

In The Name Of God



CHAPTER 26

- **The Urinary System: Functional Anatomy and Urine Formation by the Kidneys**

هدف کلی جلسه: آشنایی با سیستم ادراری، آناتومی عملکردی و تشکیل ادرار توسط کلیه ها

اهداف ویژه جلسه
در پایان دانشجو قادر باشد:

- اعمال مختلف کلیه ها را شرح دهد
- ساختار عمومی کلیه ها و مجاری ادراری را کامل توضیح دهد
- انواع نفرونهای کلیوی و اهمیت هر کدام را توضیح دهد
- تشریح عروق خونسازان به کلیه و میزان آنرا شرح دهد
- اعصاب مثانه ای را نام ببرد
- مکانیسم دفع ادرار شرح دهد
- اختلالات رایج مربوط به رفلکس ادرار کردن را شرح دهد

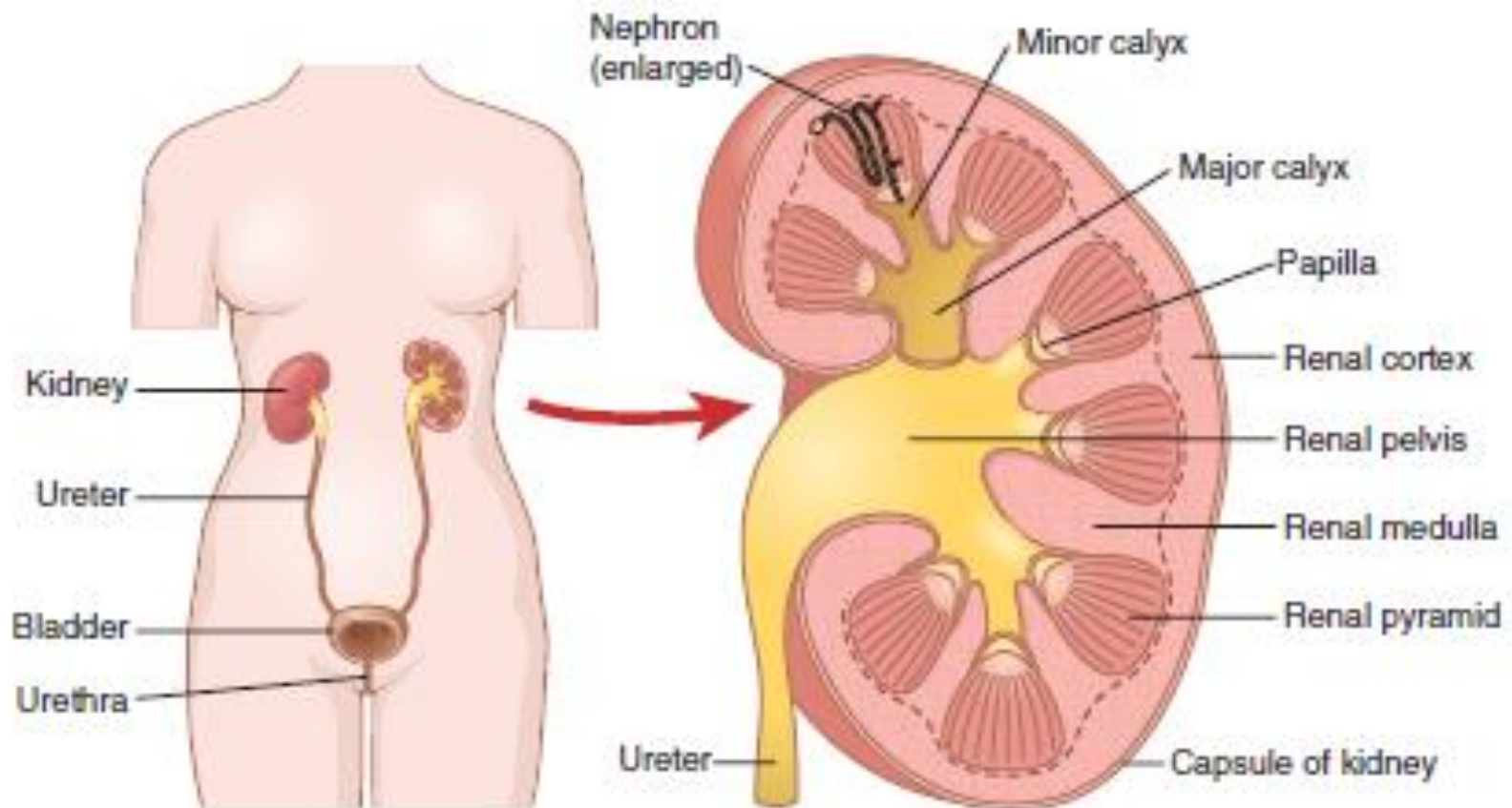
Multiple Functions of the Kidneys in Homeostasis

- Filters blood plasma, eliminates waste, returns useful chemicals to blood
- Regulation of water and electrolyte balances ➤
- Regulation of body fluid osmolality and electrolyte concentrations
- Secretes renin, erythropoietin, controls RBC count
- Regulation of arterial pressure ➤
- Regulates acid-base balance
- Detoxifies free radicals and drugs
- Gluconeogenesis
- Regulates vit.D₃ production

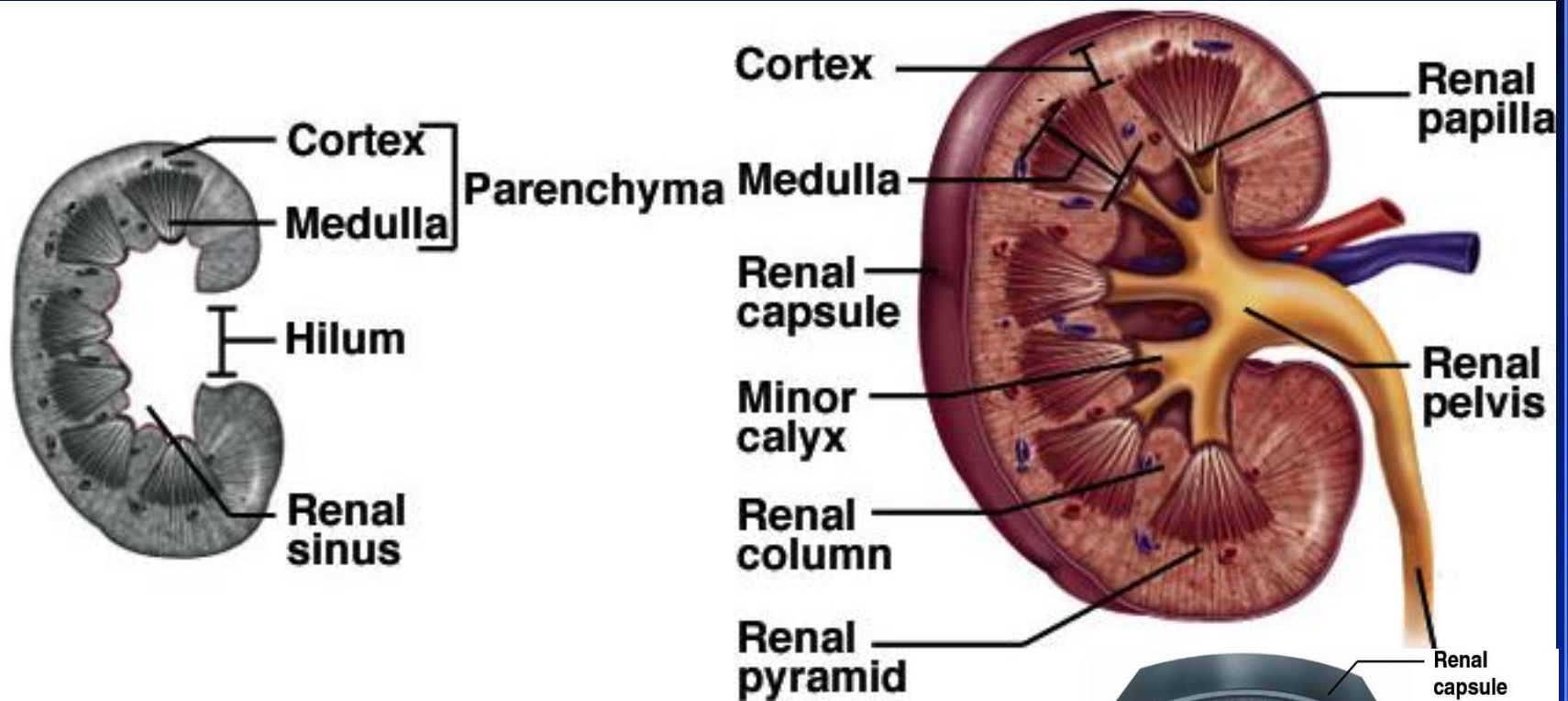
Anatomy of Kidney

- Position, weight and size
 - retroperitoneal, level of T12 to L3
 - about 150 g each
 - about size of a bar of soap (12×6×3 cm)
- Shape
 - lateral surface - convex; medial - concave

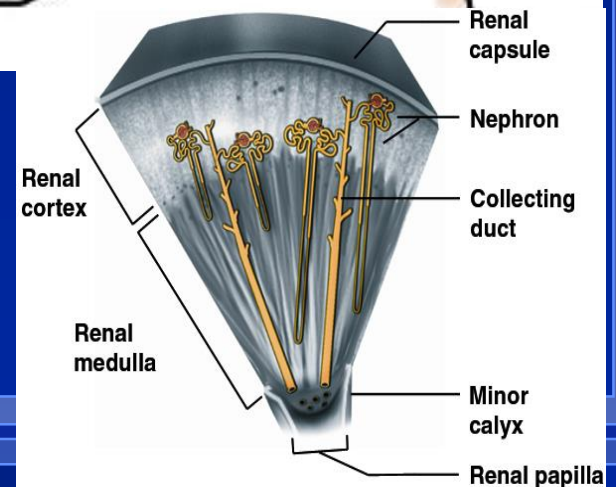
General Organization of the Kidneys and Urinary Tract



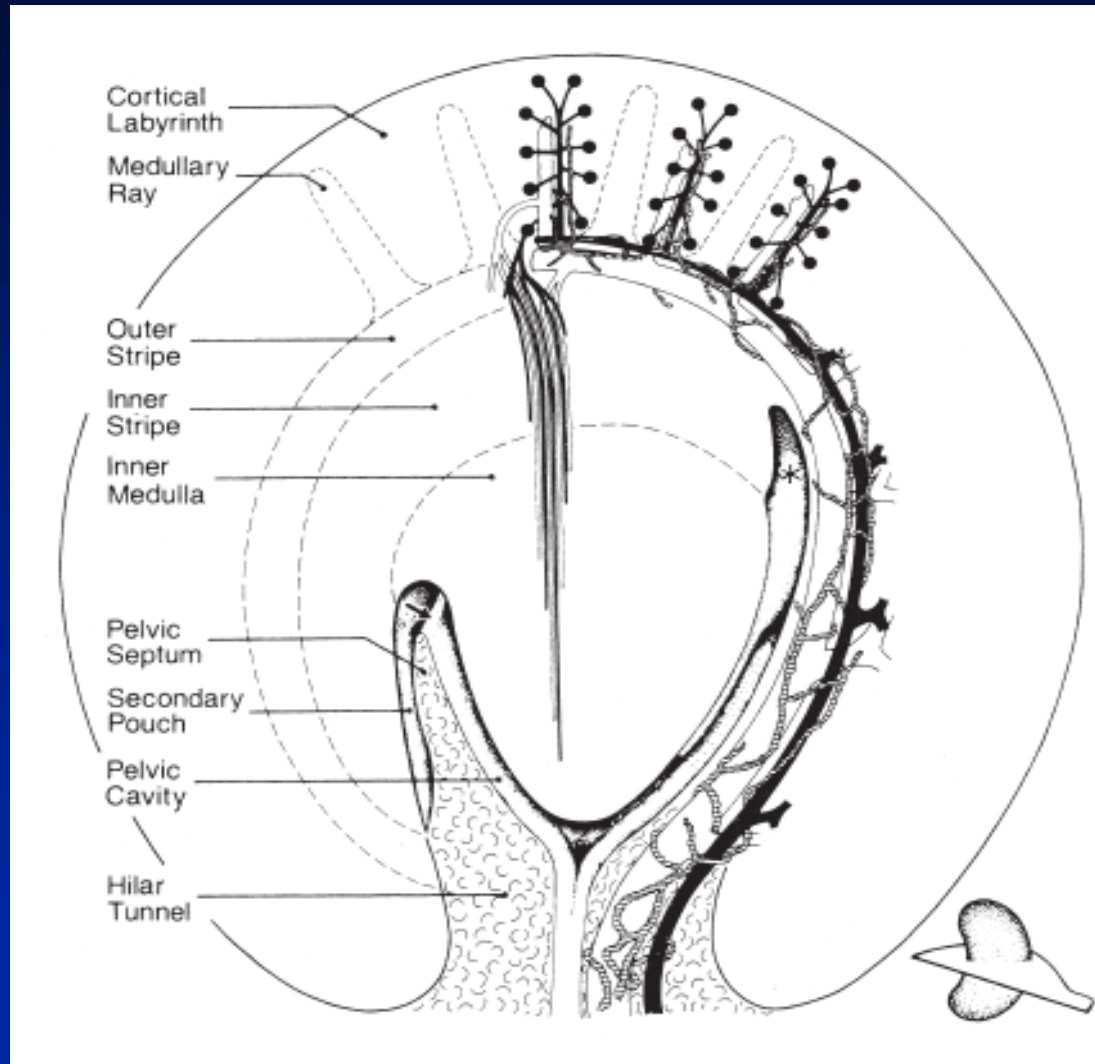
Total organization of the Kidneys

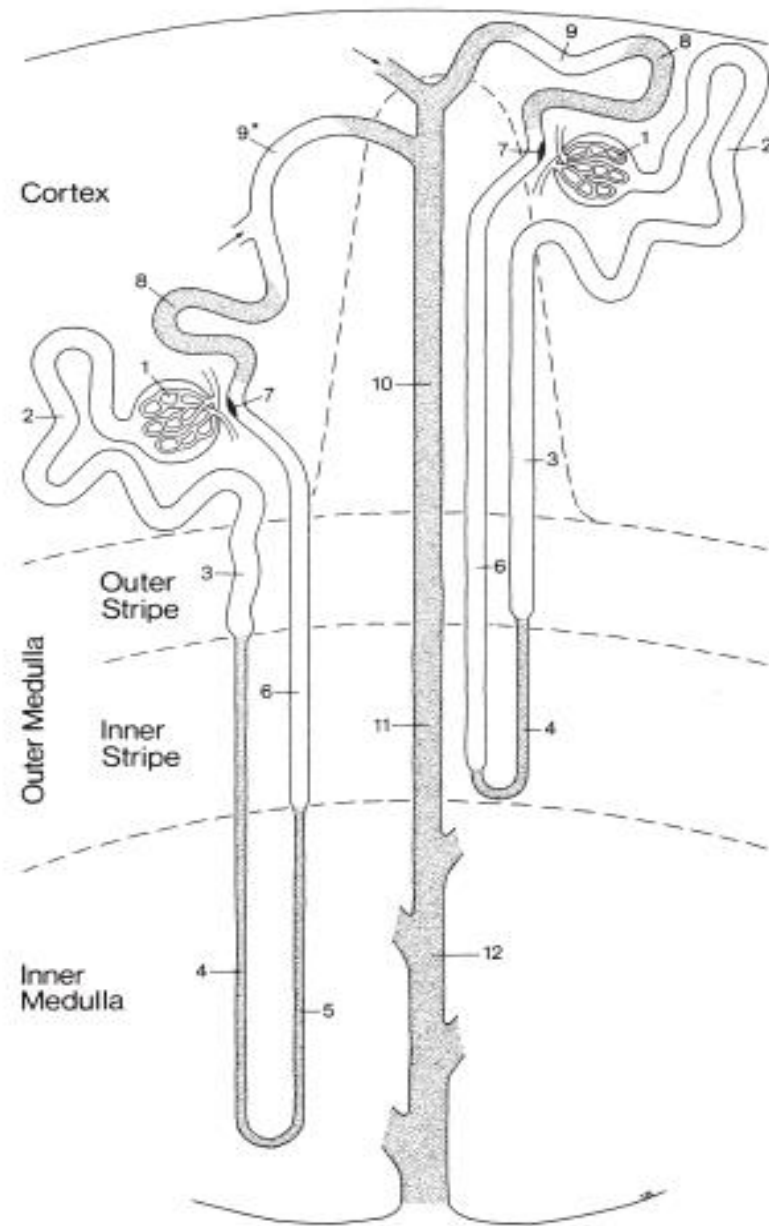


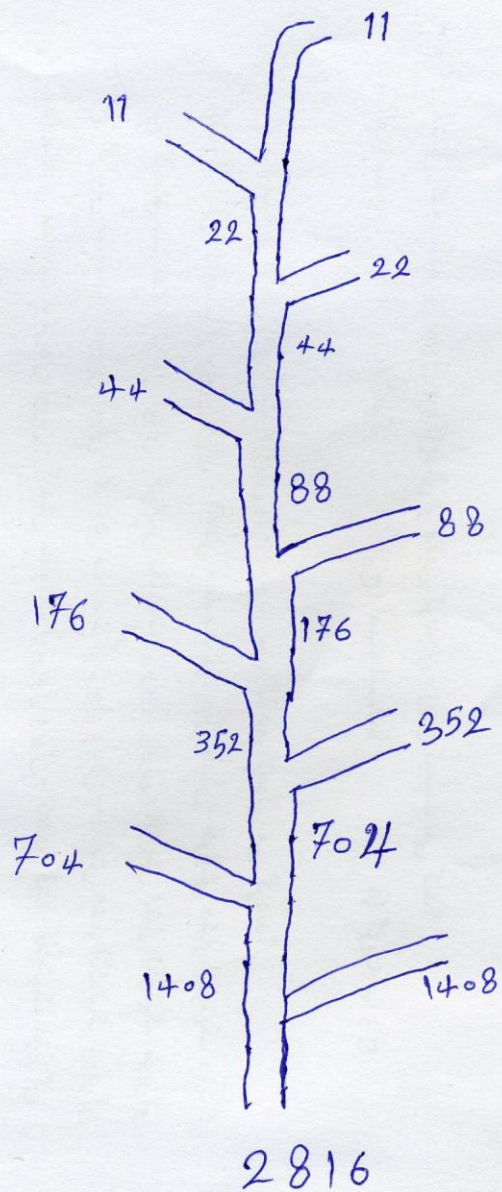
- **Renal cortex:** outer 1 cm
- **Renal medulla:** renal columns, pyramids - papilla
- **Lobe of kidney:** pyramid and it's overlying cortex



Anatomic parts of a kidney



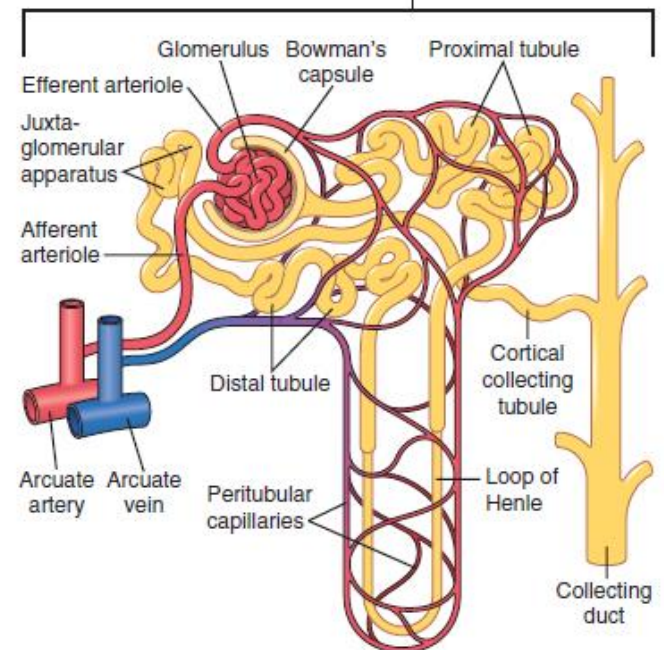
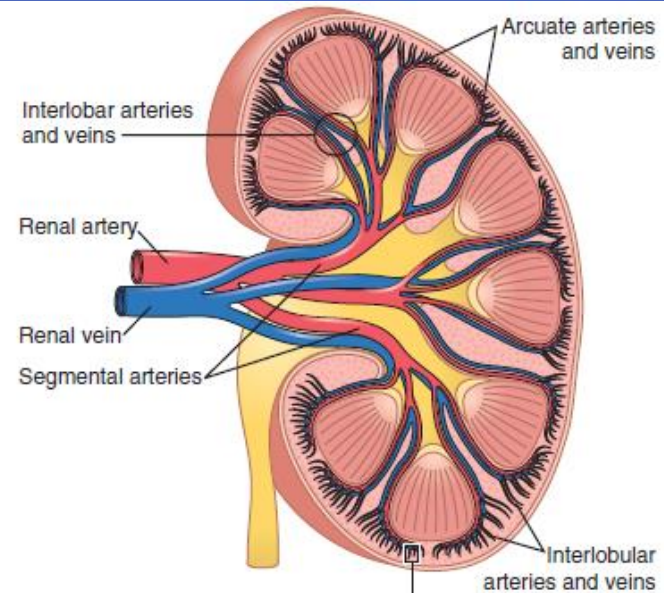




Renal Blood Supply (22%)

- Renal artery → segmental arteries
 - interlobar arteries (up renal columns, between lobes)
 - arcuate arteries (over pyramids)
 - interlobular arteries (up into cortex)
 - afferent arterioles
 - glomerulus (60 mmHg)
 - efferent arterioles (near medulla → vasa recta)
 - peritubular capillaries (13 mmHg)
 - interlobular veins → arcuate veins → interlobar veins
- Renal vein

Section of the human kidney showing the major vessels

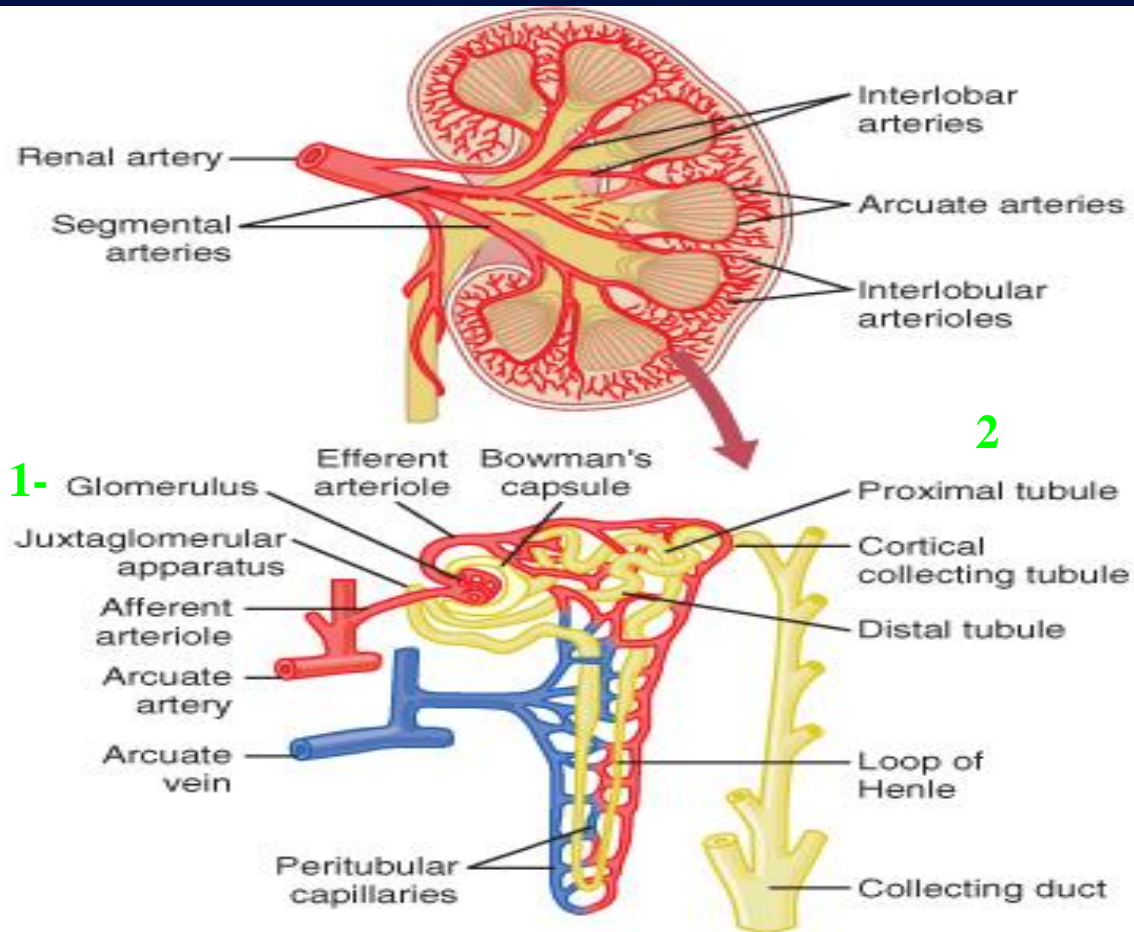


Unique characteristics of kidney circulation

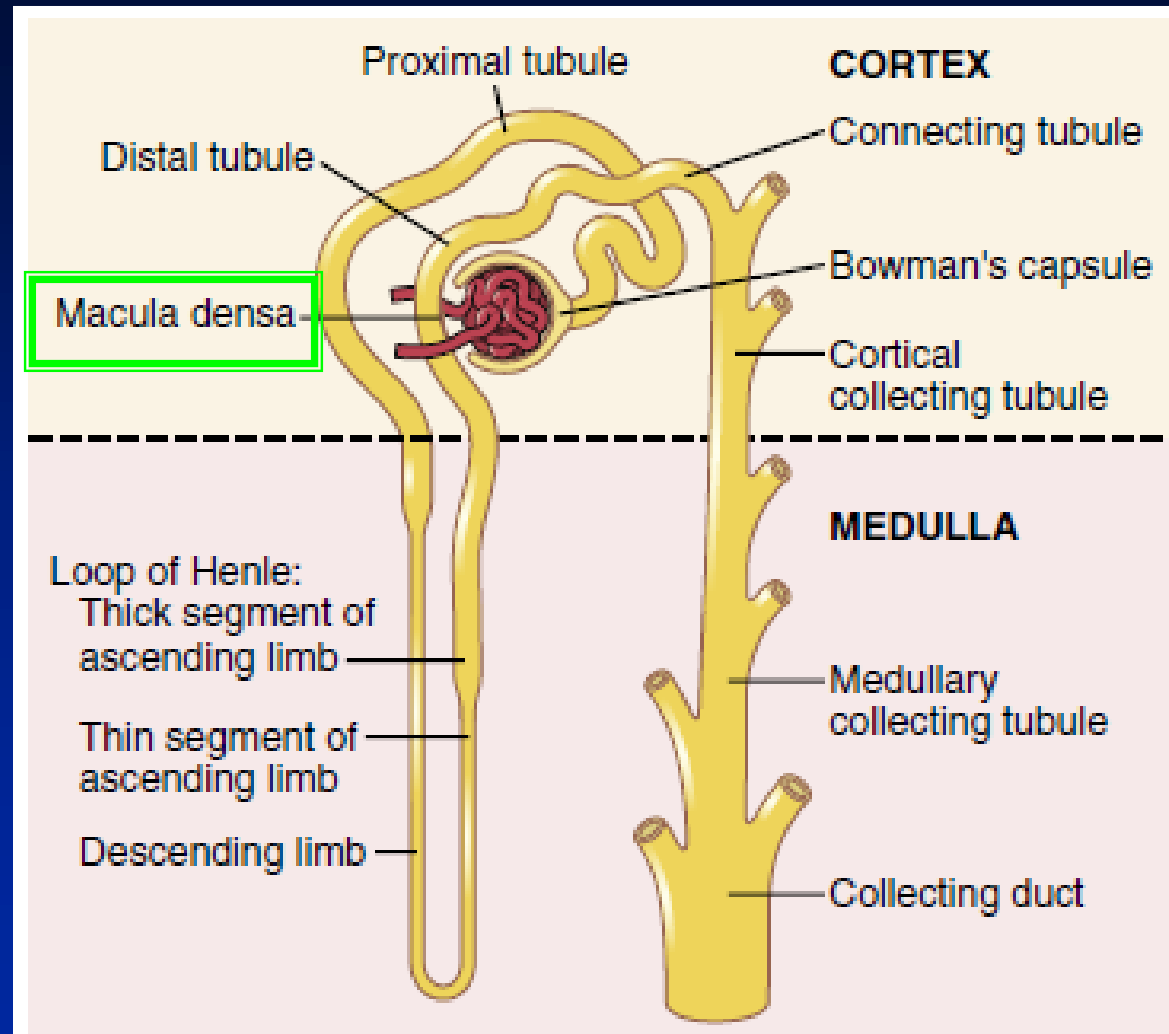
- Have two capillary beds in series
- High glomerular capillary pressure (60 mmHg)
- Low peritubular capillary pressure (13 mmHg)
- Increase of oncotic pressure along capillary
- Stability of hydrostatic pressure

(systemic: 30 \longrightarrow 10)

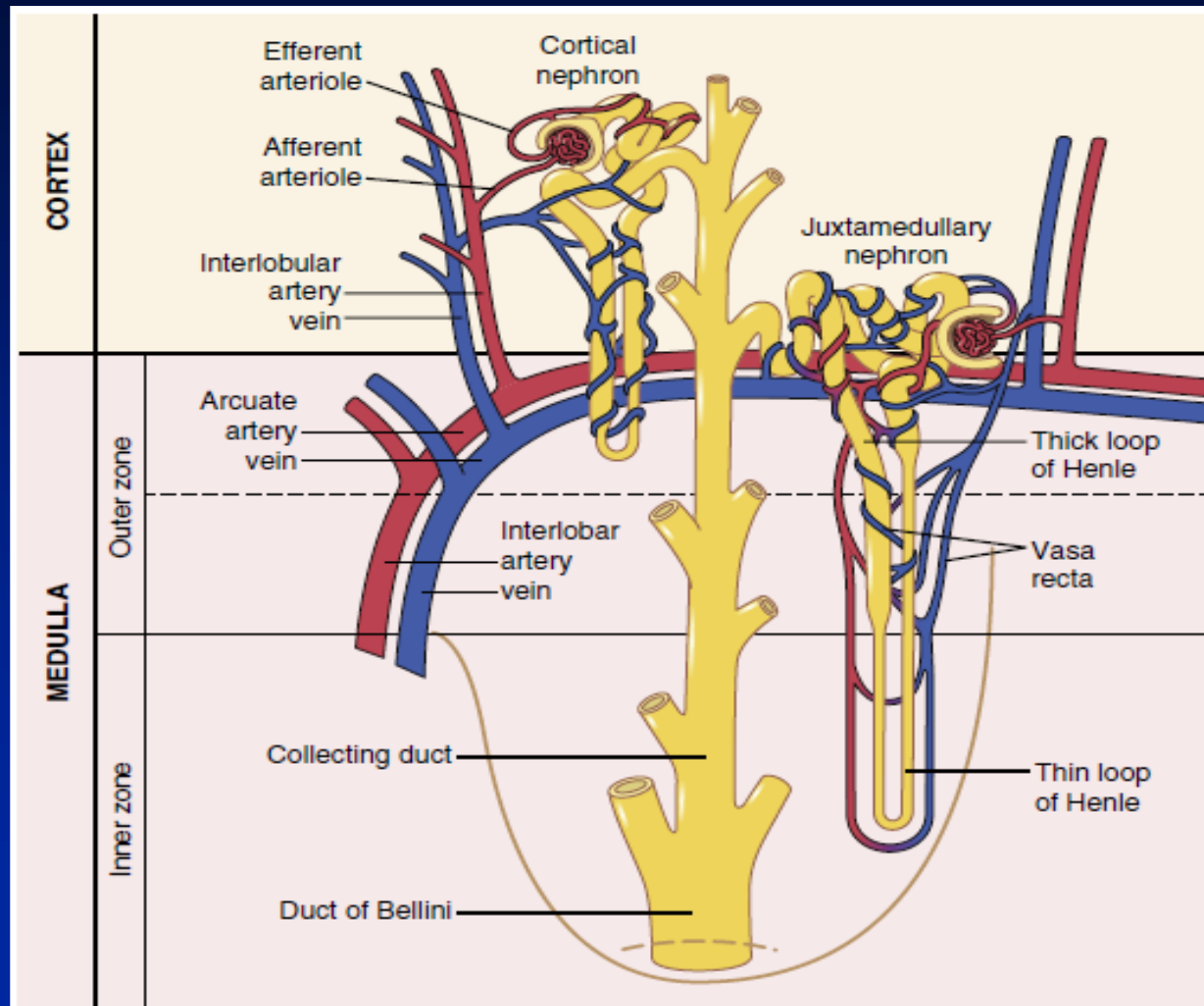
The Nephron Is the Functional Unit of the Kidney



Basic tubular segments of the nephron

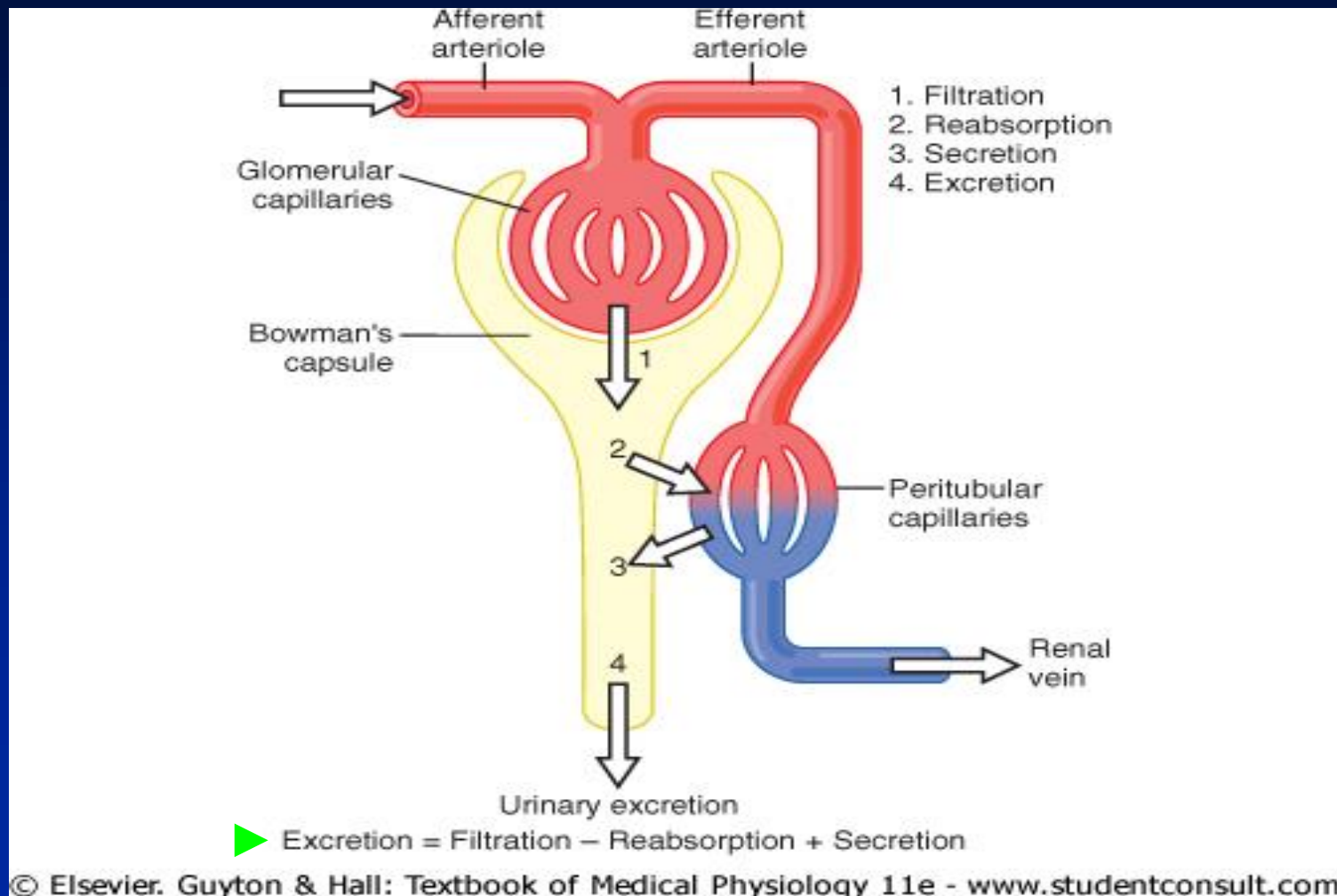


Regional Differences in Nephron Structure: Cortical and Juxtamedullary Nephrons

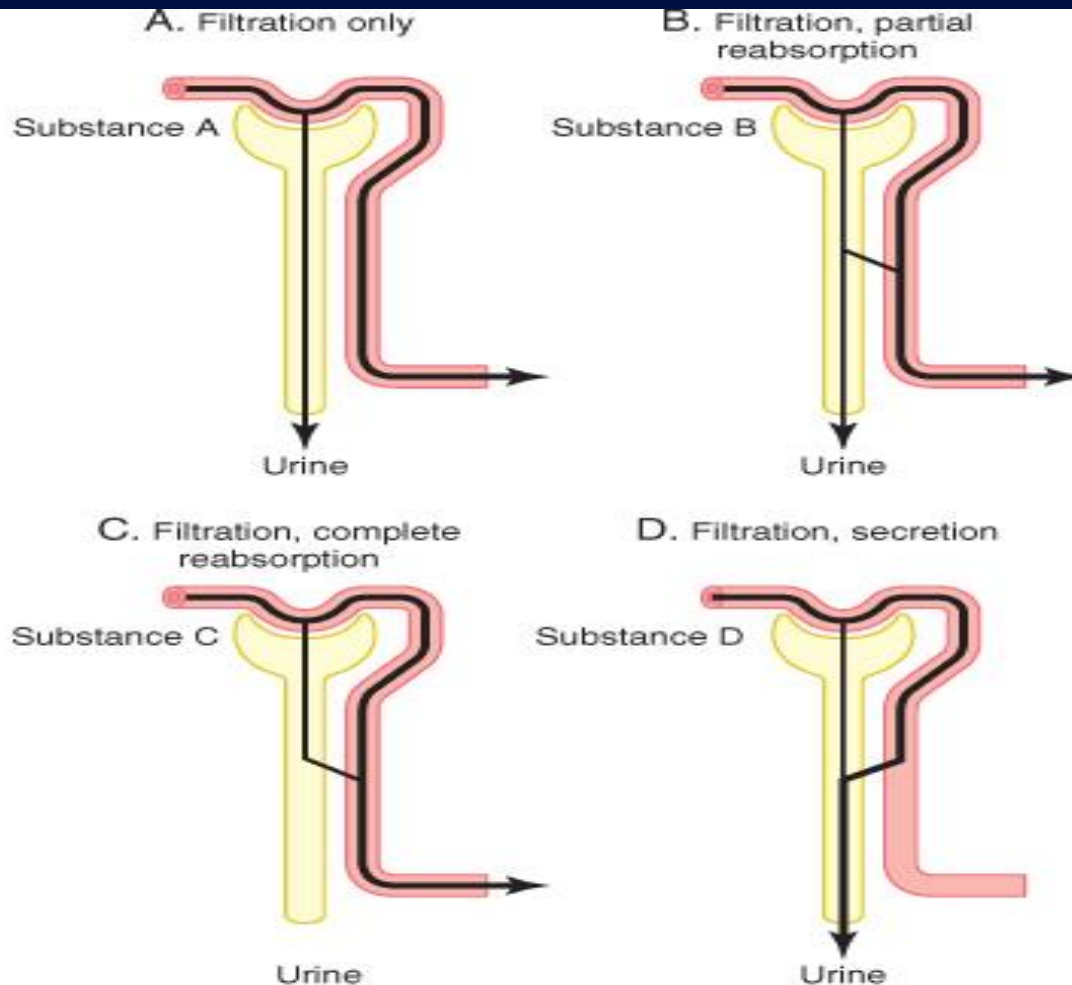


Urine formation results from glomerular filtration, tubular reabsorption and tubular secretion

Basic kidney process that determine the composition of urine: 1- filtration 2- reabsorption 3- secretion



Renal handling of 4 hypothetical substances

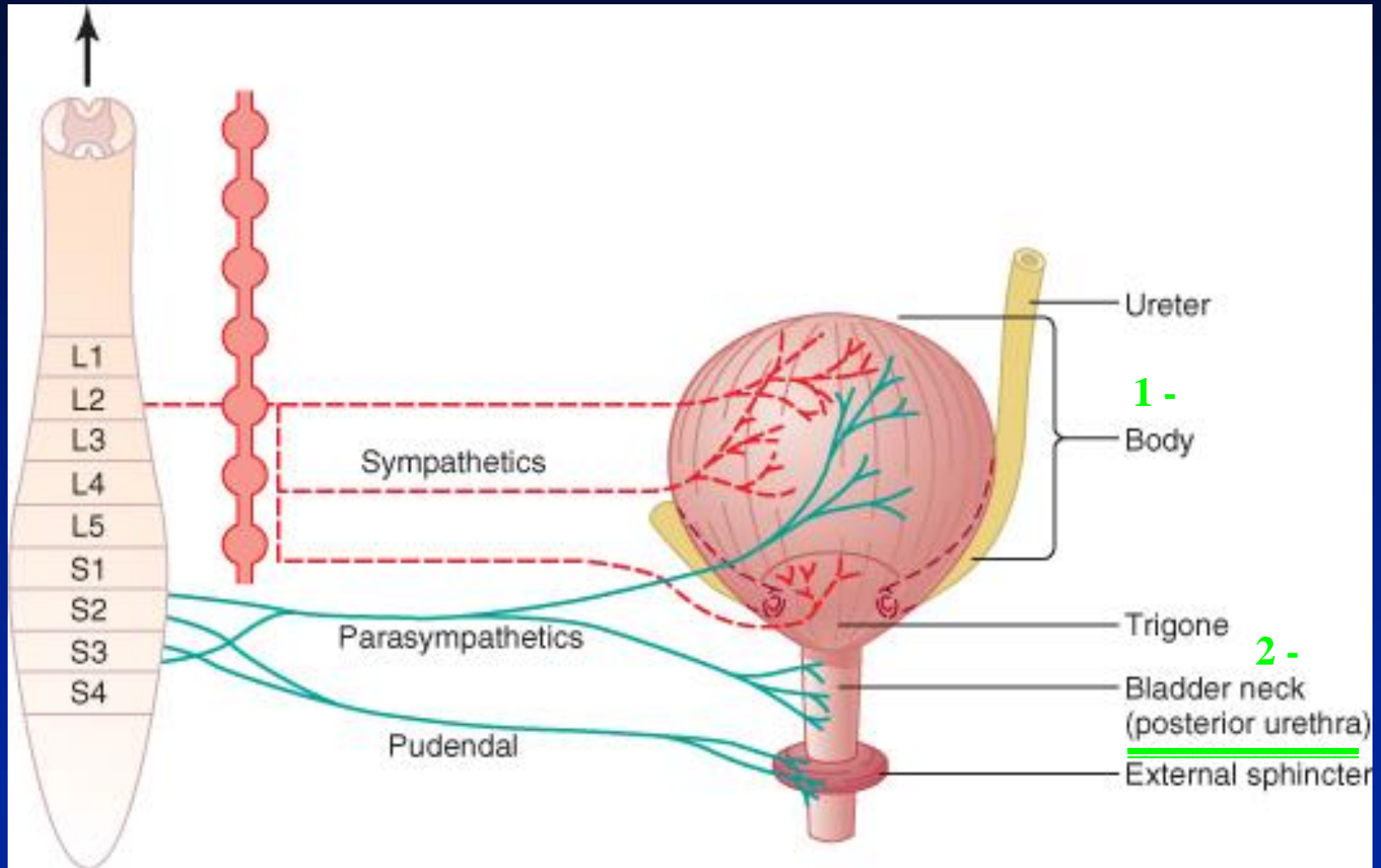


- **Filtration, Reabsorption, and Secretion of Different Substances (importance & rate)**
- **Why Are Large Amounts of Solutes Filtered and Then Reabsorbed by the Kidneys?**

Micturition

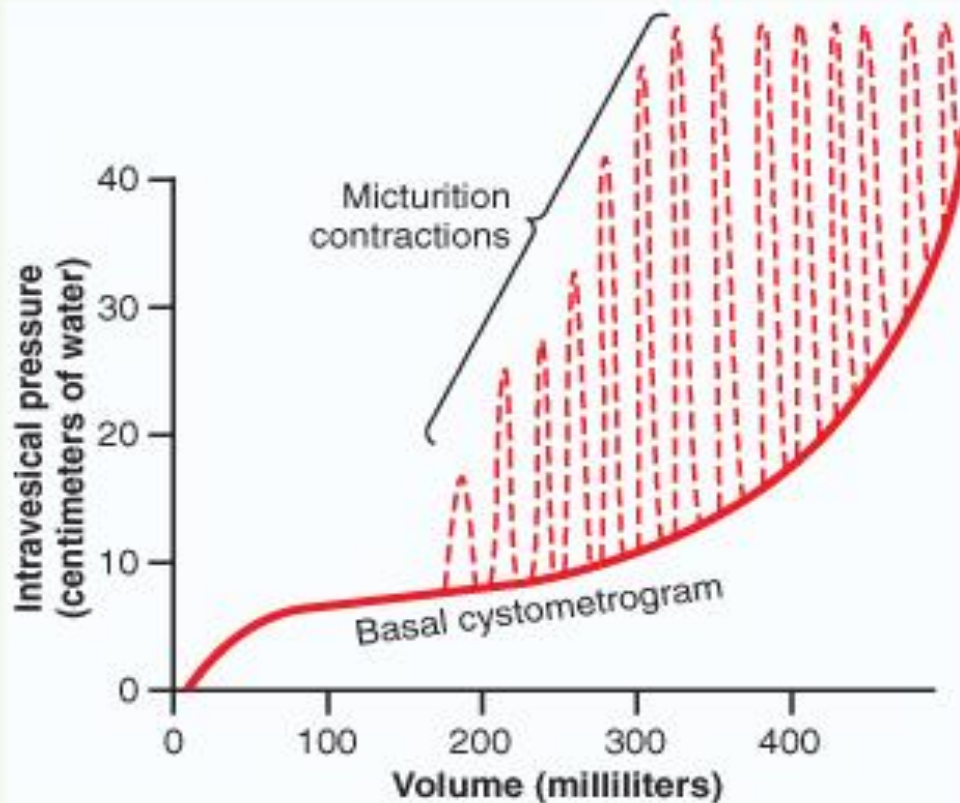
- Micturition is an autonomic spinal cord reflex, but it can be inhibited or facilitated by cerebral cortex or brain stem
- **Physiologic Anatomy and Nervous Connections of the Bladder**

Urinary bladder and its innervation



- **Transport of Urine from the Kidney Through the Ureters and into the Bladder**
(ureter peristaltic)
- **Pain Sensation in the Ureters, and the Ureterorenal Reflex**
- **Filling of the Bladder and Bladder Wall Tone; the Cystometrogram**

Normal cystometrogram showing acute pressure waves caused by micturition reflexes



- **Micturition Reflex** (self-regenerative)
- **Facilitation or Inhibition of Micturition by the Brain**

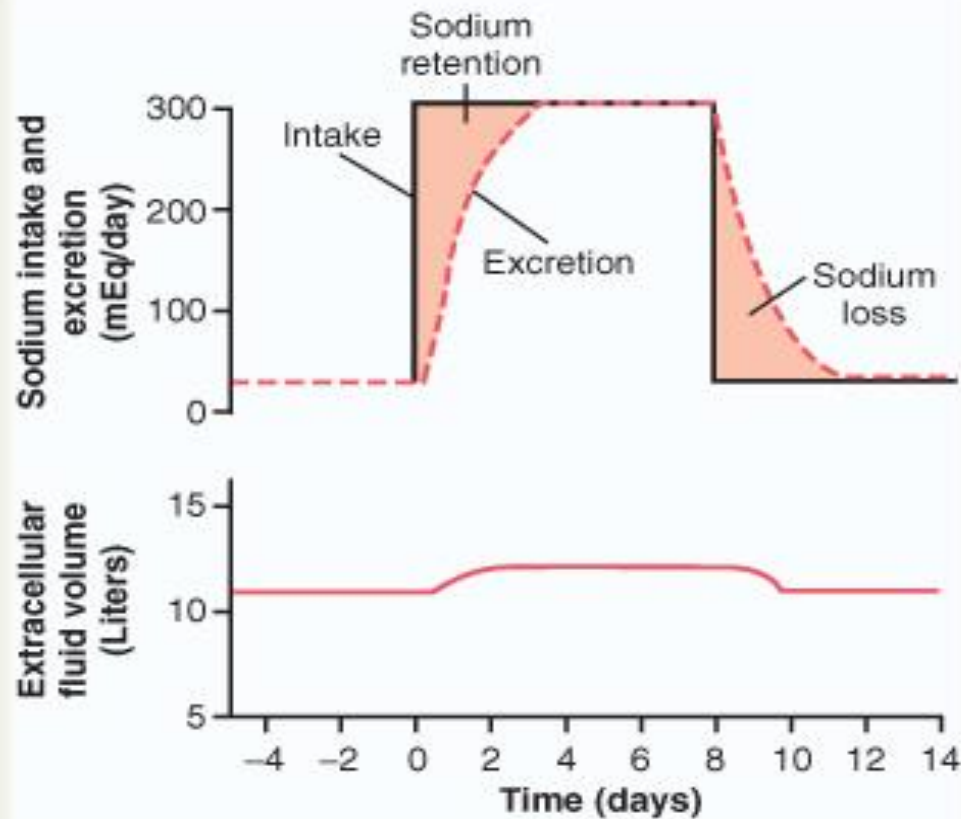
Abnormalities of Micturition

- **Atonic Bladder Caused by Destruction of Sensory Nerve Fibers**
- **Automatic Bladder Caused by Spinal Cord Damage Above the Sacral Region**
- **Uninhibited Neurogenic Bladder Caused by Lack of Inhibitory Signals from the Brain**

Thanks for your attention

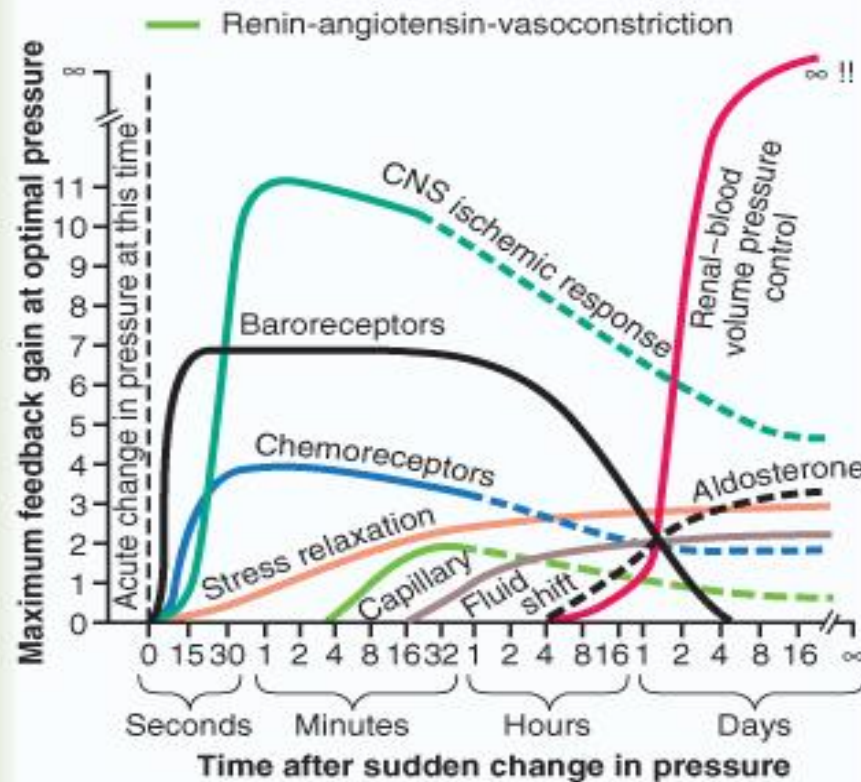


Effect of 10 times increasing in Na^+ intake on its urinary excretion and ECF volume



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Approximate potency of various arterial pressure control mechanisms



- 1- Short time effect by Rennin release
- 2- Long time effect

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