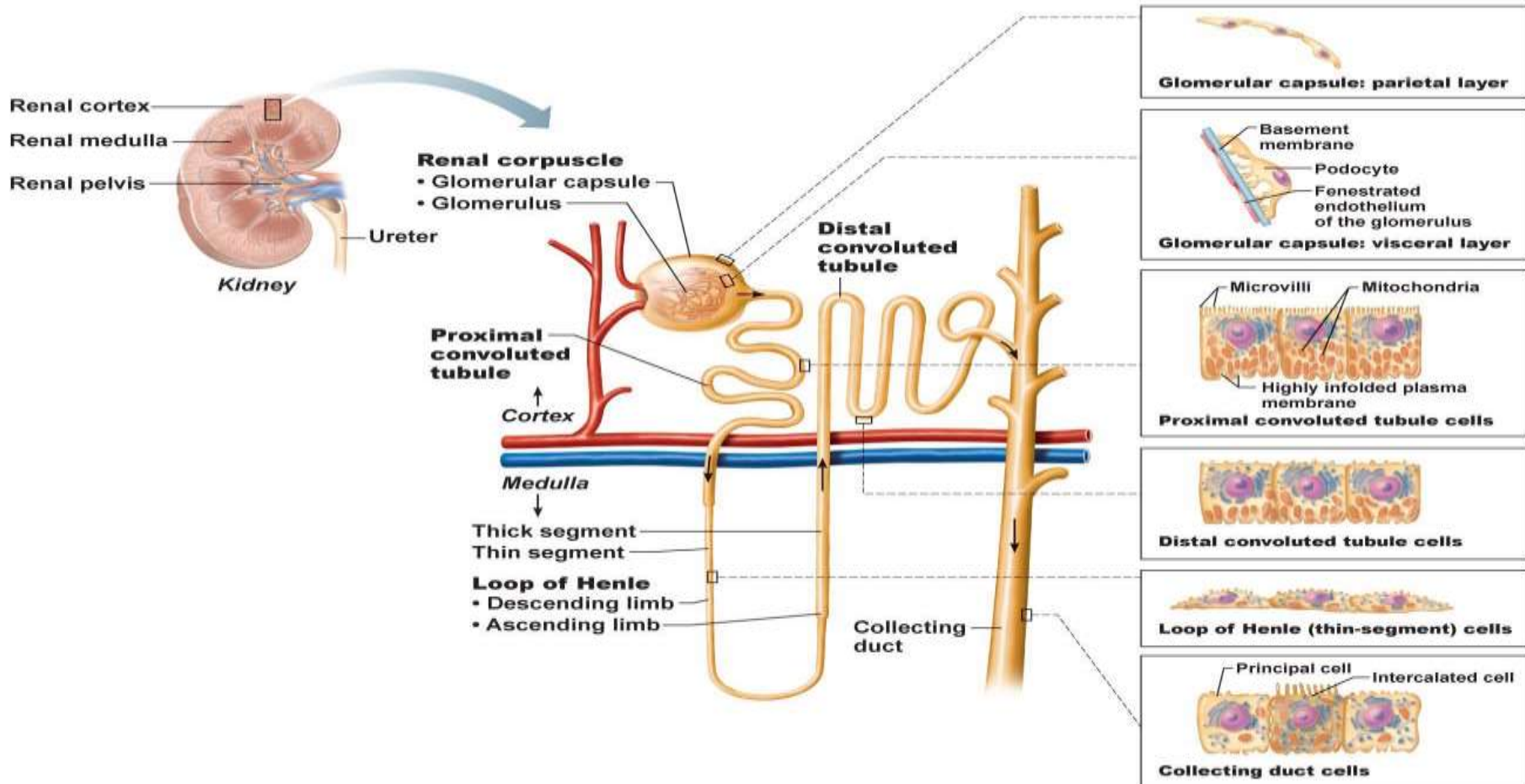
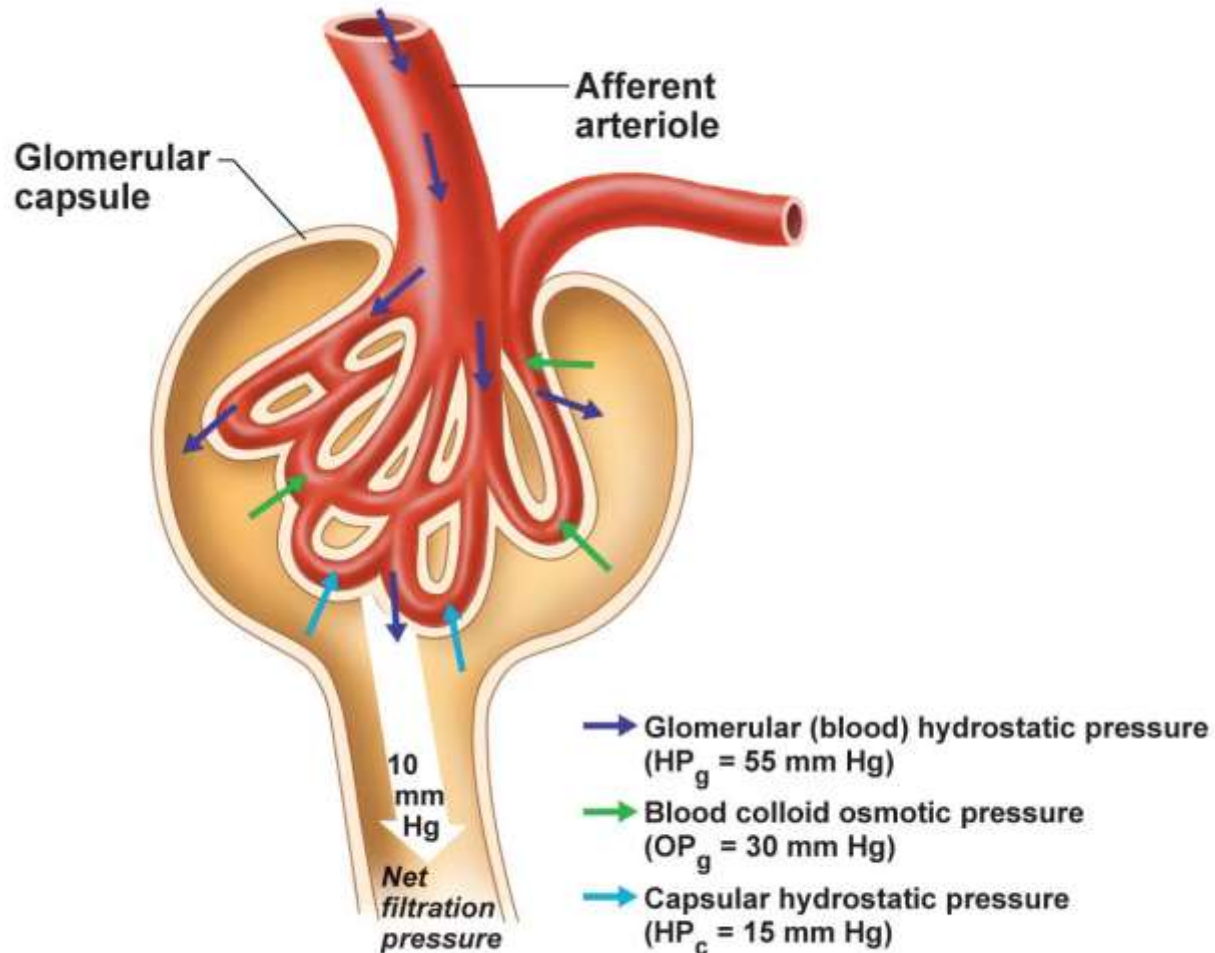


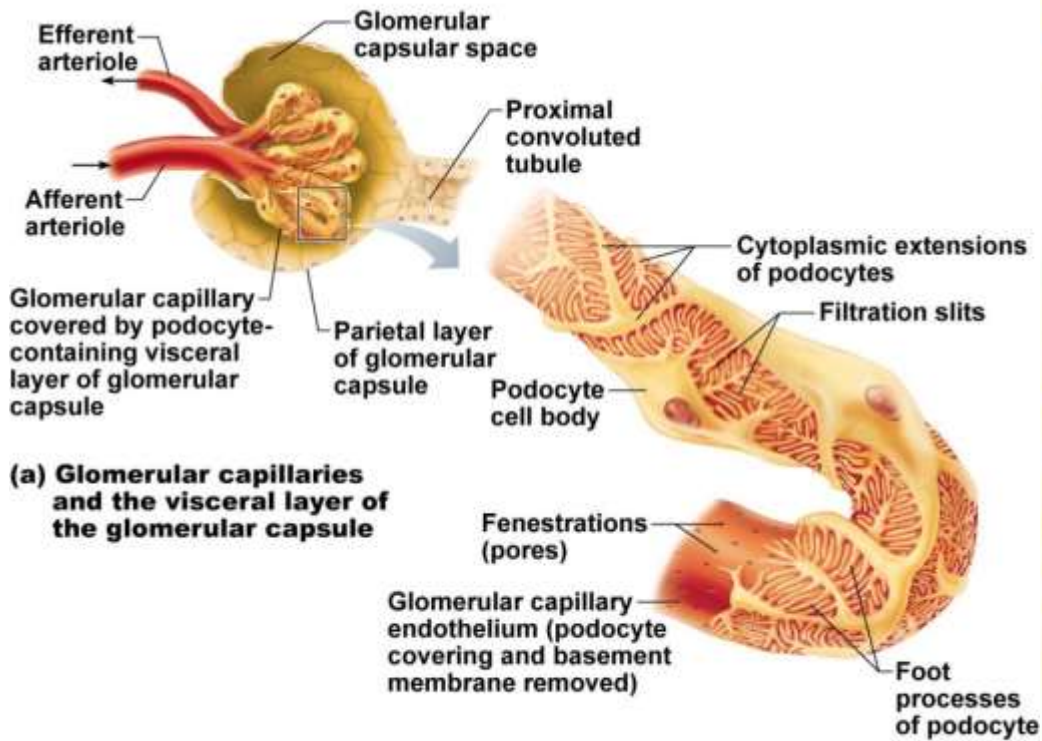
# URINE FILTRATION



# Non-Selective Filtration



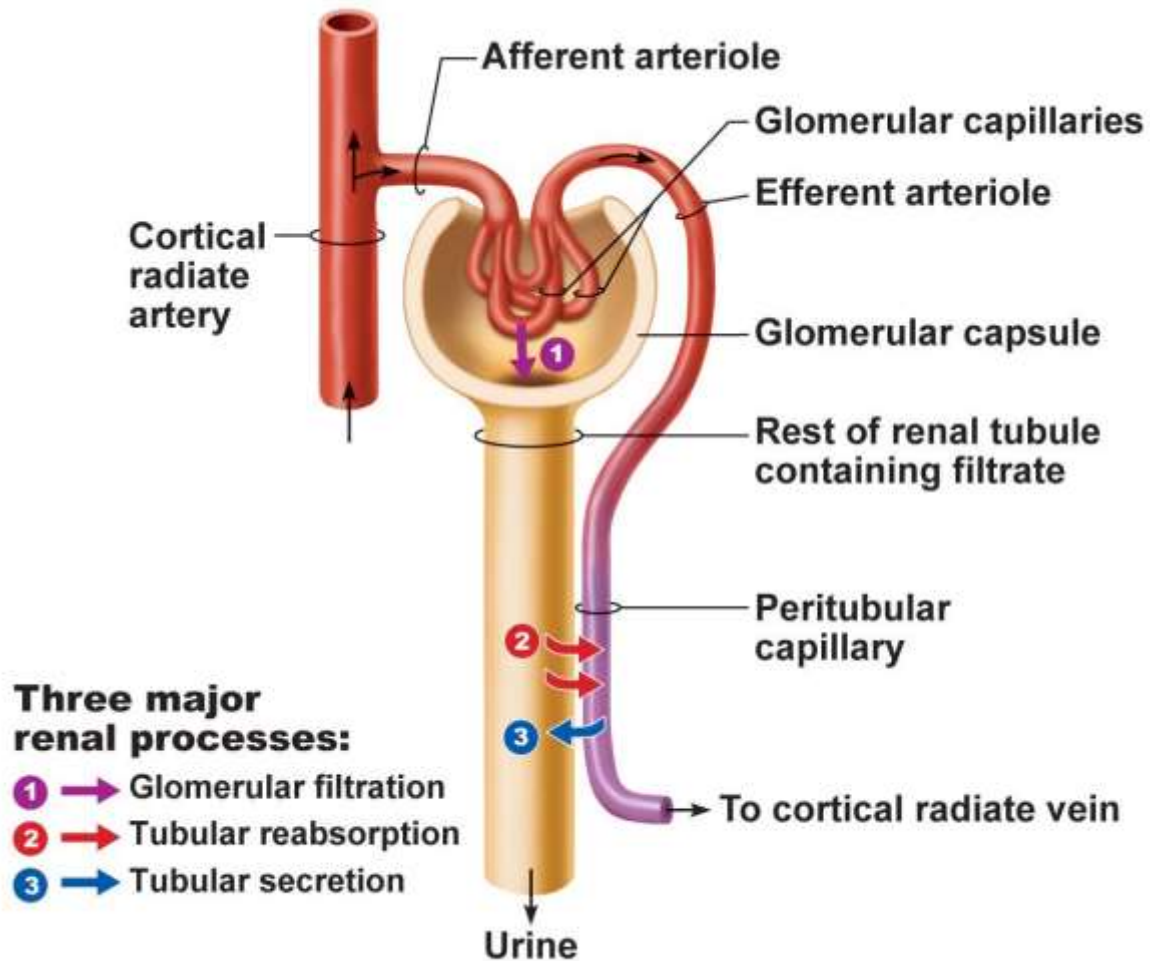
# Filtration Membrane



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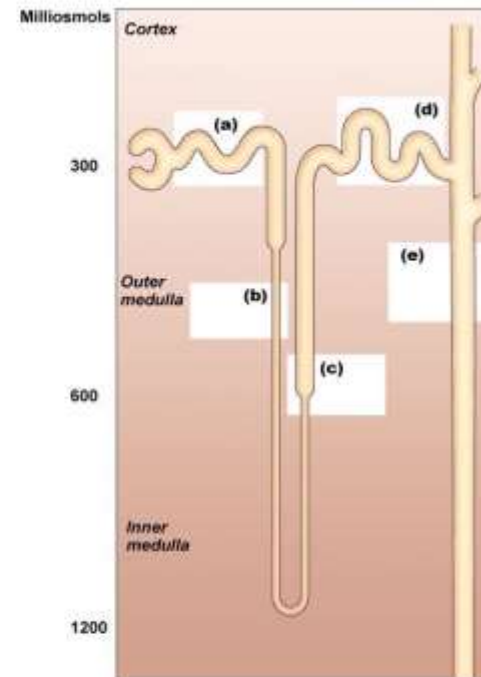
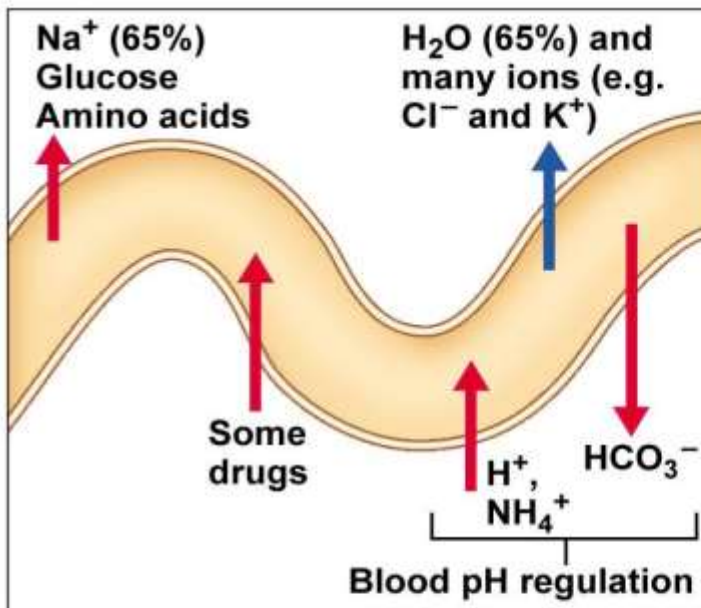


# Renal Physiology





# Tubular Reabsorption



## (a) Proximal convoluted tubule:

- 65% of filtrate volume reabsorbed
- $\text{Na}^+$ , glucose, amino acids, and other nutrients actively transported;  $\text{H}_2\text{O}$  and many ions follow passively
- $\text{H}^+$  and  $\text{NH}_4^+$  secretion and  $\text{HCO}_3^-$  reabsorption to maintain blood pH (see Chapter 26)
- Some drugs are secreted

- Active transport (primary or secondary)
- Passive transport

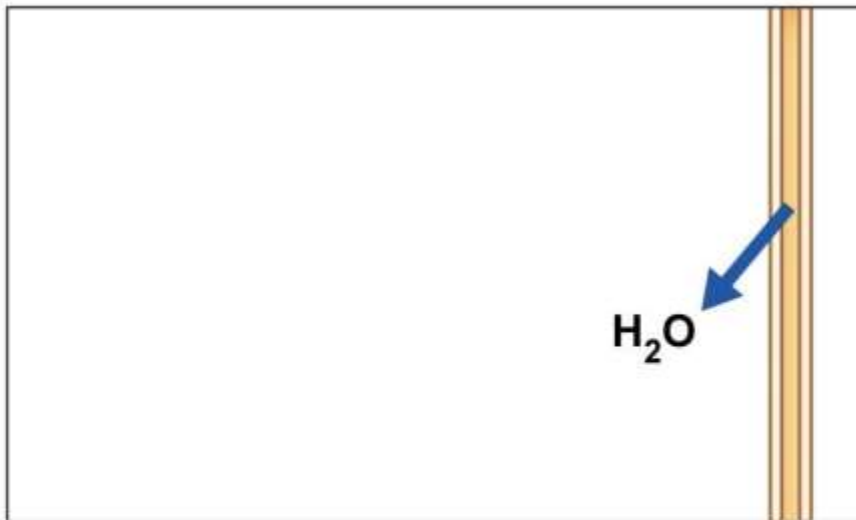


# Tubular Reabsorption at the PCT

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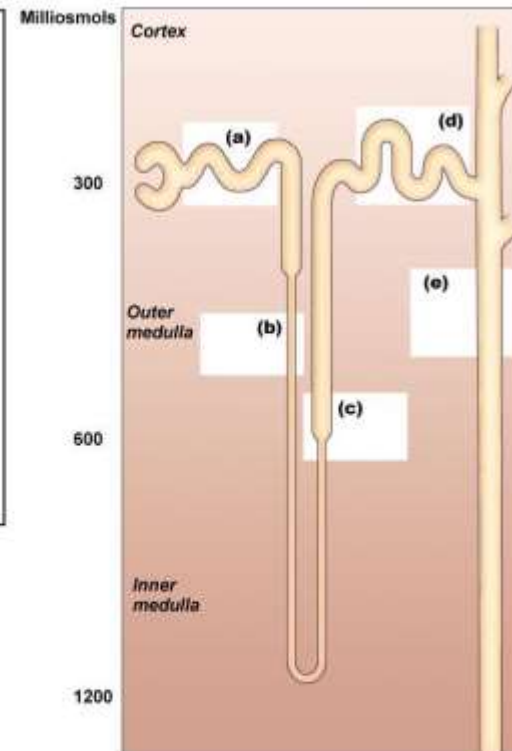
- Glucose, lactate, amino acids and vitamins – 100%
- Bicarbonate ions ( $\text{HCO}_3^-$ ) – 90%
- Water and sodium ions – 65%
- Potassium ions – 55%
- Chloride ions – 50%

# Tubular Reabsorption

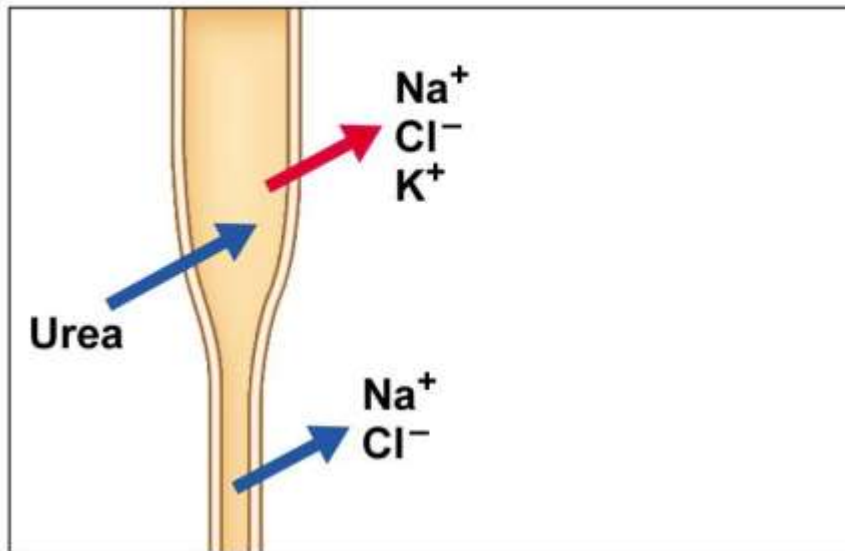


## (b) Descending limb of loop of Henle

- Freely permeable to  $H_2O$
- Not permeable to  $NaCl$
- Filtrate becomes increasingly concentrated as  $H_2O$  leaves by osmosis

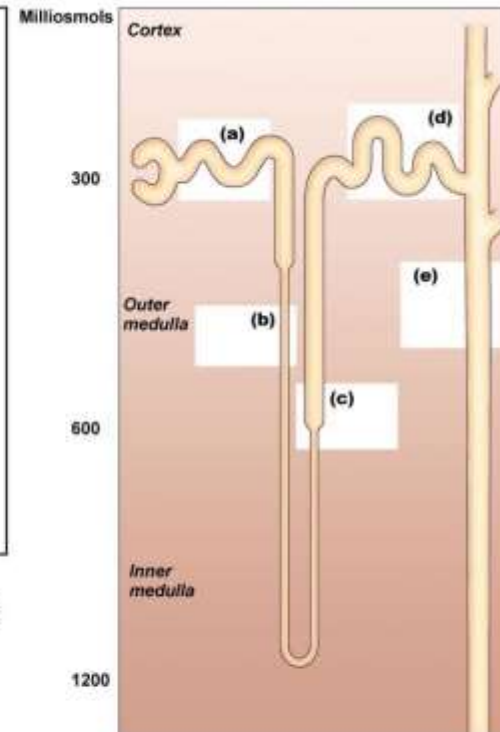


# Tubular Reabsorption



## (c) Ascending limb of loop of Henle

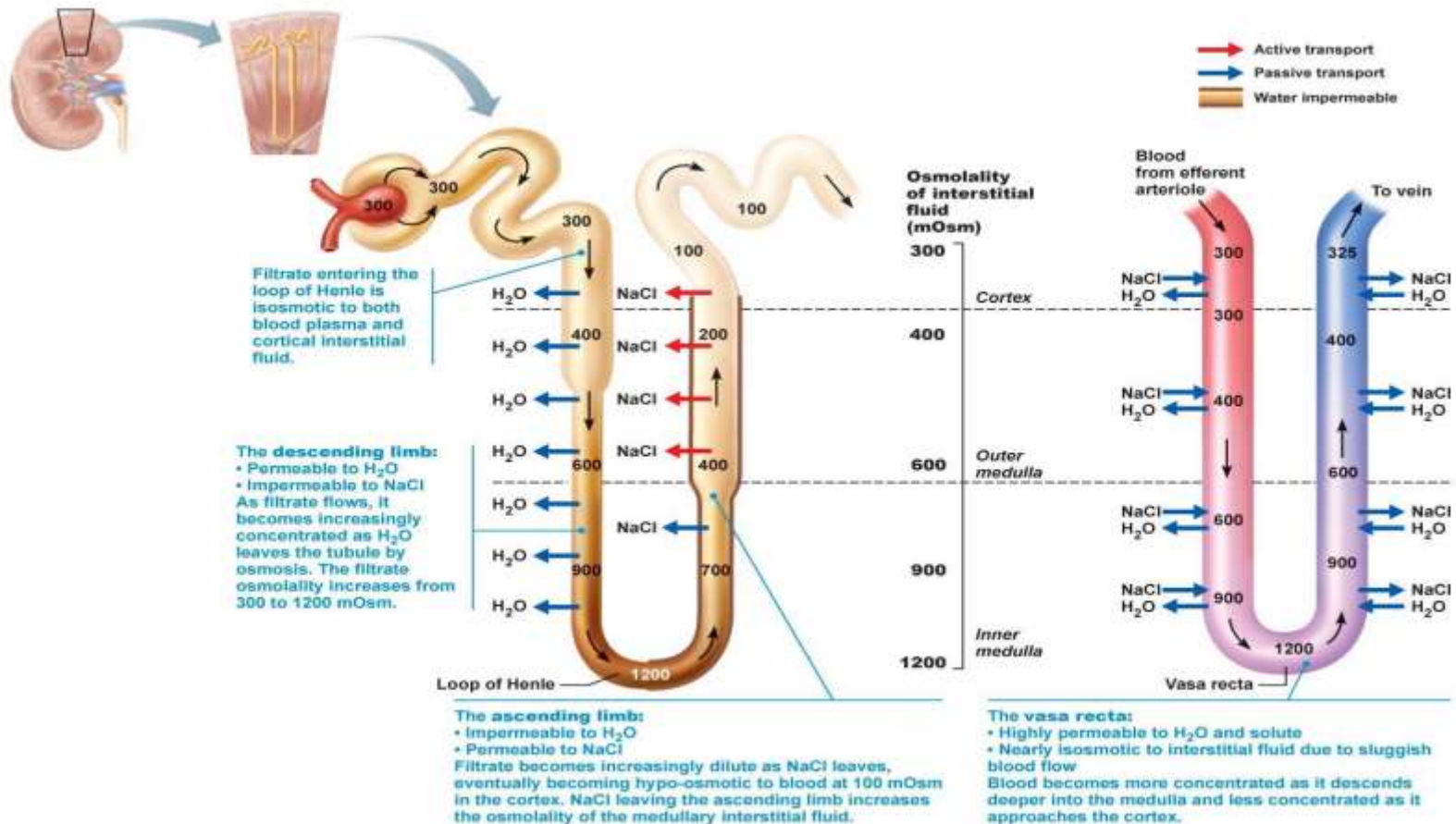
- Impermeable to  $\text{H}_2\text{O}$
- Permeable to  $\text{NaCl}$
- Filtrate becomes increasingly dilute as salt is reabsorbed



- Active transport (primary or secondary)
- Passive transport



# Countercurrent Mechanism



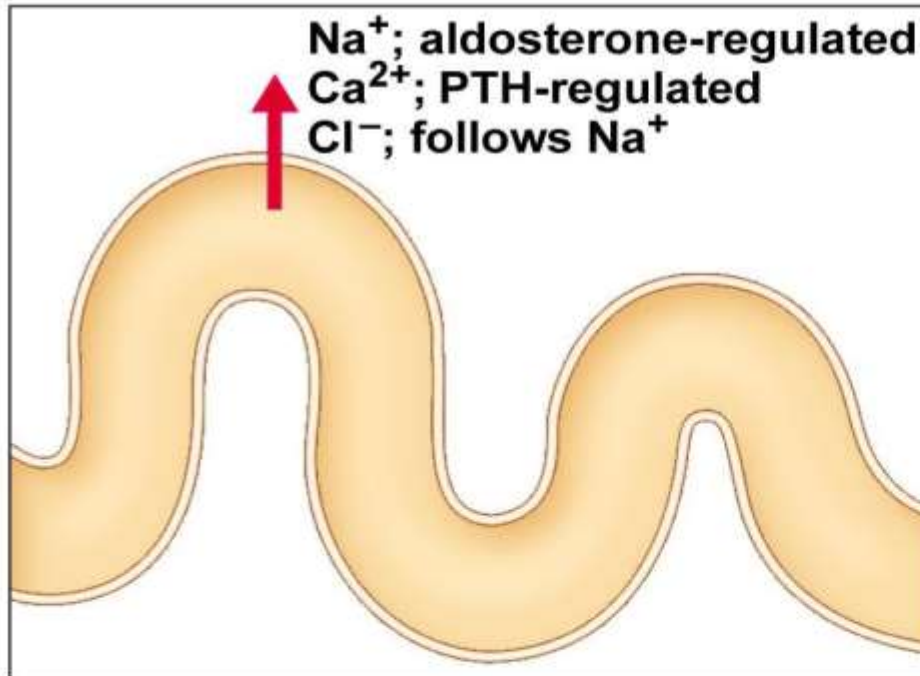


# Tubular Reabsorption at the Loop

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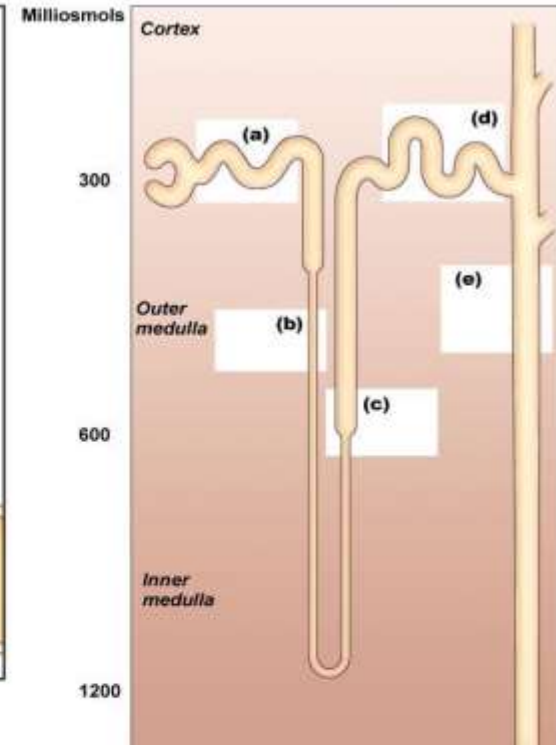
- Chloride – 35%
- Potassium – 30%
- Sodium ions – 25%
- Water – 10%

# Tubular Reabsorption



## (d) Distal convoluted tubule

- Na<sup>+</sup> reabsorption regulated by aldosterone
- Ca<sup>2+</sup> reabsorption regulated by parathyroid hormone (PTH)
- Cl<sup>-</sup> cotransported with Na<sup>+</sup>



- Active transport (primary or secondary)
- Passive transport

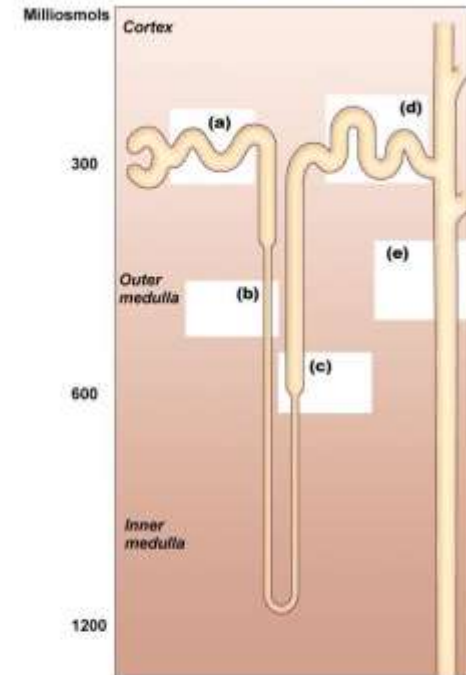
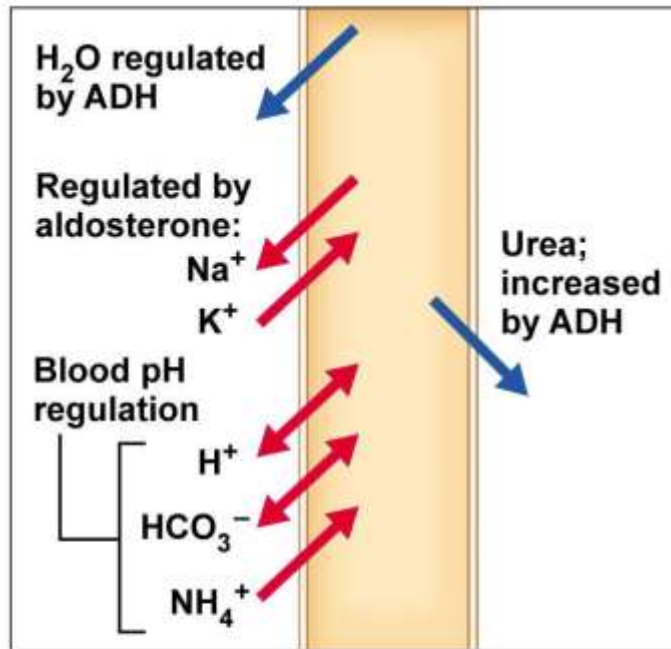


# Tubular Reabsorption at the DCT

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- Water – 25%
- Chloride – 10%
- Sodium ions – 10%

# Tubular Reabsorption



## (e) Collecting duct

- H<sub>2</sub>O reabsorption through aquaporins regulated by ADH
- Na<sup>+</sup> reabsorption and K<sup>+</sup> secretion regulated by aldosterone
- H<sup>+</sup> and HCO<sub>3</sub><sup>-</sup> reabsorption or secretion to maintain blood pH (see Chapter 26)
- Urea reabsorption increased by ADH

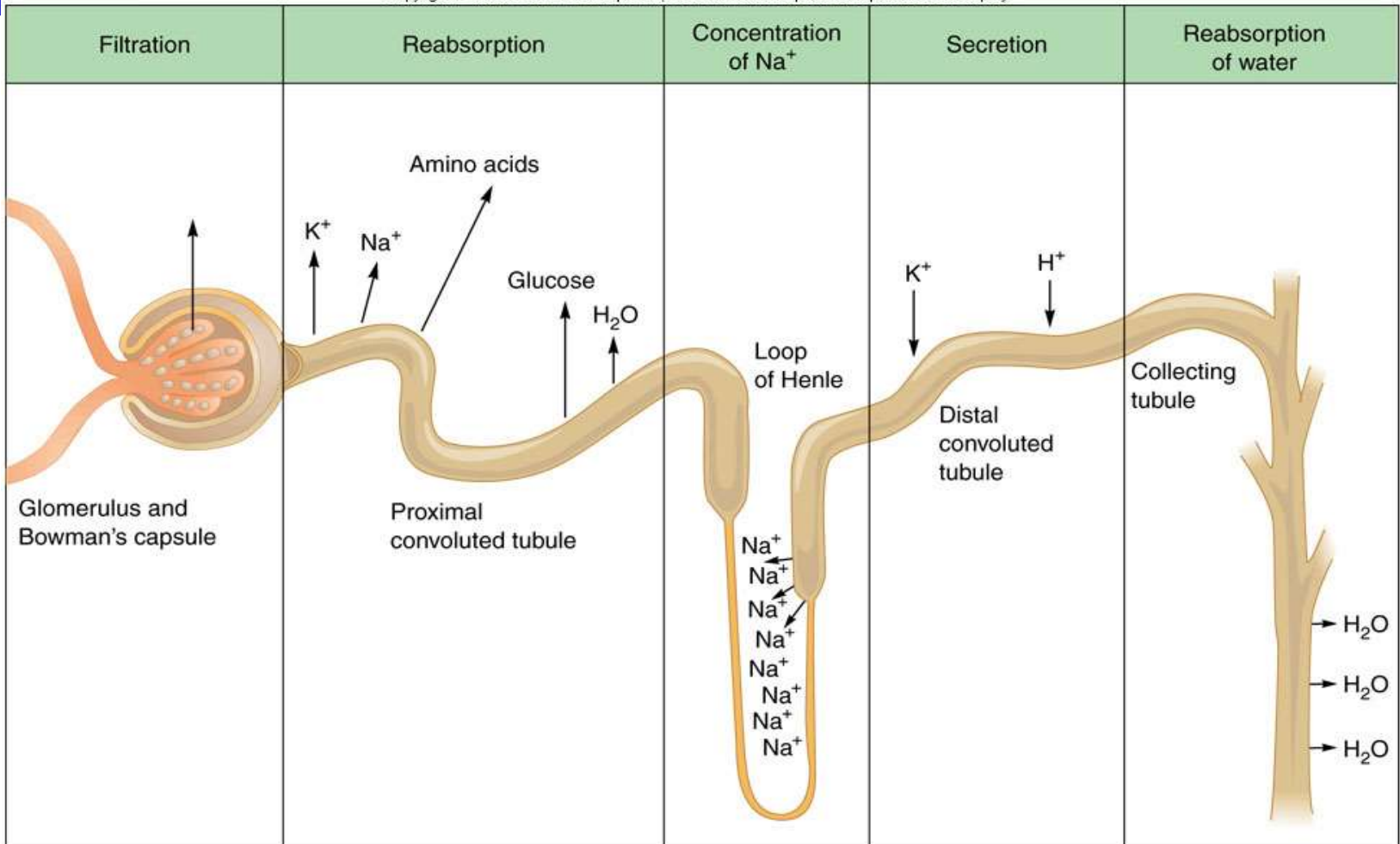
→ Active transport (primary or secondary)

→ Passive transport



# Tubular Secretion

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# Urine Formation

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## ■ Urine composition

- 90-95% water
- Solutes constitute the other 5%
  - Metabolic wastes (urea, uric acid, and creatinine)
  - Ions ( $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{PO}_4^{3-}$ ,  $\text{SO}_4^{2-}$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ )
  - Toxins and pigments (urochrome)
  - Hormones

## ■ Urine characteristics

- Yellow in color
- Slightly aromatic or ammonia odor
- pH slightly acidic (can vary from 4.5 to 8.0)
- Specific gravity 1.001 to 1.035