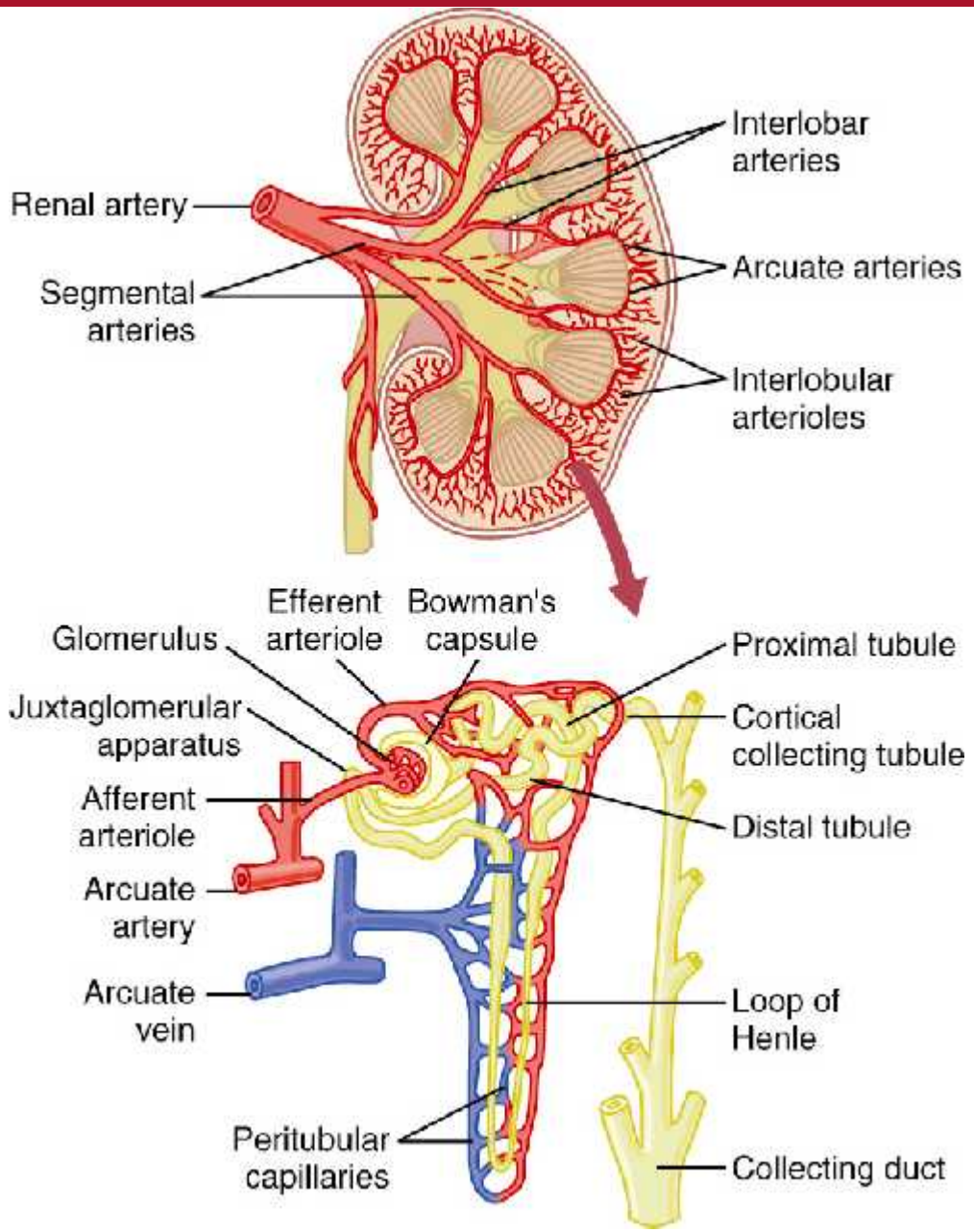


Nephron: functional unit of the kidney

Figure 26-3;
Guyton and Hall

Nephron Tubular Segments

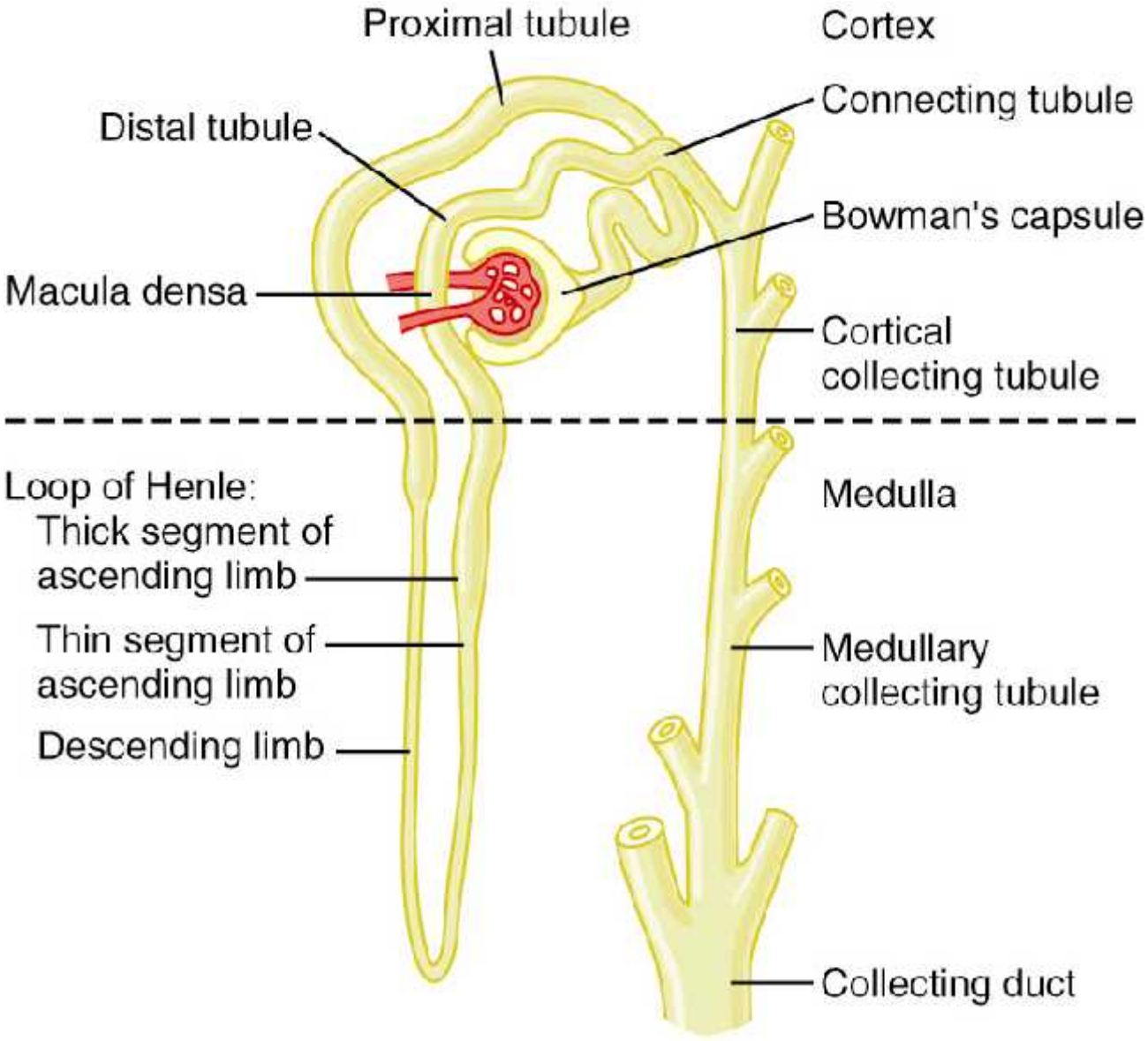
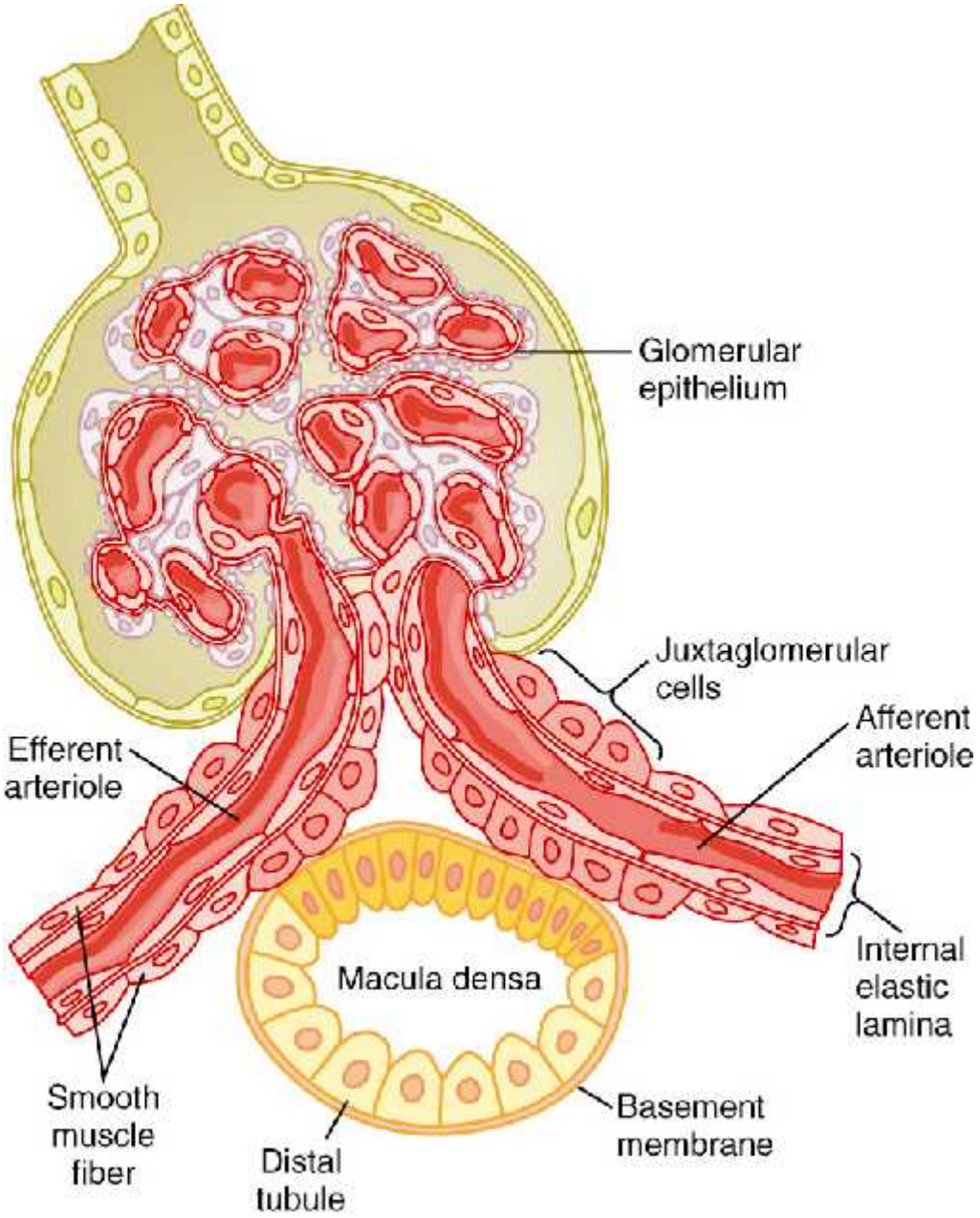


Figure 26-4;
Guyton and Hall



Structure of the juxtaglomerular apparatus: macula densa

Figure 26-17;
Guyton and Hall

Cortical and Juxtamedullary Nephron Segments

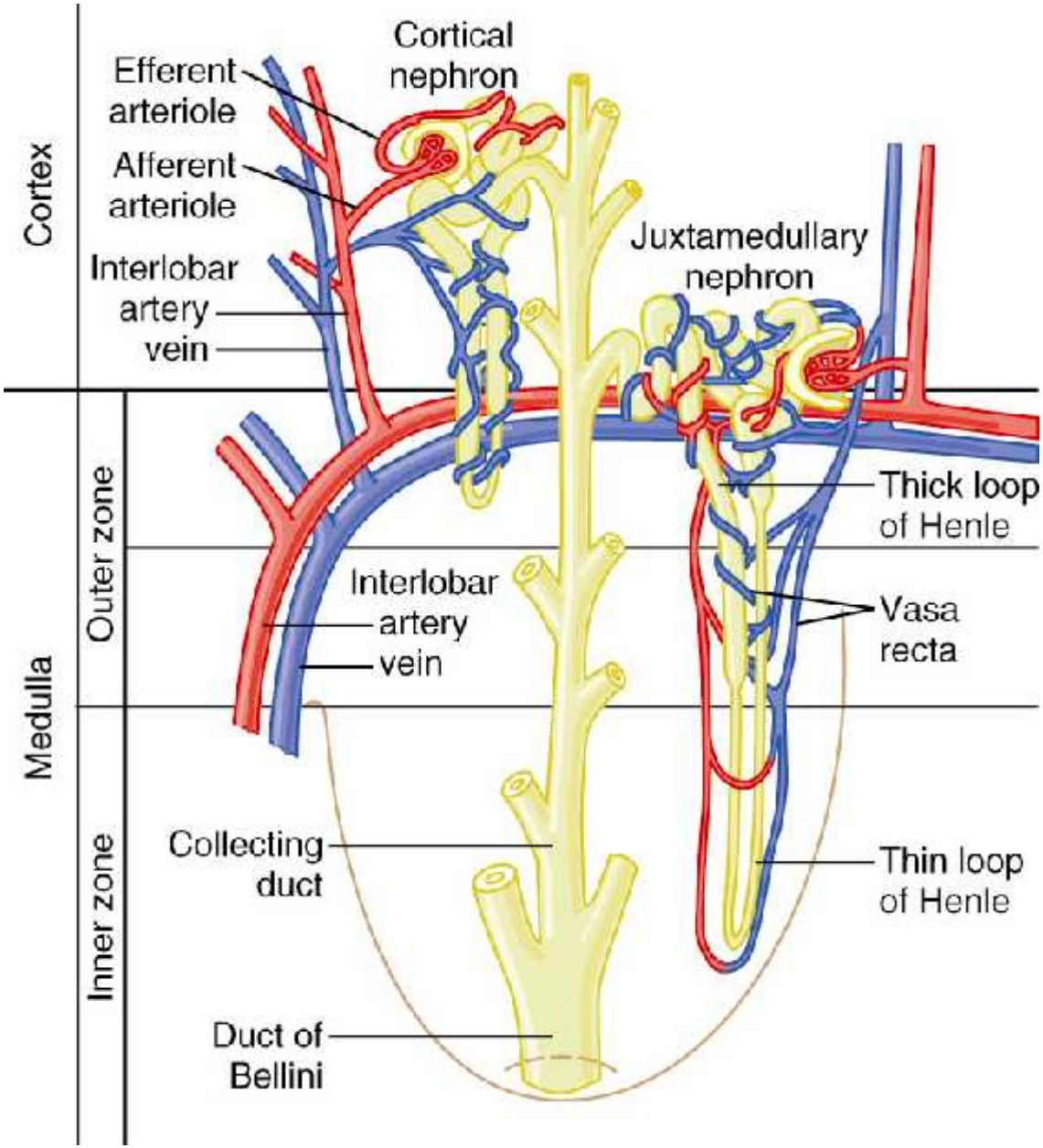


Figure 26-5;
Guyton and Hall

Summary of Kidney Functions

- Excretion of metabolic waste products: urea, creatinine, bilirubin, hydrogen
- Excretion of foreign chemicals: drugs, toxins, pesticides, food additives
- Secretion, metabolism, and excretion of hormones
  - renal erythropoetic factor
  - 1,25 dihydroxycholecalciferol (Vitamin D)
  - Renin
- Regulation of acid-base balance
- Gluconeogenesis: glucose synthesis from amino acids
- Control of arterial pressure
- Regulation of water & electrolyte excretion

Basic Mechanisms of Urine Formation

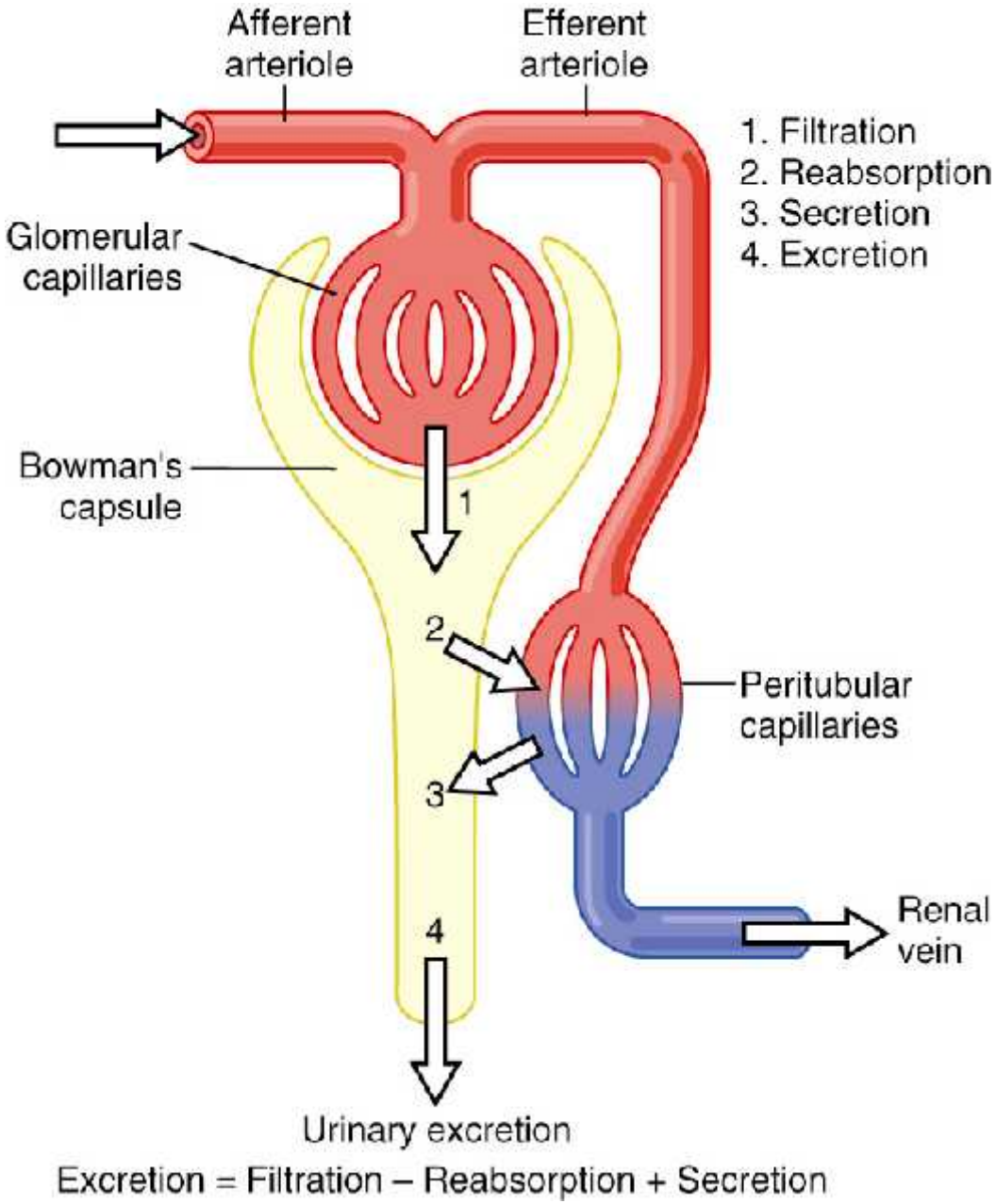
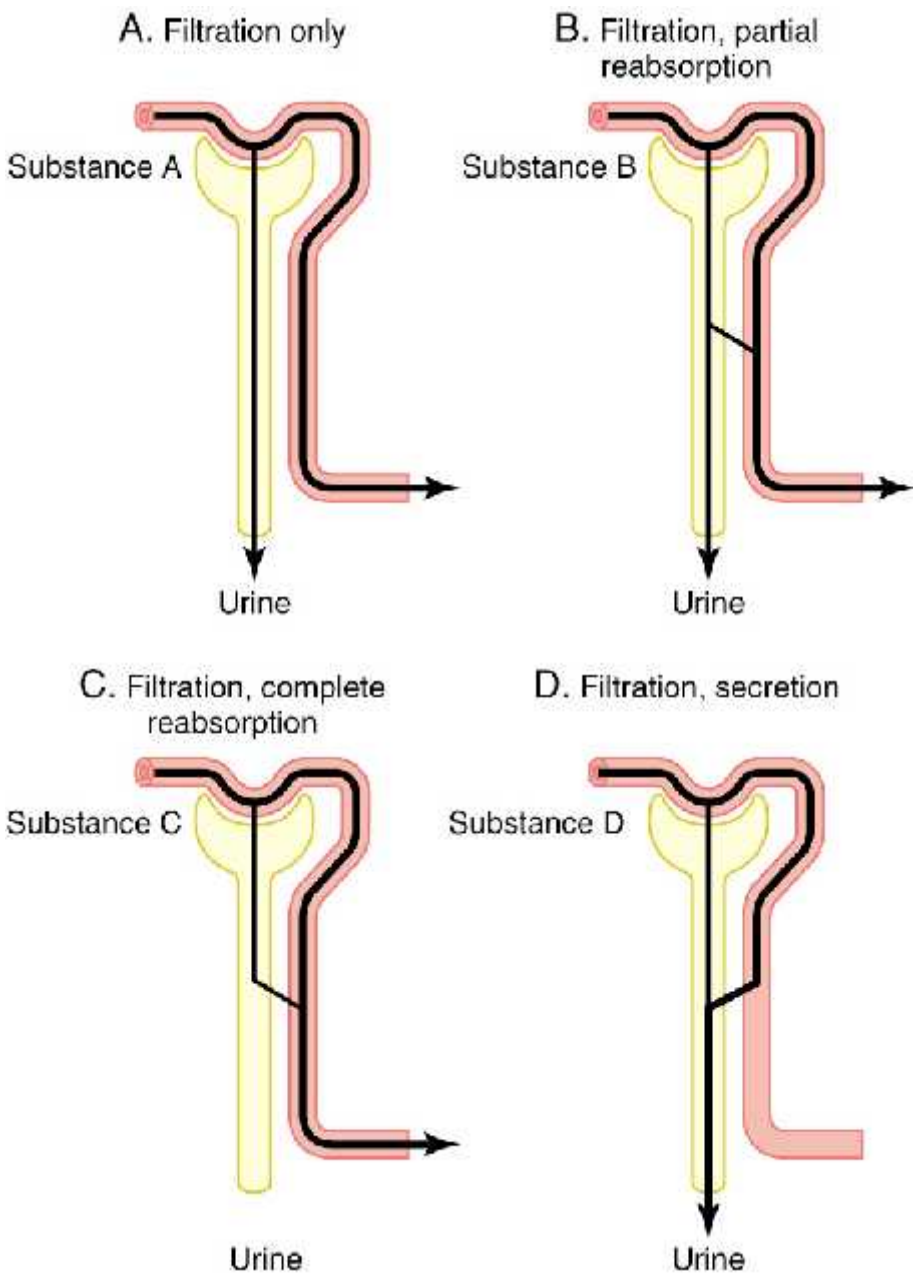
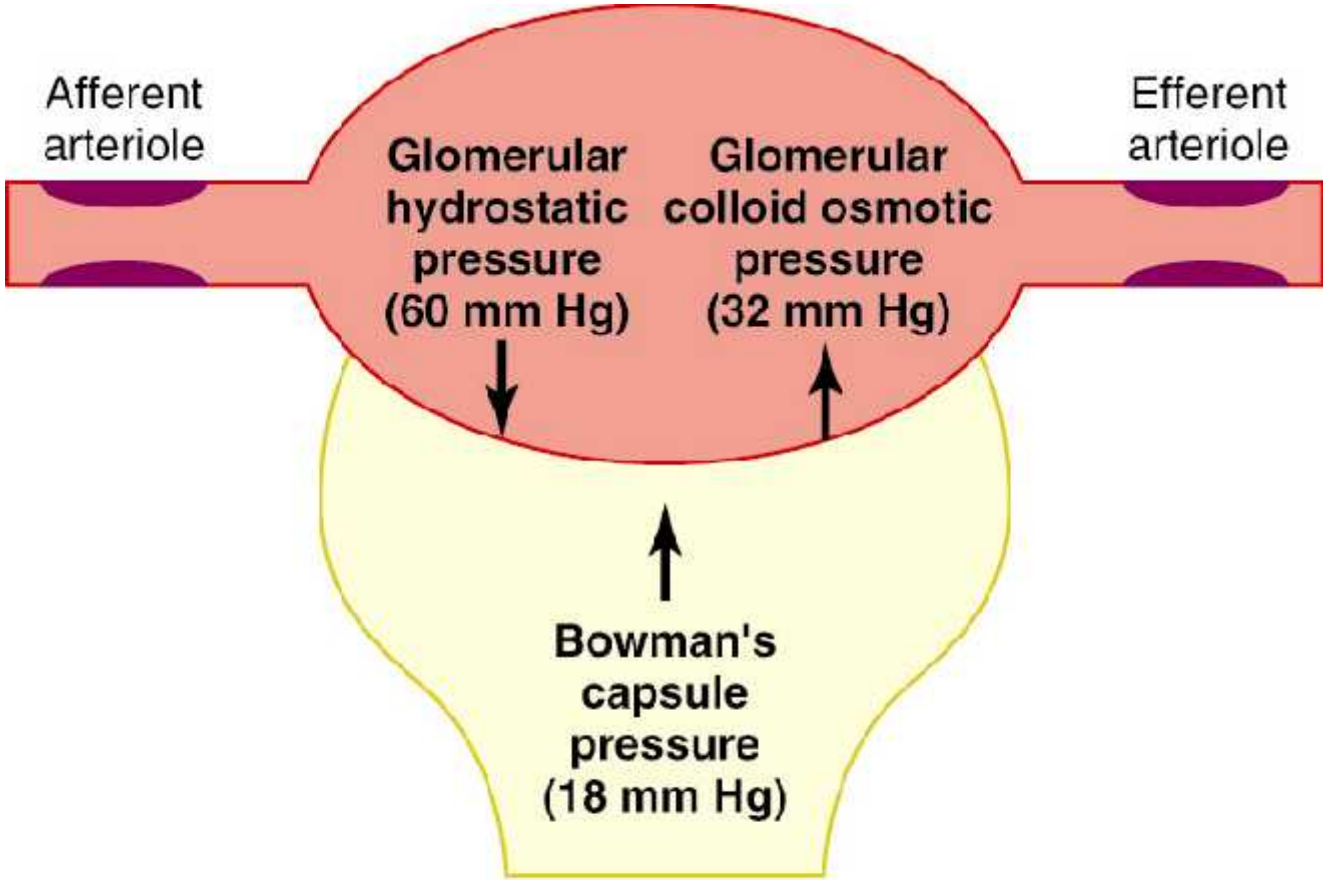


Figure 26-8;
Guyton and Hall



Renal Handling of Different Substances

Figure 26-9;
Guyton and Hall



Net filtration pressure (10 mm Hg) = Glomerular hydrostatic pressure (60 mm Hg) − Bowman's capsule pressure (18 mm Hg) − Glomerular oncotic pressure (32 mm Hg)

Figure 26-12; Guyton and Hall

ASSESSING KIDNEY FUNCTION

- Albumin excretion (microalbuminuria)
- Plasma concentration of waste products
  (e.g. BUN, creatinine)
- Urine specific gravity, urine concentrating ability
- Imaging methods (e.g. MRI, PET, arteriograms,
  iv pyelography, ultrasound etc)
- Isotope renal scans
- Biopsy
- Clearance methods (e.g. 24-hr creatinine clearance)
- etc

Clearance

- **Clearance** is a general concept that describes the rate at which substances are removed (cleared) from the plasma.

Clearance Technique

Renal clearance of a substance is the volume of plasma completely cleared of a substance per min.

$$Cs \times Ps = Us \times V$$

$$\mathbf{Cs} = \frac{Us \times V}{Ps}$$

Where: **Cs** = clearance of substance S

Ps = plasma conc. of substance S

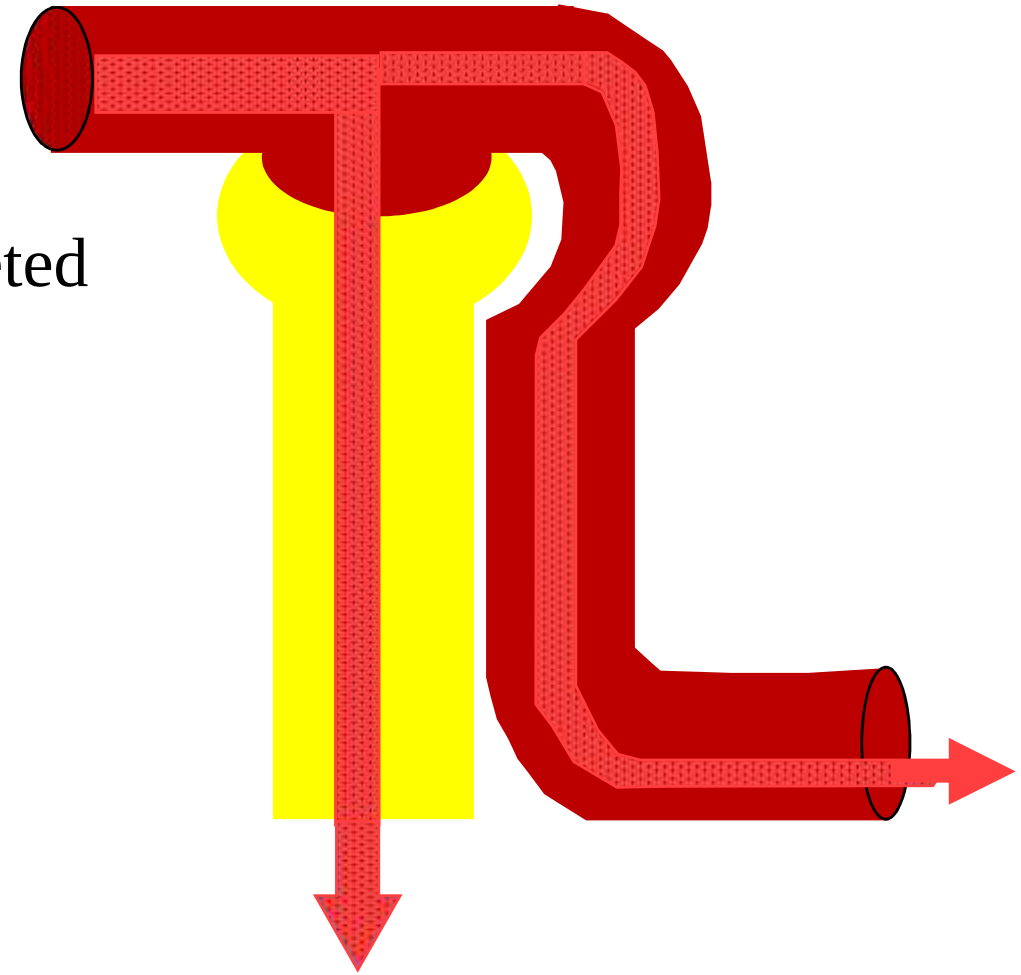
Us = urine conc. of substance S

V = urine flow rate

Use of Clearance to Measure GFR

For a substance that is freely filtered, but not reabsorbed or secreted (inulin, ^{125} I-iothalamate, ~creatinine),

renal clearance = GFR



amount filtered = amount excreted

$$GFR \times P_{in} = U_{in} \times V$$

$$GFR = \frac{U_{in} \times V}{P_{in}}$$

PROPERTIES OF MATERIAL

1- easy to be taken by individual.

2- not digest or metabolize by the body

3 - it is completely filtered at the glomerulus

4--neither secreted nor reabsorbed by the tubules

5 - not naturally present in the body (because the amount infused will be known)

Calculate the GFR from the following data:

P_{inulin} = 1.0 mg / 100ml
U_{inulin} = 125 mg/100 ml
Urine flow rate = 1.0 ml/min

$$GFR = C_{inulin} = \frac{U_{in} \times V}{P_{in}}$$

$$GFR = \frac{125 \times 1.0}{1.0} = 125 \text{ ml/min}$$

CLEARANCES OF DIFFERENT SUBSTANCES

Substance	Clearance (ml/min)
inulin	125
glucose	0
sodium	0.9
urea	70

Clearance of inulin (C_{in}) = GFR

if Cx < Cin: indicates reabsorption of x

if Cx > Cin: indicates secretion of x