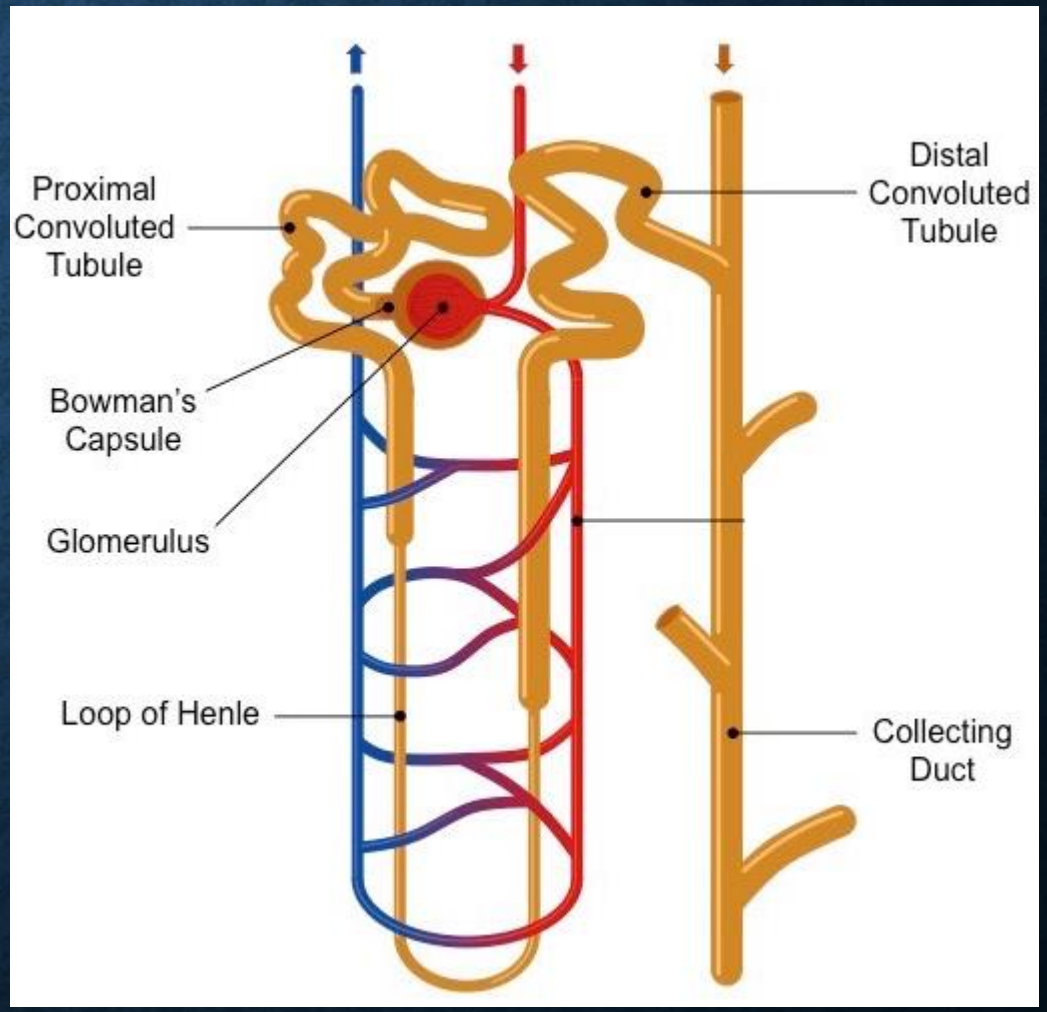
KIDNEY STRUCTURE AND FUNCTION

- Nephron microscopic tube-like filtration unit found in the kidneys that filters and reabsorbs various substances from the blood; produces urine



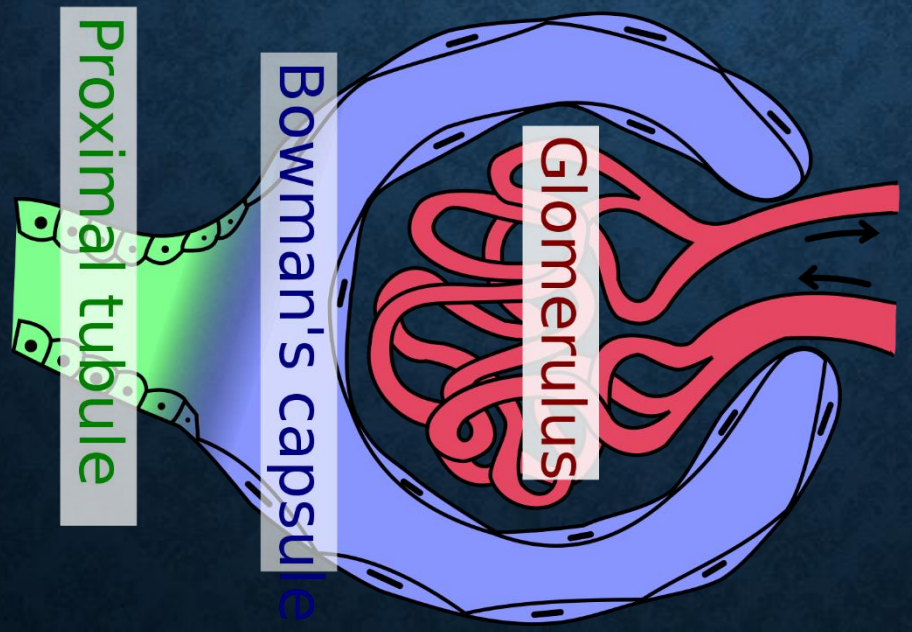
THE NEPHRON

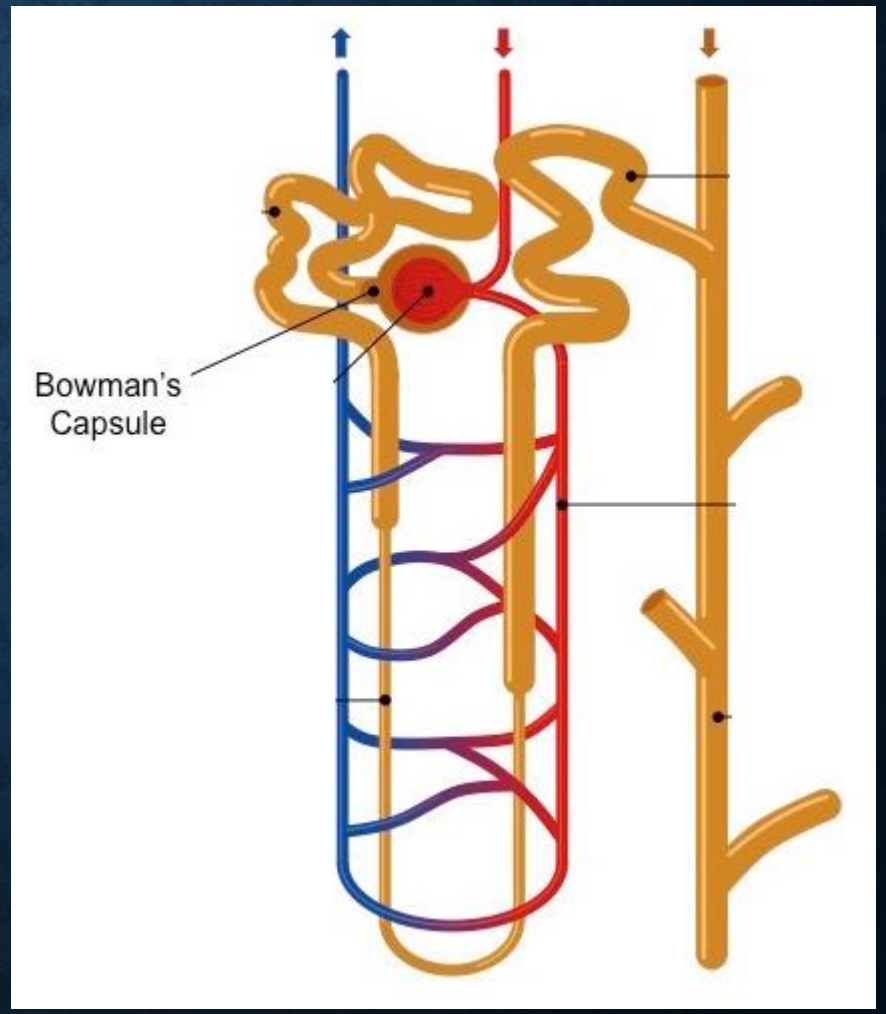
- Each nephron is organized into three main regions:
- a filter
- a tubule
- a collecting duct.



THE NEPHRON – THE FILTER

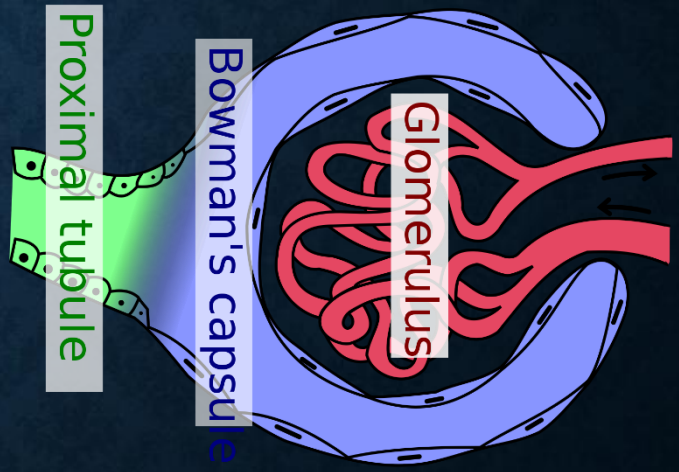
- Bowman's capsule the cap-like structure at the top of each nephron





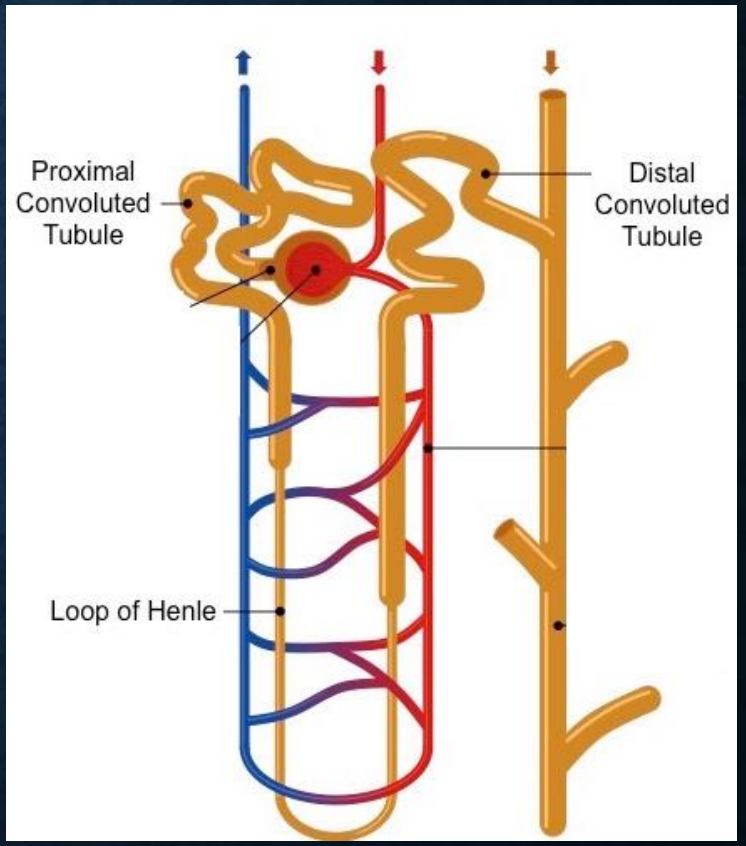
THE NEPHRON – THE FILTER

- Within each capsule, a renal artery enters and splits into a fine network of capillaries called a glomerulus.
- The walls of the glomerulus act as a filtration device. They are impermeable to proteins, other large molecules, and red blood cells, so these remain within the blood.
- Water, small molecules, ions, and urea—the main waste products of metabolism—pass through the walls and proceed farther into the nephron. The filtered fluid that proceeds from the glomerulus into the Bowman's capsule of the nephron is referred to as filtrate.



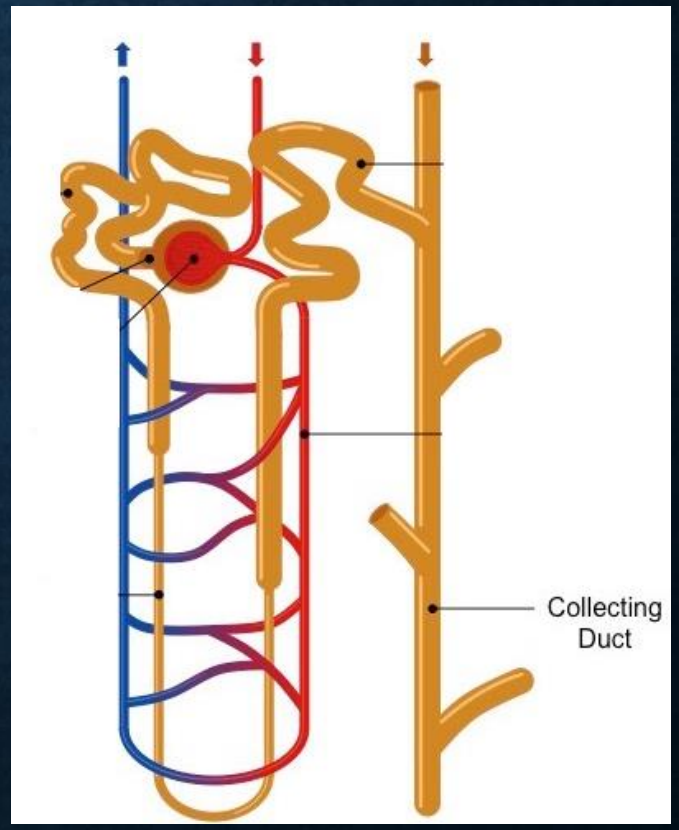
THE NEPHRON – A TUBULE

- The Bowman's capsule is connected to a small, long, narrow tubule that is twisted back on itself to form a loop.
- This long, hairpin loop is a reabsorption device.
- The tubule has three sections:
- the proximal tubule
- the loop of Henle
- and the distal tubule.
- Like the small intestine, this tubule absorbs substances that are useful to the body, such as glucose and a variety of ions, from the filtrate passing through it. Unlike the small intestine, this tubule also secretes substances into the tissues surrounding it.

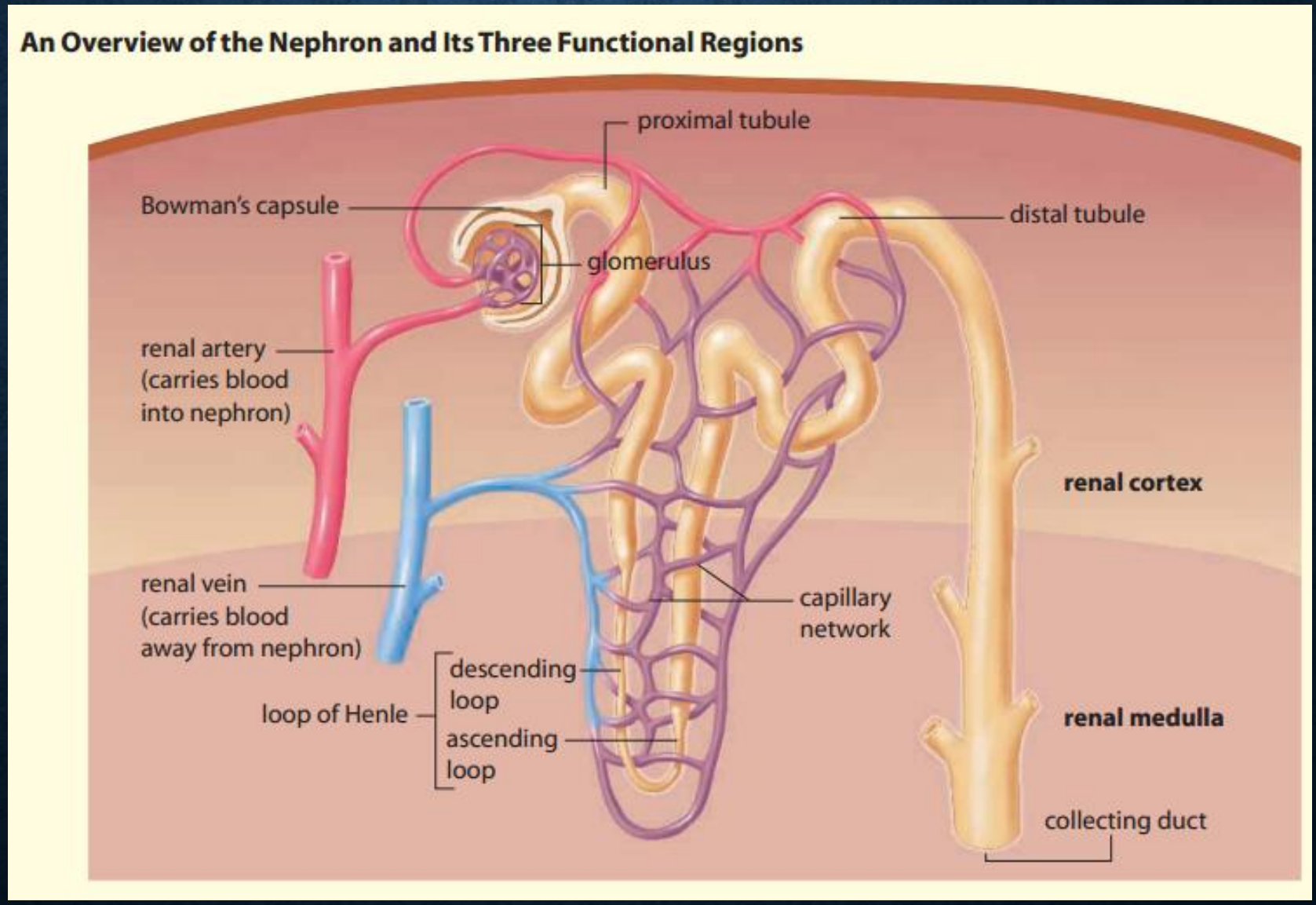


THE NEPHRON – THE COLLECTING DUCT

- The tubule empties into a larger pipe-like channel called a collecting duct.
- The collecting duct functions as a water-conservation device, reclaiming water from the filtrate passing through it so that very little precious water is lost from the body.
- The filtrate that remains in the collecting duct is a suspension of water and various solutes and particles.
- It is now called urine. Its composition is distinctly different from the fluid that entered the Bowman's capsule. The solutes and water reclaimed during reabsorption are returned to the body via the renal veins.

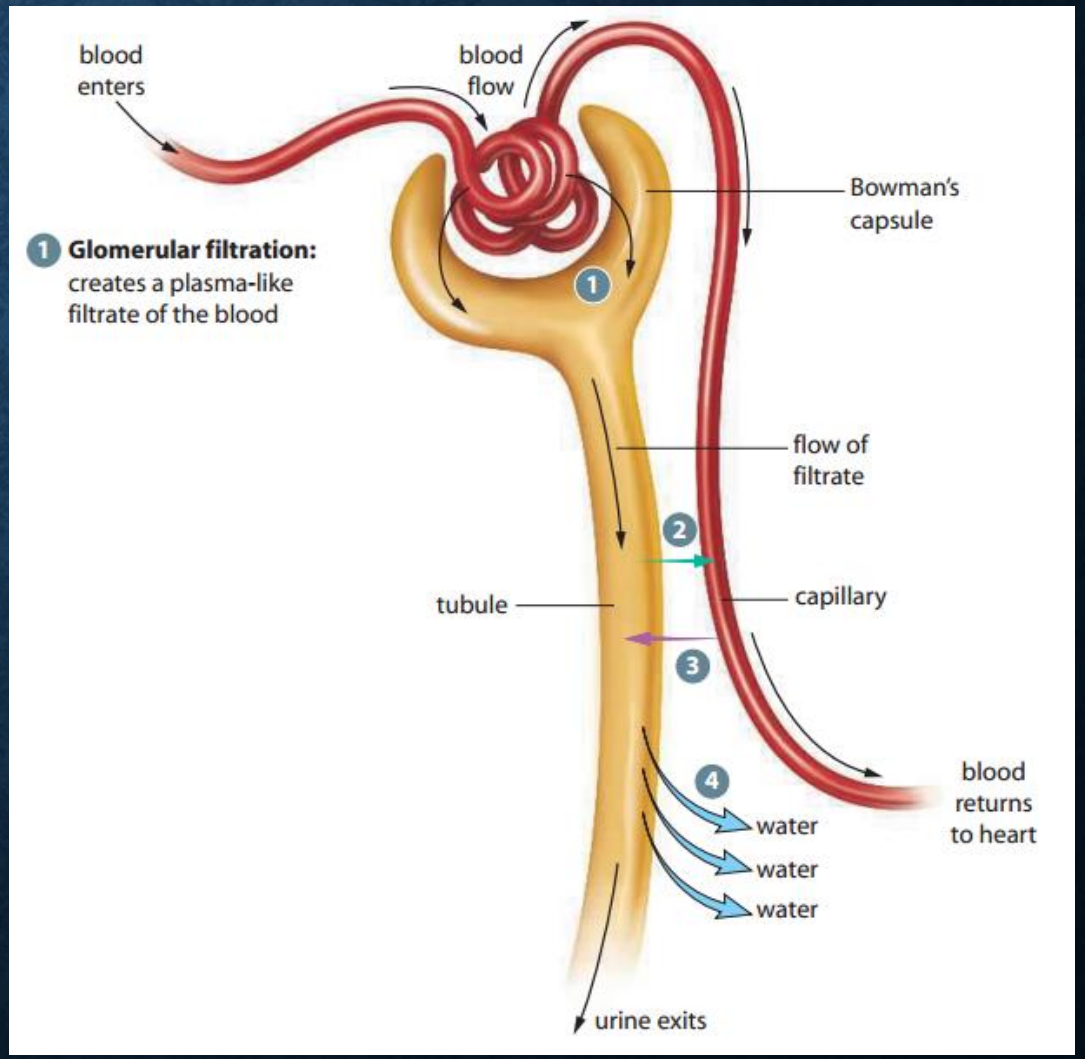


KIDNEY STRUCTURE AND FUNCTION



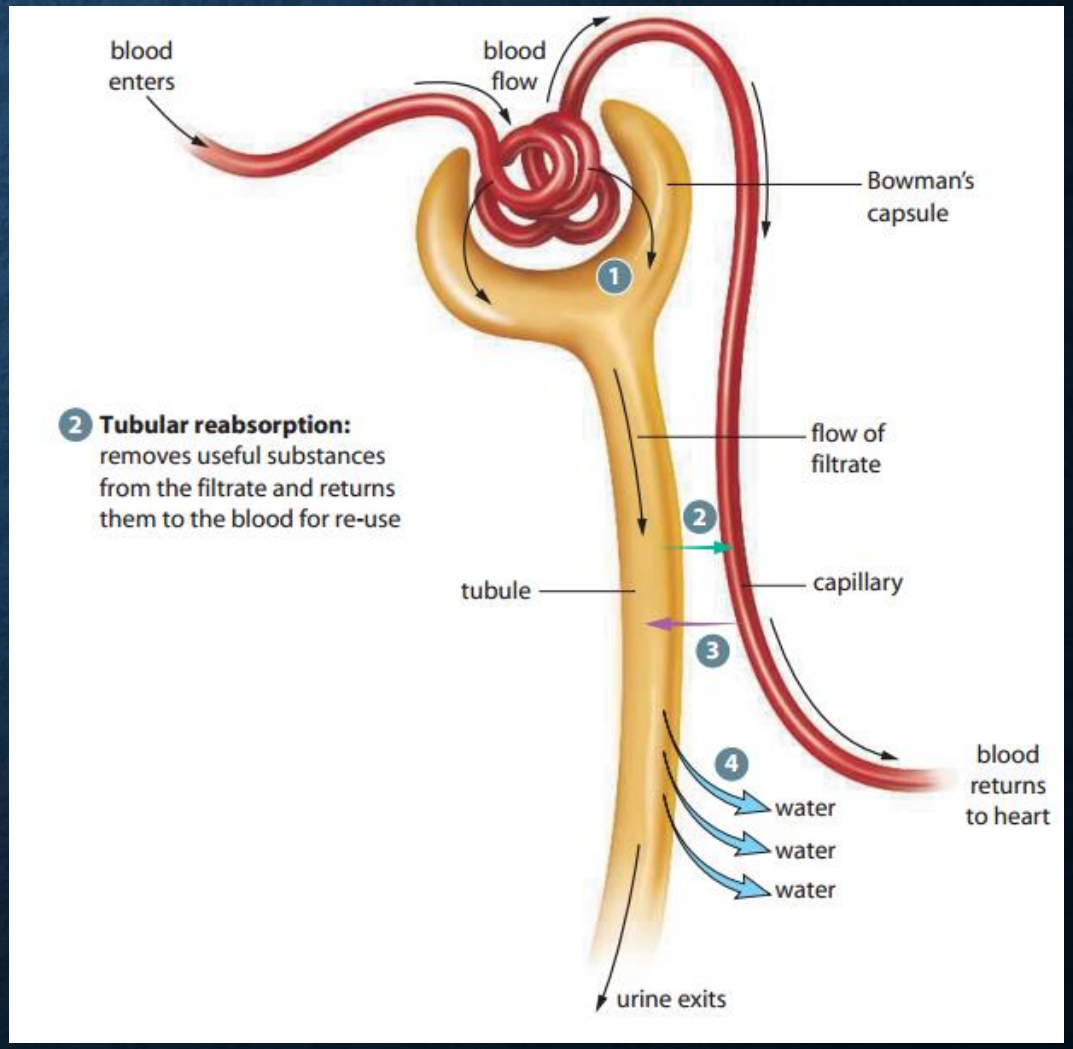
URINE FORMATION IN THE NEPHRON

- glomerular filtration process that results in the movement of water and solutes, except proteins, from the blood plasma into the nephron down a pressure gradient



URINE FORMATION IN THE NEPHRON

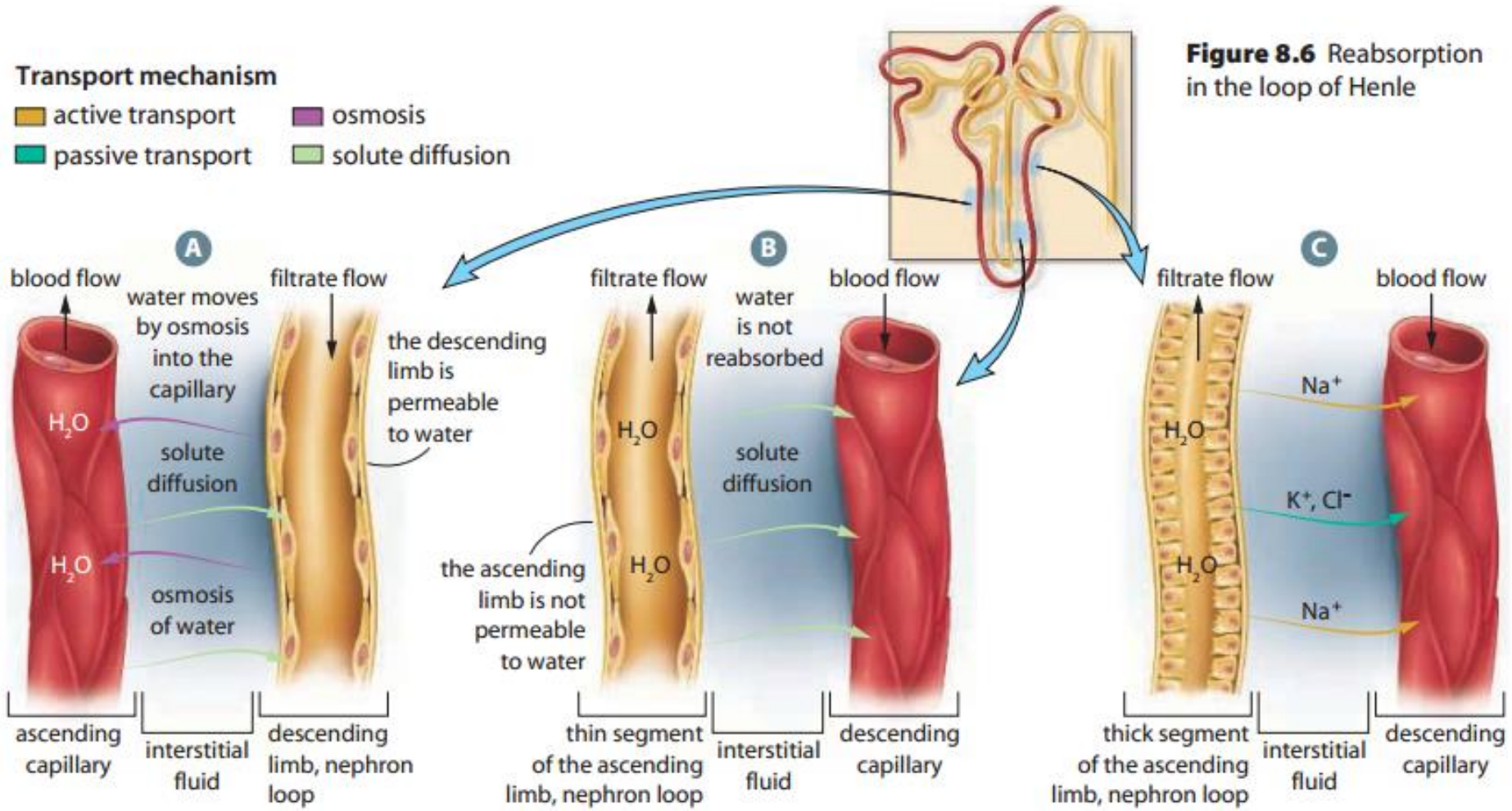
- tubular reabsorption process in which water and useful solutes are reabsorbed from the filtrate in the nephron and transported into capillaries for re-use by the body



URINE FORMATION IN THE NEPHRON

- The cells of the descending limb are permeable to water and only slightly permeable to ions.
- As a result of the salty environment of the medulla and permeability of the descending limb, water diffuses from the filtrate to the capillaries by osmosis.
- As water moving through the descending limb leaves the filtrate, the concentration of sodium ions (Na+) inside the tubule increases, reaching its maximum concentration at the bottom of the loop.
- As the filtrate continues around the bend of the loop of Henle and into the ascending limb, the permeability of the nephron tubule changes.
- Near the bend, the thin portion of the ascending tubule is now impermeable to water and slightly permeable to solutes. Sodium ions diffuse from the filtrate along their concentration gradient and pass into nearby blood vessels

Figure 8.6 Reabsorption in the loop of Henle



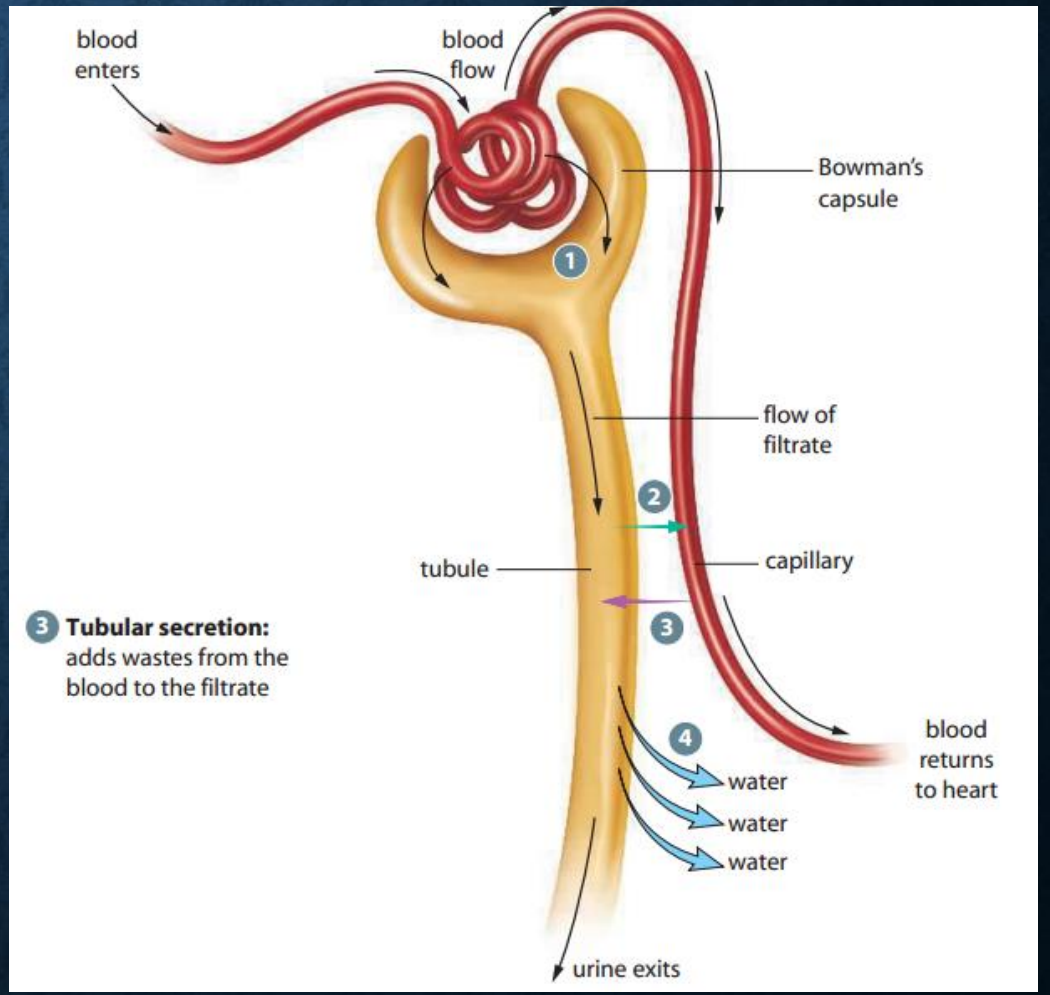
A Water diffuses from the filtrate into surrounding capillaries. Solutes, to a much lesser extent, diffuse in the opposite direction.

B The ascending limb of the loop of Henle is not permeable to water. Solutes diffuse from the filtrate into the surrounding capillaries.

C Active transport of sodium and passive transport of other ions occurs in the thick segment of the ascending limb of the loop of Henle. There is no reabsorption of water in this part of the nephron.

URINE FORMATION IN THE NEPHRON

- tubular secretion process that moves additional wastes and excess substances from the blood into the filtrate in the nephron; uses mainly active transport

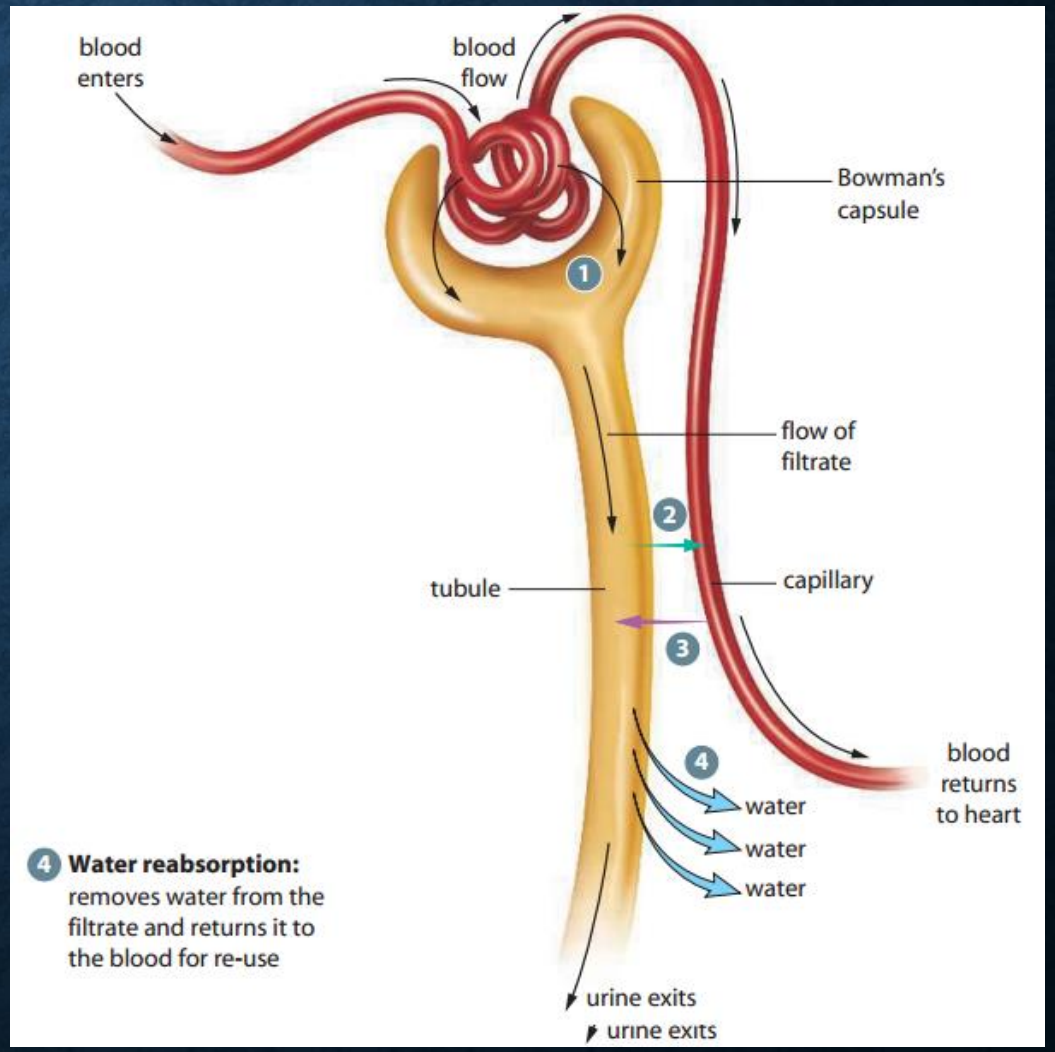


URINE FORMATION IN THE NEPHRON

- Potassium ions (K+) are actively secreted into the distal tubule from the bloodstream in the capillaries.
- Hydrogen ions (H+) are also actively secreted as necessary in order to maintain the pH of the blood.
- Other substances that are not normally part of the body, such as penicillin and other drugs, are secreted into the distal tubule.

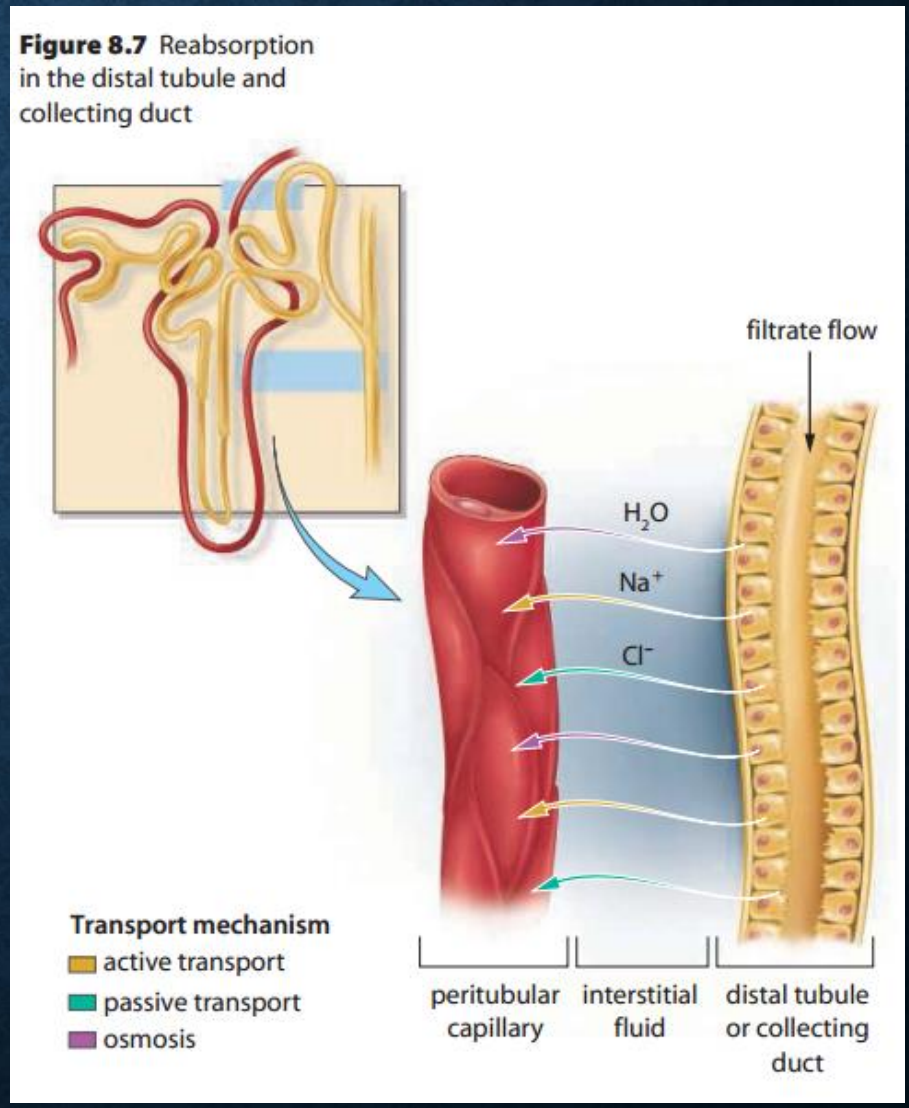
URINE FORMATION IN THE NEPHRON

- water reabsorption process that removes water from the filtrate in the nephron and returns it to the blood for re-use by body systems



URINE FORMATION IN THE NEPHRON

- The active reabsorption of sodium ions from the filtrate into the capillaries depends on the needs of the body
- Passive reabsorption of negative ions such as chloride occurs by electrical attraction. The reabsorption of ions decreases the concentration of the filtrate, which causes water to be reabsorbed by osmosis into the blood stream as well from the collecting duct.



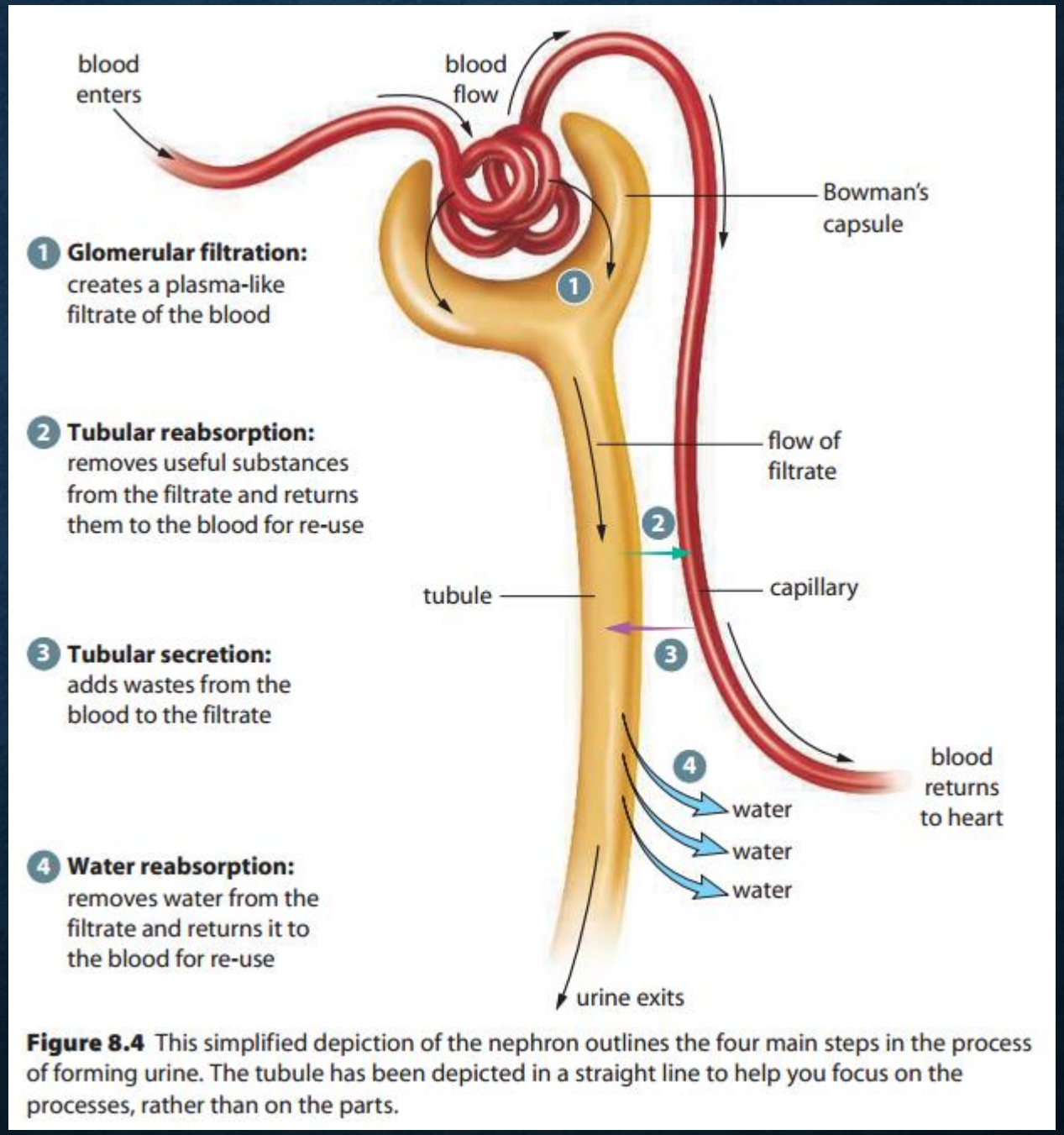


Figure 8.4 This simplified depiction of the nephron outlines the four main steps in the process of forming urine. The tubule has been depicted in a straight line to help you focus on the processes, rather than on the parts.

Table 8.2 A Summary of Nephron Functions

Part of the Nephron	Function
Glomerulus	**Filtration** • Glomerular blood pressure forces some of the water and dissolved substances from the blood plasma through the pores of the glomerular walls
Bowman's capsule	Receives filtrate from glomerulus
Proximal tubule	**Reabsorption** • Active reabsorption of all nutrients, including glucose and amino acids • Active reabsorption of positively charged ions such as sodium, potassium, calcium • Passive reabsorption of water by osmosis • Passive reabsorption of negatively charged ions such as chloride and bicarbonate by electrical attraction to positively charged ions **Secretion** • Active secretion of hydrogen ions
Descending loop of Henle	**Reabsorption** • Passive reabsorption of water by osmosis
Ascending loop of Henle	**Reabsorption** • Active reabsorption of sodium ions • Passive reabsorption of chloride and potassium ions
Distal tube	**Reabsorption** • Active reabsorption of sodium ions • Passive reabsorption of water by osmosis • Passive reabsorption of negatively charged ions such as chloride and bicarbonate **Secretion** • Active secretion of hydrogen ions • Passive secretion of potassium ions by electrical attraction to chloride ions
Collecting tube	**Reabsorption** • Passive reabsorption of water by osmosis

INVESTIGATION 8.B

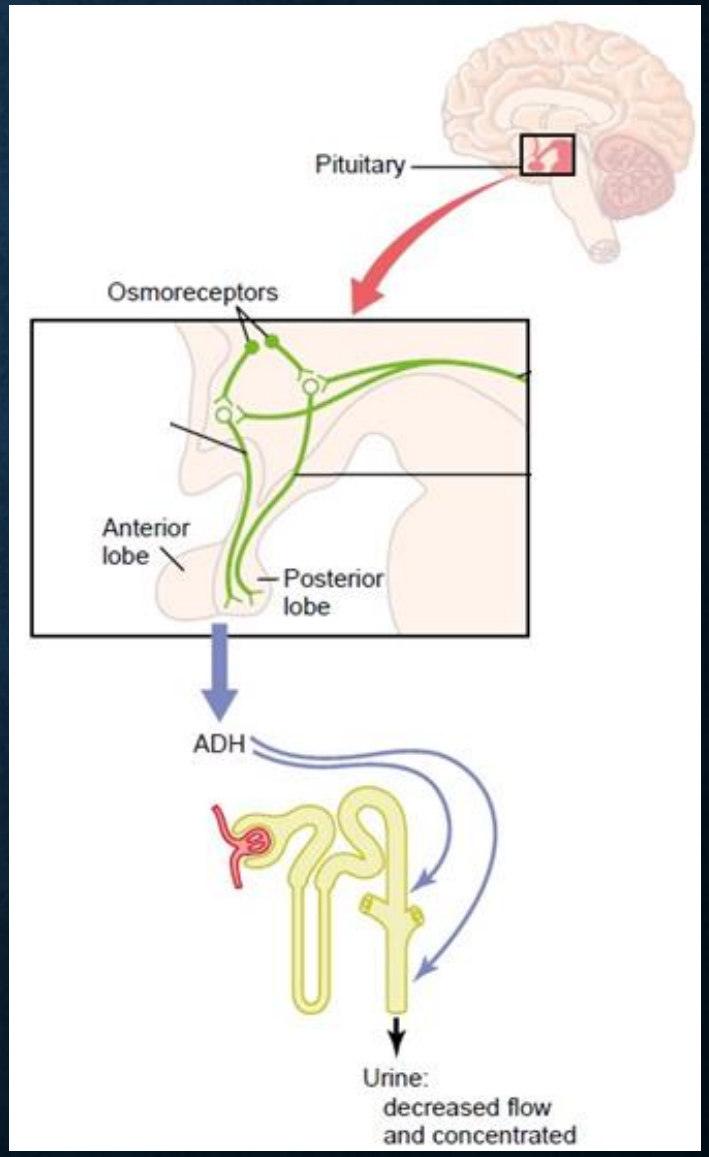
- Urinalysis

THE KIDNEYS AND HOMEOSTASIS

- The amount of water reabsorbed from the filtrate influences two important characteristics of blood: its volume and the concentration of plasma solutes.
- The force generated as water moves by osmosis is called osmotic pressure.
- The greater the concentration gradient, the greater the osmotic pressure becomes.
- Osmotic pressure affects many cellular activities, especially the exchange of materials between cells and blood.
- Blood volume influences blood pressure and, thus, affects the health of the cardiovascular system.

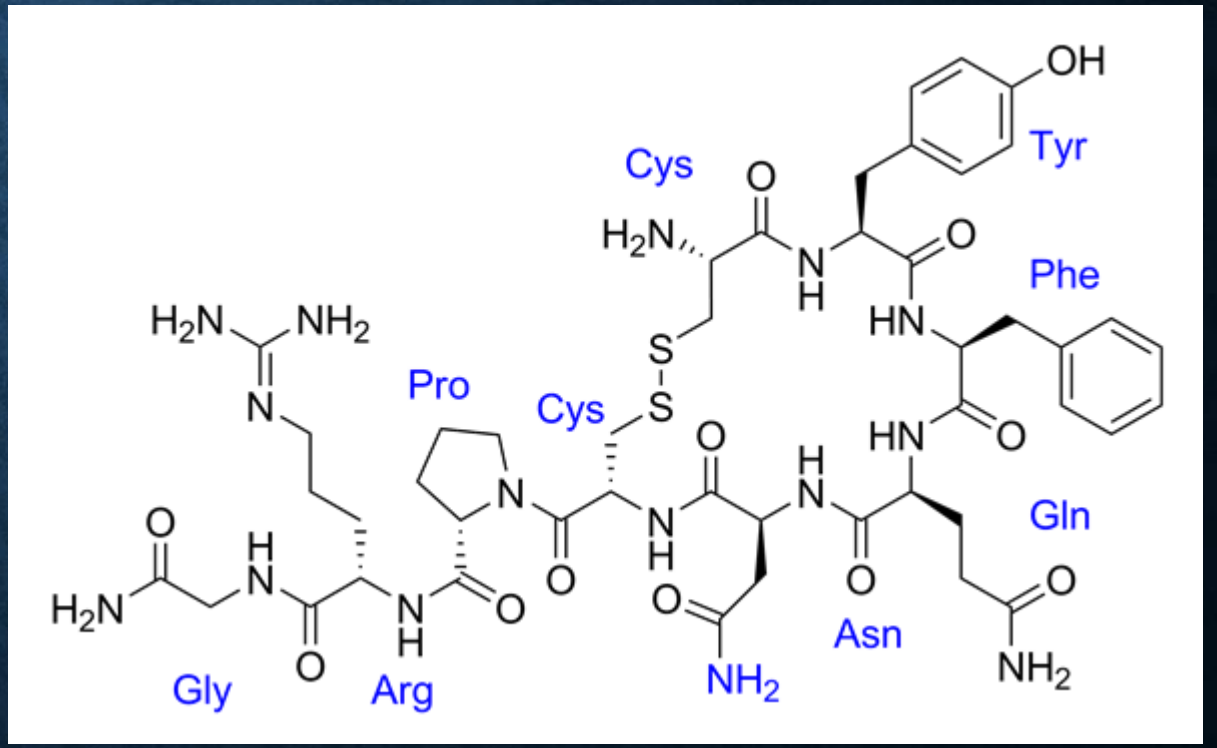
HOMEOSTASIS - REGULATING REABSORPTION OF WATER

- The hypothalamus regulates mechanisms that enable the body to maintain homeostasis. When blood plasma becomes too concentrated (for example, if you are dehydrated), osmotic pressure increases. In response, osmoreceptors in the hypothalamus send impulses to the adjacent pituitary gland in the brain that causes the release of antidiuretic hormone(ADH).



HOMEOSTASIS - REGULATING REABSORPTION OF WATER

- antidiuretic hormone (ADH) hormone regulated by the hyphothalamus and released by the pituitary gland that increases the permeability of the distal tubule and the collecting duct in the nephrons of the kidneys, allowing more water to be reabsorbed into the blood from the filtrate



HOMEOSTASIS - REGULATING REABSORPTION OF WATER

- Conversely, if blood plasma is too dilute (that is, if the osmotic pressure is too low), osmoreceptors stop or prevent the release of ADH.
- As a result, the distal tubule and the collecting duct become less permeable to water.
- This allows more water to be excreted in the urine, concentrating the solutes in the blood. The osmotic pressure of the plasma and tissue fluids rises to normal.
- NEGATIVE FEEDBACK LOOP

HOMEOSTASIS - REGULATING REABSORPTION OF WATER

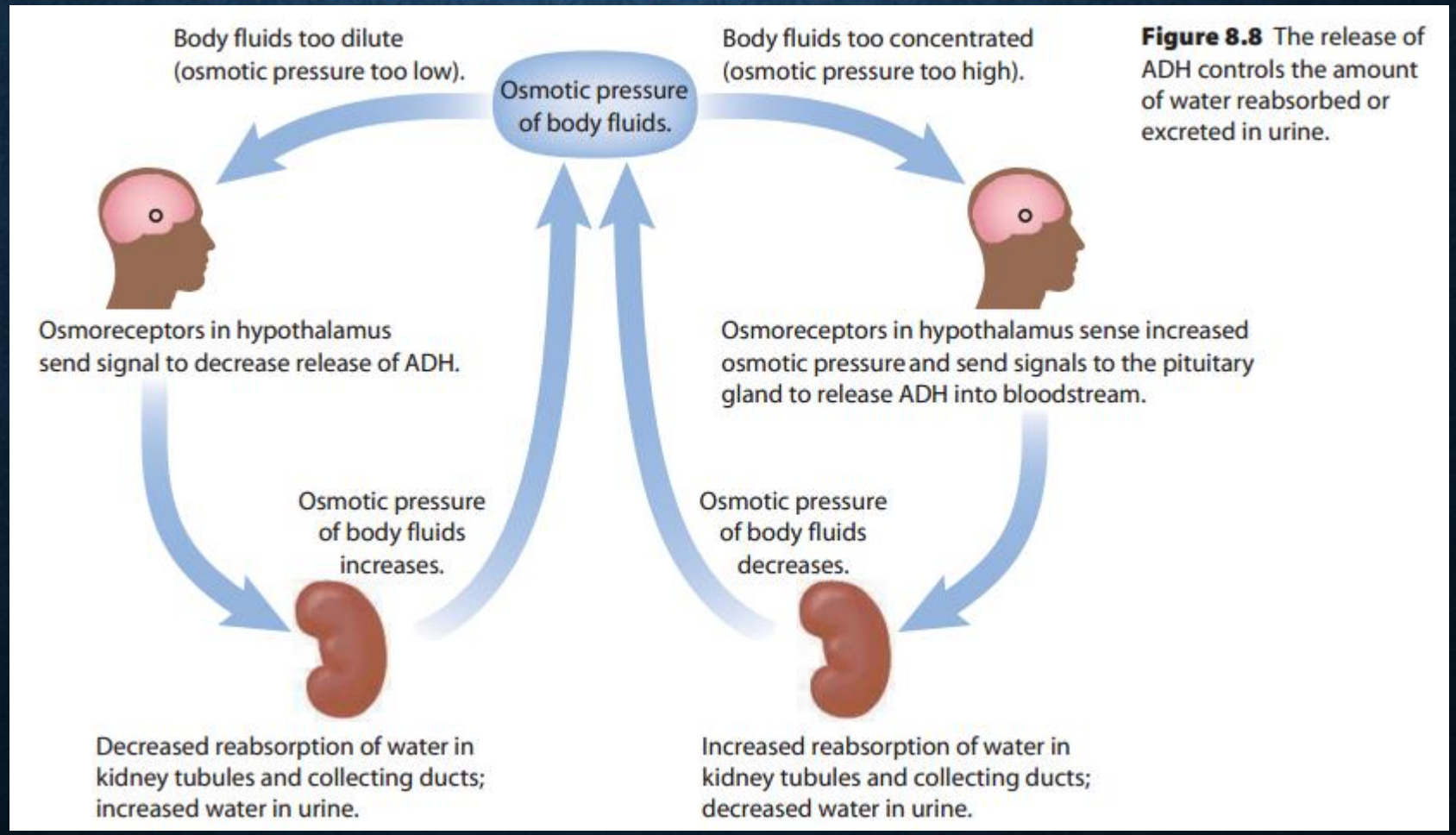
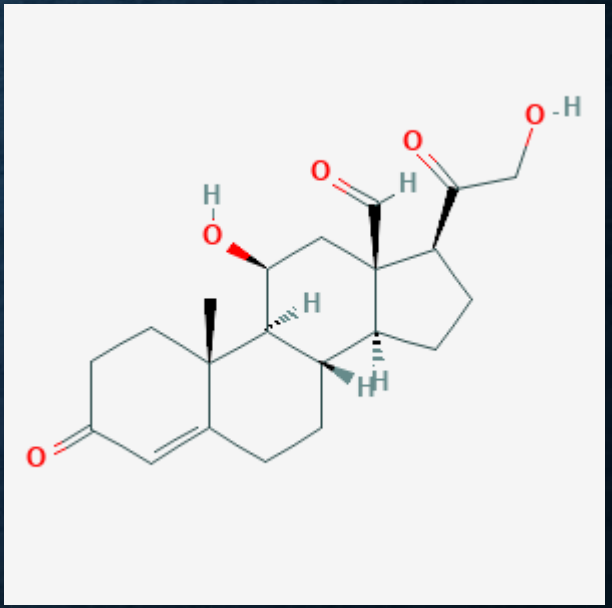


Figure 8.8 The release of ADH controls the amount of water reabsorbed or excreted in urine.

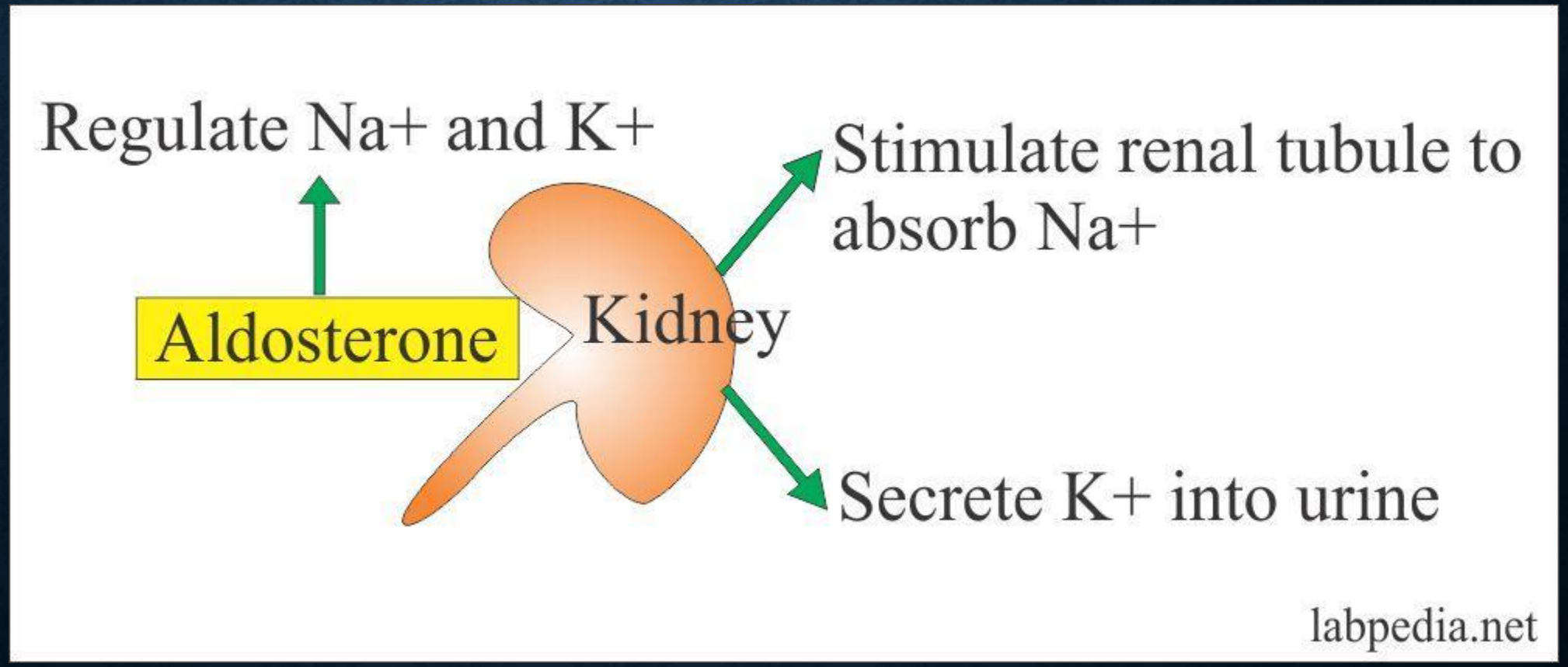
HOMEOSTASIS - REABSORPTION OF SALTS

- aldosterone a type of mineralocorticoid hormone secreted by the adrenal cortex; stimulates the distal tubule and collecting duct of the kidneys to increase the absorption of sodium into the bloodstream, which is followed by the passive absorption of water and chloride



- Aldosterone also stimulates the secretion of potassium ions (K+) into the distal tubes and collecting ducts if K+concentration in the blood is too high.

HOMEOSTASIS - REABSORPTION OF SALTS



DISORDERS AND TREATMENTS OF THE EXCRETORY SYSTEM

- Create a poster

- Cystitis
- Urethritis
- Renal Insufficiency

- Hemodialysis
- Peritoneal Dialysis
- Kidney Transplant

CASE STUDY

Make a Decision

- Investigation 8.A Identifying Structures of the Excretory System