

General Human Anatomy & Physiology

Chapter 7

The Urinary System

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2nd Year

Medical Intelligent System

1st Semester 2023-2024

Functions of the Urinary System

- 1. Elimination of waste products
 - Nitrogenous wastes
 - Toxins
 - Drugs

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Functions of the Urinary System

- 2. Regulate aspects of homeostasis
 - Water balance
 - Electrolytes
 - Acid-base balance in the blood
 - Blood pressure
 - Red blood cell production
 - Activation of vitamin D

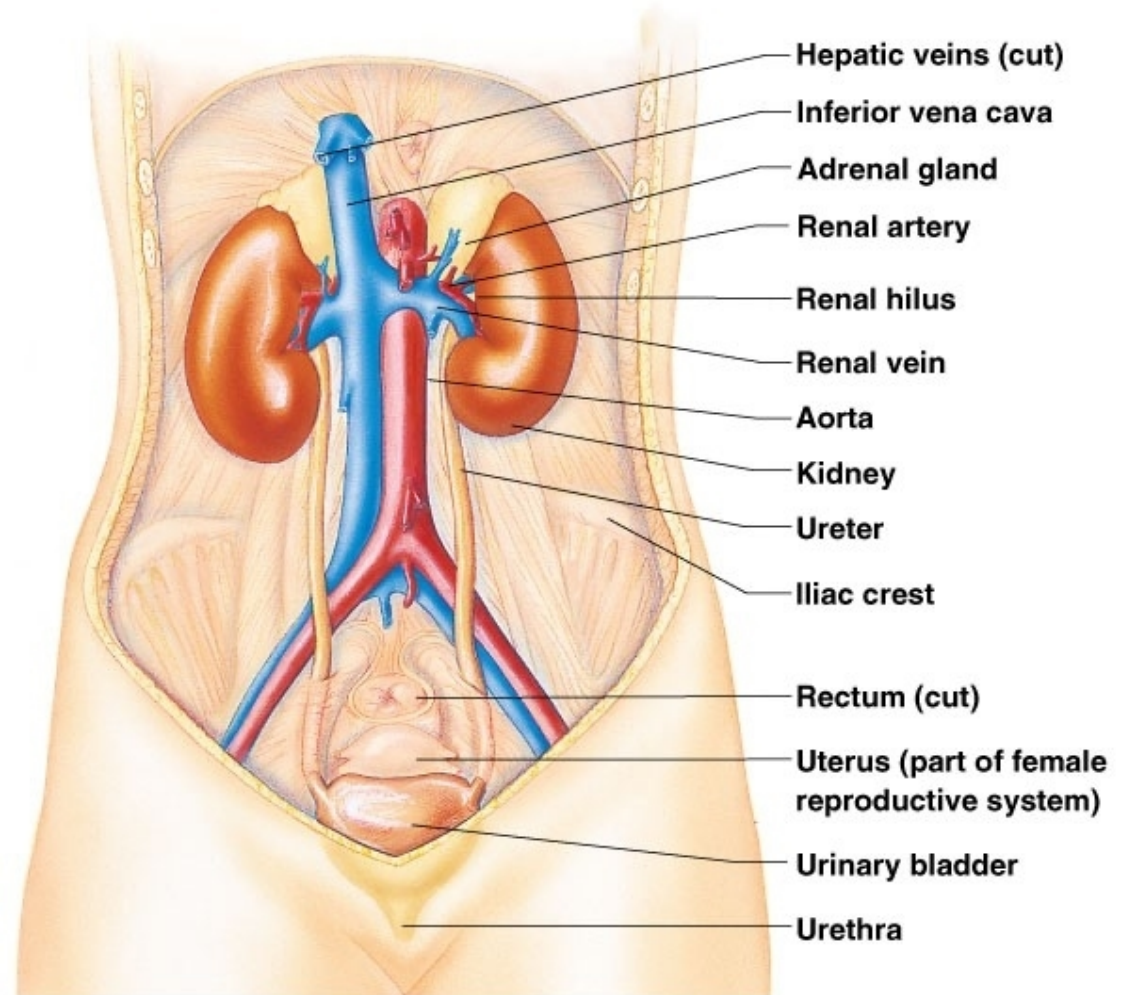
Organs of the Urinary system

Kidneys •

Ureters •

Urinary bladder •

Urethra •



(a)

Location of the Kidneys

- Against the dorsal body wall
- At the level of T₁₂ to L₃
- The right kidney is slightly lower than the left
- Attached to ureters, renal blood vessels, and nerves at renal hilus
- Atop each kidney is an adrenal gland

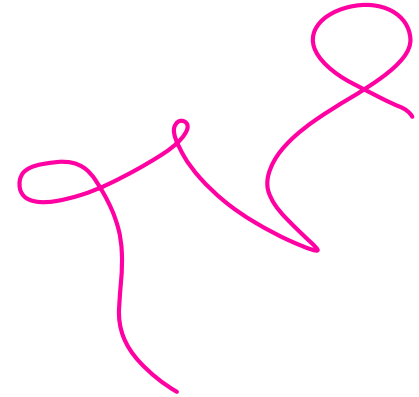


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Coverings of the Kidneys

- Renal capsule
 - Surrounds each kidney
- Adipose capsule
 - Surrounds the kidney
 - Provides protection to the kidney
 - Helps keep the kidney in its correct location



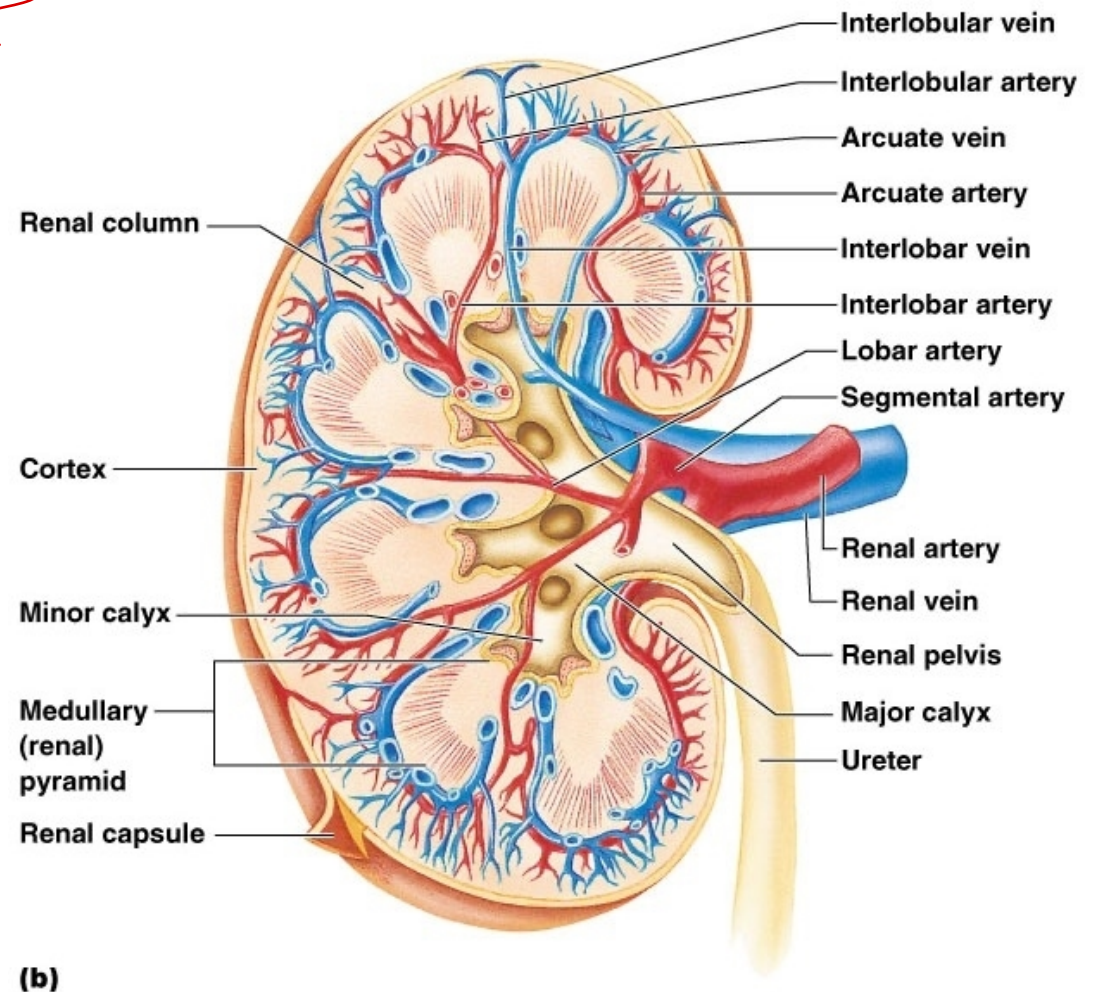
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Regions of the Kidney

Renal cortex –
outer region

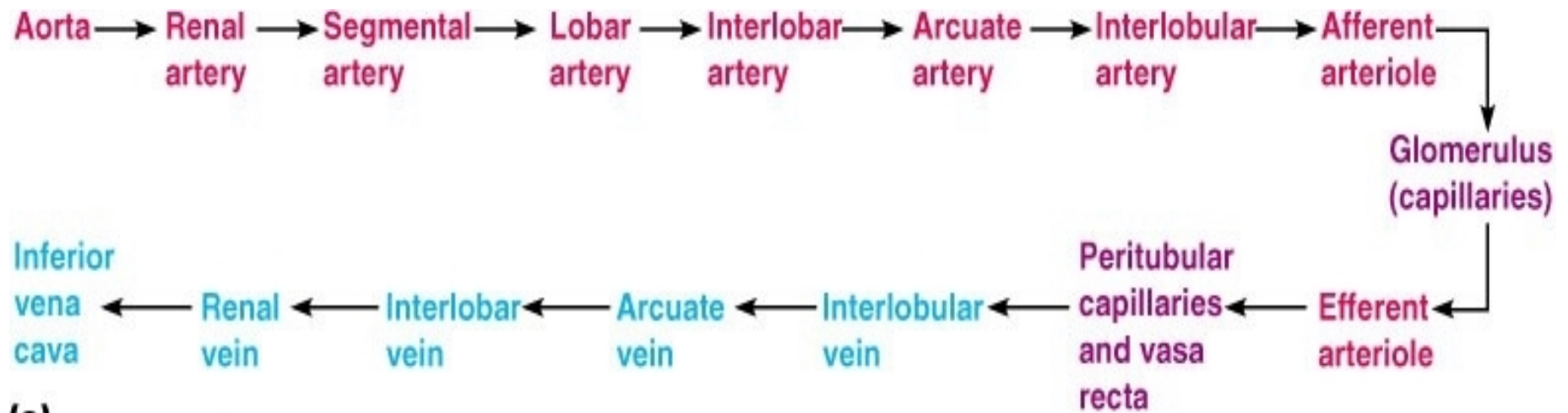
Renal medulla –
inside the cortex

Renal pelvis –
inner collecting
tube



Blood Flow in the Kidneys

signature



(c)

Nephrons



- The structural and functional units of the kidneys
- Responsible for forming urine
- Main structures of the nephrons

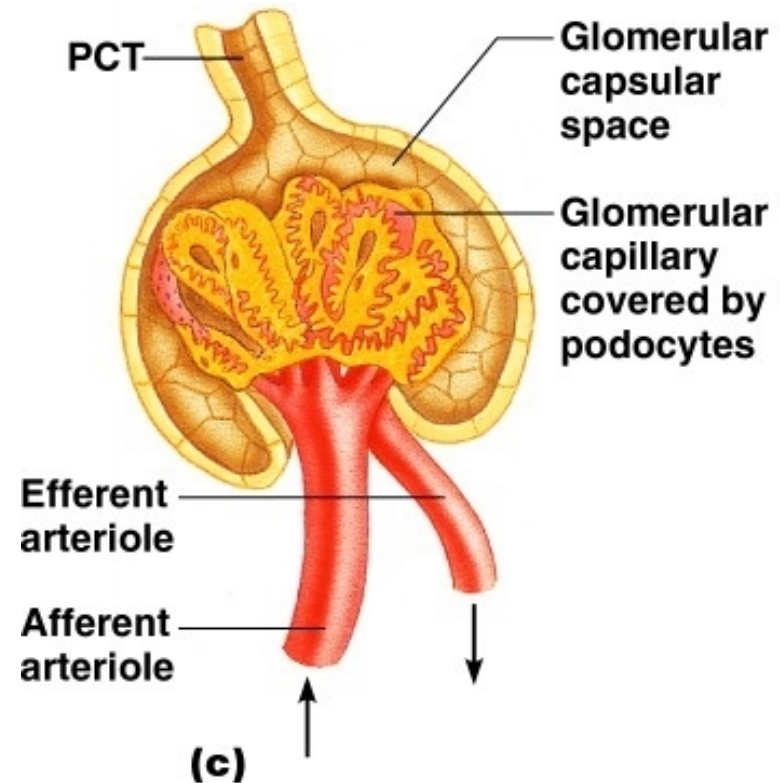
• Glomerulus

• Renal tubule



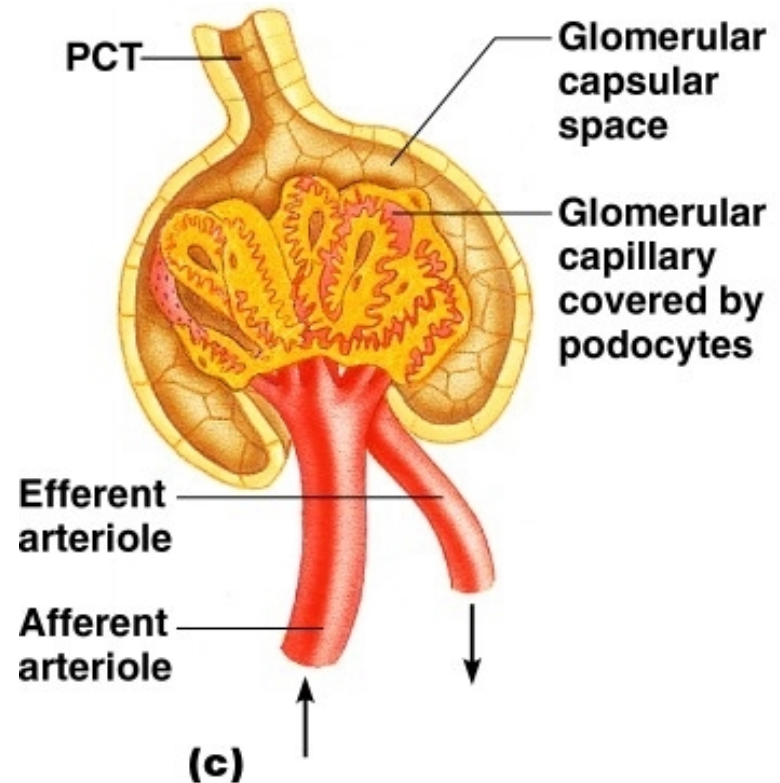
Glomerulus

- A specialized capillary bed
- Attached to arterioles on both sides (maintains high pressure)
- Large afferent arteriole
- Narrow efferent arteriole



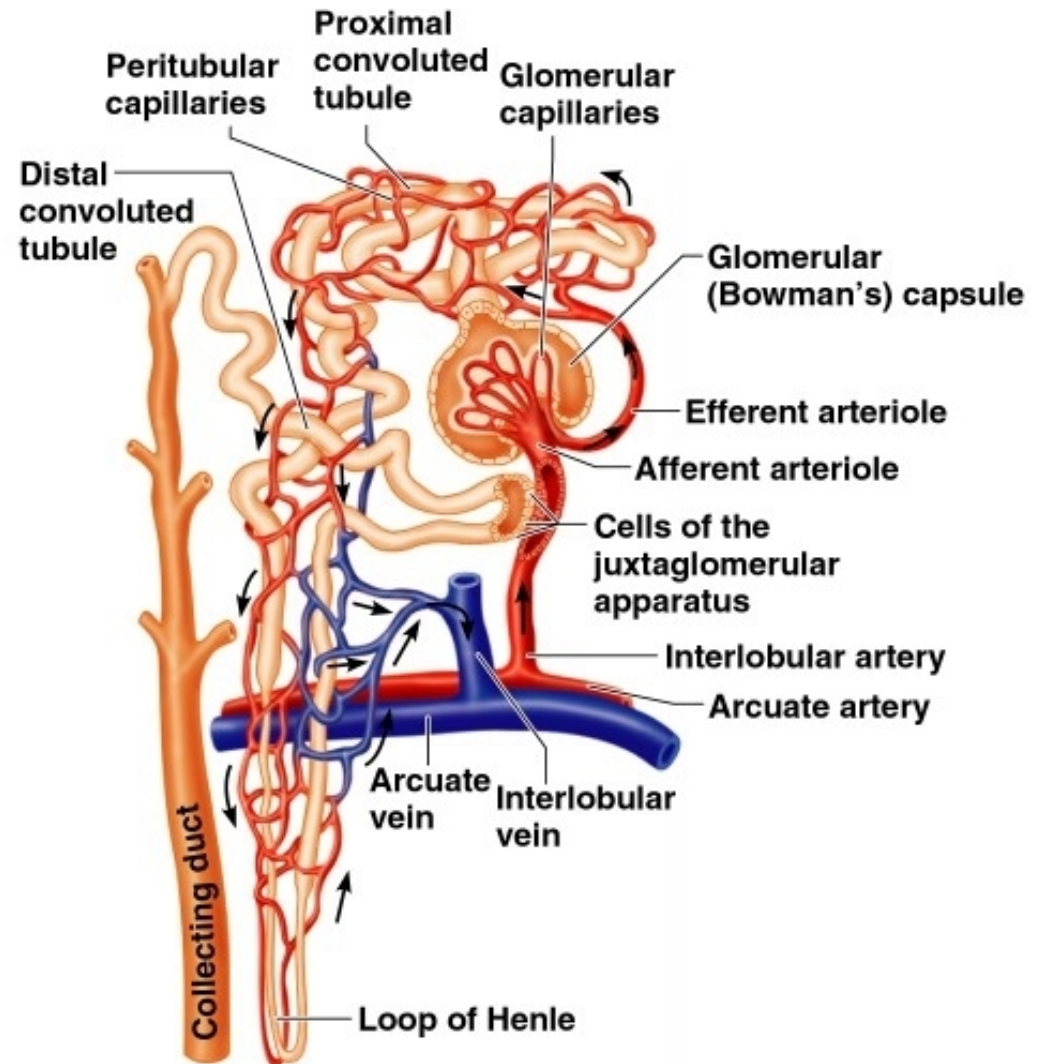
Glomerulus

- The glomerulus sits within a glomerular capsule (the first part of the renal tubule)



Renal Tubule

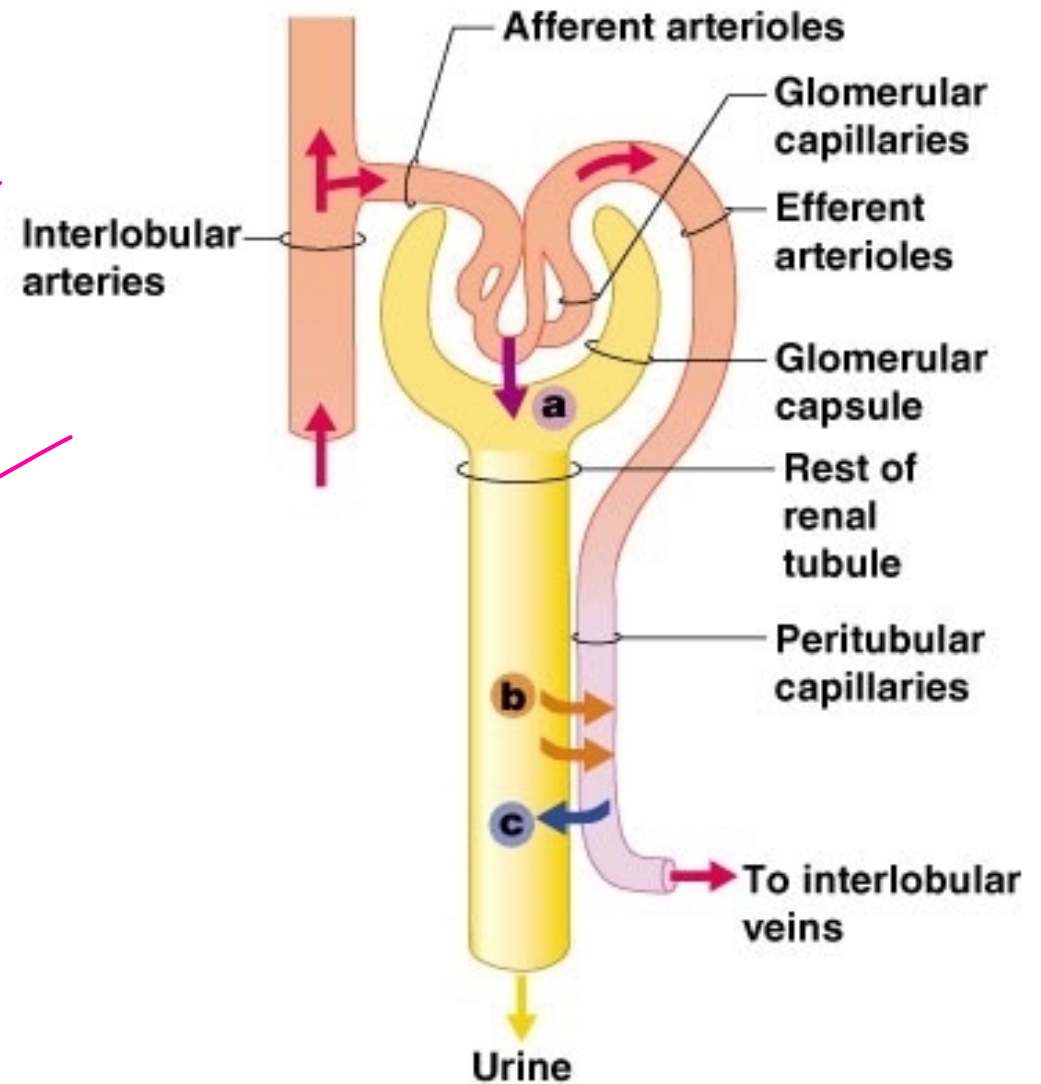
- Glomerular (Bowman's) capsule
- Proximal convoluted tubule
- Loop of Henle
- Distal convoluted tubule



(b)

Urine Formation Processes

- Filtration
- Reabsorption
- Secretion



Filtration

- Nonselective passive process
- Water and solutes smaller than proteins are forced through capillary walls
- Blood cells cannot pass out to the capillaries
- Filtrate is collected in the glomerular capsule and leaves via the renal tubule



Reabsorption

- The peritubular capillaries reabsorb several materials
 - Some water
 - Glucose
 - Amino acids
 - Ions
 - Some reabsorption is passive, most is active
 - Most reabsorption occurs in the proximal convoluted tubule
- 
- A hand-drawn red diagram of a nephron. It shows a long, curved proximal convoluted tubule on the left, a small circular loop of Henle in the middle, and a straight distal tubule on the right. The proximal convoluted tubule is highlighted with a red bracket, indicating the site of most reabsorption.

Materials Not Reabsorbed

- Nitrogenous waste products

- Urea

- Uric acid

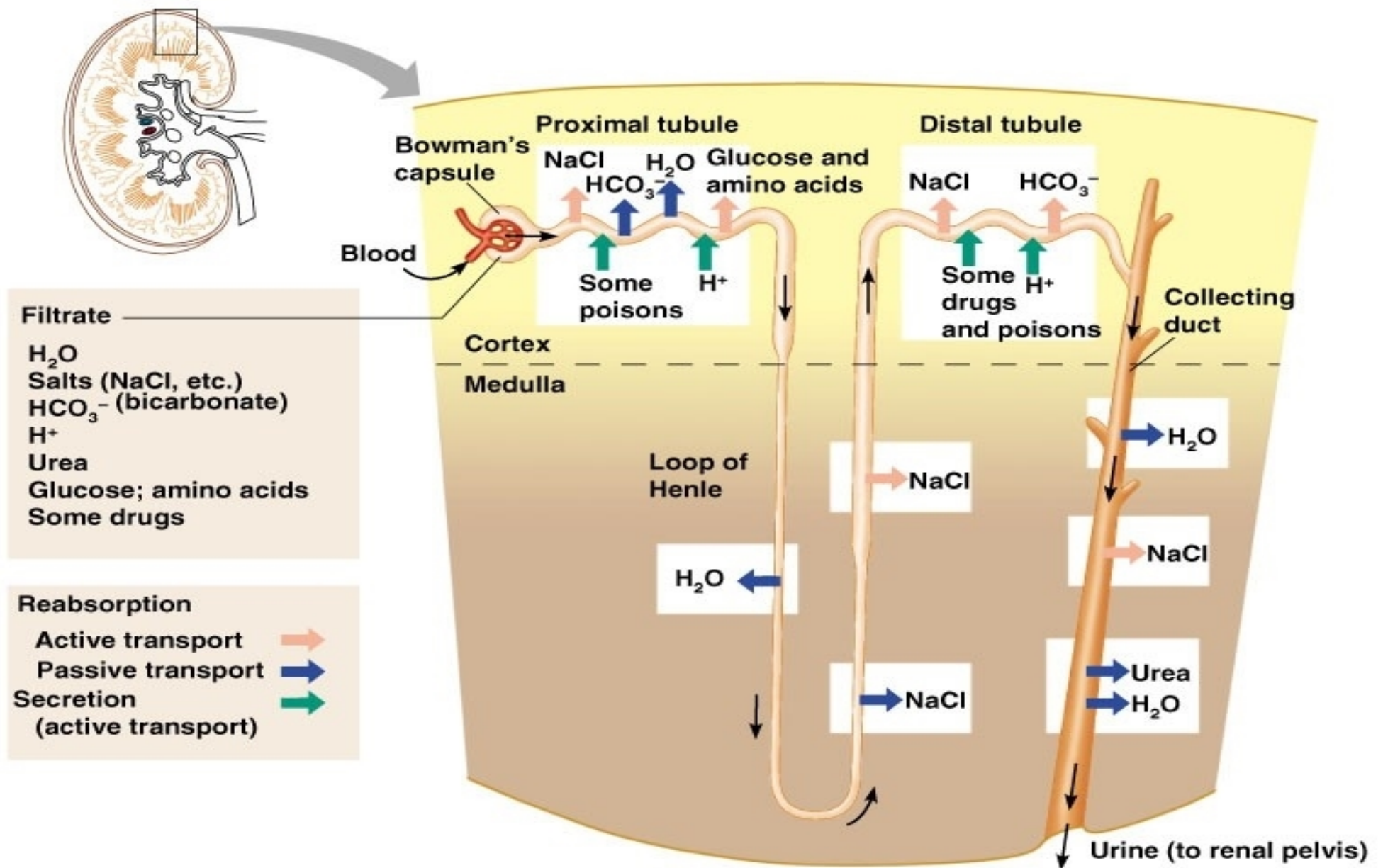
- Creatinine

- Excess water

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Formation of Urine



Characteristics of Urine Used for Medical Diagnosis

- Colored somewhat yellow due to the pigment urochrome (from the destruction of hemoglobin) and solutes
- Sterile
- Slightly aromatic
- Normal pH of around 6 (varies 4.5-8)
- Specific gravity of 1.001 to 1.035

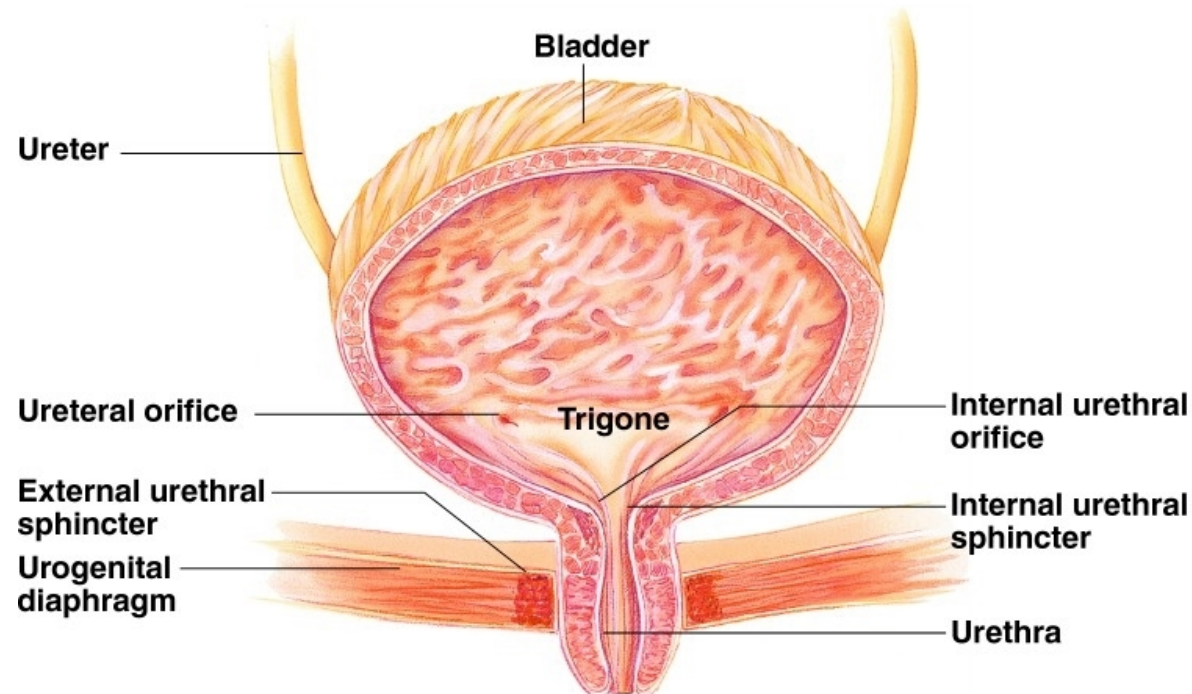


Ureters

- Slender tubes attaching the kidney to the bladder
 - Continuous with the renal pelvis
 - Enter the posterior aspect of the bladder
- Runs behind the peritoneum
- Peristalsis aids gravity in urine transport

Urinary Bladder

- Smooth, collapsible, muscular sac
- Temporarily stores urine

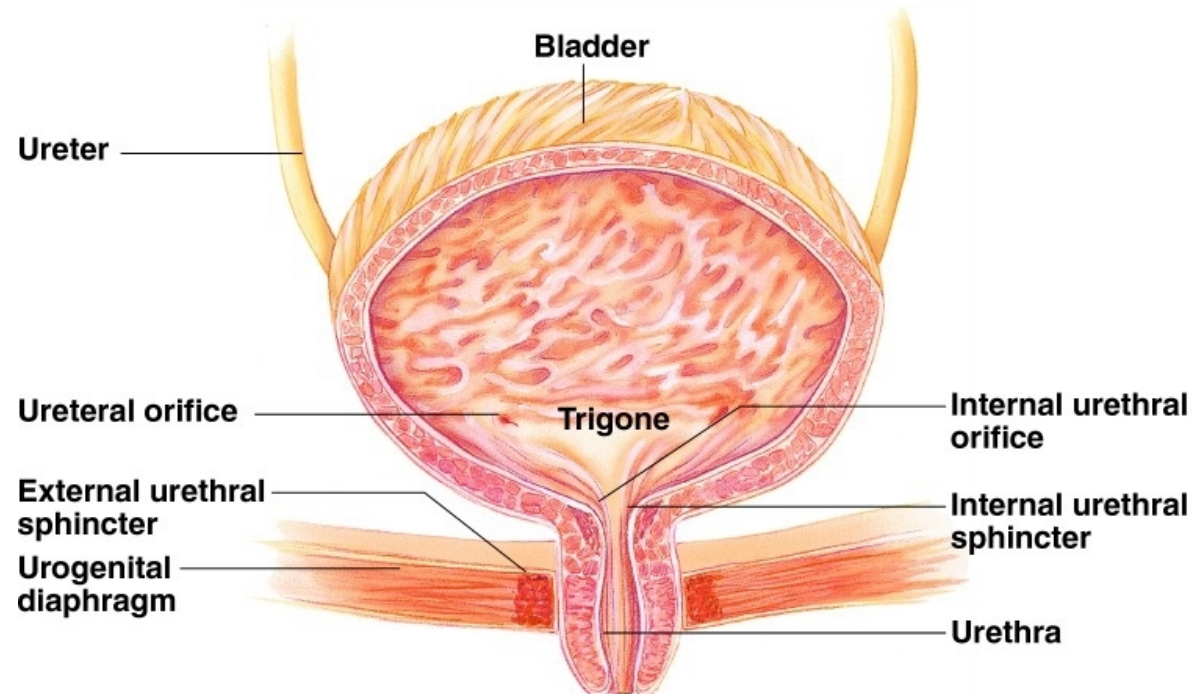


Urinary Bladder

Trigone – three openings •

Two from the ureters •

One to the urethrea •



Urinary Bladder Wall

M CQ

- Three layers of smooth muscle (detrusor muscle)
- Mucosa made of transitional epithelium
- Walls are thick and folded in an empty bladder
- Bladder can expand significantly without increasing internal pressure

Urethra

- Thin-walled tube that carries urine from the bladder to the outside of the body by peristalsis
- Release of urine is controlled by two sphincters
 - Internal urethral sphincter (involuntary)
 - External urethral sphincter (voluntary)

Urethra Gender Differences

- Length

- Females – 3–4 cm (1 inch)
- Males – 20 cm (8 inches)

- Location

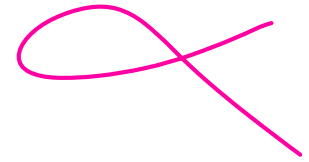
- Females – along wall of the vagina
- Males – through the prostate and penis



Urethra Gender Differences

- Function
 - Females – only carries urine
 - Males – carries urine and is a passageway for sperm cells

Micturition (Voiding)



- Both sphincter muscles must open to allow voiding
 - The internal urethral sphincter is relaxed after stretching of the bladder
 - Activation is from an impulse sent to the spinal cord and then back via the pelvic splanchnic nerves
 - The external urethral sphincter must be voluntarily relaxed

Maintaining Water Balance

- Normal amount of water in the human body
 - Young adult females – 50%
 - Young adult males – 60%
 - Babies – 75%
 - Old age – 45%
- Water is necessary for many body functions and levels must be maintained

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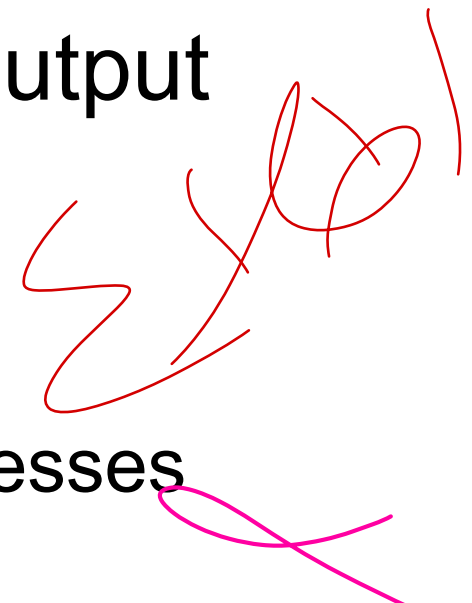
Distribution of Body Fluid

- Intracellular fluid (inside cells)
- Extracellular fluid (outside cells)
 - Interstitial fluid
 - Blood plasma

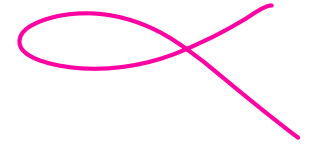
Total body water volume = 40 L, 60% body weight		
Intracellular fluid volume = 25 L, 40% body weight	Extracellular fluid volume = 15 L, 20% body weight	
	Interstitial fluid volume = 12 L, 80% of ECF	Plasma volume = 3 L, 20% of ECF

Maintaining Water Balance

- Water intake must equal water output
- Sources for water intake
 - Ingested foods and fluids
 - Water produced from metabolic processes
- Sources for water output
 - Vaporization out of the lungs
 - Lost in perspiration
 - Leaves the body in the feces
 - Urine production

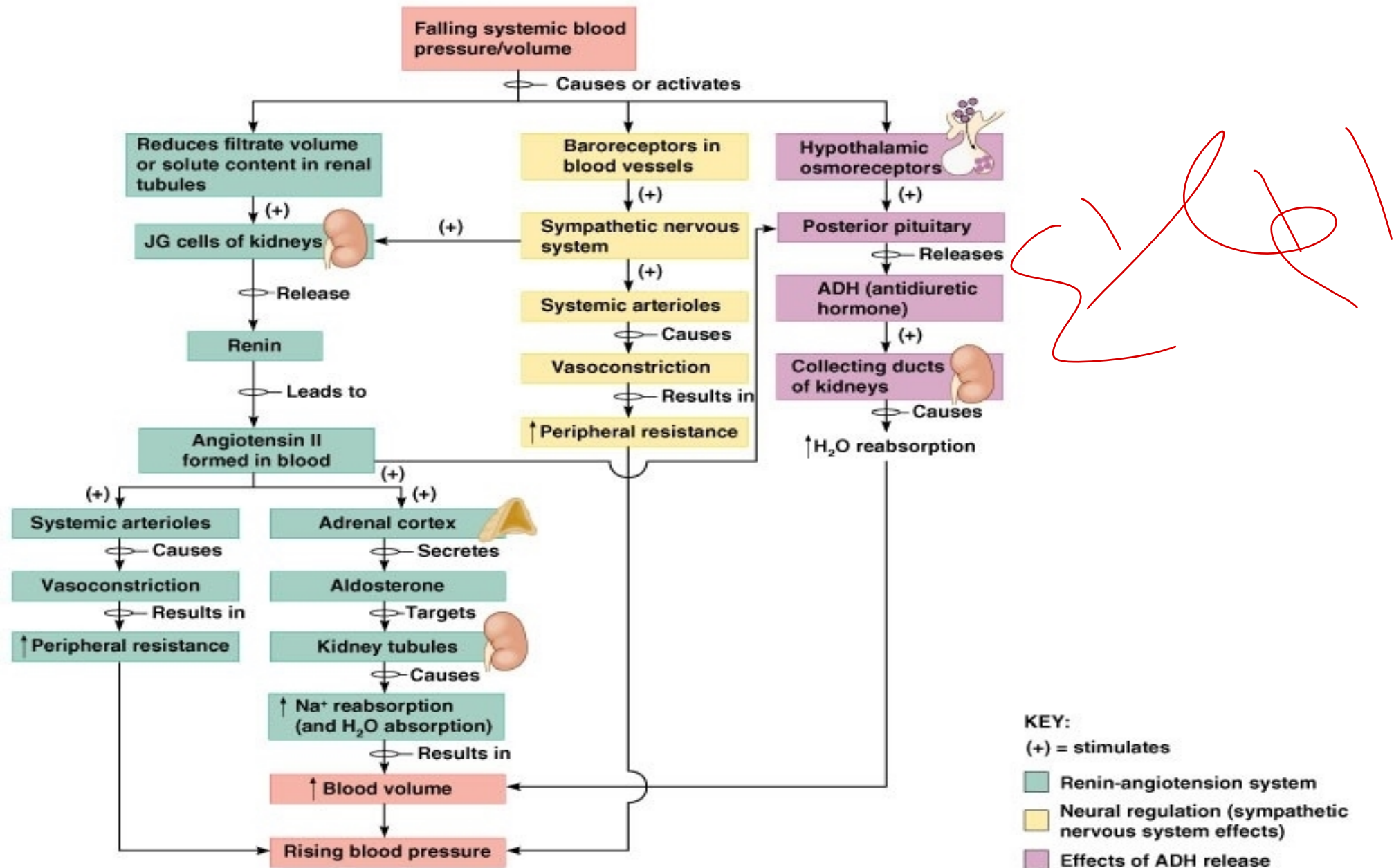


Maintaining Water Balance



- Dilute urine is produced if water intake is excessive
- Less urine (concentrated) is produced if large amounts of water are lost
- Proper concentrations of various electrolytes must be present

Maintaining Water/Electrolyte Balance



Developmental Aspects of the Urinary System

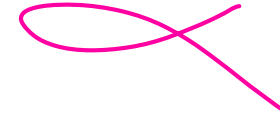
- Functional kidneys are developed by the third month
- Urinary system of a newborn
 - Bladder is small
 - Urine cannot be concentrated

Developmental Aspects of the Urinary System

25/10/18

- Control of the voluntary urethral sphincter does not start until age 18 months
- Urinary infections are the only common problems before old age

Aging and the Urinary System



- There is a progressive decline in urinary function
- The bladder shrinks with aging
- Urinary retention is common in males



Thank
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