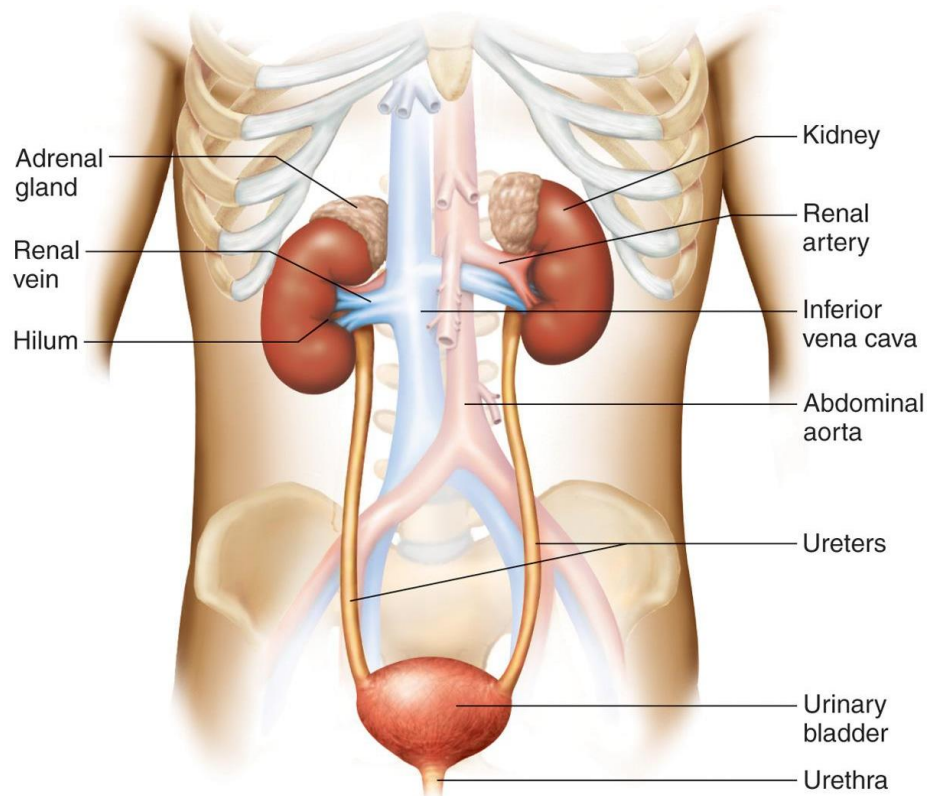


# Human Physiology

Lecture 10 – Monday 14/3/2016

“Introduction to the Urinary System” with Dr. Khalid

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Note: (B) means concept coming from the book, which was not included in the lecture.

## The urinary system

- We are going to understand the mechanism of formation of urine in the kidney.
- The kidney “cleans” the blood in our body.
- Waste products or excess components inside our bodies are removed by 2 ways
  - By the kidney
  - By the lungs (for gases like CO<sub>2</sub>)
- The urinary system contains the 2 kidneys, 2 ureters, urethra (مجرى البول), and the bladder (المثانة).
- Ureters draw the fluid (urine) to the bladder.

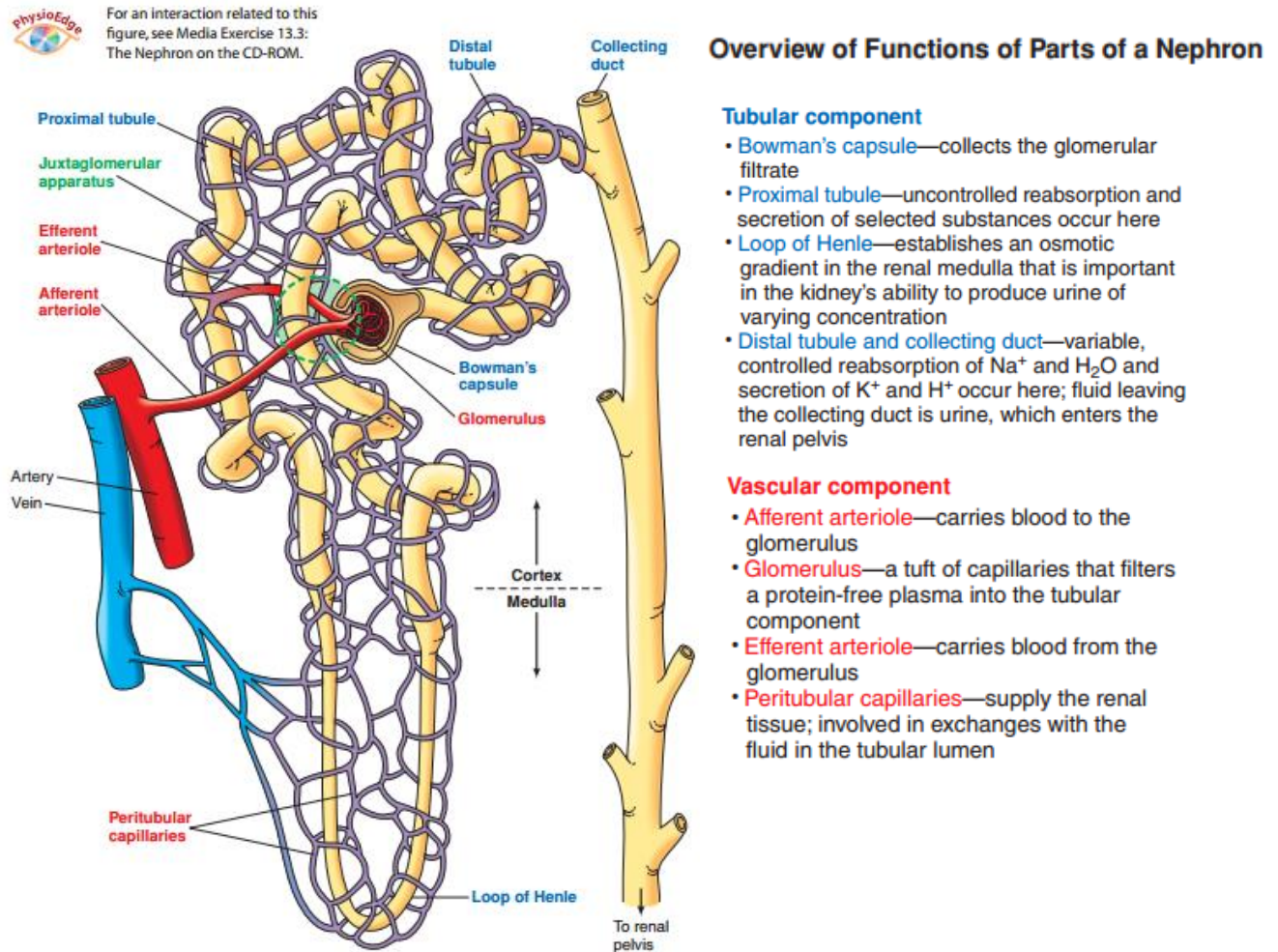
## Kidneys

The kidney has several functions, including:

1. **Maintaining the balance of H<sub>2</sub>O in our body** (major function)
2. Since it maintains the balance of water, it also **maintains the balance of fluids in our body**. [Remember from BIO107, if a lot of water enters the cell, it bursts; And if a lot of water leaves the cell it shrinks]
3. **Regulating the level of electrolytes in our body** (example: the concentration of Na<sup>+</sup>)
4. **Production of erythropoietin**, the hormone that causes the bone marrow to produce red blood cells.
5. **Activating vitamin D**.
6. **Regulating the pH of the blood // the acid-base balance** of the blood.
7. **Removing/excreting the waste products of the reactions in our body**, like Bilirubin that we studied before.
8. **(B): Excreting foreign compounds** like drugs, food additives or anything that is not nutritive for our body (اخراج اي مادة لا تفيد الجسم من ناحية غذائية & اخراج المخدرات)
9. **(B): Maintaining plasma volume** – which is carried out by the kidney’s regulation of salt (Na<sup>+</sup> and Cl<sup>-</sup>) & water balance... It’s important for the long-term regulation of blood pressure in the arteries.
10. **(B): Producing renin** – an enzymatic hormone that causes the reaction that contributes to salt conservation (حفظ الأملاح) by the kidneys.

## Microscopic structure of the kidney

- The functional unit of the kidney is the **nephron** (responsible for the formation of **urine**)
- Each kidney contains more than 1 million nephrons; so both kidneys combined have more than 2 million nephrons (about 2.5 million).



- Nephron and the small blood vessels work together to produce urine (not just the nephron only).
- During the formation of the fluid, we do not call it urine, we call it **filtrate**.
- The tubular components of the nephron:
  - Loop of Henle
  - Proximal tubule
  - Distal tubule
  - Collecting duct
  - Bowman's capsule

- The vascular components (الأوعية الدموية):
  - Afferent arteriole (carries blood to the glomerulus)
  - Efferent arteriole (carries blood from the glomerulus)
  - Glomerulus
  - Capillaries

## The 3 main renal processes

There are three processes that are involved in forming urine: **glomerular filtration, tubular reabsorption, and tubular secretion.**

### Glomerular filtration:

- All the plasma is filtered except the proteins. In this first step, we call the fluid filtrate & has the same concentration as blood plasma (except proteins).
- Only 20% of the plasma that enters the glomerulus is filtrated (by pressure). The remaining 80% are not filtrated & continue to circulate around the body.
- GFR = Glomerular Filtration Rate = volume of filtrate formed per minute which is equal to 125 mL/min [by both kidneys]. 125mL/min is equal to 180 liters per day. Since the average person has around 5.5 liters of blood, this means that every 40 minutes all your blood has entered the kidney & has been filtered.

### Tubular/selective reabsorption:

- Returning or reabsorbing of some of the filtrate // the body takes back useful substances. These re-absorbed substances are not excreted by urine, they are taken back by the capillaries to the vein system.
- It is called selective because not all substances are reabsorbed. Creatinine, for example, has 0% reabsorption. Glucose, has 100% reabsorption.
- Of the 180 liters formed, about 178.5 liters are reabsorbed. The remaining 1.5 liters leave the body as urine (so the average urine volume is 1.5 liters).

### Tubular secretion:

- Selective movement/transfer of substances from the blood to the filtrate.
- Some substances are secreted more than filtered like Potassium ions and drugs.

**Note:** The information from the book is found in pages 405 to 409 (chapter 13)