Excretion and osmoregulation

Excretory products and their elimination

Lecture 5

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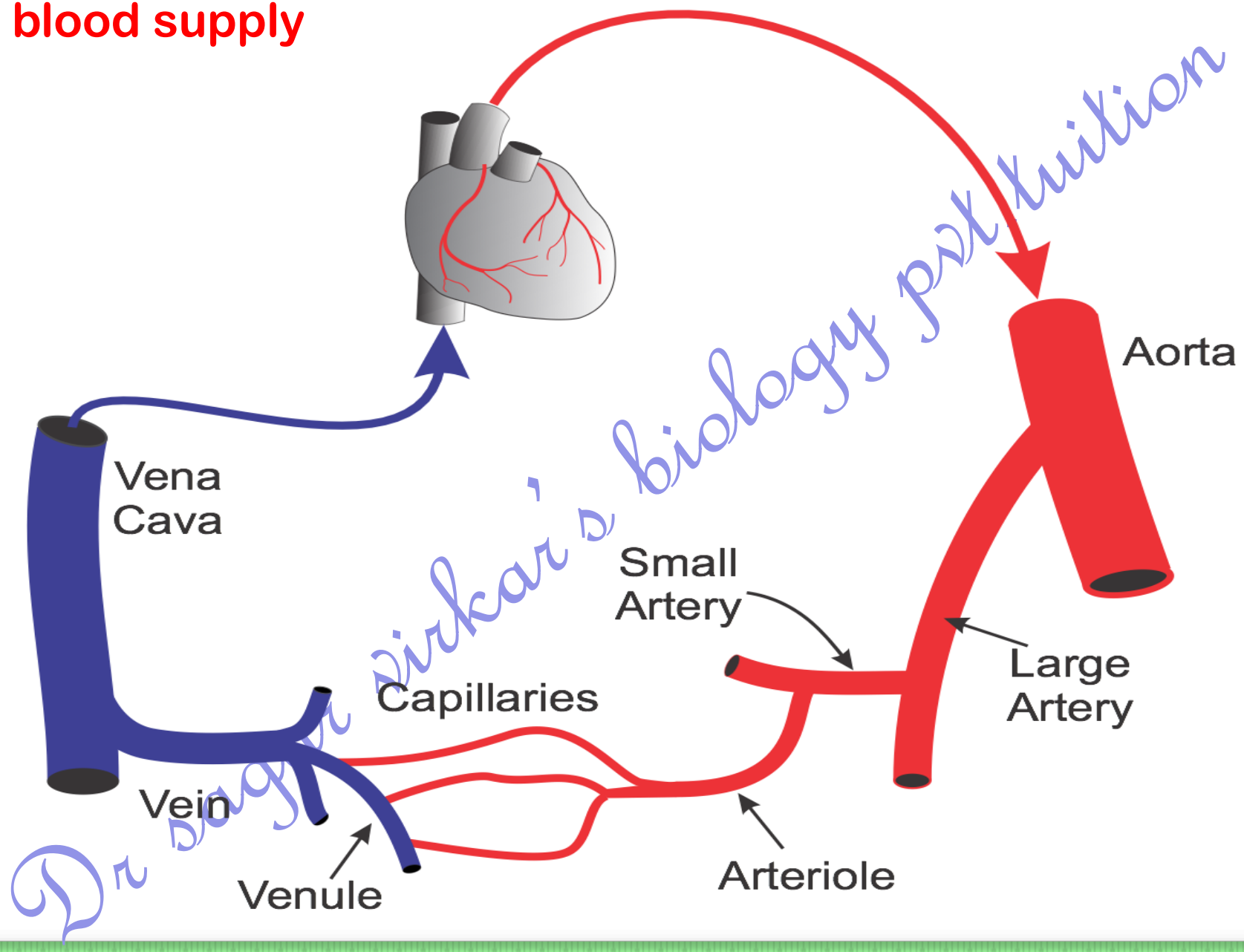
blood supply



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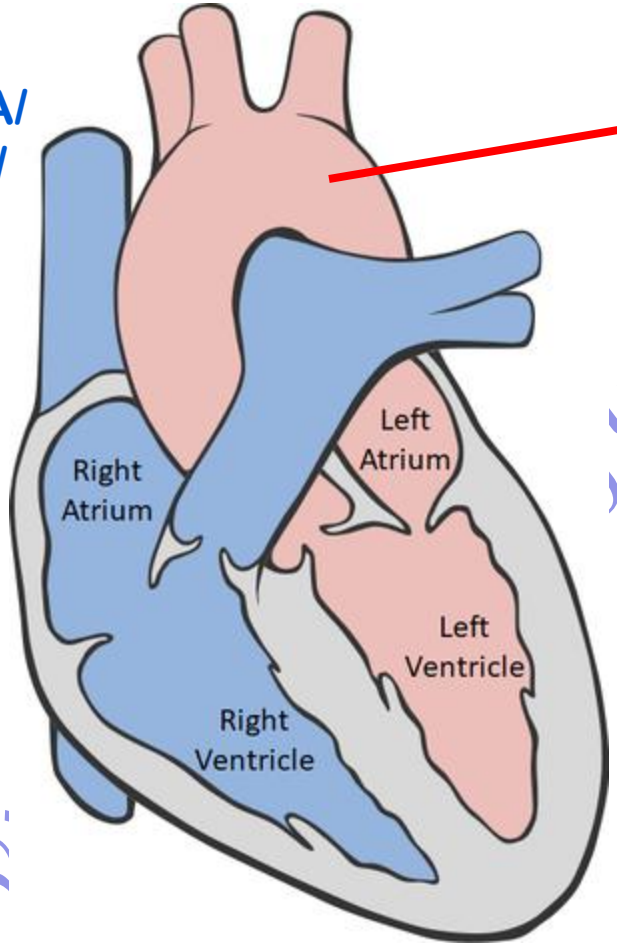
SUPERIOR VENA CAVA/
INFERIOR VENA CAVA/
CORONARY SULCUS



AORTA

ARTERY

ARTERIOLE

CAPILLARY

cells

CAPILLARY

VEINULE

VEIN

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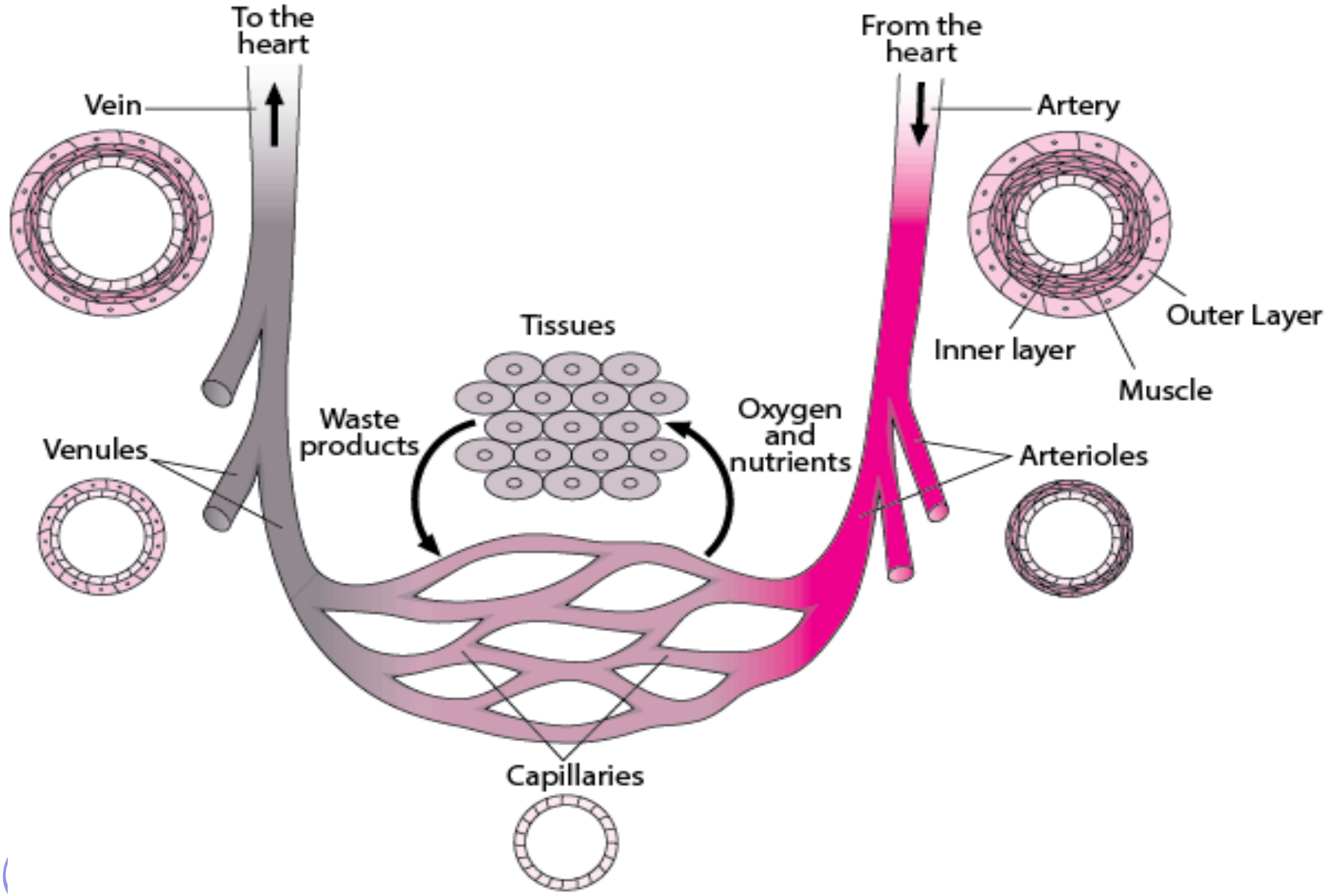
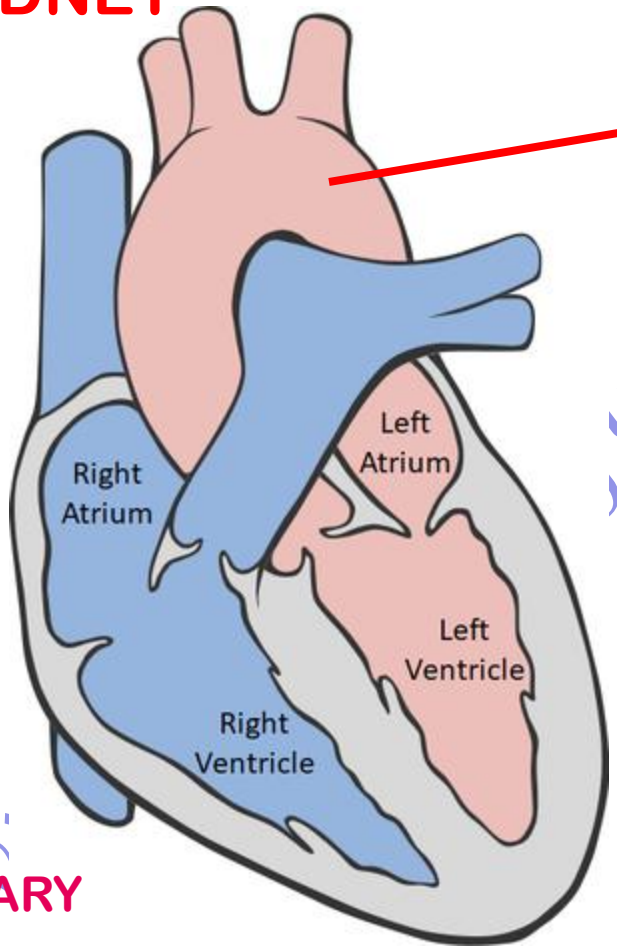

To the heart
From the heart
Vein
Artery
Outer Layer
Inner layer
Muscle
Tissues
Waste products
Oxygen and nutrients
Venules
Arterioles
Capillaries

blood supply TO KIDNEY



AORTA

RENAL ARTERY

AFFERENT ARTERIOLE

CAPILLARY

cells

CAPILLARY

EFFERENT ARTERIOLE

PERITUBULAR CAPILLARY

VEINULE

VEIN

INFERIOR VENA CAVA

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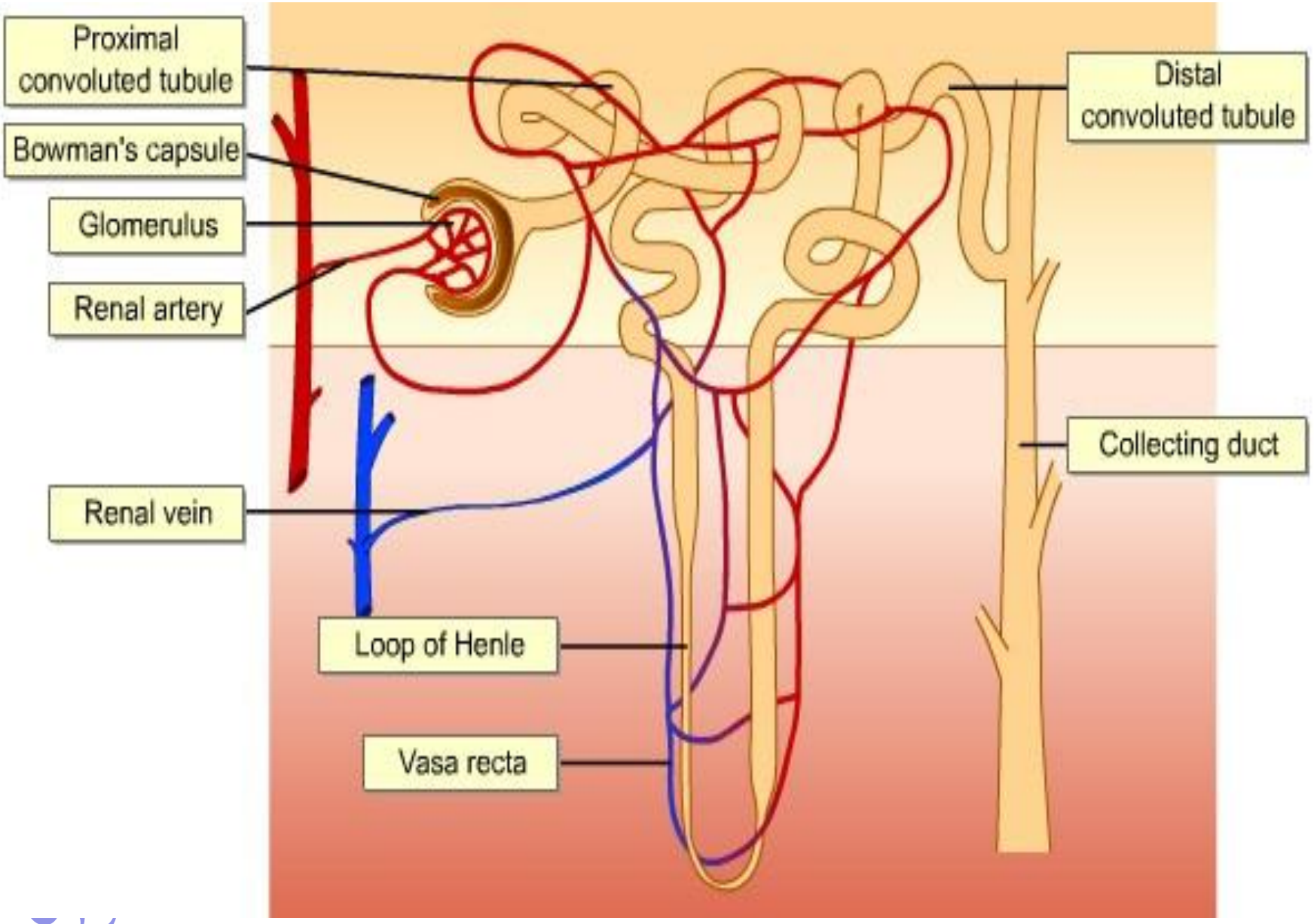
Proximal convoluted tubule
Bowman's capsule
Glomerulus
Renal artery
Renal vein
Loop of Henle
Vasa recta
Distal convoluted tubule
Collecting duct

Glomerulus :

Glomerulus is a bunch of fine blood capillaries lying in the cup of Bowman's capsule. A small terminal branch of renal artery called as afferent arteriole enters the cup cavity and undergoes extensive fine branching to form network of several capillaries. This bunch is called as glomerulus. Capillary wall is fenestrated. All capillaries reunite and form an efferent arteriole that leaves the cup cavity. Diameter of afferent is greater than efferent arteriole to create a high hydrostatic pressure in glomerulus. It is important for ultrafiltration

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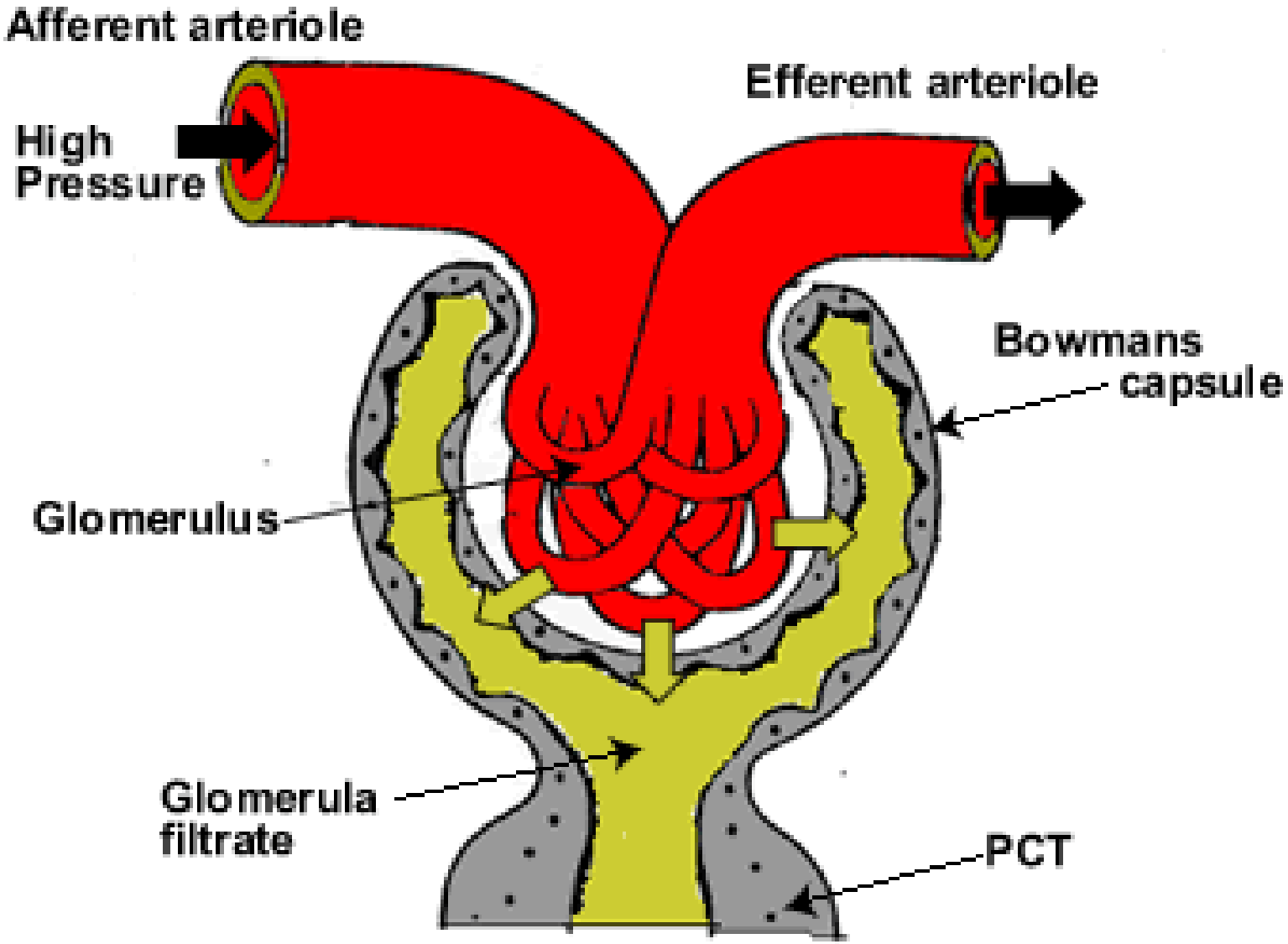
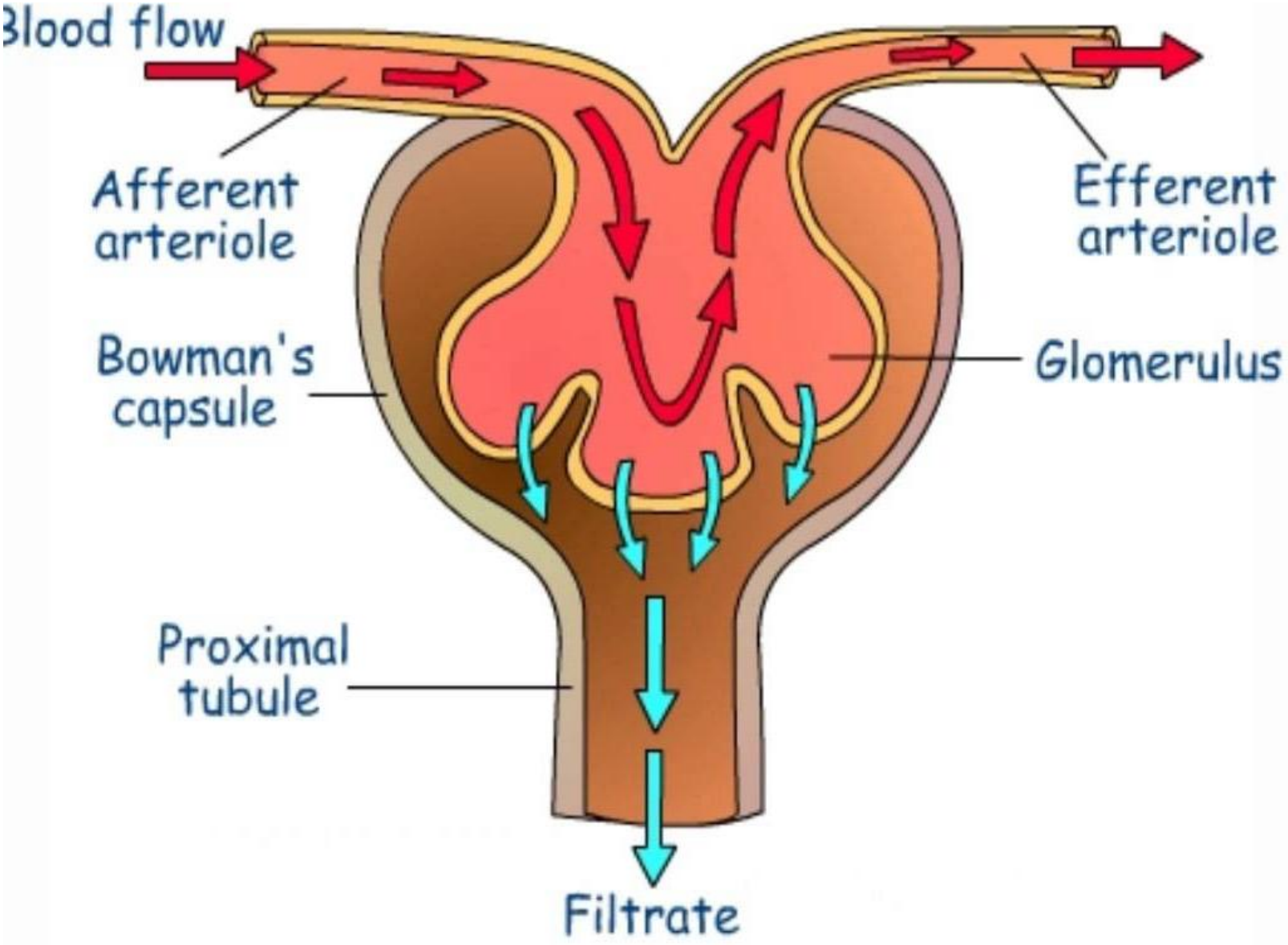
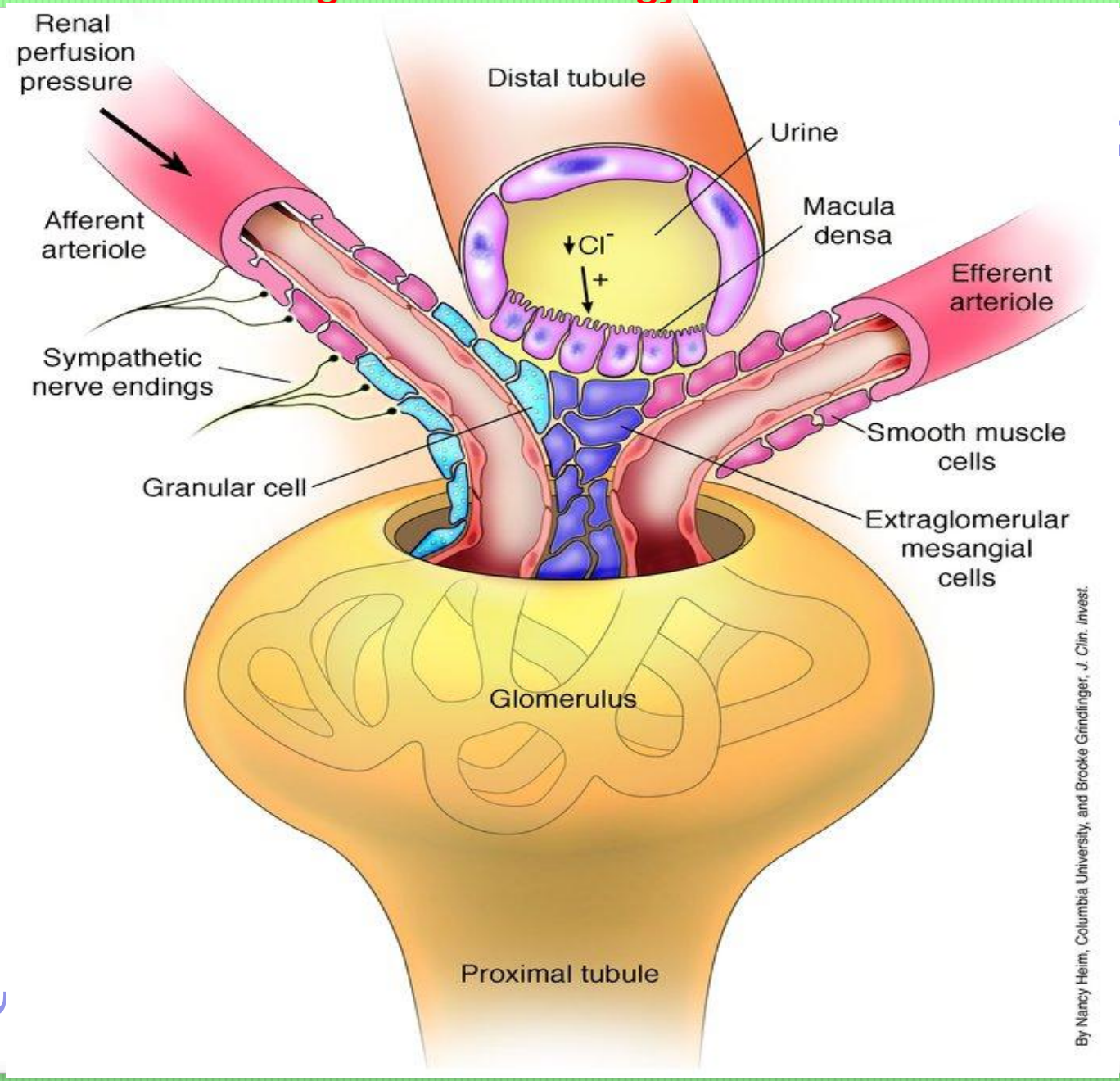
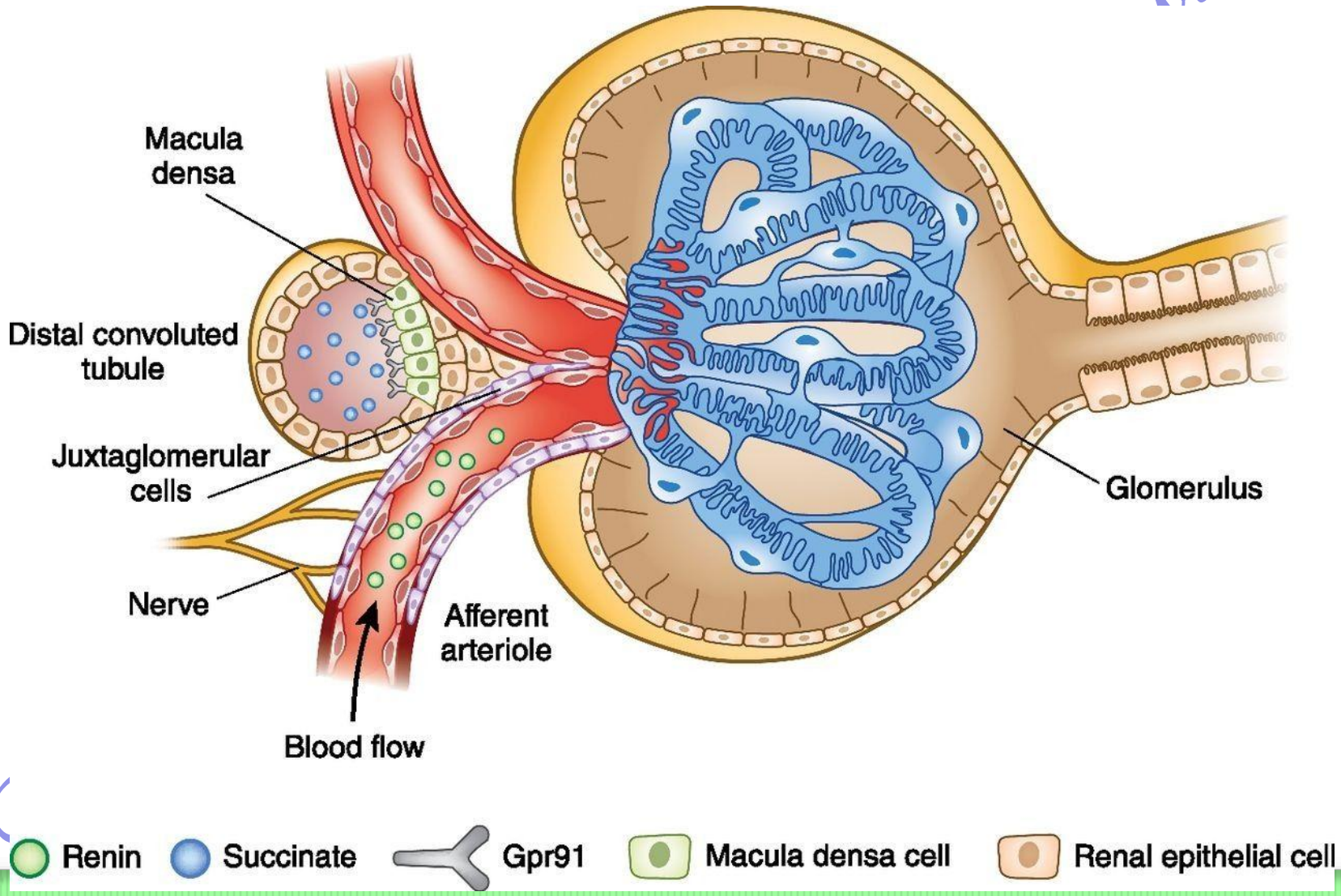

Afferent arteriole
Efferent arteriole
High Pressure
Bowmans capsule
Glomerulus
Glomerula filtrate
PCT


Blood flow
Afferent arteriole
Efferent arteriole
Bowman's capsule
Glomerulus
Proximal tubule
Filtrate

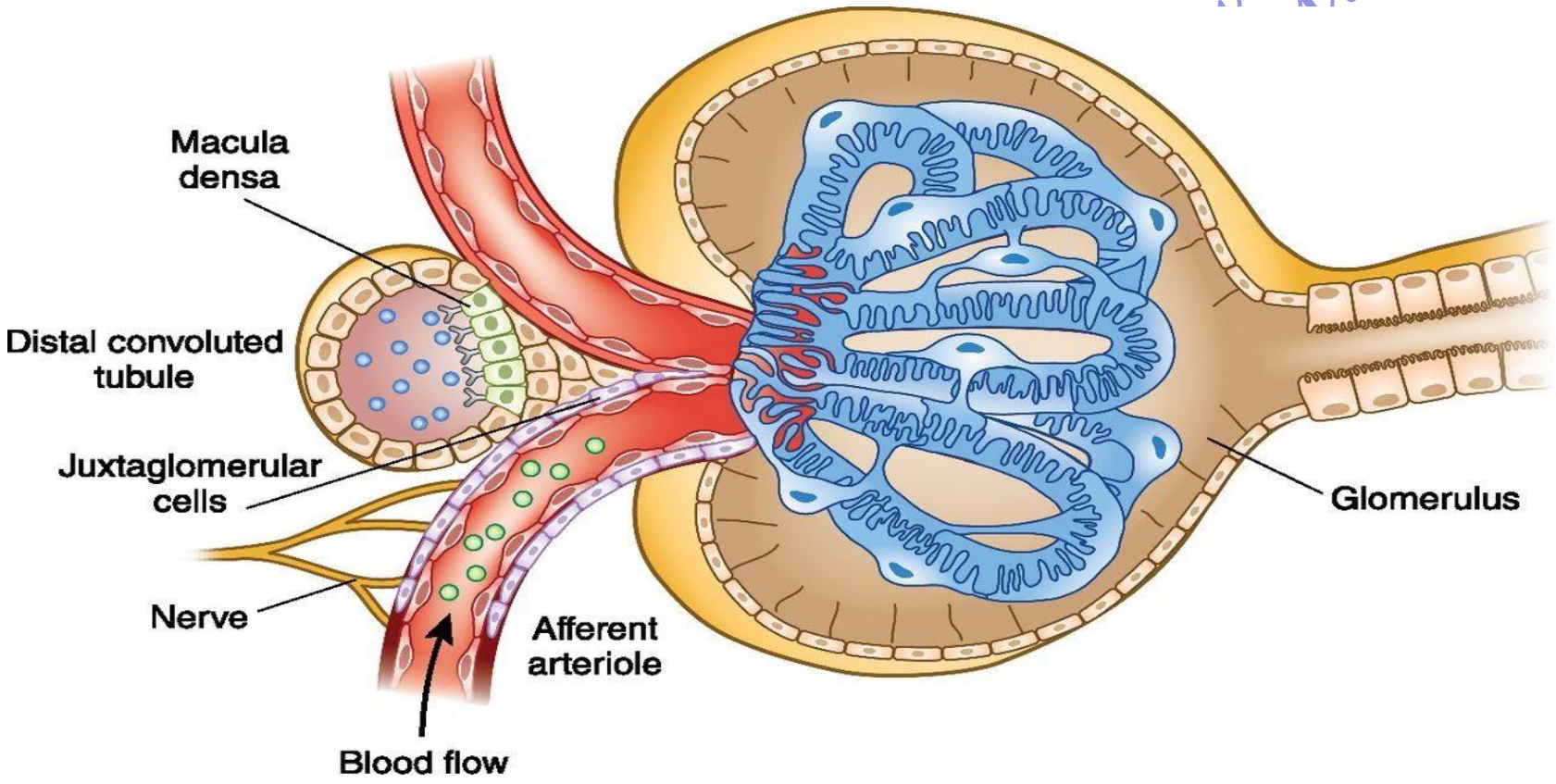

Renal perfusion pressure
Distal tubule
Urine
Macula densa
Afferent arteriole
Cl^-
+
Efferent arteriole
Sympathetic nerve endings
Smooth muscle cells
Granular cell
Extraglomerular mesangial cells
Glomerulus
Proximal tubule
By Nancy Heim, Columbia University, and Brooke Grindlinger, J. Clin. Invest.

Some smooth muscle cells of the wall of afferent arteriole are modified in such a way that their sarcoplasm is granular. These cells are called **juxtaglmerular cells / JG cells**



In each nephron , beginning part of DCT makes contact with the afferent arteriole of same nephron. Cells in the wall of DCT in this region are packed more densely than those in other region of DCT.

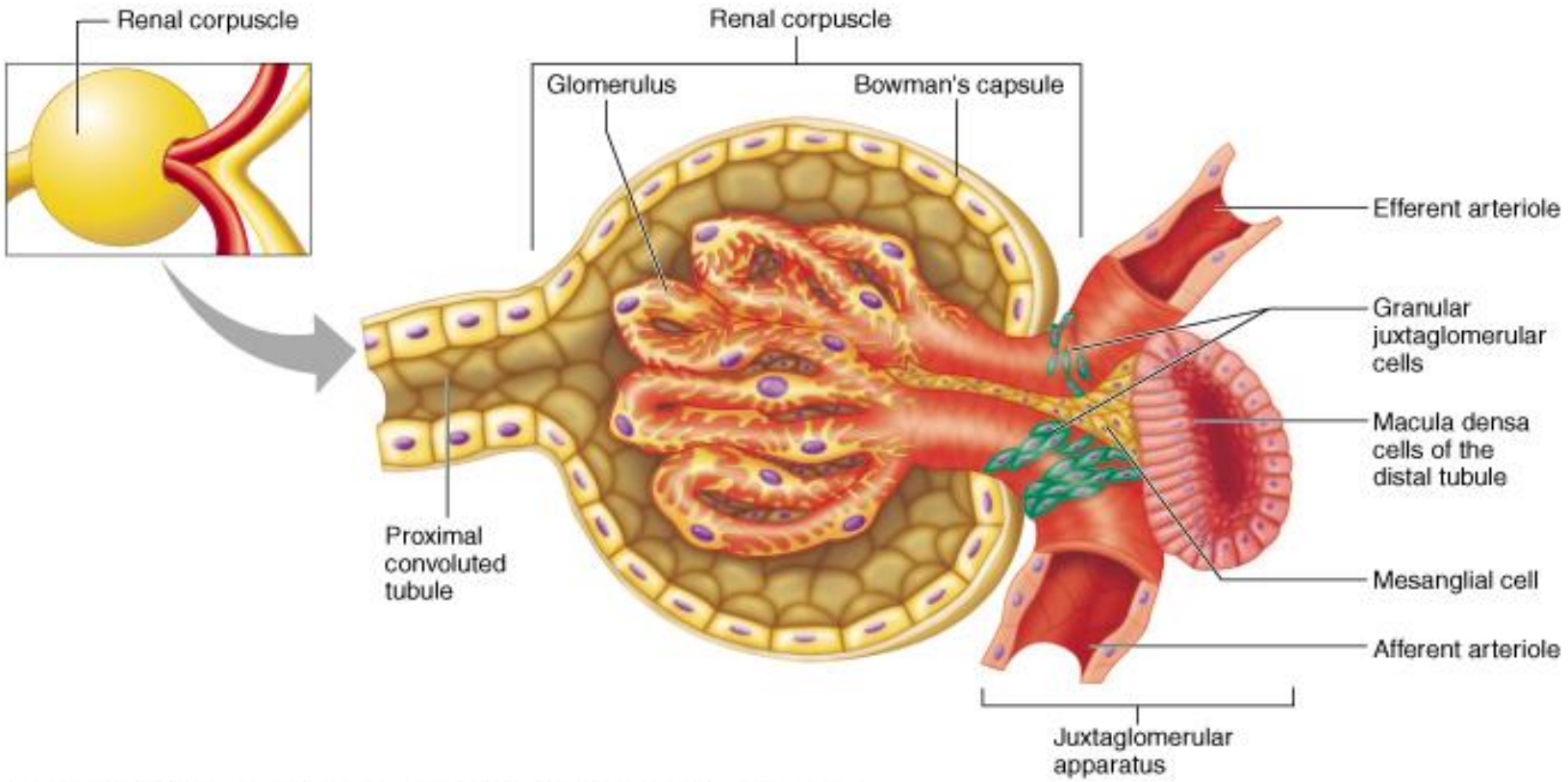
This is called **macula densa.**



JGA =Juxta Glomerular Apparatus

JG cells

Macula Densa



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1. Heart –left ventricle
2. aorta
3. Renal artery
4. Renal arteriole
5. Afferent arteriole
6. Glomerular capillary
7. Efferent arteriole
8. Peritubular capillary network
9. Renal veinule
10. Renal vein
11. Inferior vena cava
12. Right ventricle -heart

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URINE FORMATION / PHYSIOLOGY OF URINE

Process of urine formation completed in three steps

1. Ultra filtration /glomerular filtration
2. Selective reabsorption
3. Tubular secretion /augmentation

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Ultra filtration / glomerular filtration

Filtration under extreme pressure Diameter of afferent arteriole is greater than efferent arteriole. Diameter of capillaries is still smaller than both arterioles. Due to such difference in diameter, blood flows with greater pressure through glomerulus. This is called as glomerular hydrostatic pressure (GHP) and normally, it is about 55 mm Hg.

This pressure is opposed by osmotic

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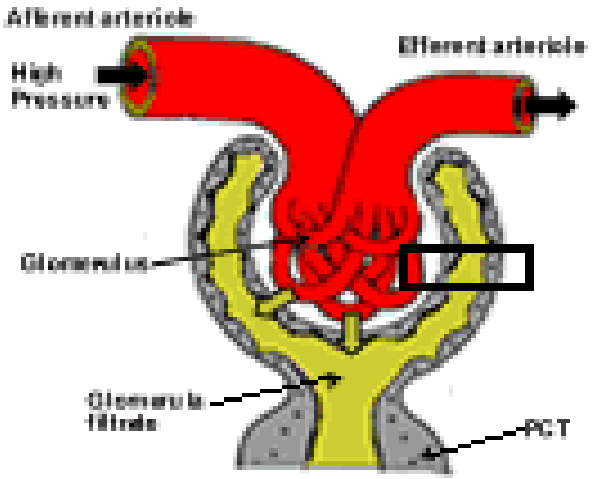
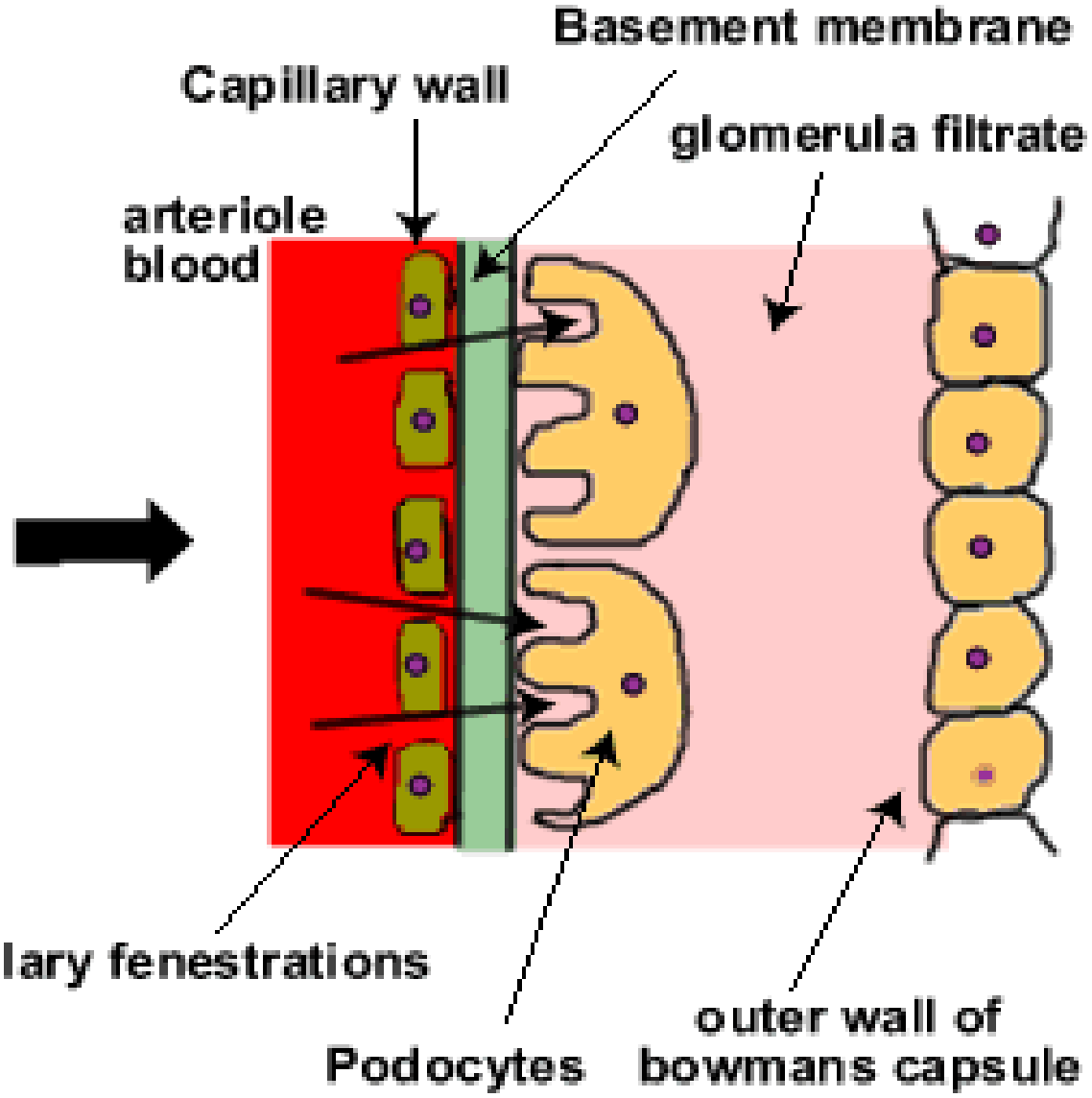
Ultrafiltration



Malphigian Body



Ultrafiltration

This pressure is opposed by osmotic pressure of blood (normally, about 30 mm Hg) and capsular pressure (normally, about 15 mm Hg). Hence net / effective filtration pressure (EFP) is 10 mm Hg.

Walls of capillaries are extremely thin.

Under the effect of high pressure, walls become permeable to major components of blood (except blood cells and macromolecules like protein). Thus plasma except proteins oozes out through wall of capillaries.

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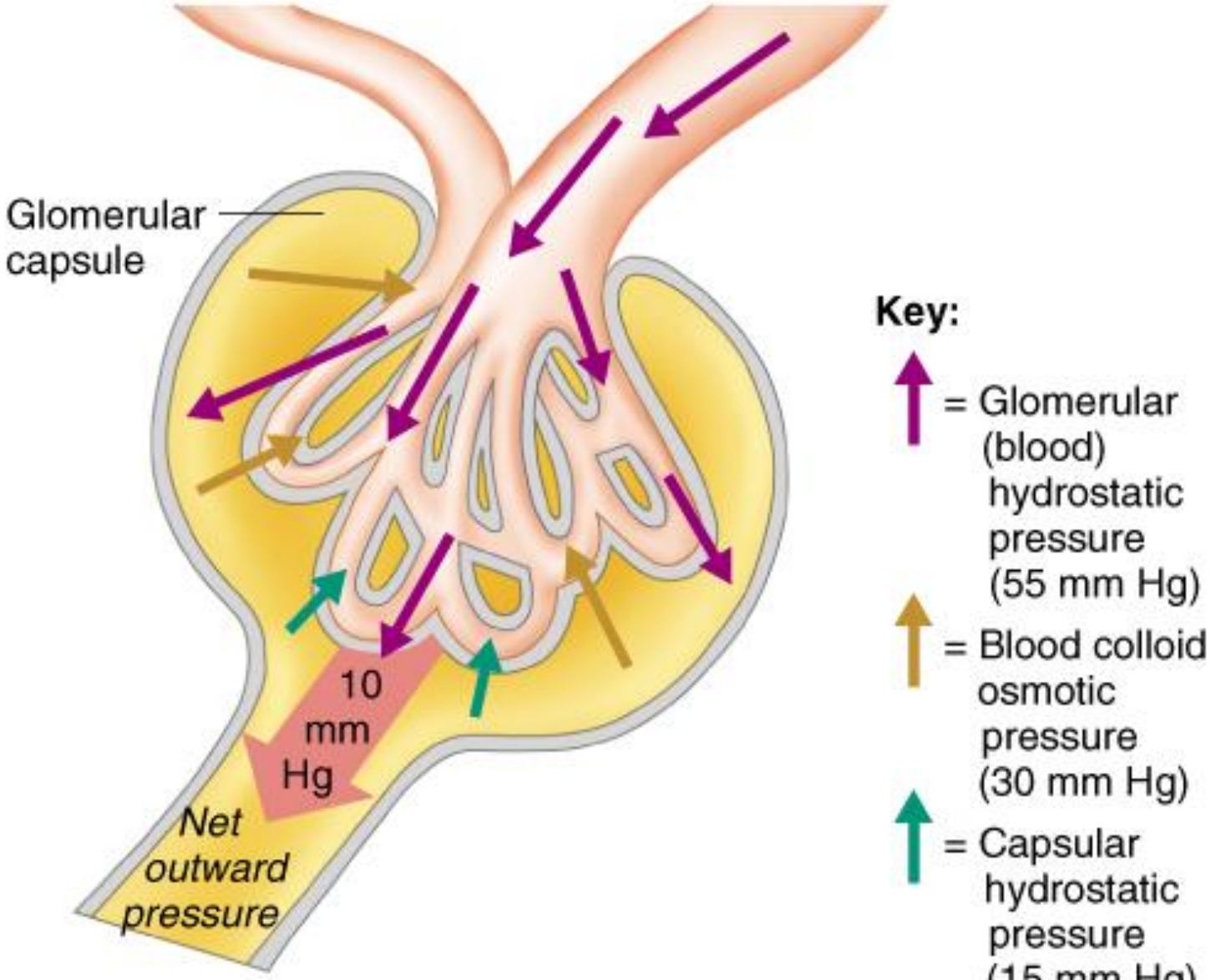

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Rate of blood flow

About 600 ml blood
passes through each kidney per minute

time	1 kidney	2 kidney
1	600 ml	1200 ml
2	1200 ml	2400 ml
3	1800 ml	3600 ml
4	2400 ml	4800 ml

Adult human have 4.5 to 5.5 liter

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GFR = glomerular filtration rate

The blood (plasma) flowing through kidney (glomeruli) is filtered as glomerular filtrate - at a rate of 125 ml / min. (180 L/day).

time	GFR
1min	125 ml
60 min	60 * 125 = 7500 ml
1 day = 24 * 60 min	24 * 60 * 125 = 1,80,000 ml =180 liter

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Composition of filtrate /Glomerular filtrate / deproteinized plasma/primary urine

alkaline,
contains
urea, amino acids, glucose, pigments, and inorganic ions.
Glomerular filtrate passes through filtration slits into capsular space and then reaches the proximal convoluted tubule.

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BLOOD

PLASMA

1. Water(98%)
2. Protein
3. Nutrient
4. Gases
5. Mineral
6. Clotting factor
7. Nitrogenous waste

NH3, urea ,uric acid

CORPUSCLES

- PLATLETS
- R.B.C
- W.B.C

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