

Station 1

EXCRETION

What is excretion?

Excretion is the process of removing wastes and excess water from the body.

ORGANS INVOLVED WITH EXCRETION

ORGAN	EXCRETION
SKIN	SWEAT
LUNGS	CARBON DIOXIDE
INTESTINES	FECES
KIDNEYS	URINE

Excretion is a crucial part of homeostasis; it involves removing any metabolic wastes from the body.

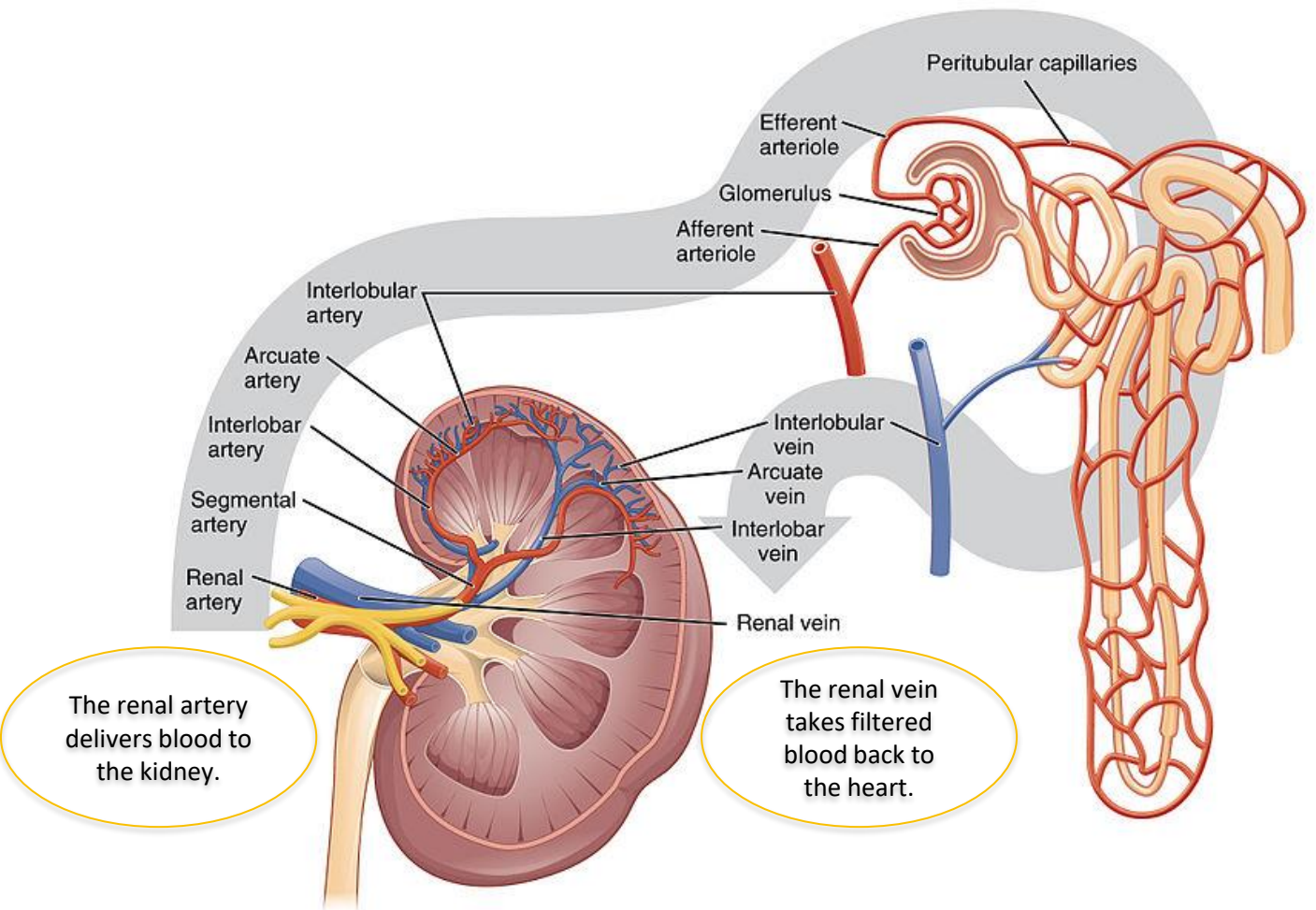
Station 2

THE KIDNEYS

The main organs of the excretory system are the kidneys. **The kidneys main job is to excrete waste.**

Secondary kidney functions:

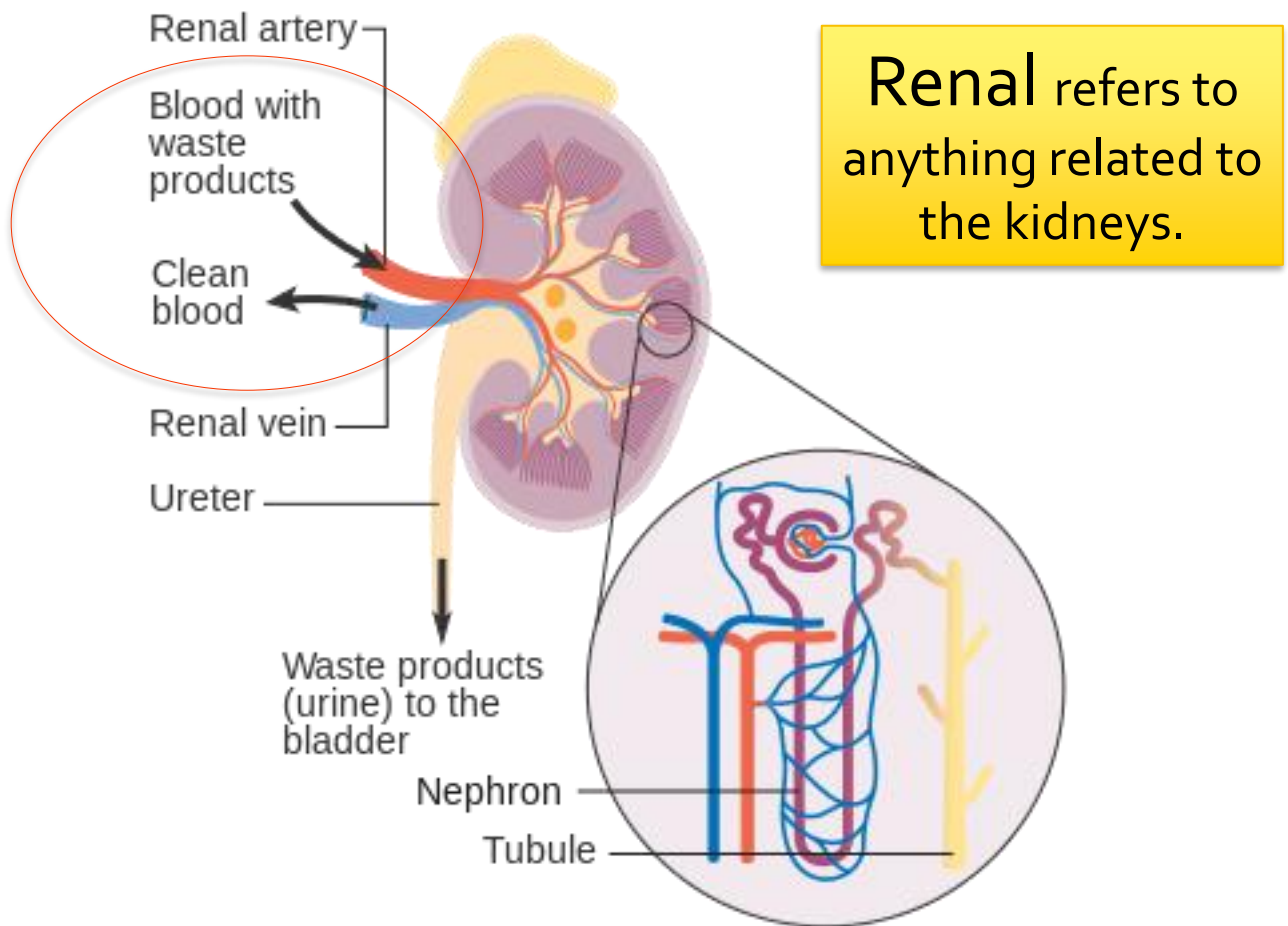
- **Maintain correct water levels in the blood**
- **Maintain electrolyte and salt levels in the blood**
- **Produce hormones**



Station 3

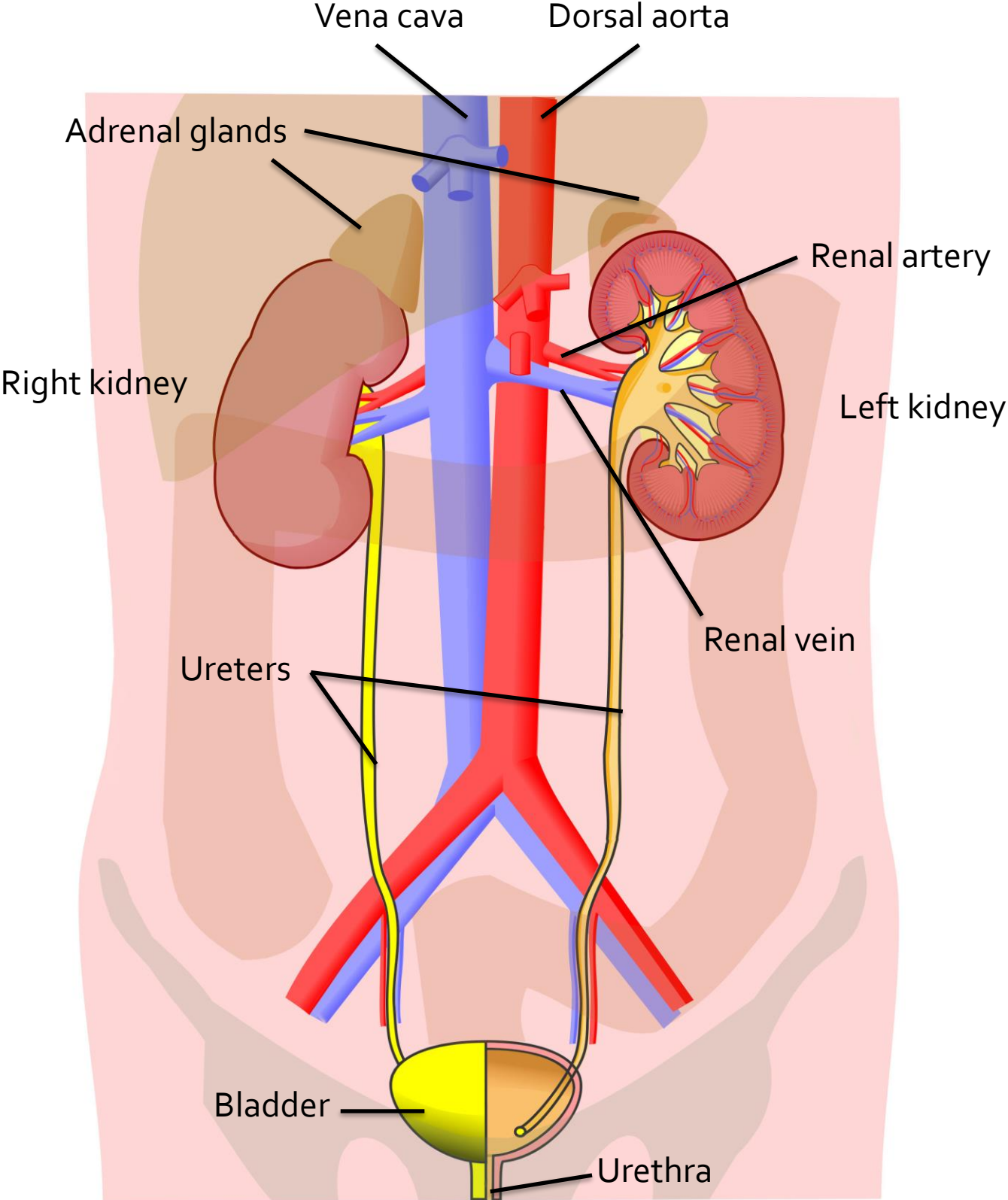
THE KIDNEYS as a FILTER

The main organs of the excretory system are the kidneys- they filter the blood from MANY substances.



The kidneys are connected to the circulatory system through the renal artery and vein. They filter blood that contains waste and send clean blood back to the heart.

Station 4 Urinary system



Station 5

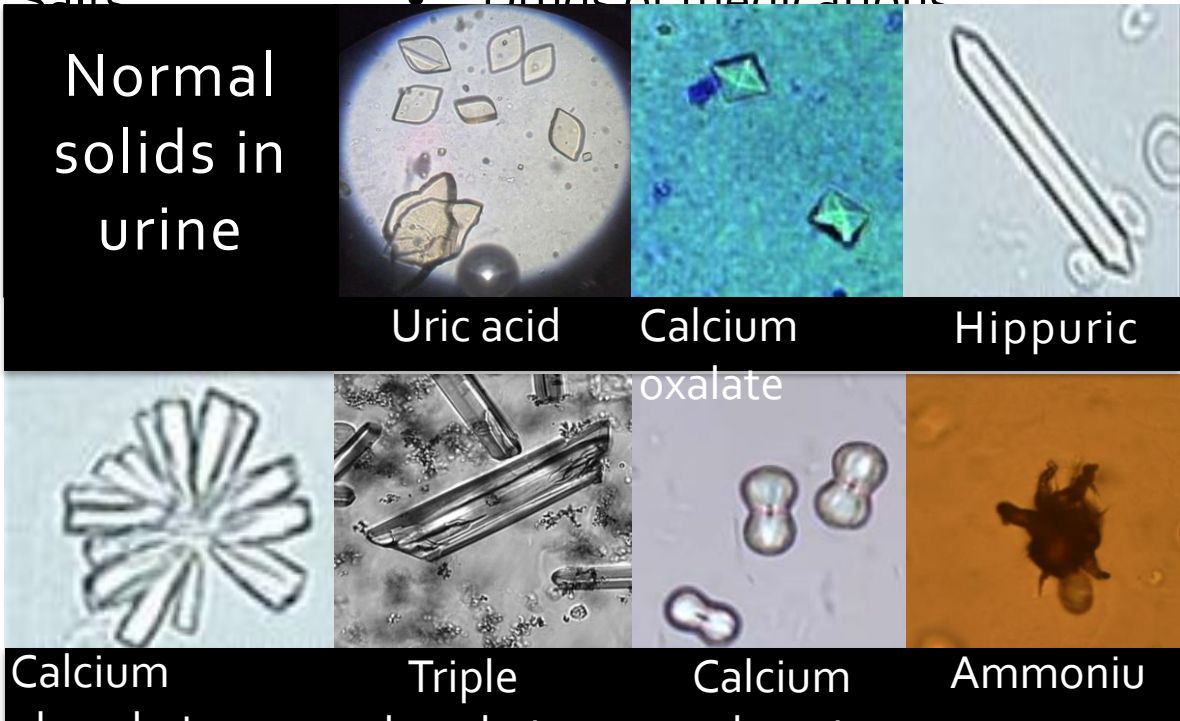
WHAT IS FILTERED?

Your metabolism is an ongoing process of all the chemical reactions in your body.

Every chemical reaction creates a product. Some of the products we can use, but the ones that we can't are considered waste.

Examples of waste that is filtered from the blood:

- Extra water
- Bicarbonate
- Urea
- Salts
- Some amino acids
- Drugs or medications



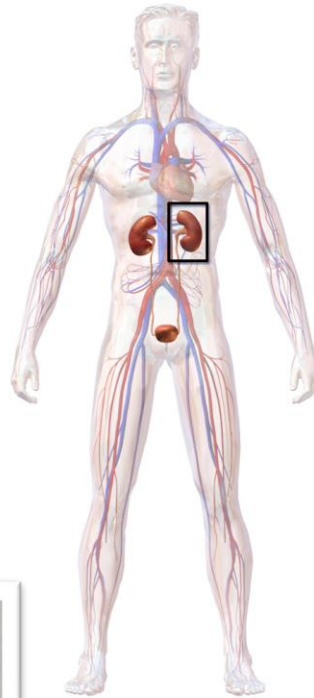
Station 6

KIDNEY STONES

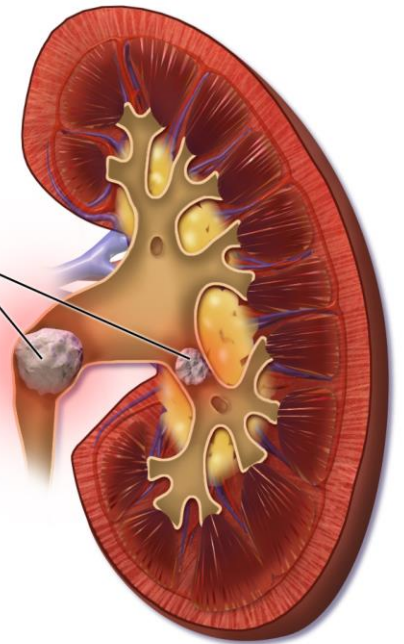
The solids in urine are typically made of insoluble crystal forming substances.

If these crystals stick together, a kidney stone can form.

The most common type of kidney stone is formed from calcium oxalate, but others include triple phosphate (aka struvite), and uric acid.



Kidney stones

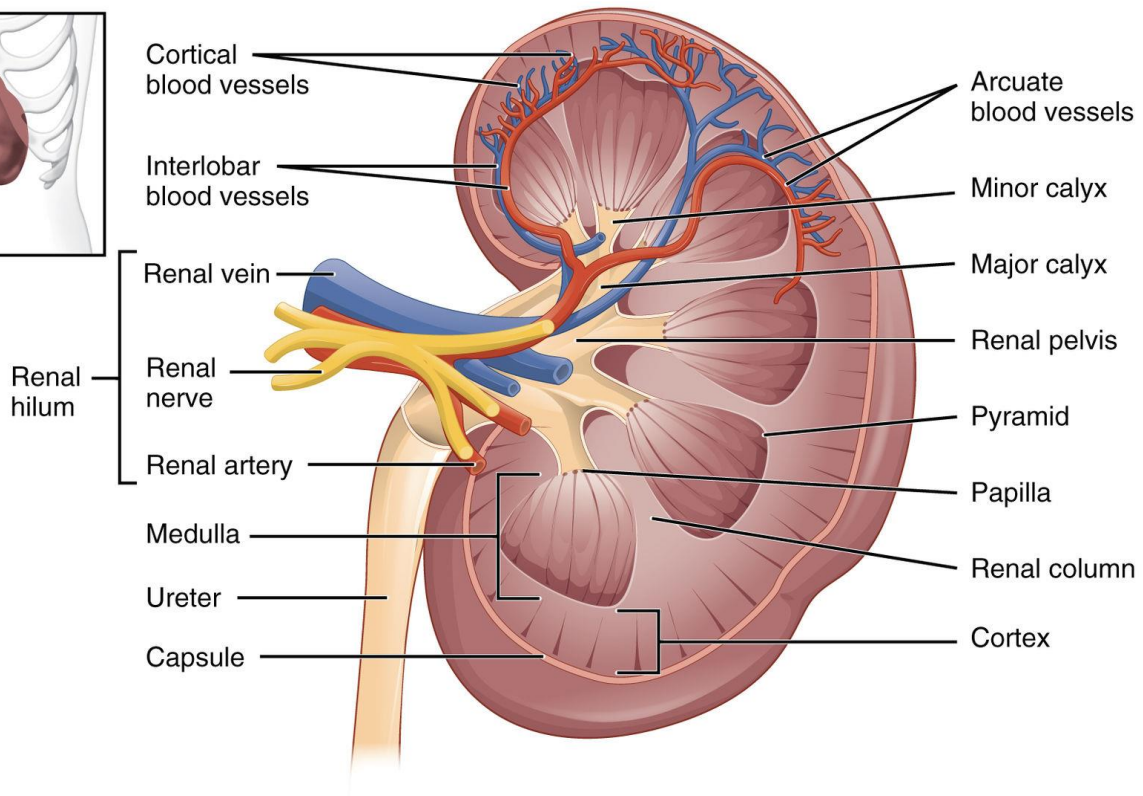
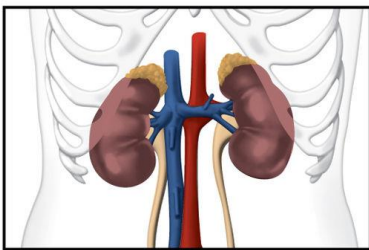


Kidney stones typically pass through the urinary tract without pain, but if they are too large they can be very painful. Your diet and genetics can play a role in kidney stones.

Station 7

KIDNEY ANATOMY

There are two kidneys in the body each about the size of a clenched fist. The kidneys are located towards the lower back on either side of the spine.



When viewing a cross section of the kidney, there is an outer region and an inner region.

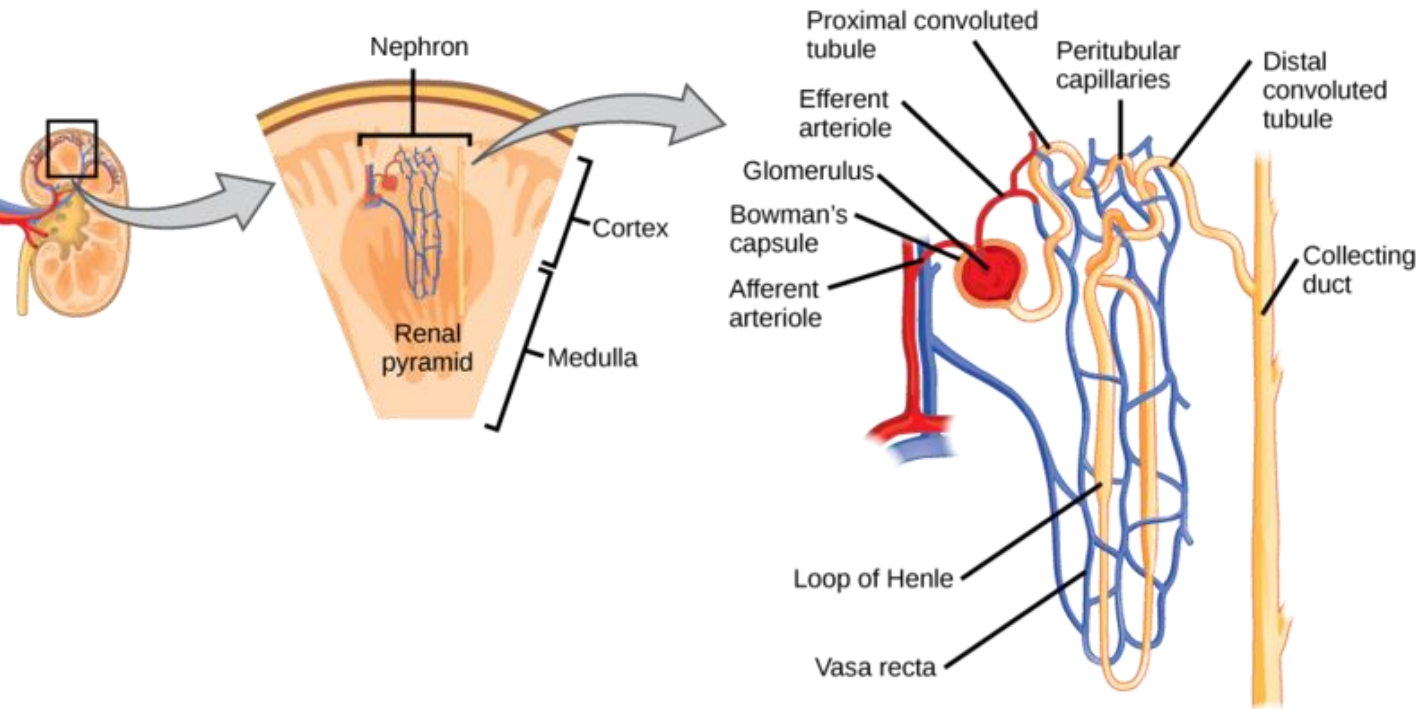
The outer shell is called the renal cortex, and the center is called the renal medulla.

Station 8

NEPHRONS

A kidney is not one big filter, but rather many smaller units that function as one.

These tiny filtering units called nephrons.



Many nephrons are found within the kidneys. A nephron is the smallest functional unit of the kidney. Each nephron filters the blood and produces urine through a series of steps.

Station 8

NEPHRONS continued

2. Proximal convoluted tubule:

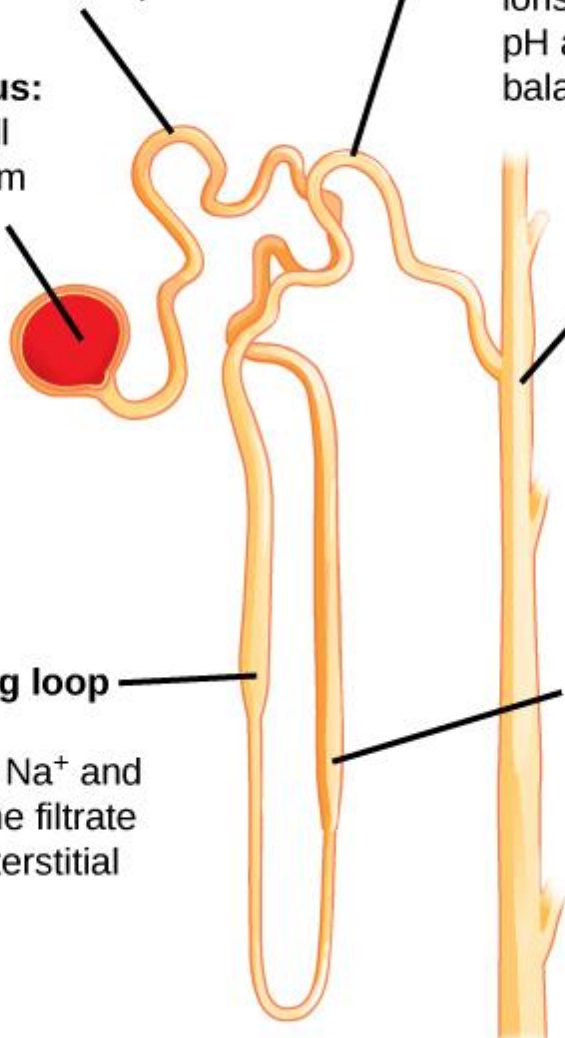
reabsorbs ions, water, and nutrients; removes toxins and adjusts filtrate pH

1. Glomerulus:

filters small solutes from the blood

5. Distal tubule:

selectively secretes and absorbs different ions to maintain blood pH and electrolyte balance



6. Collecting duct:

reabsorbs solutes and water from the filtrate

4. Ascending loop of Henle:

reabsorbs Na^+ and Cl^- from the filtrate into the interstitial fluid

3. Descending loop of Henle:

aquaporins allow water to pass from the filtrate into the interstitial fluid

*Filtrate refers to the liquid and chemicals that are passed through the nephrons to be filtered.

Each kidney contains approximately 1 million nephrons.

Station 9

URINE

Many waste products of the cell are rich in nitrogen and must be filtered from the bloodstream.

Examples of these include urea, uric acid, and creatinine.

WHAT'S IN IT?

Urine is 90%-95% water

Remaining 5%-10% is usually made of solutes such as urea, uric acid, ammonia, hormones, dead blood cells, salts, minerals, and can also contain toxins.

Outside of water, the stuff your urine is made up of can depend on what you've drank, eaten, consumed, or even absorbed through your skin!



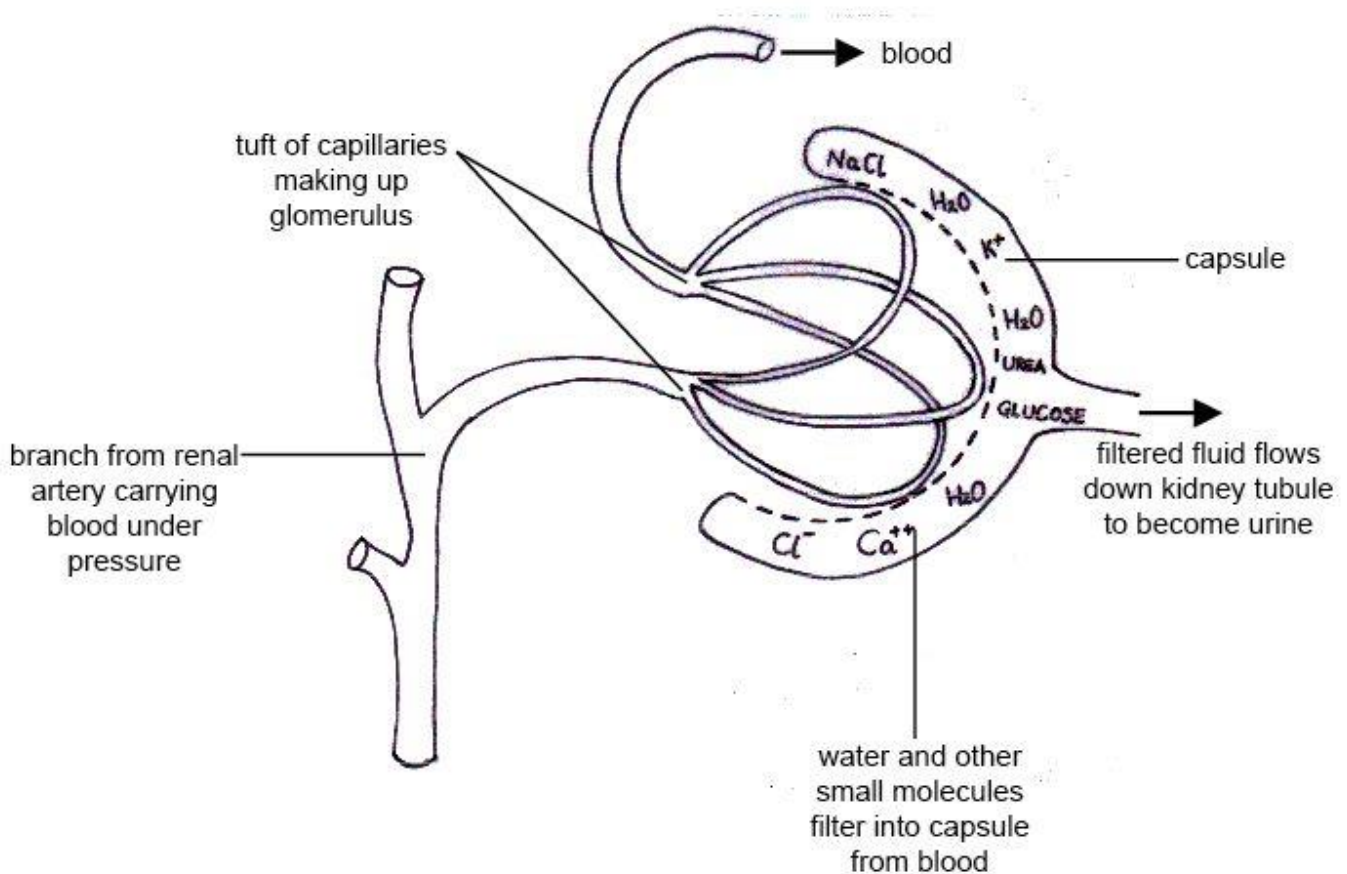
Station 10

PLASMA – NOT BLOOD CELLS

Plasma makes up a huge portion of your blood- the plasma is everything except the red and white blood cells.

Plasma contains proteins and electrolytes to help our body function.

Blood CELLS are too big to fit through the nephron filtration system, but the plasma is filtered through, which carries the waste.



Blood in the urine can be a sign of disease or

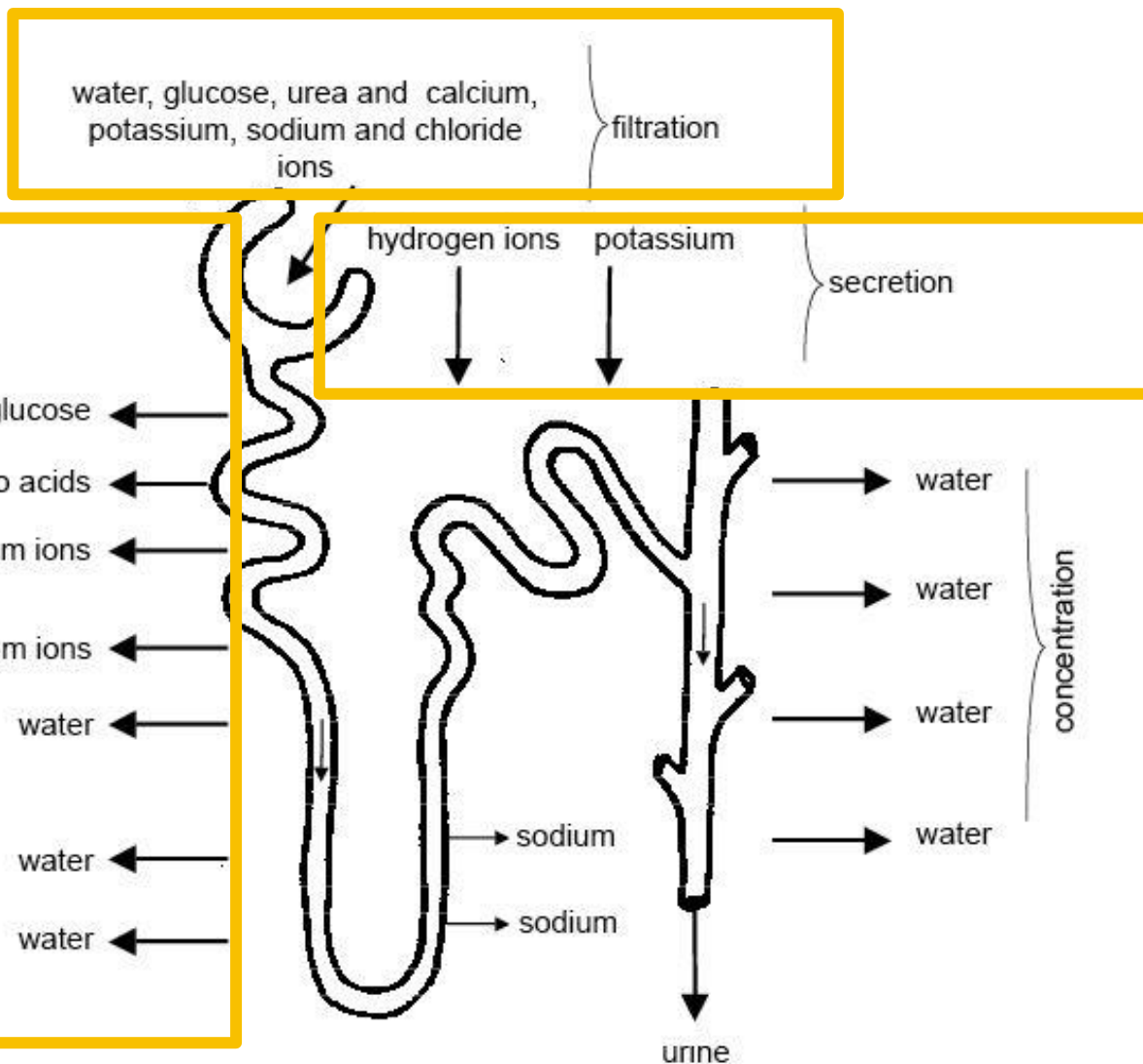
Station 11

STEPS OF URINE FORMATION

Urine formation within the nephrons has 3 basic steps:

1. Filtration
2. Reabsorption (back to blood stream)
3. Secretion (from bloodstream into nephron)

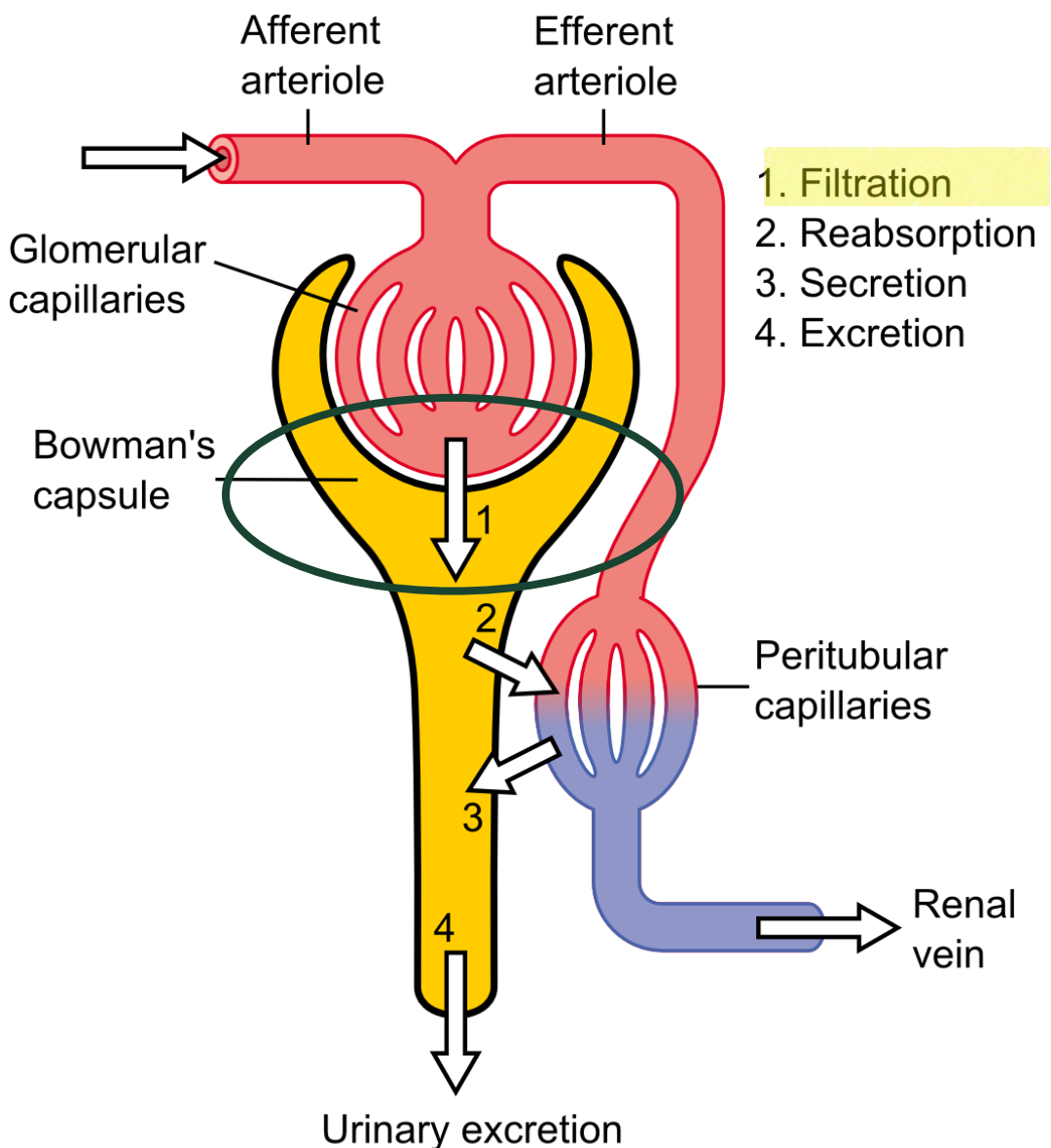
Urine formation occurs in the nephrons.



Station 12

FILTRATION

Most filtration occurs in the glomerulus. Naturally occurring blood pressure forces solutes (water, salt, urea, glucose, and amino acids, etc.) into the Bowman's capsule. Blood cells and proteins are too large to pass through and remain in the blood vessels.



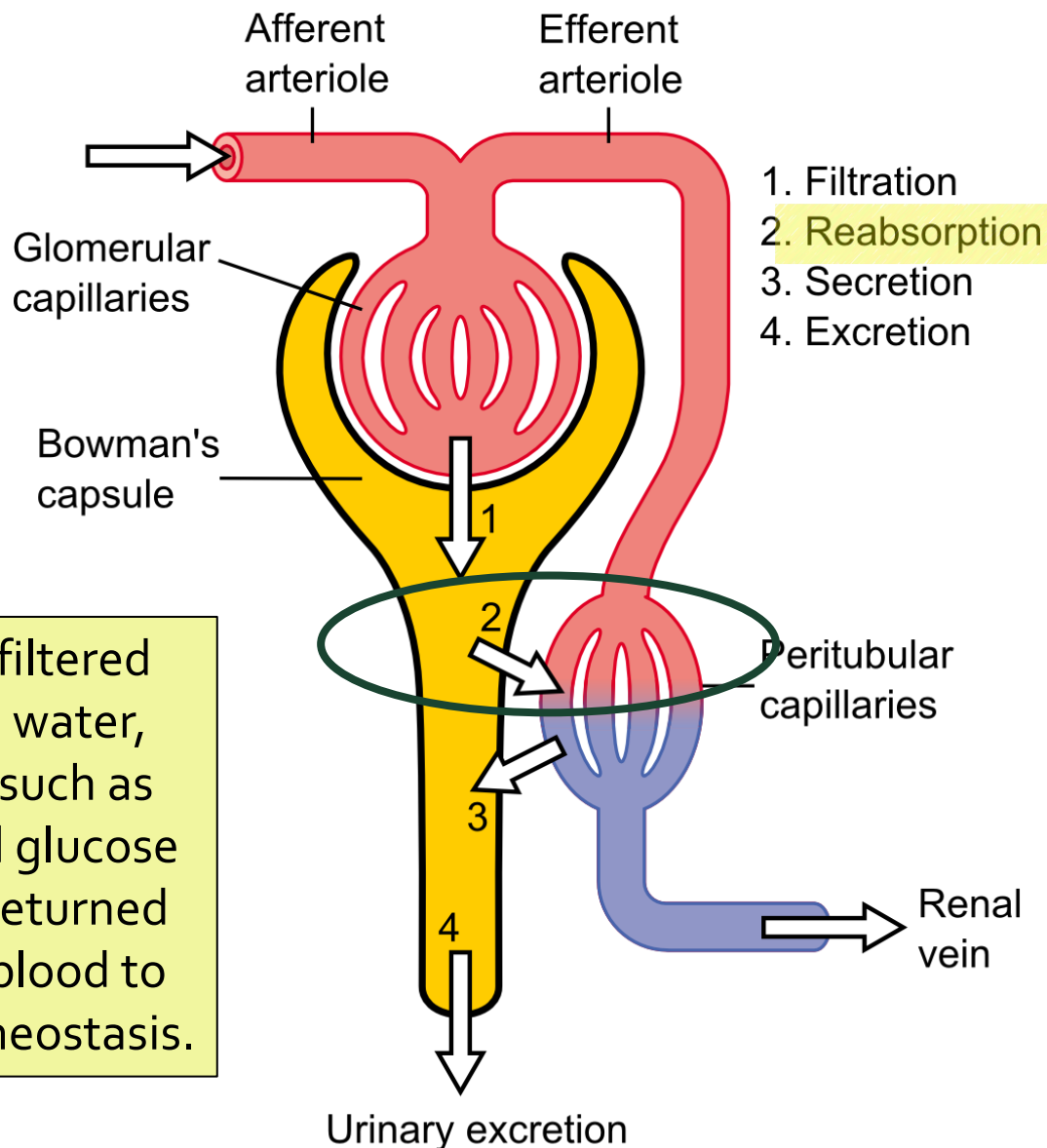
$$\text{Excretion} = \text{Filtration} - \text{Reabsorption} + \text{Secretion}$$

Station 13

REABSORPTION

Reabsorption- Nephrons to Bloodstream

Reabsorption is the process of returning the clean, filtered plasma back into the circulatory system. The concentrated fluid that remains after reabsorption is the urine.



Along with filtered plasma and water, substances such as salt, ions and glucose can also be returned back to the blood to maintain homeostasis.

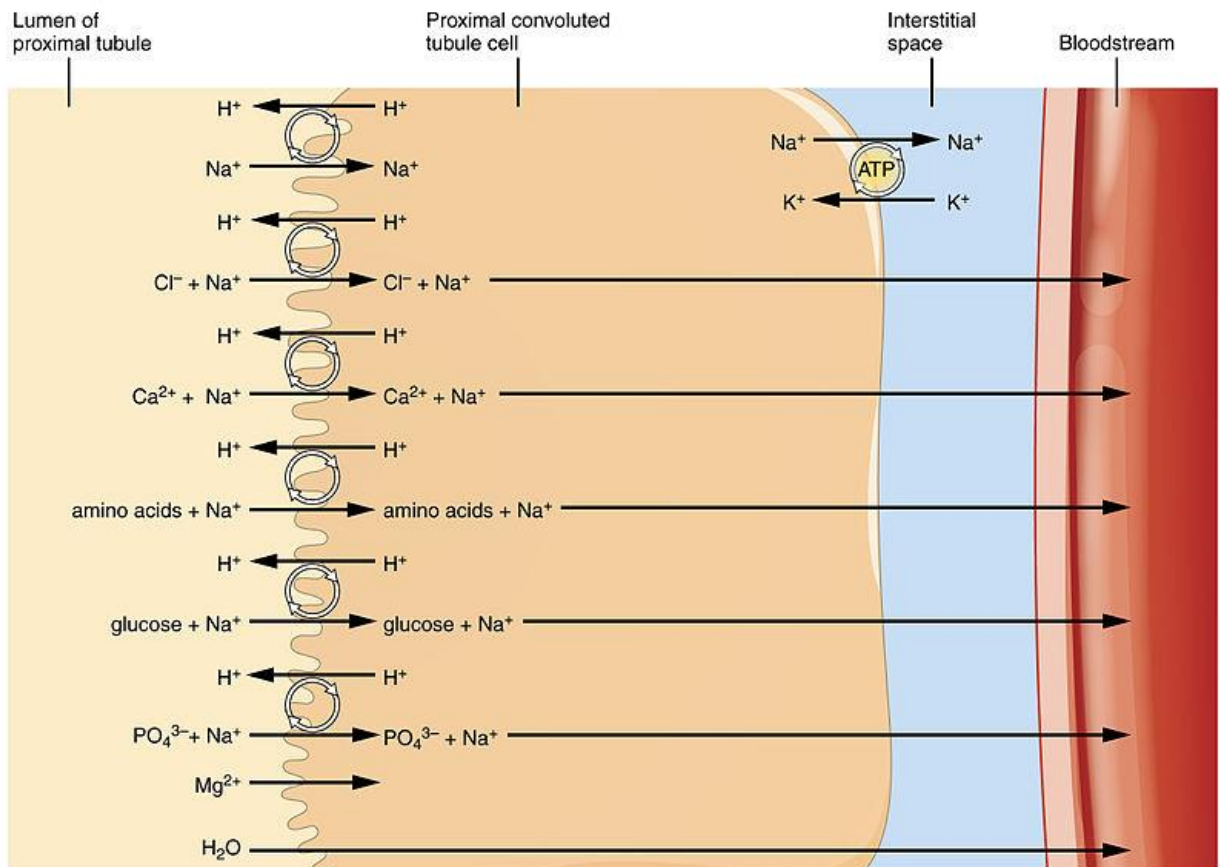
$$\text{Excretion} = \text{Filtration} - \text{Reabsorption} + \text{Secretion}$$

Station 13

REABSORPTION CONTINUED

Reabsorption is important because it takes back reusable fluid, which is reintroduced into the bloodstream to become part of the existing plasma.

If this fluid were excreted with urine, you would lose more than 10 times the amount of your bodily fluids every day. Reabsorption ensures that your body only excretes what it needs to and preserves your body fluid homeostasis!

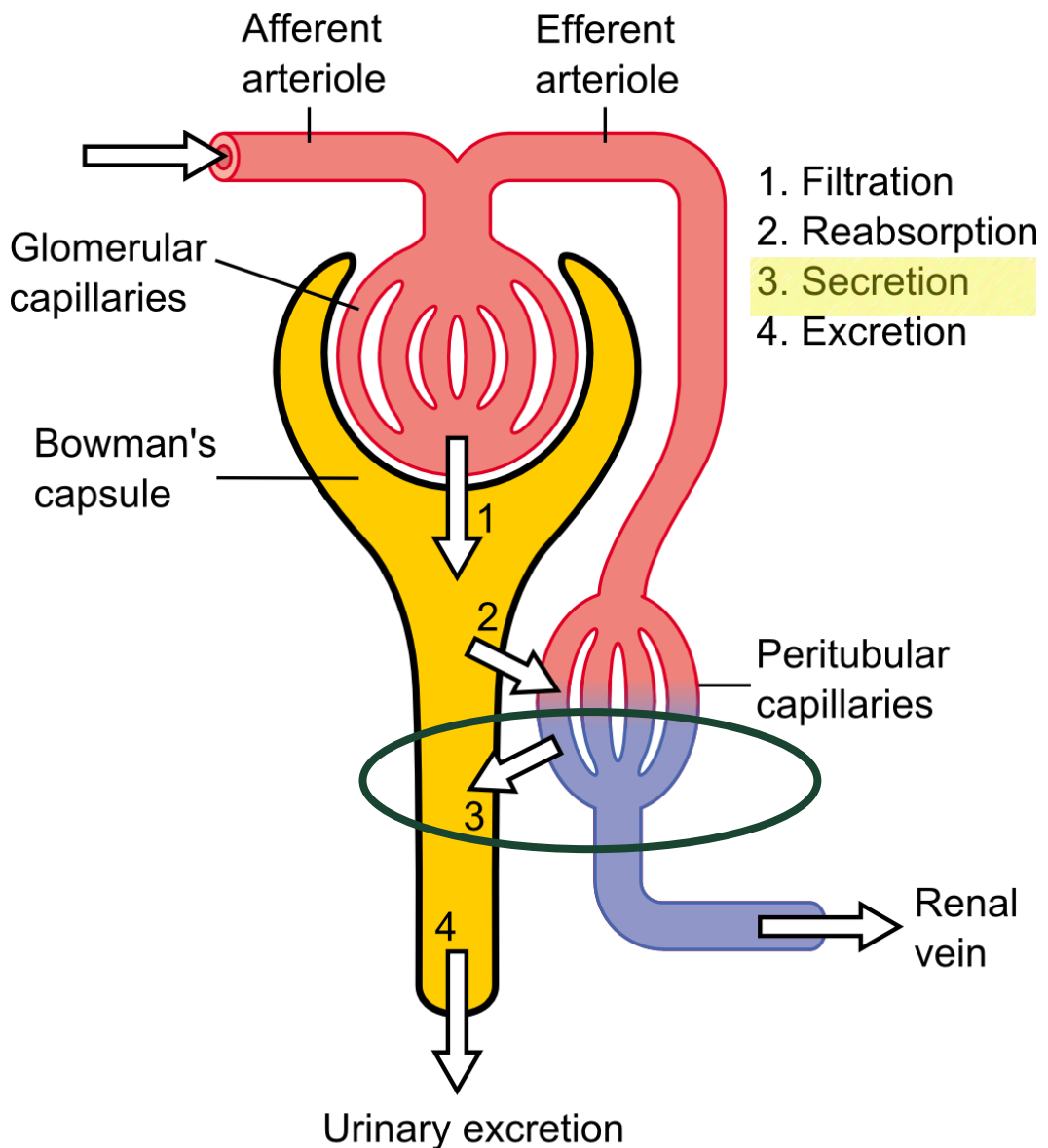


Station 14

SECRETION

Secretion- Bloodstream to Nephrons

Secretion is the opposite of reabsorption. Materials that are secreted into the nephrons from the blood vessels are waste products, such as ions, some types of hormones, and drugs.

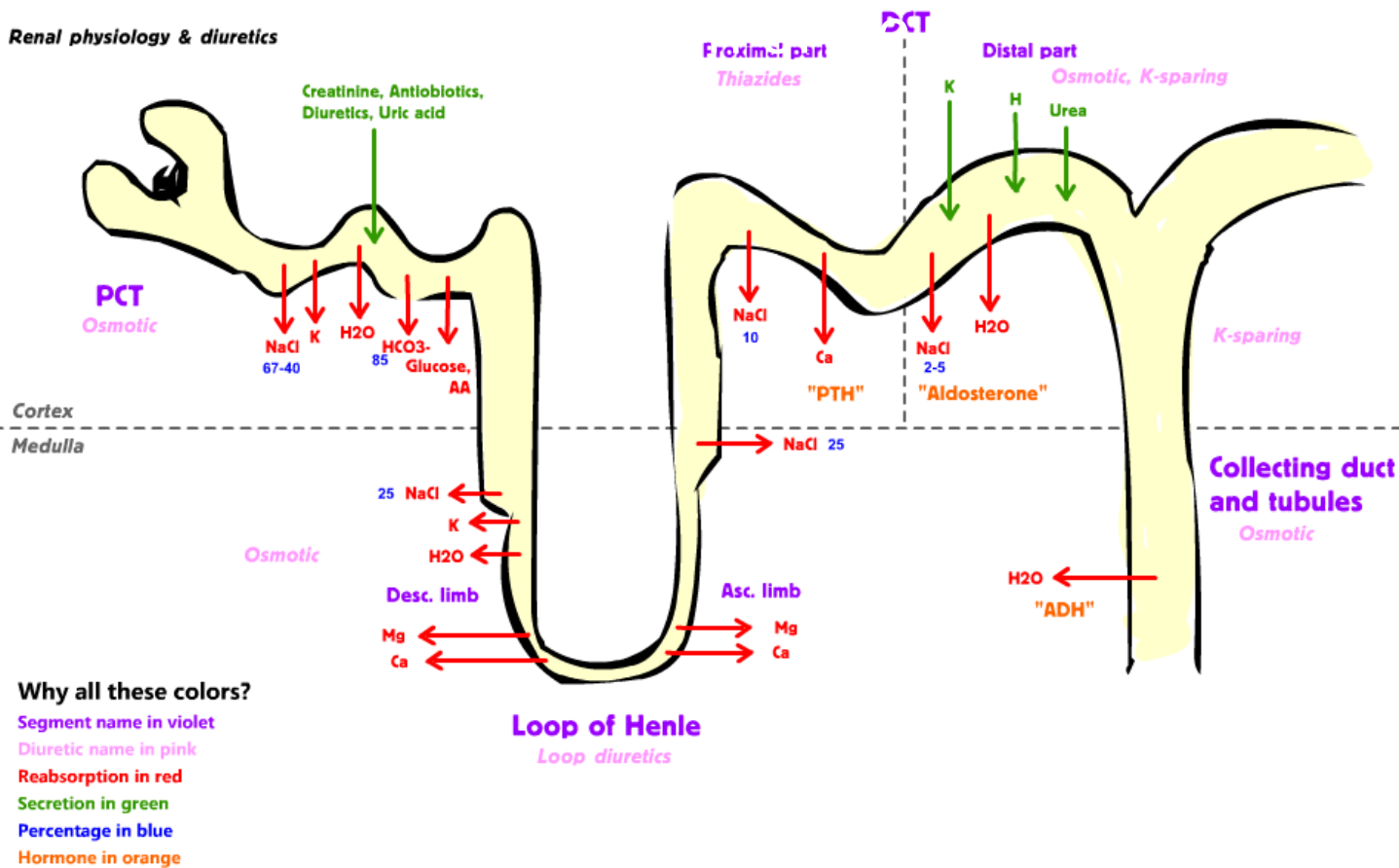


$$\text{Excretion} = \text{Filtration} - \text{Reabsorption} + \text{Secretion}$$

Station 15

CELL TRANSPORT WITHIN THE KIDNEYS

The processes of the nephrons rely on active or passive cell transport to filter the blood

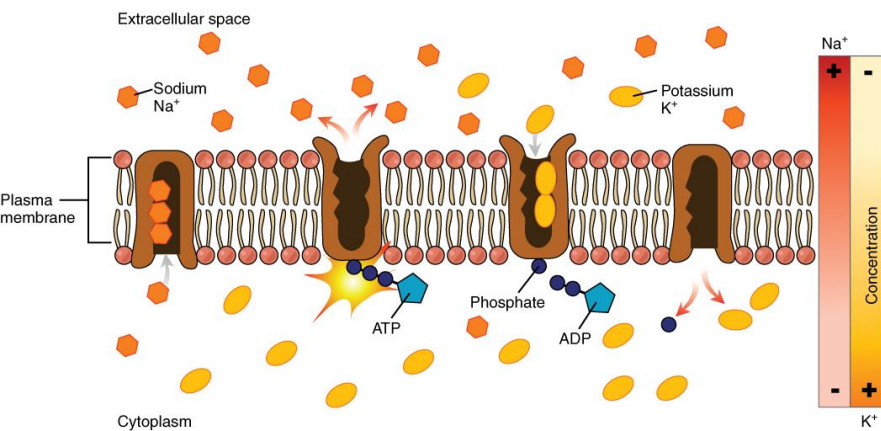
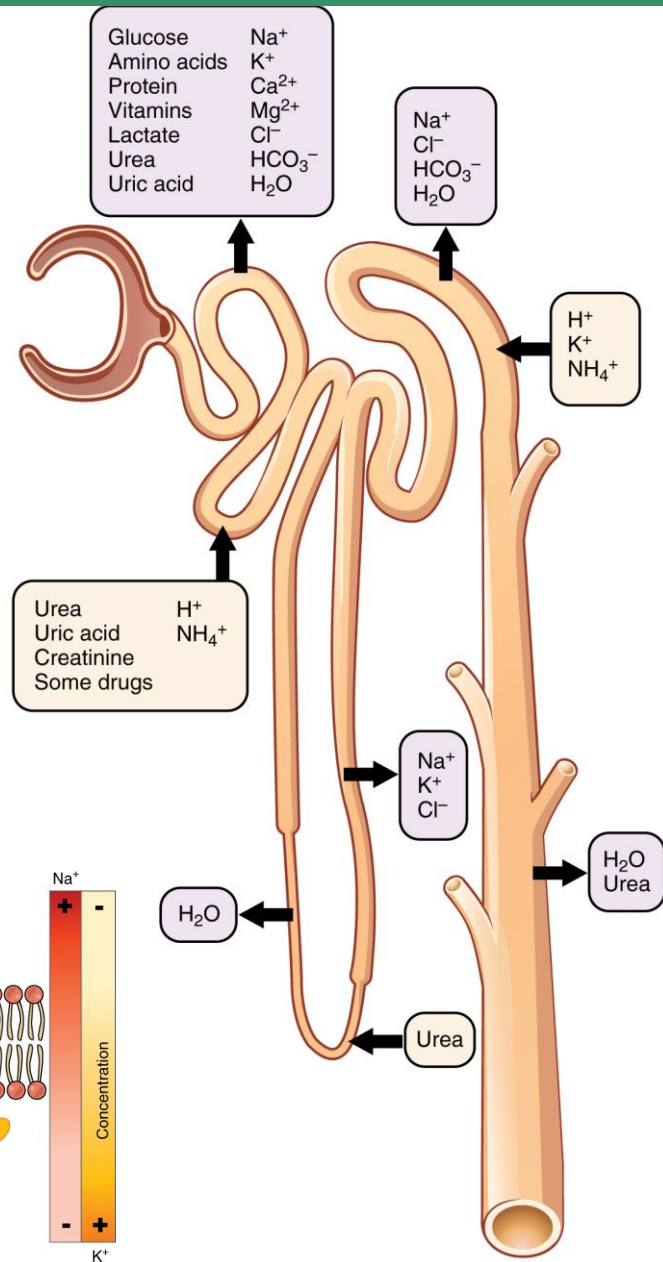


The passing of fluids, ions, amino acids, sugars, etc. occurs across the cell membrane of the nephrons.

Station 15

CELL TRANSPORT WITHIN THE KIDNEYS continued

The cell transport occurs between the nephrons and the blood vessels. This helps maintain homeostasis.



The nephrons have very active sodium potassium pumps in their cells!

Station 16

Relationship to Endocrine System (Homeostasis)

The endocrine system communicates with the body via hormones. With the kidneys, the endocrine system can use a hormone to tell the kidneys when the body does not have enough water (dehydration).

Hypothalamus senses that body is dehydrated



Hypothalamus stimulates pituitary to release ADH (antidiuretic hormone).

The target tissue for the ADH hormone is the kidneys. It binds to receptors on the kidneys and causes the kidneys to retain water instead of releasing it as waste. This causes you to feel thirsty so that you replenish any lost water.

As the water in the blood reaches a more normal state, the hypothalamus stops the pituitary from making more ADH.



Station 17



CELL TRANSPORT & HOMEOSTASIS

Think tank station

WATER BALANCE

When the water level of our blood plasma is high, less water is reabsorbed back into the bloodstream, and the urine is more dilute.

When the water level of our blood plasma is low, more water is reabsorbed back into the bloodstream and the urine is more concentrated.



Station 18

URINE SAMPLES

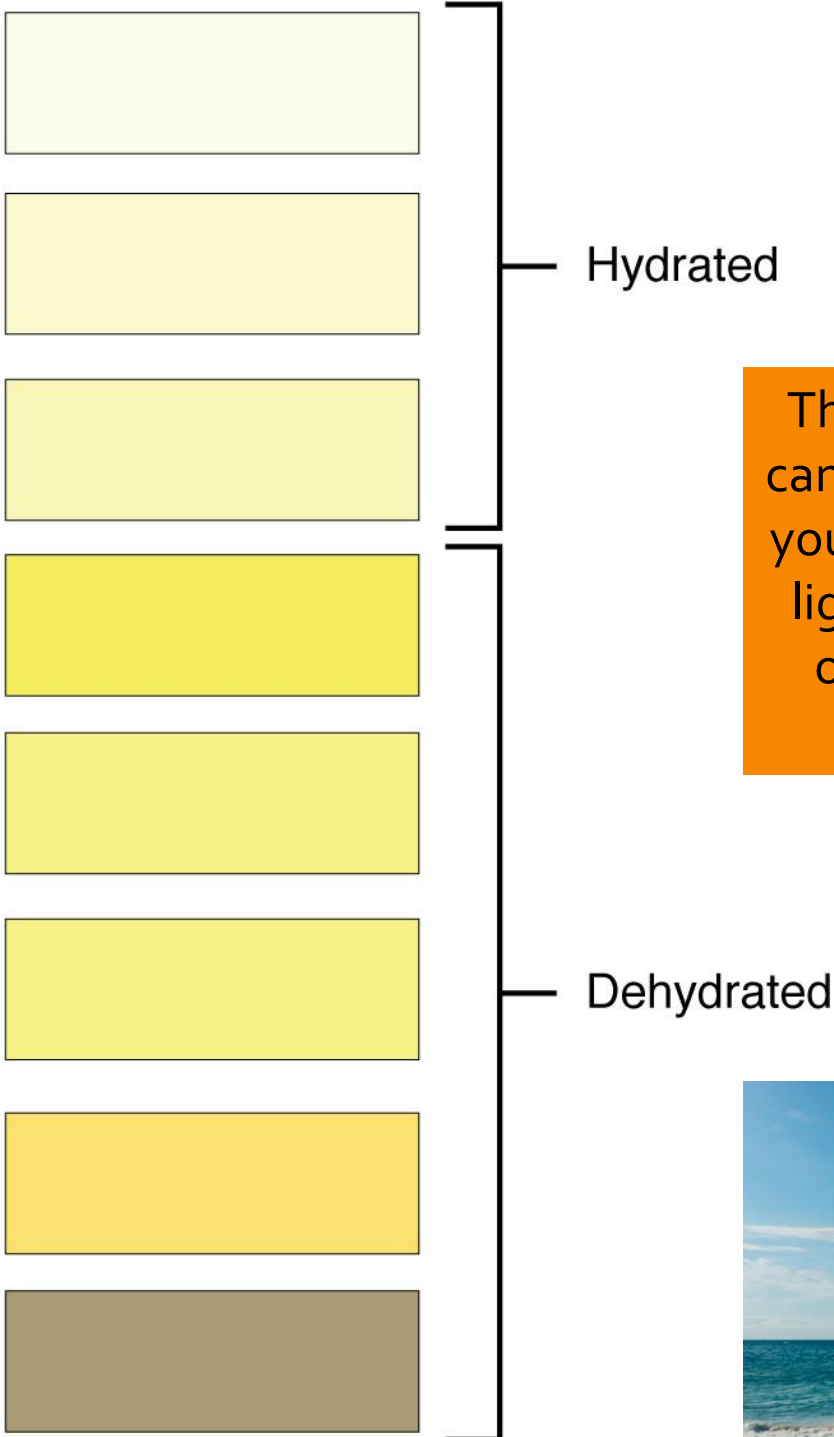
Testing urine for different chemicals is easy and painless, and a urine sample can be used to detect many things such as:

- Pregnancy
- Diseases such as diabetes
- Some sexually transmitted diseases
- Infection
- Drugs



Station 19

DEHYDRATION



The color of your urine can reveal how hydrated you are. Urine should be light in color. If golden or dark, you need to drink more water!

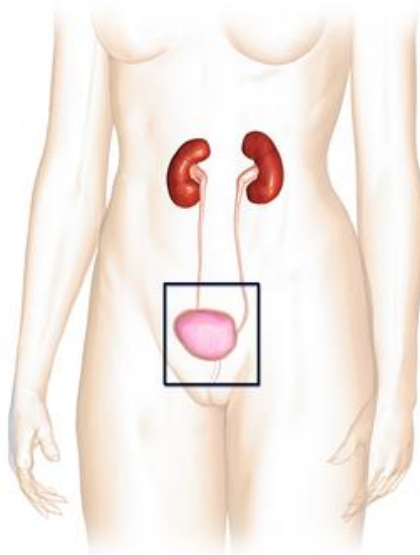


Station 20

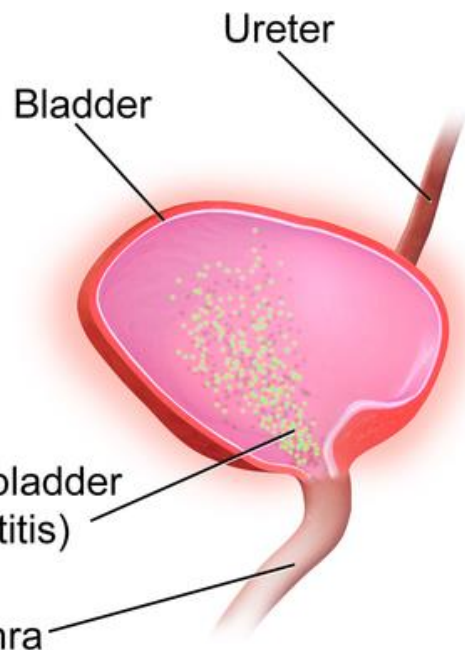
URINARY TRACT INFECTION (UTI)

UTIs or bladder infections are caused by bacteria that stick to the lining of the bladder. Typically, antibiotics are used to treat UTIs.

UTIs are more common in women than men and can be prevented by drinking plenty of water, maintaining good hygiene, and urinating frequently.



Bladder Infection



Harmful pathogens enter bladder causing inflammation (cystitis)

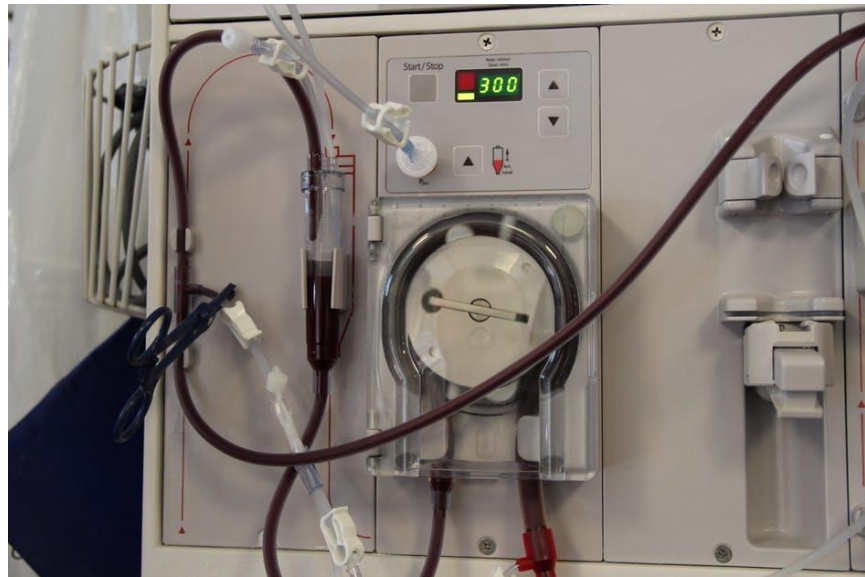
Urethra

Station 21

DIALYSIS

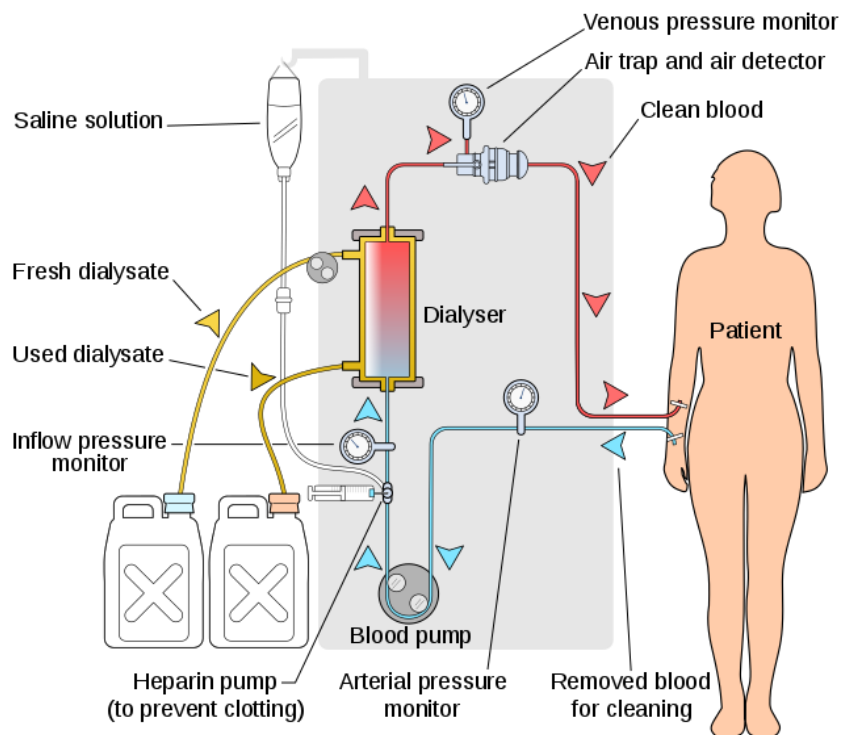
Dialysis is a treatment that takes over your kidney functions for patients that have

Hemodialysis is a common method in which the blood is filtered using a machine outside the body. The machine cleans the blood and returns it back to the body.



The first artificial kidney machine was invented in 1943 by Dutch scientist Willem

Kolff.



Station 22

Interesting Facts

- If in an extreme survival situation, you can drink your own urine if it is diluted. You can drink it 1-3 times before it becomes too concentrated with waste.
- Technically, holding your pee does not cause a bladder infection. Bacteria cause infection. However, if you hold your urine in frequently for too long, any bacteria that may be in your bladder have more time to replicate and this can lead to a UTI.
- The kidneys filter about 180 liters (47.5 Gallons) of blood each day it cycles throughout the urinary system.
 - ***Why don't we lose 47.5 gallons of urine each day?***
- The yellow hue that is seen in urine is from a substance called urobilin. Urobilin is a breakdown product of the blood's hemoglobin and is removed by the kidneys (it is also the same molecule that makes our bruises appear yellow).
- Every 45 minutes the kidneys have cycled through all your blood.