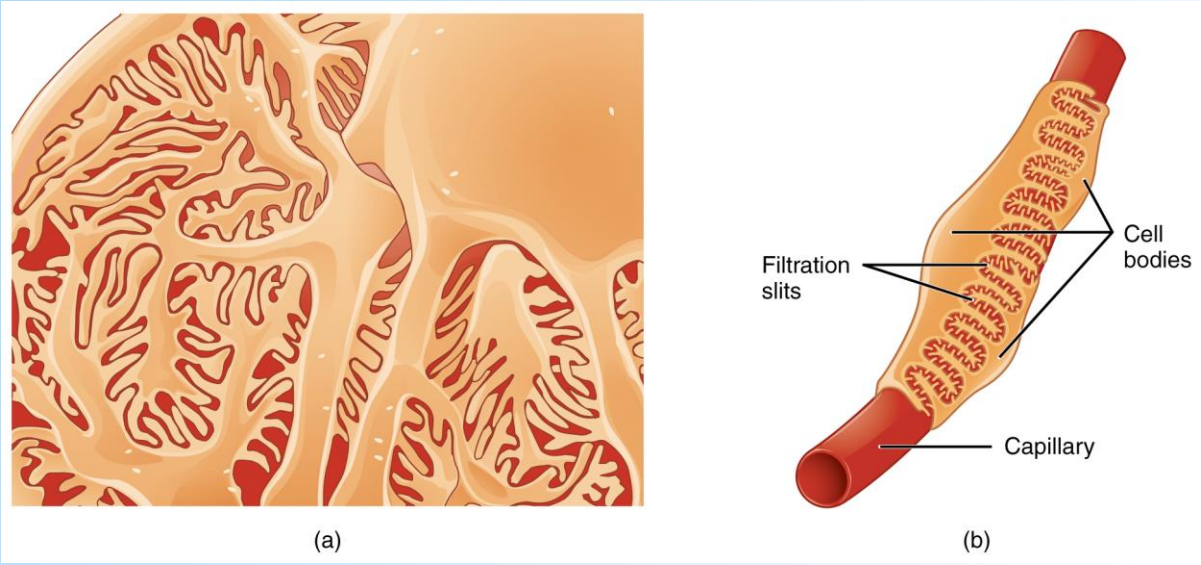
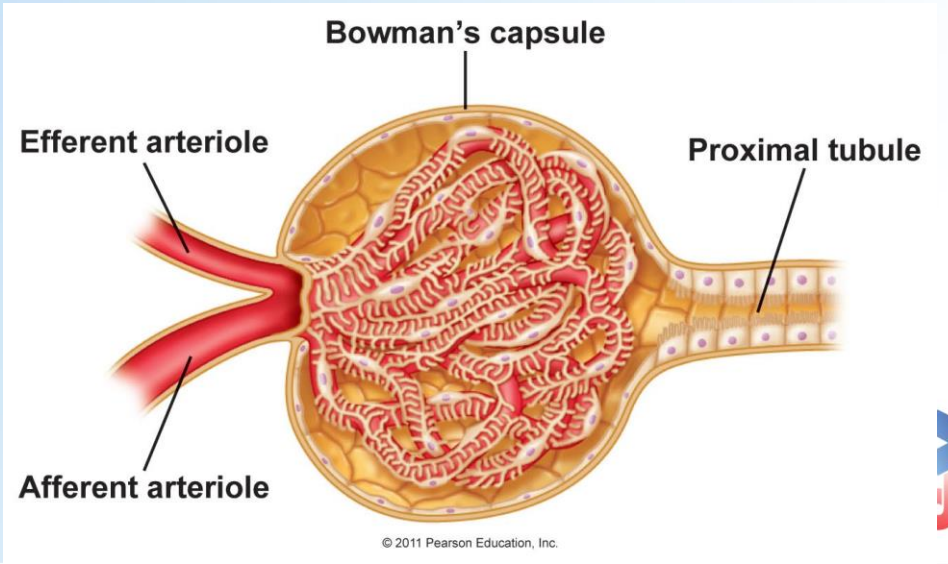
Renal Physiology

Glomerular filtration rate

- Ultrafiltrate
- Endothelium
  - Pores 70-100nm in diameter
- The basement membrane
  - Lamina rara interna
  - Lamina densa
  - Lamina rara externa
- Epithelium
  - Podcytes with foot processes
  - Holes 25-60nm in diameter

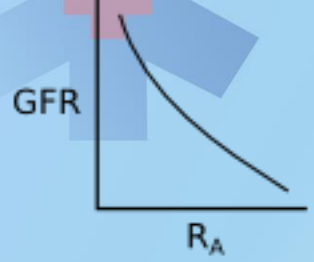




Properties of the barier

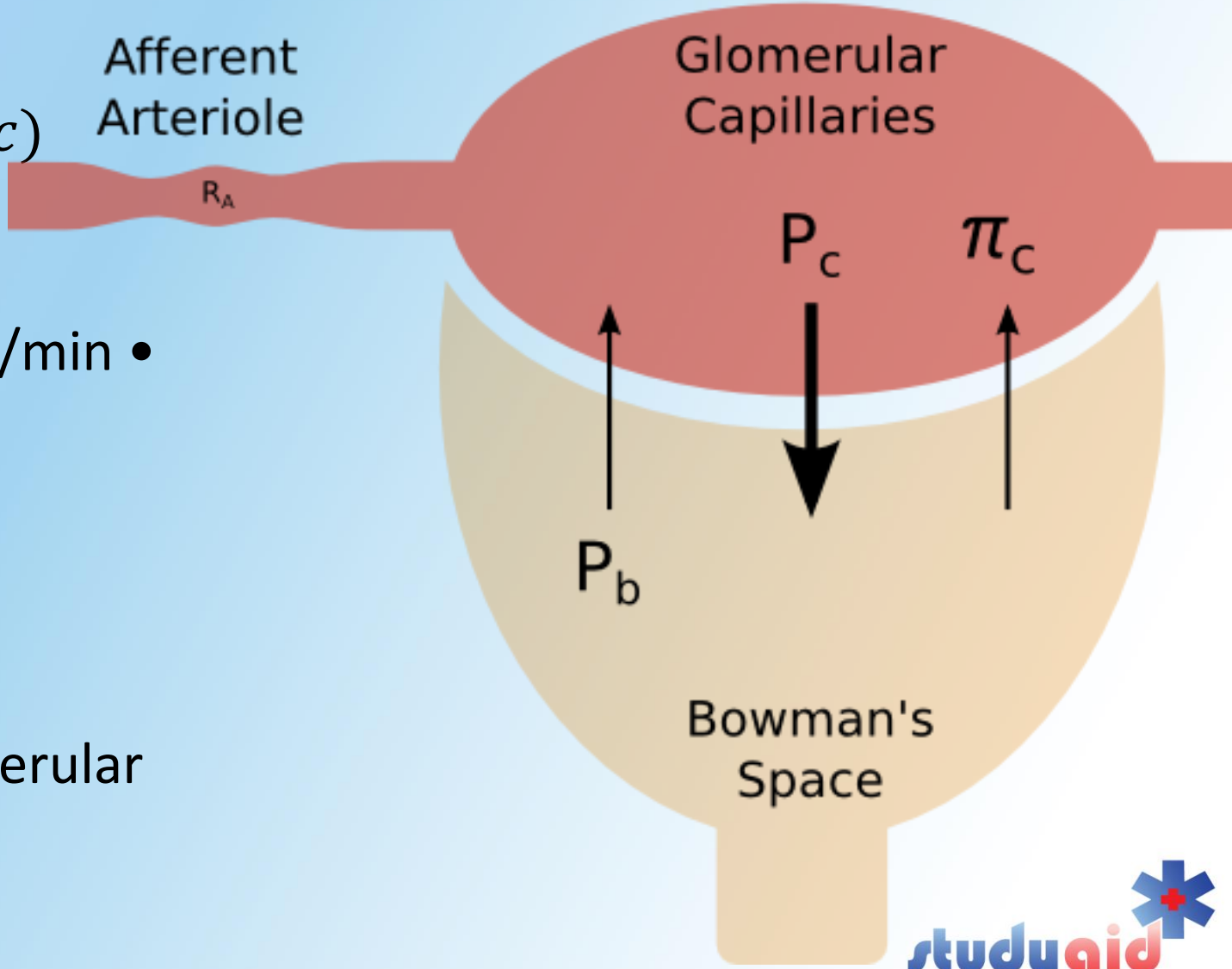
- Small solutes are filtered more than big solutes
- Negatively charged endothelium
- Repels negatively charged solutes, atracts positevely charged solutes

Starling equation



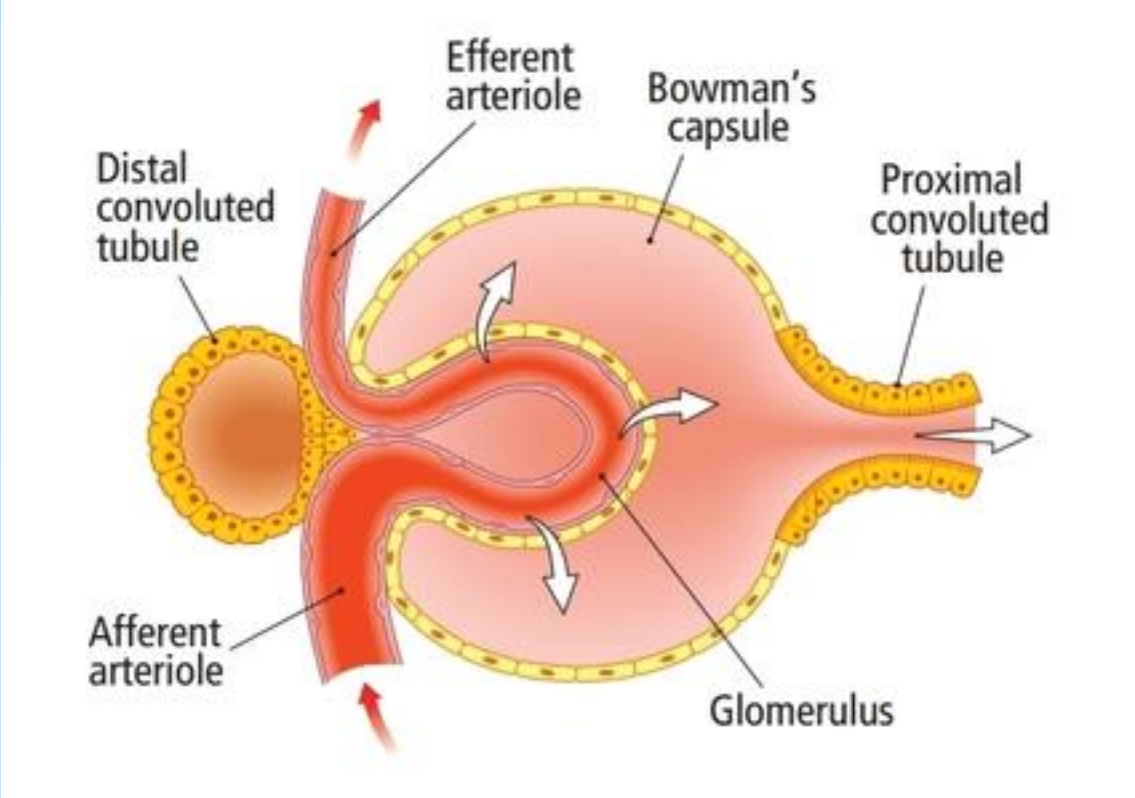
$$GFR = K_f(P_c - P_b) - \pi_c$$

- $GFR = Kf[(Pgc - Pbs) - \pi gc)$
- GFR = Glomerular filtration rate (mL/min)
- Kf = Hydraulic conductance (mL/min • mm Hg)
- PGC = Hydrostatic pressure in glomerular capillary (mm Hg)
- PBS = Hydrostatic pressure in Bowman's space (mm Hg)
- πGC = Oncotic pressure in glomerular capillary (mm Hg)



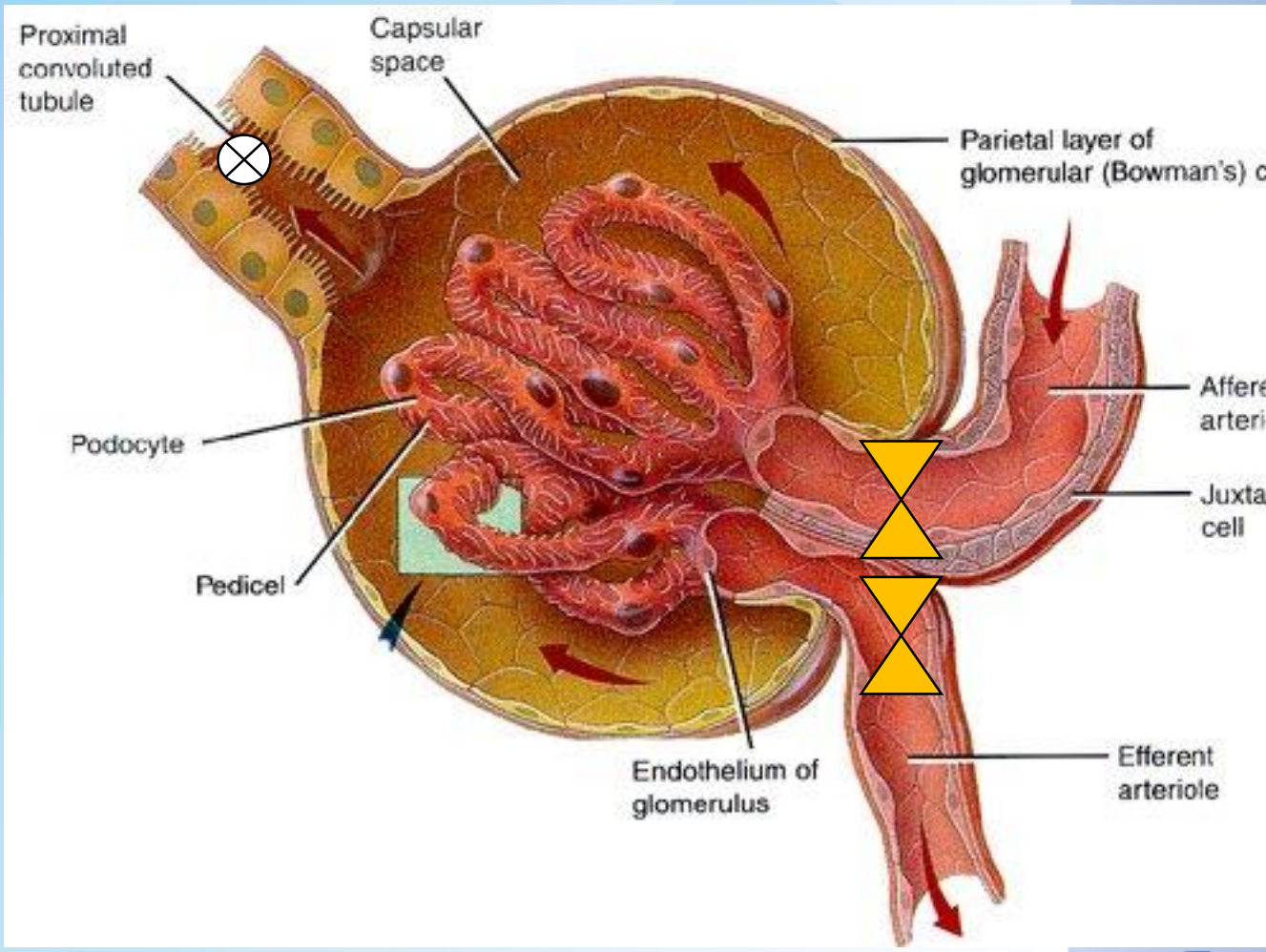
Starling equation

- Filtration decreases at the end of the glomerular capilaries
- Oncotic pressure ⬆
- filtration equilibrium



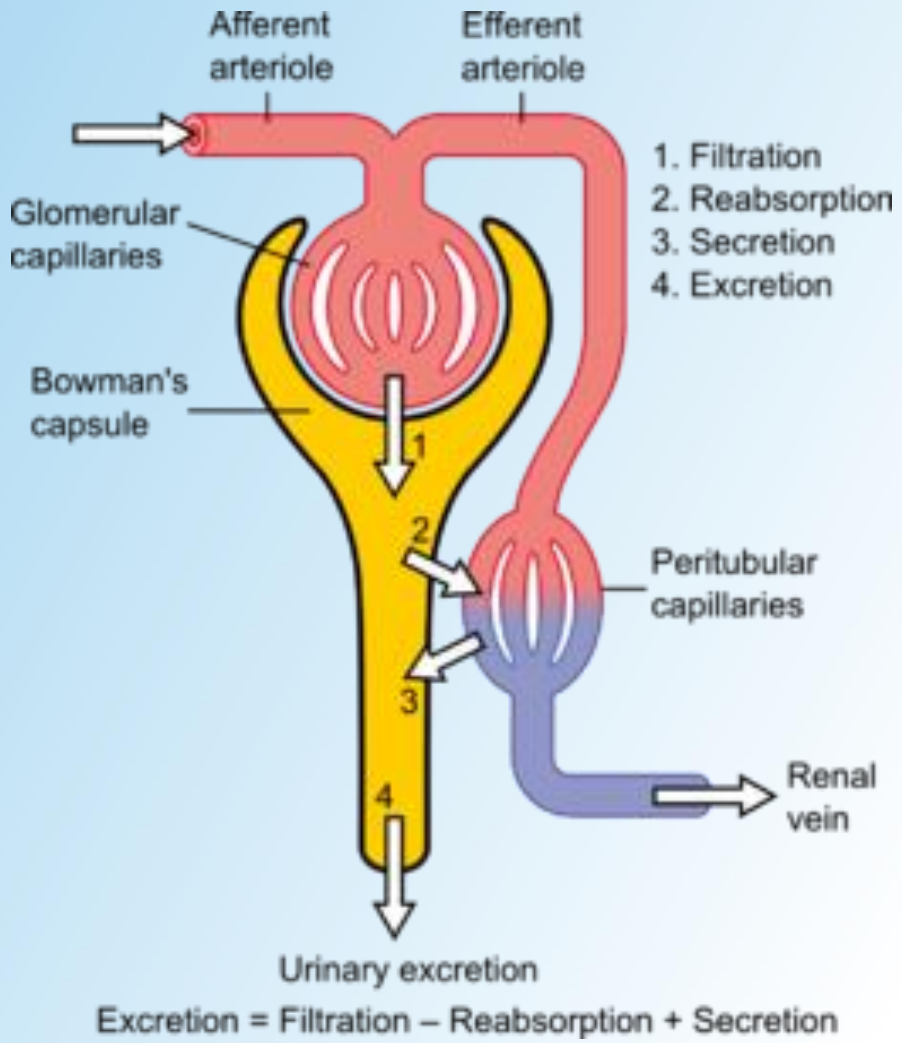
Changes in GFR

Effect	RPF	GFR
Constriction of afferent arteriole	↓	↓
Constriction of efferent arteriole	↓	↑
Increased plasma protein concentration	N.C.	↓
Decreased plasma protein concentration	N.C.	↑
Constriction of the ureter	N.C.	↓



Measuring GFR

- Measured with a substance that:
  - 1) freely filtered
  - 2) neither secreted nor reabsoarbed
  - 3) dosent alter the GFR
- Inulin
- Creatinine
- Blood urea nitrogen (BUN)

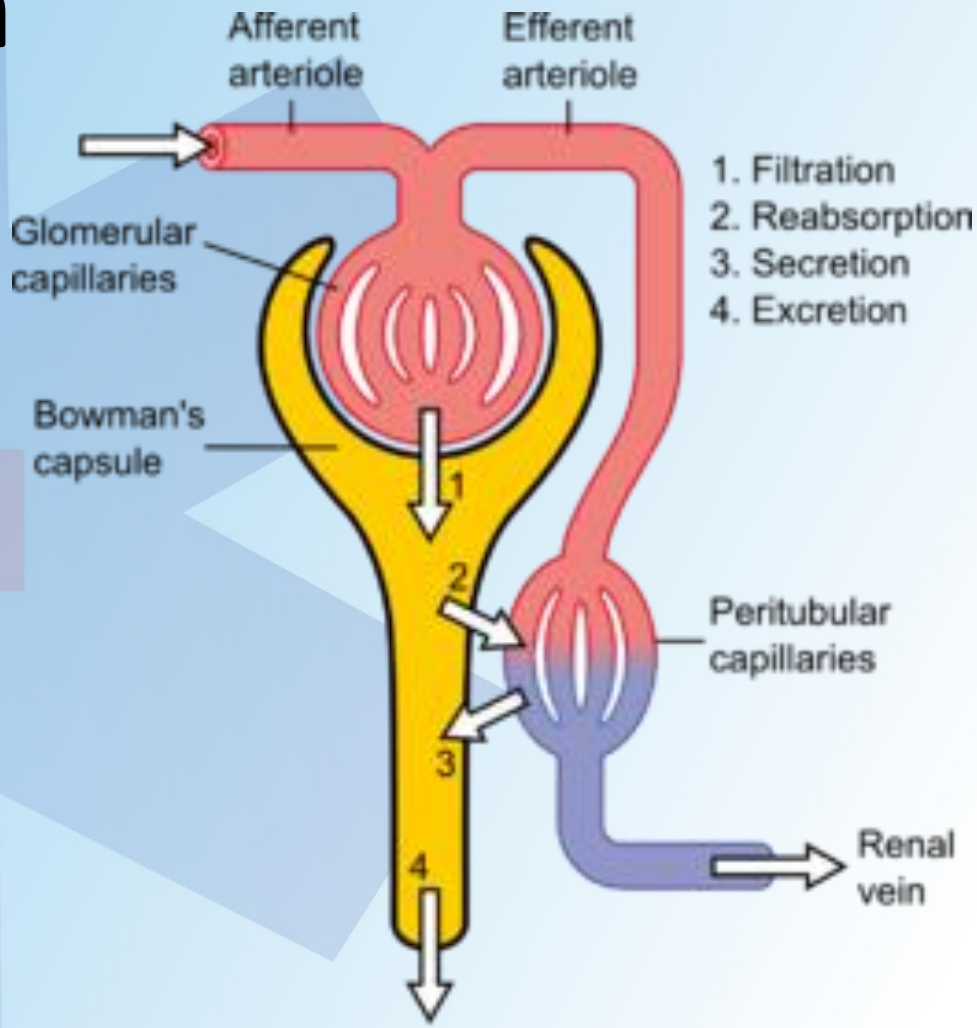


Filtration fraction

- How much of the blood is filtered
- Usually at around 20%

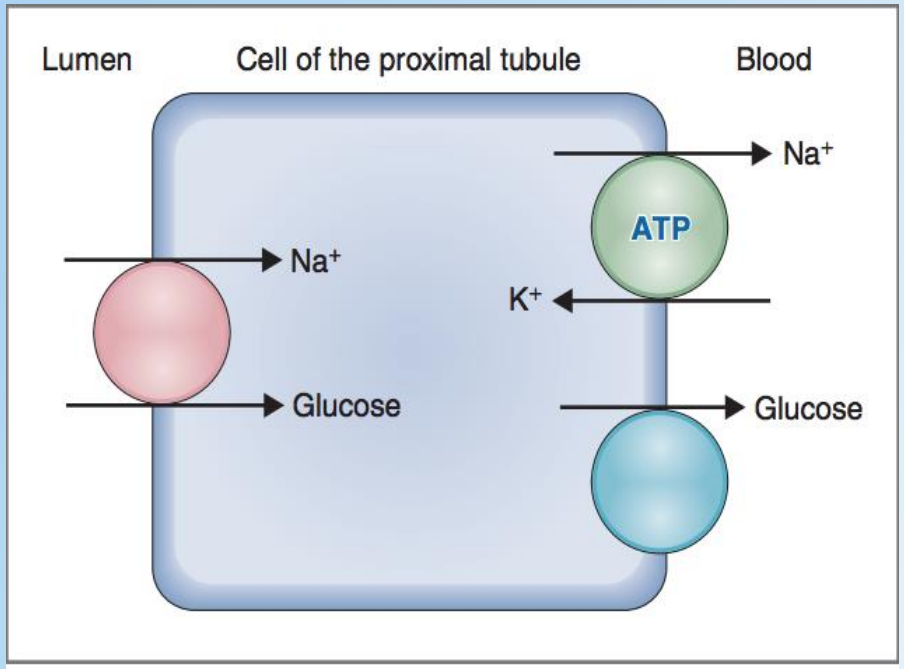
Reabsorption and secretion

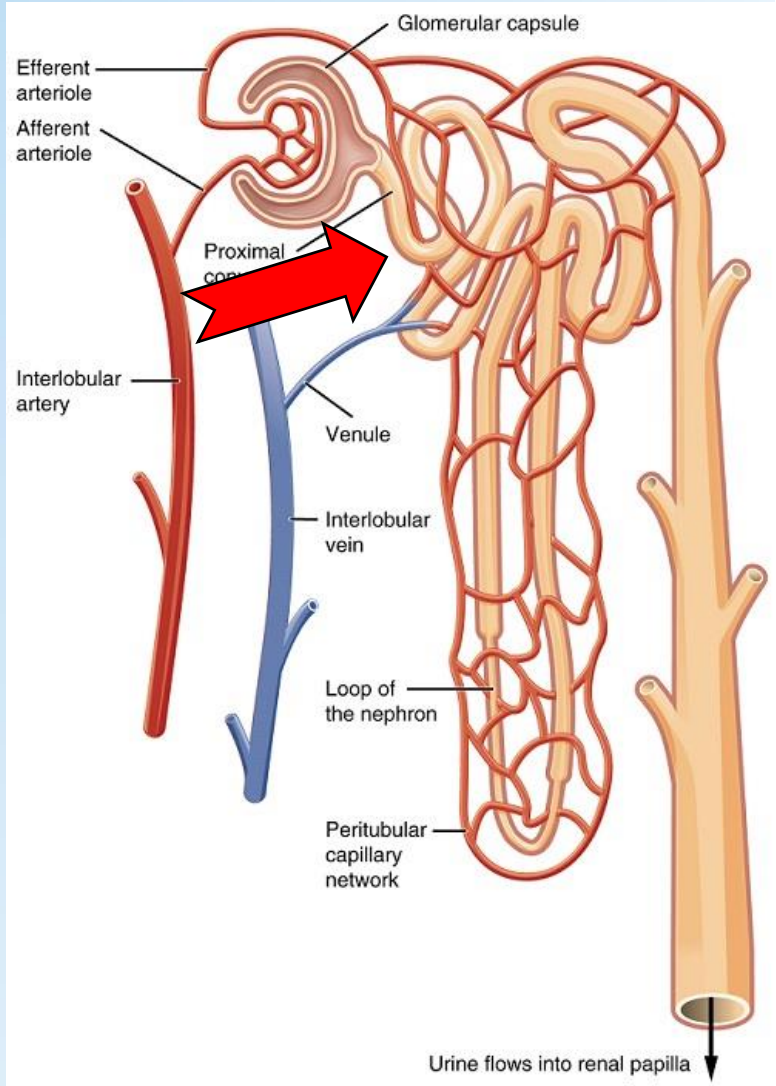
- Filtration
- Reabsorption
- Secretion
- Excretion



Glucose reabsorption

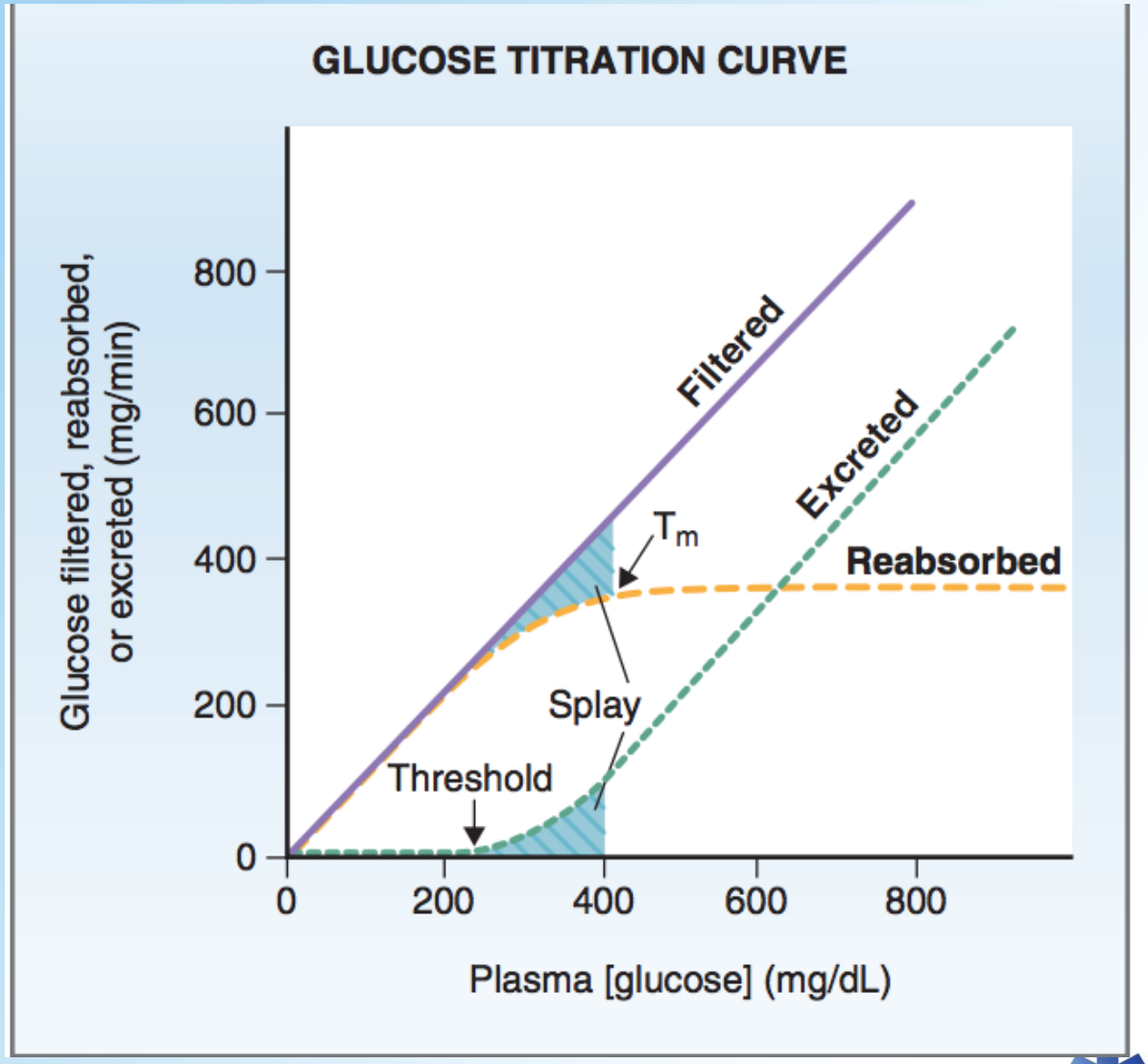
- Na^2-Glucose transporter (SGLT)
- secondary active transport
- facilitated diffusion
- GLUT 1 and GLUT 2





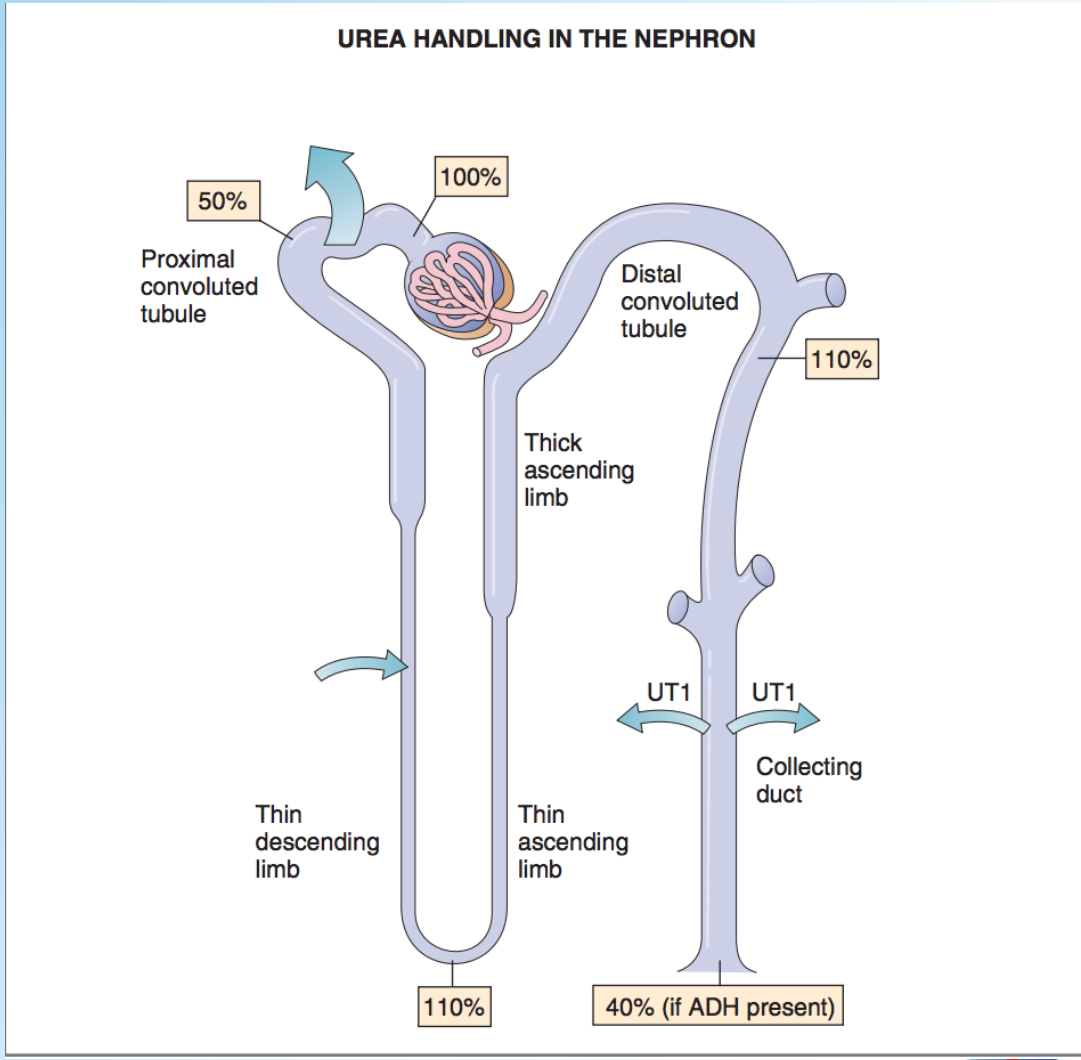
Glucose titration curve

- More glucose in blood = More glucose is fltered
- Threshold at 200mg/dL
- Splay
- Fully saturated at 350mg/dL
- Glucosuria



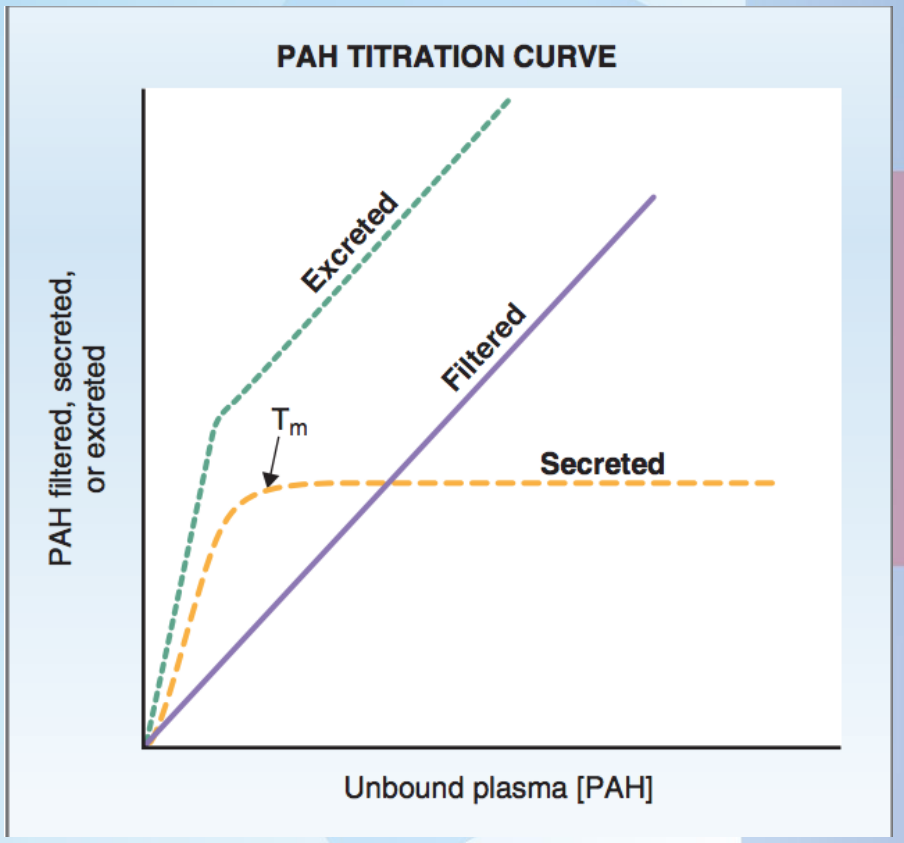
Urea reabsorption/secretion

- Secreted passively by facilitaded and simple diffusion



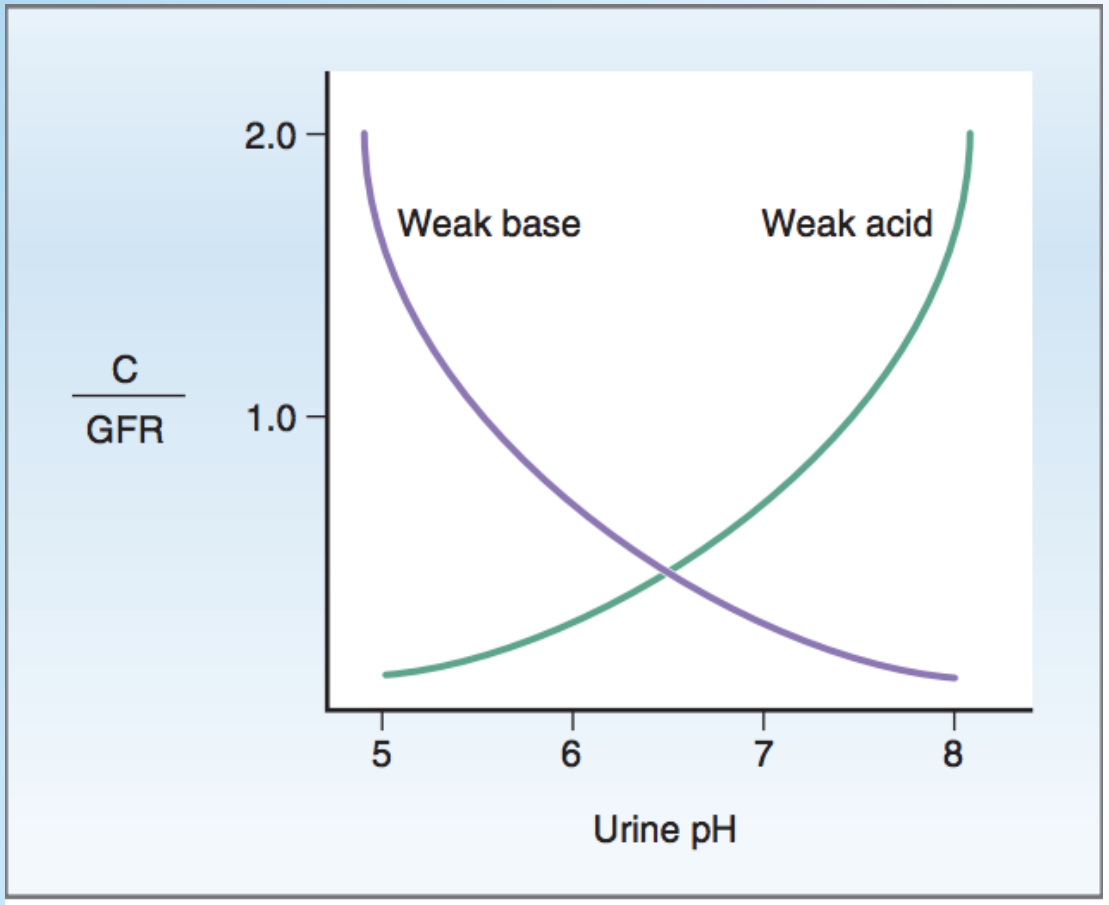
Para-Aminohippuric Acid Secretion

- Secretes also penicillin
- Inhibited by probenecid



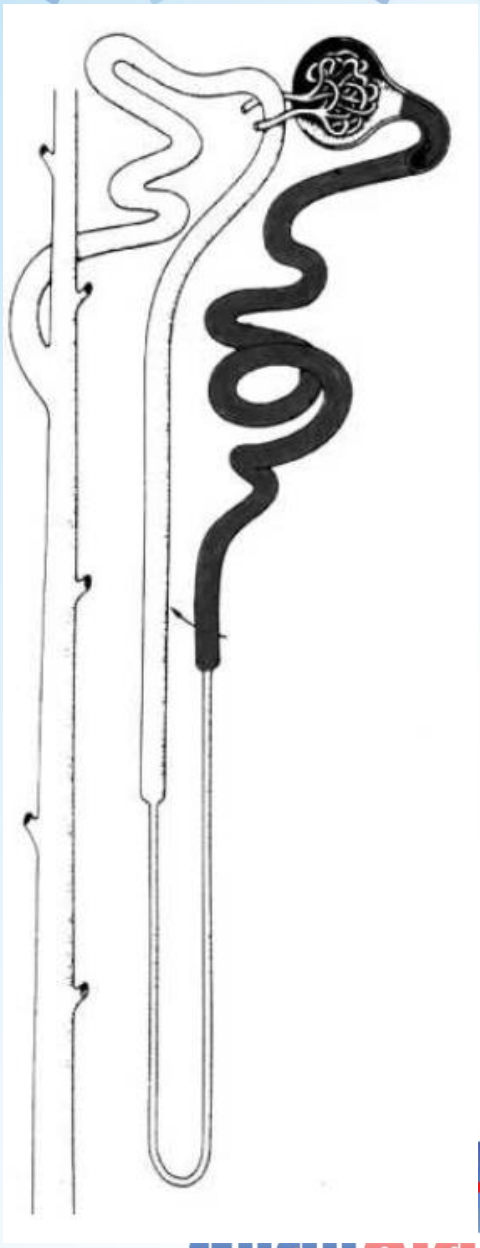
Weak Acids and Bases—Non-Ionic Diffusion

- Weak acid exists in two forms
  - HA (Uncharged, low ph)
  - A^- (Charged, high ph)
- Weak bases exists in two forms
  - B (Unharged, high ph)
  - BH^+ (Charged, low ph)
- Uncharged acids and bases are secreted and reabsorbed freely



Proximal tubule

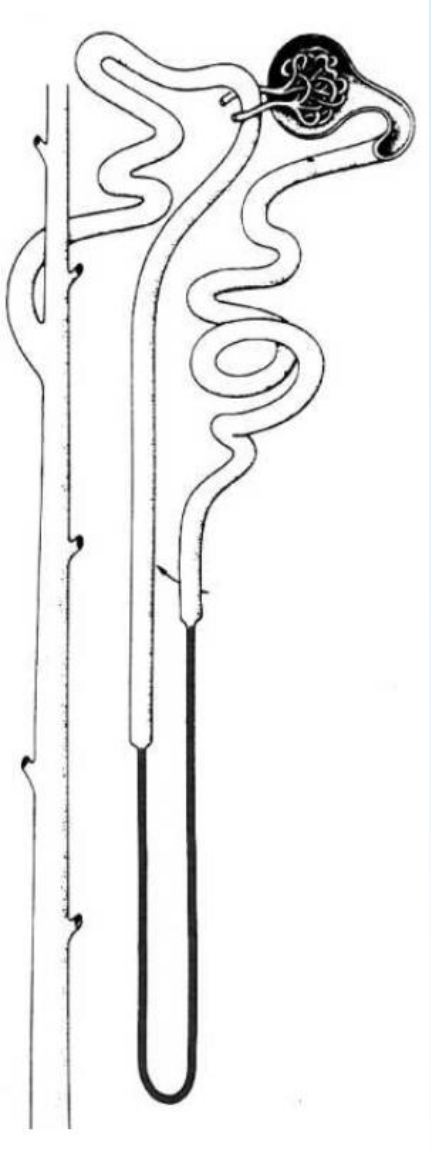
- Resorption of water (70-80%)
- Resorption of ions (Na^+, Cl^-), glucose, amino acids
  - Membrane transporters
- Resorption of some metabolites and drugs
- Secretion of ammonia, urea, exogenous compounds



Thin limb

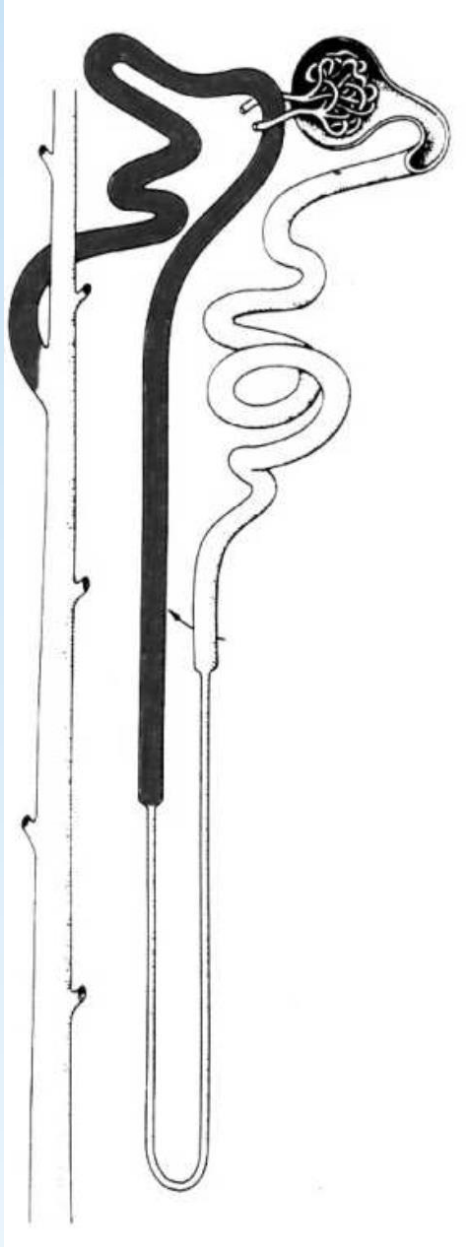
- Resorption of water

  The resorption of water makes urine more concentrated



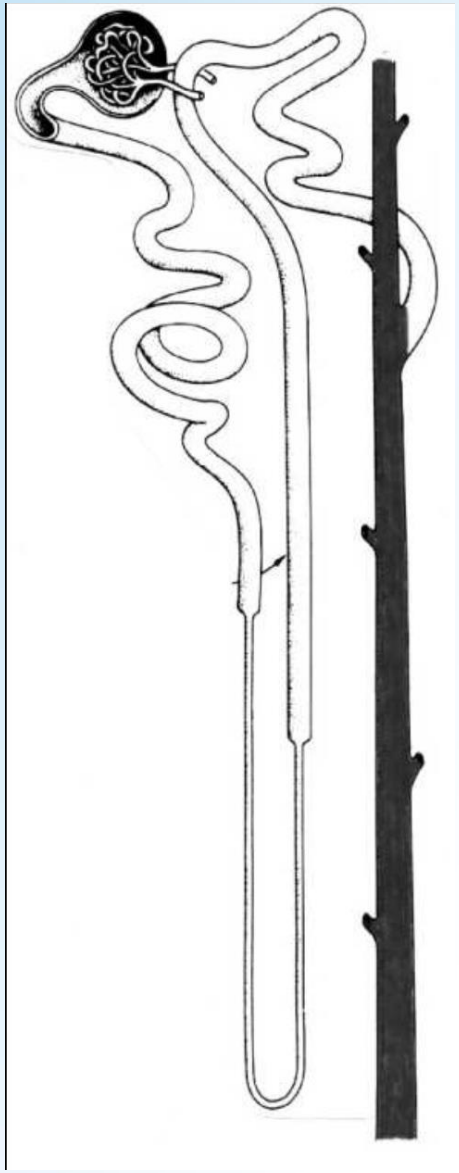
Distal tubule

- Resorption of Na^+, Cl^-
  - Controlled by aldosterone
- Secretion of K^+, H^+
  - Acidifies urine
- Resorption of water



Collecting tubule

- Several nephrons empty into one collecting tubule
- Resorption of water
  - Membrane channels (*aquaporins*), mediated by ADH

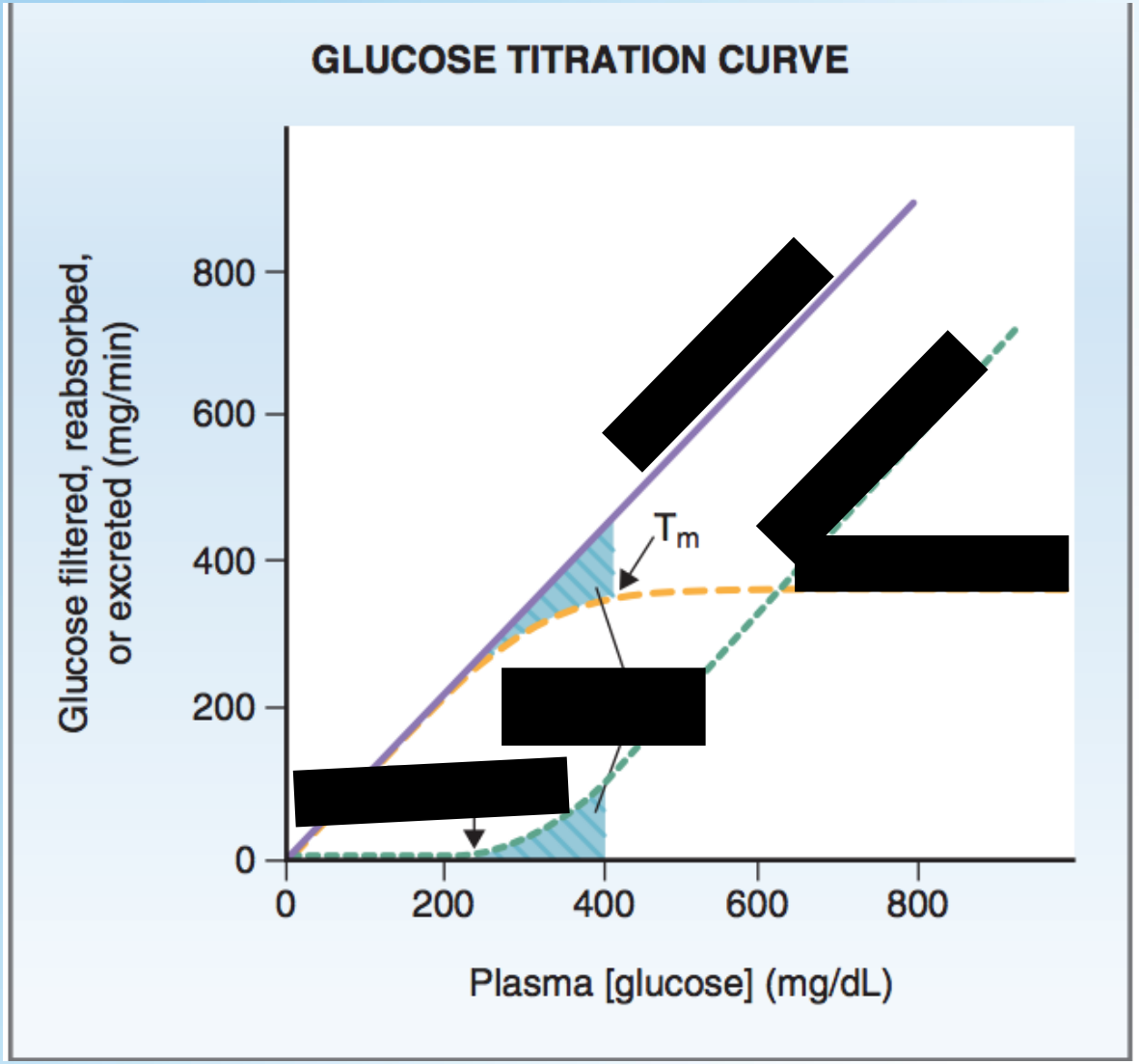


All statements are true except

- A) Capillaries in the bowman capsule have pores 70-100mm
- B) The basement membrane in the bowman capsule contains three layers
- C) The endothelium of the capillaries is positivelly charged
- D) The podocytes have foot procceses

Filtration equilibrium is reached by what mechanism?

- A) Increased oncotic pressure in the capillaries in the nephron
- B) decreased hydrostatic pressure in the cappilaries in the nephron
- C) increased oncotic pressure in the bowman space
- D) increased hydrostatic pressure in the bowman space


GLUCOSE TITRATION CURVE
Glucose filtered, reabsorbed, or excreted (mg/min)
800
600
400
200
0
T_m
0
200
400
600
800
Plasma [glucose] (mg/dL)