

Urinary System

Kidney, Urinary Bladder

Urinary System

Is responsible for the creation, storage and elimination of urine.

- allows the body to eliminate nitrogenous wastes, such as urea and uric acid

-Allows the body to adjust its concentrations of salt by producing dilute or concentrated urine.

-Maintains homeostasis

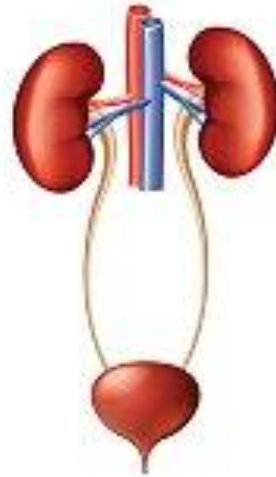
- The urinary system maintains homeostasis in several ways:
 - Removal of urea (nitrogenous waste) from the bloodstream.
 - Control of water and salt balance in the bloodstream.
 - Involved in blood pressure regulation.

Urinary System-Functions

- Regulation of the volume of blood by excretion or conservation of water.
- Regulation of the electrolyte content of the blood by the excretion or conservation of minerals.
- Regulation of the acid-base balance of the blood by excretion or conservation of ions
- Regulation of all of the above in tissue fluid.

Urinary System-Parts

- Kidneys
- Ureter
- Bladder
- Urethra



Urinary System-Parts-Kidneys

is to separate urea, mineral salts, toxins and other waste products from the blood.

- filtering out wastes to be excreted in the urine.
- regulating BP
- regulating an acid-base balance
- stimulating RBC production

Urinary System-Parts-Kidneys-Structure

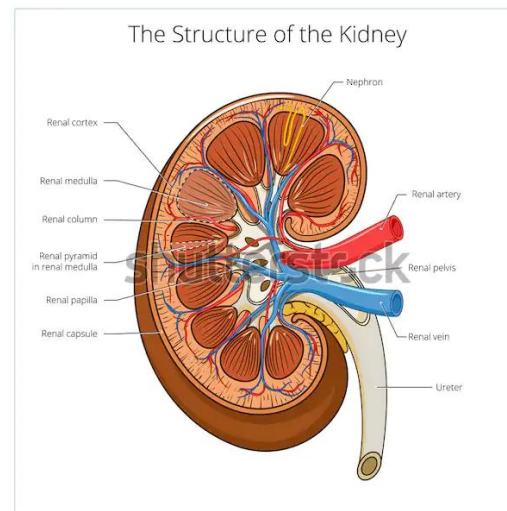
Enclosed in a strong fibrous capsule which passes over the lips of the sinus and becomes continuous with the walls of the calices.

-Kidney + capsule are surrounded by pararenal fat

-Each kidney has superior and inferior poles, medial and lateral borders/margins and anterior and posterior surfaces

-Reddish-brown in colour when fresh – colour varies between cortex and medulla

-Ovoid in outline but indented medially (the renal sinus) bean-shaped appearance



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Urinary System-Parts-Kidneys-Structure

Hilum

- At the concave part of each kidney
- Renal vein exits (anteriorly)
- Renal artery enters (posterior to renal vein)
- Renal pelvis exits (posterior to artery)

Renal pelvis

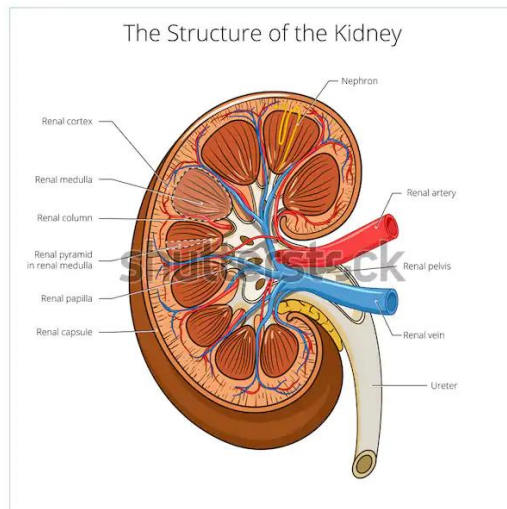
- Funnel-shaped
- Lined with transitional epithelium with a smooth muscle and connective tissue wall
- Continuous inferiorly with ureter
- Divides into major and minor calyces

Urine ► collecting tubule ► minor calyx ► major calyx ► renal pelvis
ureters bladder

Urinary System-Parts-Kidneys-Structure

Cortex

- Beneath capsule, extends towards the pelvis as renal columns lying between pyramids of medulla
- Apices of several pyramids open together into a renal papilla, each of which projects into a renal calyx



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Urinary System-Parts-Kidneys-Structure

Nephrons

- *Functional and histological subunit

- *~106 per kidney

- * = glomerulus + tubules

- *glomerulus

 - tuft of capillaries surrounded by podocytes

 - projects into Bowman's capsule

- * tubule system

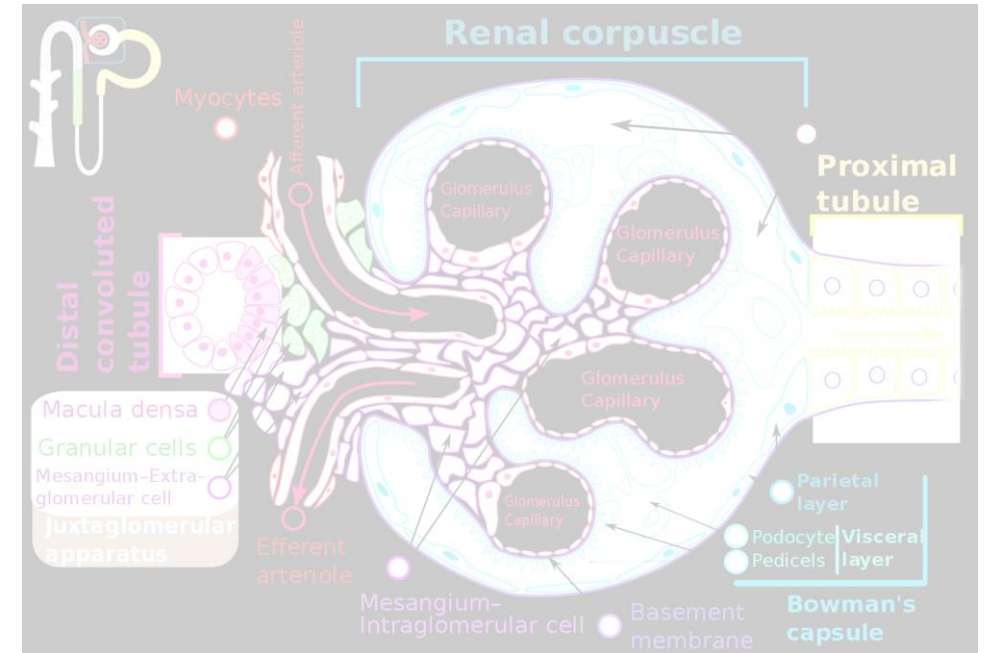
 - epithelium continuous with Bowman's capsule

 - proximal convoluted tubule → Loop of Henle → distal convoluted tubule → collecting tubule and collecting duct

- *glomeruli and convoluted tubules are in cortex

- *ducts lie in the medulla

- *glomerular capillaries supplied by afferent arteriole and drained by efferent arteriole



[https://en.wikipedia.org/wiki/Glomerulus_\(kidney\)#/media/File:Renal_corpuscle-en.svg](https://en.wikipedia.org/wiki/Glomerulus_(kidney)#/media/File:Renal_corpuscle-en.svg)

Urinary System-Parts-Kidneys-Structure

Juxtaglomerular apparatus

*Macula densa cells

-Detect chloride concentration

*Juxtaglomerular cells

- Modified smooth muscle cells

- Produce renin

- Converts angiotensin to angiotensin I

- Angiotensin I converted to angiotensin II by Angiotensin converting enzyme (ACE)

- Causes systemic vasoconstriction and increase in BP

Urinary System-Parts-Ureters

transports urine from the renal pelvis of the kidney to which it is attracted, to the bladder.

- pass beneath the urinary bladder, which results in the bladder compressing the ureters and hence preventing back
- flow of urine when pressure in the bladder is high during urination.

Urinary System-Parts-Bladder

- store urine
- expels urine into the urethra (Micturation)

Micturation – involves both voluntary and involuntary muscles.

The urinary bladder is a muscular sac that stores urine, allowing urination to be infrequent and voluntary. It is lined by transitional epithelium (urothelium).

The urothelium (AKA Transitional Epithelium) is a stratified epithelium with about 5-6 layers of urothelial cells. Urothelial Cells in the lower layers are polygonal to cuboidal, whereas the most superficial layer of cells are known as Umbrella Cells because they can stretch significantly. The key function of the urothelium is its capacity to stretch significantly without losing its impermeability to the movement of water and solutes. This is a key function that prevents water and electrolytes from diffusing back and forth between the urine and the ECF even when the epithelium is stretched tremendously as occurs in a full bladder

Urinary System-Parts-Urethra

- is the passageway through which urine is discharged from the body

Urinary System-Other Parts

Nephrons – functional unit of kidney. Each kidney is formed of about one million nephrons.

- Glomerulus – filters the blood

- Bowman's Capsule – is a large double walled cup. It lies in the renal cortex

- Tubular Component – necessary substances are being reabsorbed

- Loop of Henle – create a concentration gradient in the medulla of the kidney.

- reabsorb water and important nutrients in the filtrate.

- Renal Vein – a blood vessel that carries deoxygenated blood out of the kidneys

- Renal Artery – supply clean, oxygen-rich blood to the kidneys

- Adrenal Gland (Suprarenal Gland) – located on top of the kidneys and is essential for balancing salt and water in the body

Urinary System-Urine Formation

Glomerular Filtration

-Beginning of the process.

-A process by which the blood courses through the glomeruli, much of its fluid, containing both useful chemicals and dissolved waste materials, soaks out the blood through membranes where it is filtered and then flows into Bowman's capsule.

Tubular Reabsorption

A movement of substances out of the renal tubules back into the blood capillaries located around the tubules (peritubular capillaries).

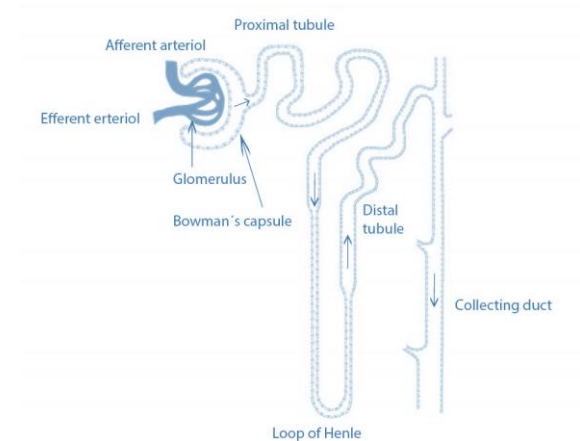
Tubular Secretion

-disposing of substances not already in the filtrate (drugs)

-eliminating undesirable substances that have been reabsorbed by passive processes (urea and uric acid)

-ridding the body of excess potassium ions

-controlling pH



<http://fblt.cz/wp-content/uploads/2013/12/nefron-ENG-01.jpg>

Urinary System-Urine Formation

Glomerular Filtration Rate

is the amount of fluid filtered from the blood into the capsule each minute. Factors governing the filtration rate at the capillary beds are:

1. total surface area available for filtration
2. filtration membrane permeability
3. net filtration pressure

About 20% of renal plasma flow is filtered each minute (125ml/min).

This is the glomerular filtration rate (GFR).

Urinary System-Other Parts_Hormones

Renin

- Increases production of angiotensin II

Aldosterone

- Stimulates water and sodium ion resorption in distal tubule

Atrial natriuretic hormone (ANP)

- Produced when atrial pressure increases (eg heart failure)
- Promote Na⁺, Cl⁻ and water loss

Antidiuretic hormone

- Increases permability of distal tubule to water, to increase water resorption (therefore increases concentration of urine)

1,25 dihydroxy vitamin D3

- Promotes calcium absorption from gut

Erythropoietin (EPO)

- Stimulates marrow to produce red blood cells

References

[\(http://fb.lt.cz/en/skripta/vii-vylucovaci-soustava-a-acidobazicka-rovnovaha/3-tvorba-moci/\)](http://fb.lt.cz/en/skripta/vii-vylucovaci-soustava-a-acidobazicka-rovnovaha/3-tvorba-moci/)

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[\(http://www.pathwaymedicine.org/nephron-histology\)](http://www.pathwaymedicine.org/nephron-histology)

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