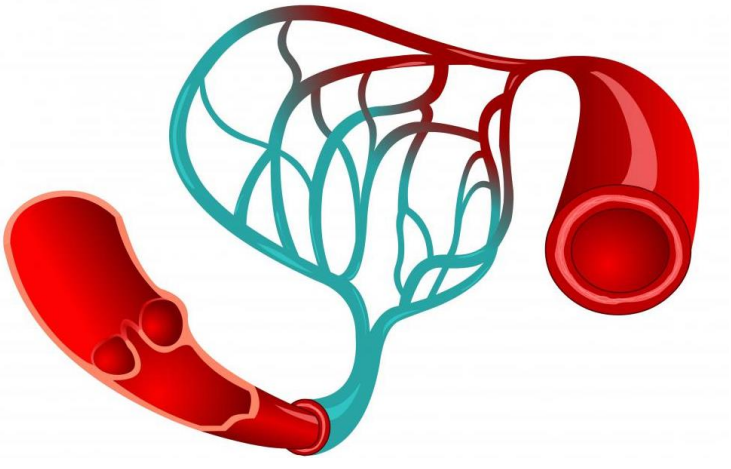
CAPILLARY CIRCULATION



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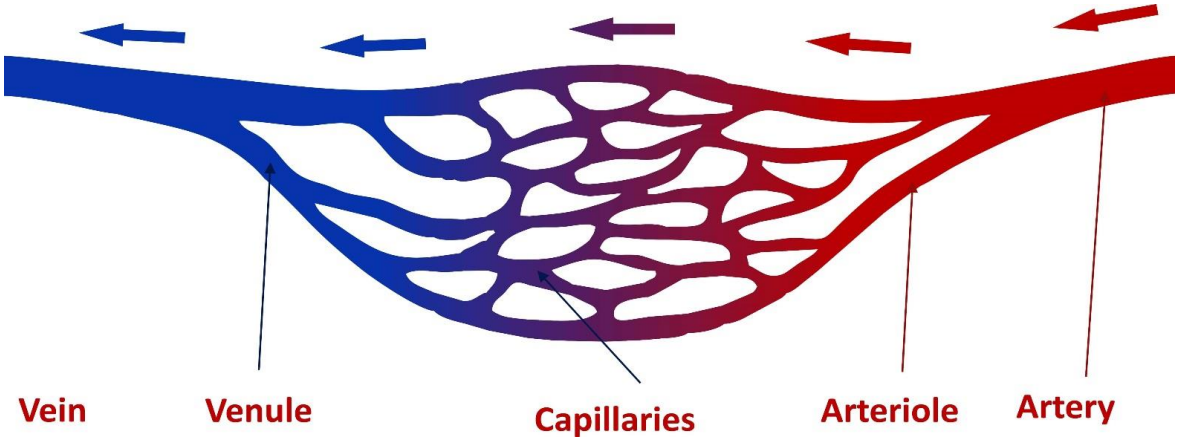
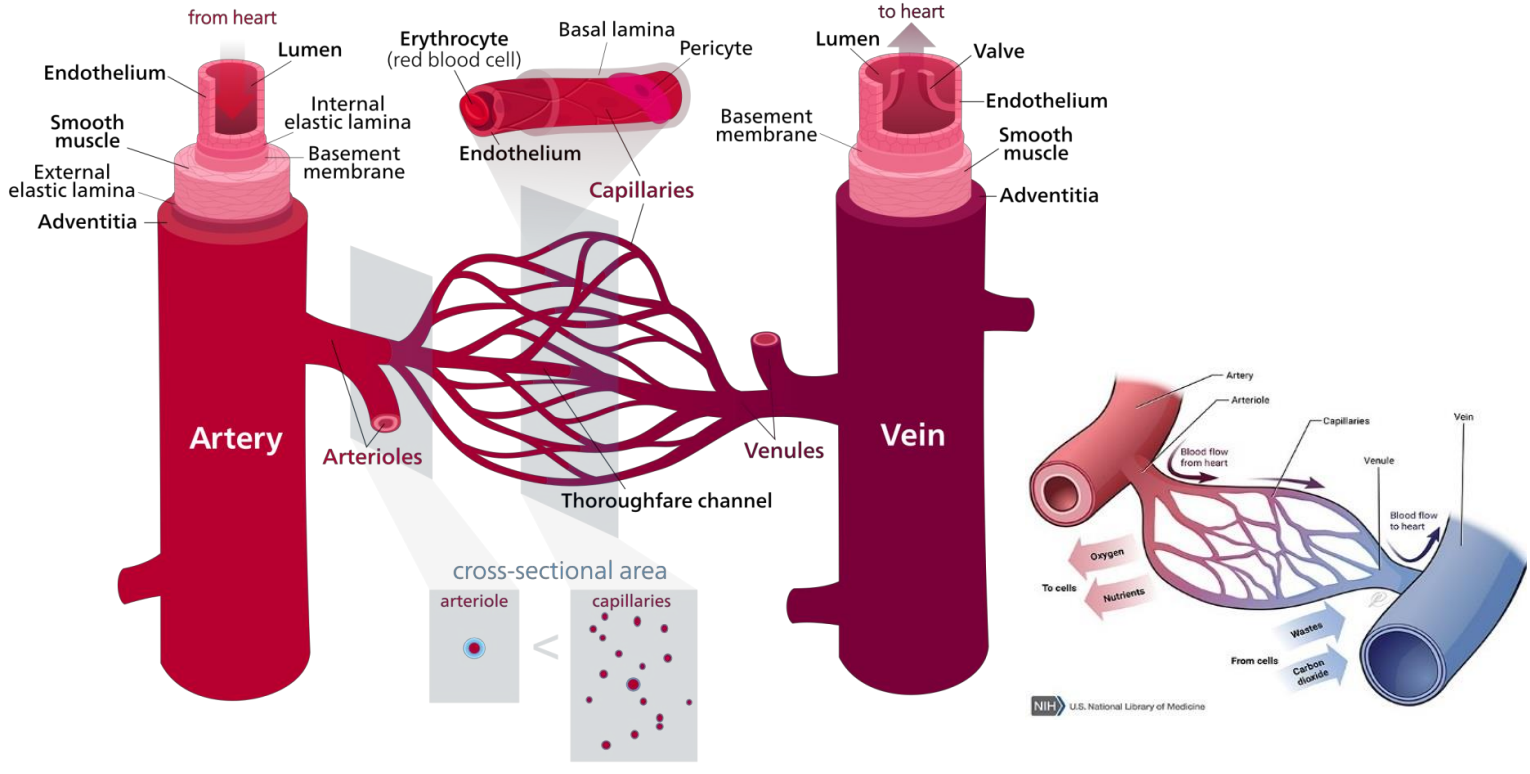
LECTURE OBJECTIVES

- Components of the microcirculation
- Types of blood capillaries
- Regulation of flow in the capillary beds.
- Diffusion and filtration.
- Define edema, state its causes and discuss its mechanisms.

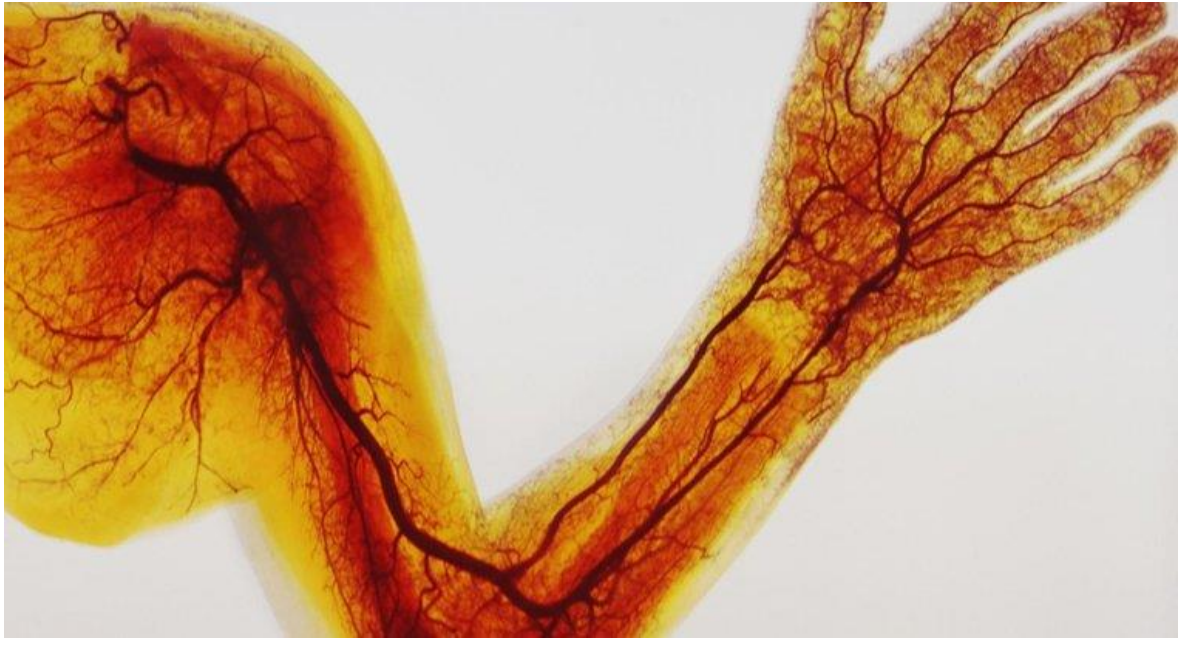
CAPILLARY



CAPILLARY


from heart
Lumen
Endothelium
Internal elastic lamina
Smooth muscle
Basement membrane
External elastic lamina
Adventitia
Erythrocyte (red blood cell)
Basal lamina
Pericyte
Endothelium
Capillaries
to heart
Lumen
Valve
Endothelium
Basement membrane
Smooth muscle
Adventitia
Artery
Arterioles
Venules
Vein
Thoroughfare channel
cross-sectional area
arteriole
capillaries
Artery
Arteriole
Capillaries
Vein
Blood flow from heart
Venule
Blood flow to heart
Oxygen
To cells
Nutrients
Wastes
From cells
Carbon dioxide
NIH U.S. National Library of Medicine

CAPILLARY



DISTRIBUTION OF BLOOD IN THE DIFFERENT PARTS OF CIRCULATORY SYSTEM

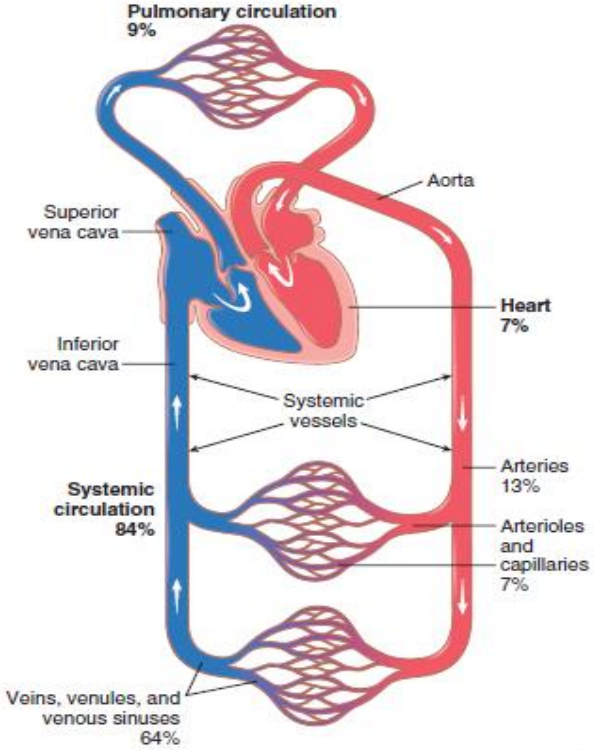


Figure 14-1. Distribution of blood (in percentage of total blood) in the different parts of the circulatory system.

COMPONENTS OF MICROCIRCULATION

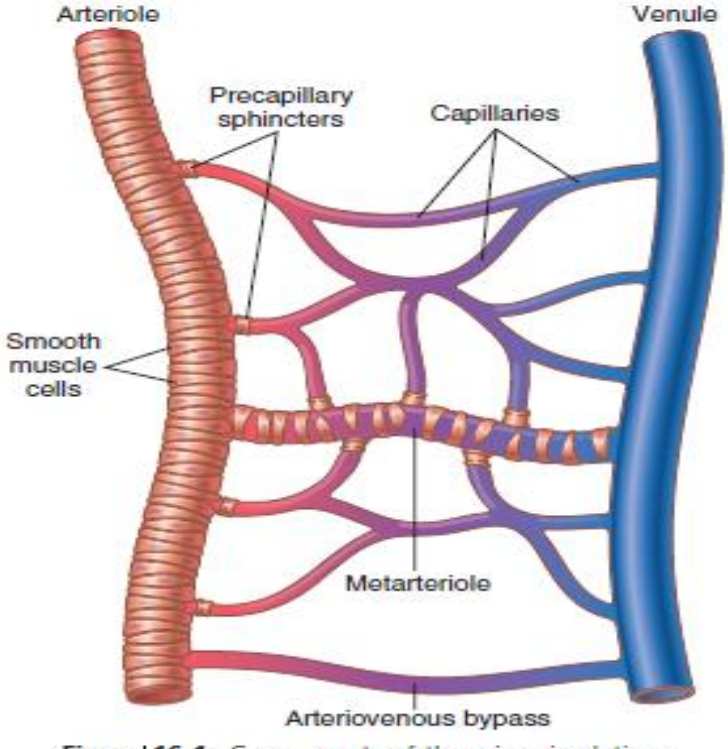
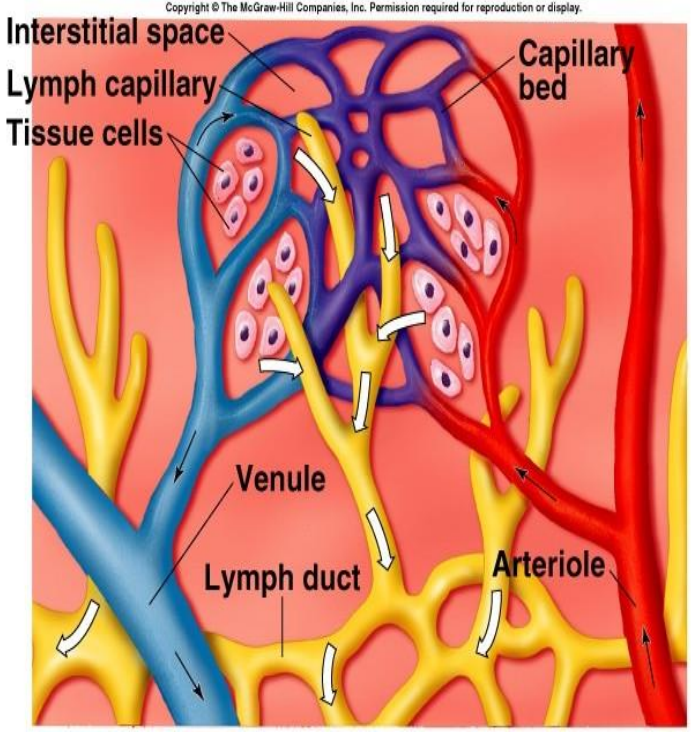
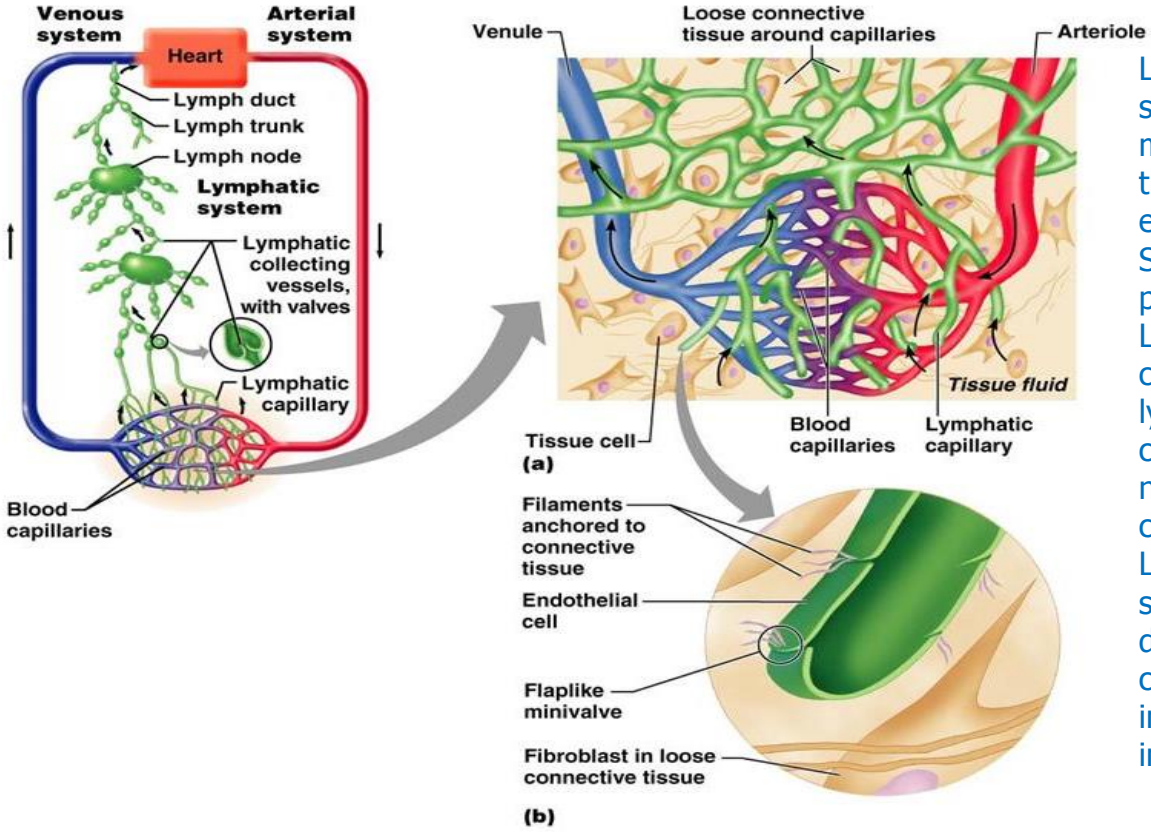


Figure 16-1. Components of the microcirculation.



COMPONENTS OF MICROCIRCULATION



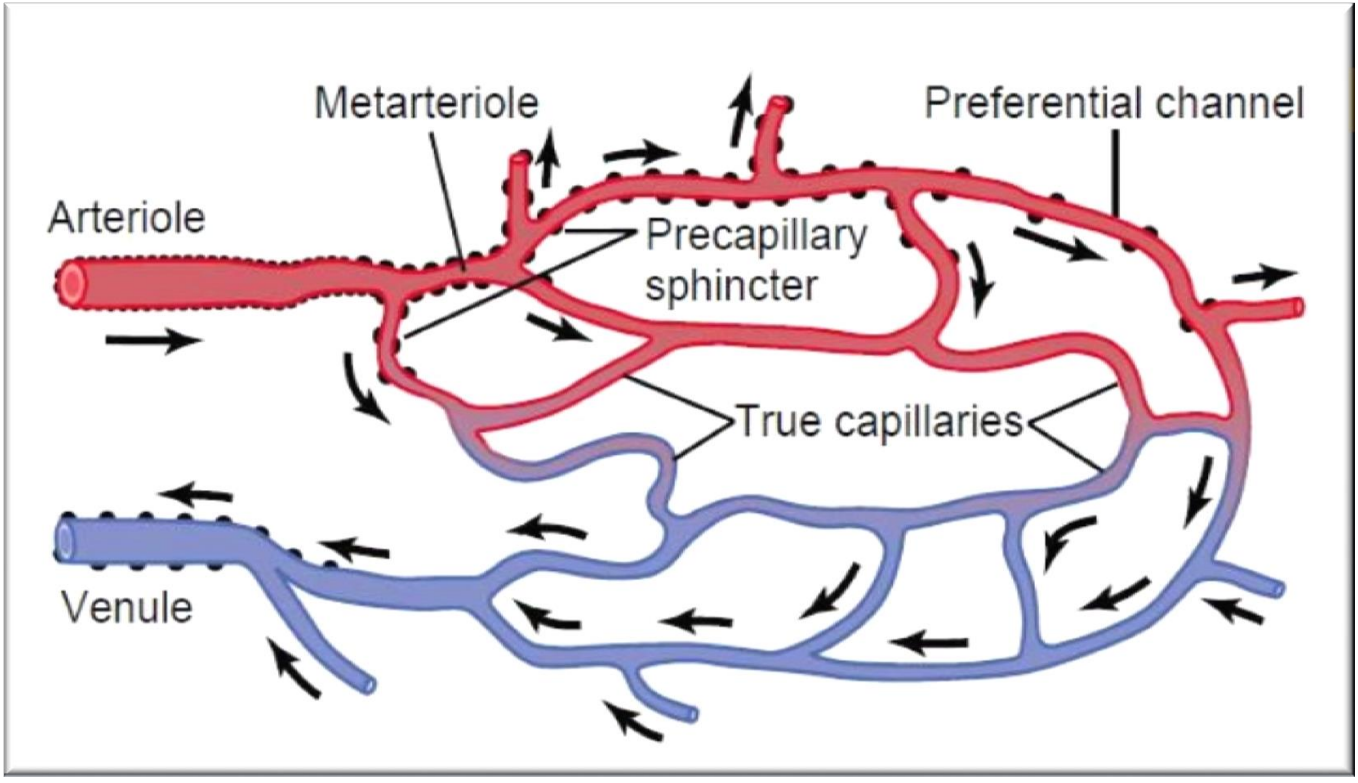
Lymphatic capillaries are small, thin-walled micro-vessels located in the spaces between cells except CNS

Serve to drain and process ECF.

Lymphatic capillary carries lymph into lymphatic vessels, connects to a lymph node to the venous circulation

Lymphatic capillaries are slightly larger in diameter than blood capillaries, allow interstitial fluid to flow into them but not out.

COMPONENTS OF MICROCIRCULATION



FUNCTIONS OF CAPILLARIES

- They form a selectively permeable barrier between the circulatory system and the tissues supplied.
- Play a metabolic role – Produce PgI2, growth factors for blood cells, fibroblast GF, platelet GF, and in the lungs; angiotensin converting enzyme
- Inactivation of intercellular messengers
- Antithrombotic function

COMPONENTS OF MICROCIRCULATION

Aorta: Elastic recoil

Arteries: Muscular, low resistance vessels

Arterioles: High resistance vessels

Capillaries: Exchange vessels

Veins and Venules: Capacitance vessels

Smallest blood vessels

Exchange vessels: Provide direct access to cells.

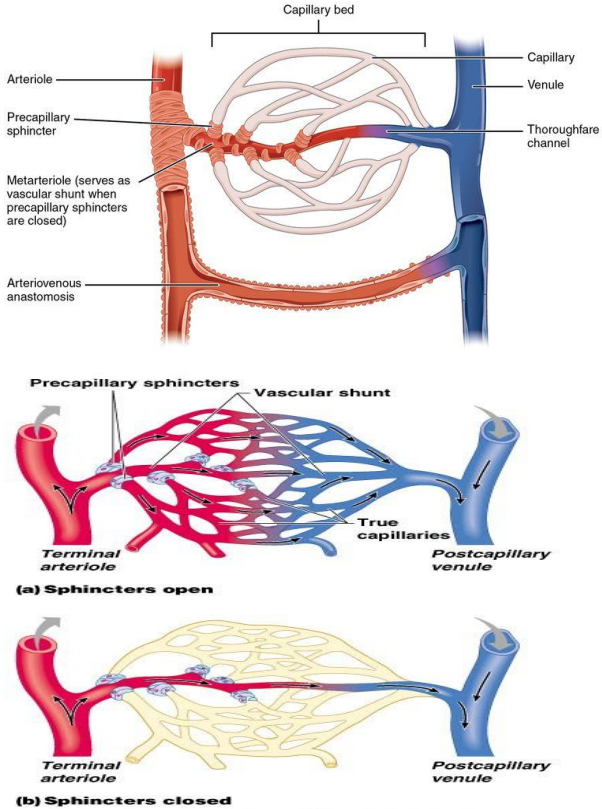
Most permeable: Permits exchange of nutrients & wastes.

CAPILLARY BED

Capillary bed consist of two types of vessels:

Vascular shunt: Directly connects an arteriole to a venule

True capillaries: Exchange vessels. Oxygen & nutrients cross to cells Carbon dioxide & metabolic waste products cross into blood



TYPES OF CAPILLARIES

Types based on diameter and or permeability:

Continuous Capillaries

Do not have fenestrae. Muscle, lung, and adipose tissue.

Fenestrated Capillaries

Found in kidney glomeruli, small intestine, and endocrine glands.

Have pores, allow large substances to pass but not plasma proteins.

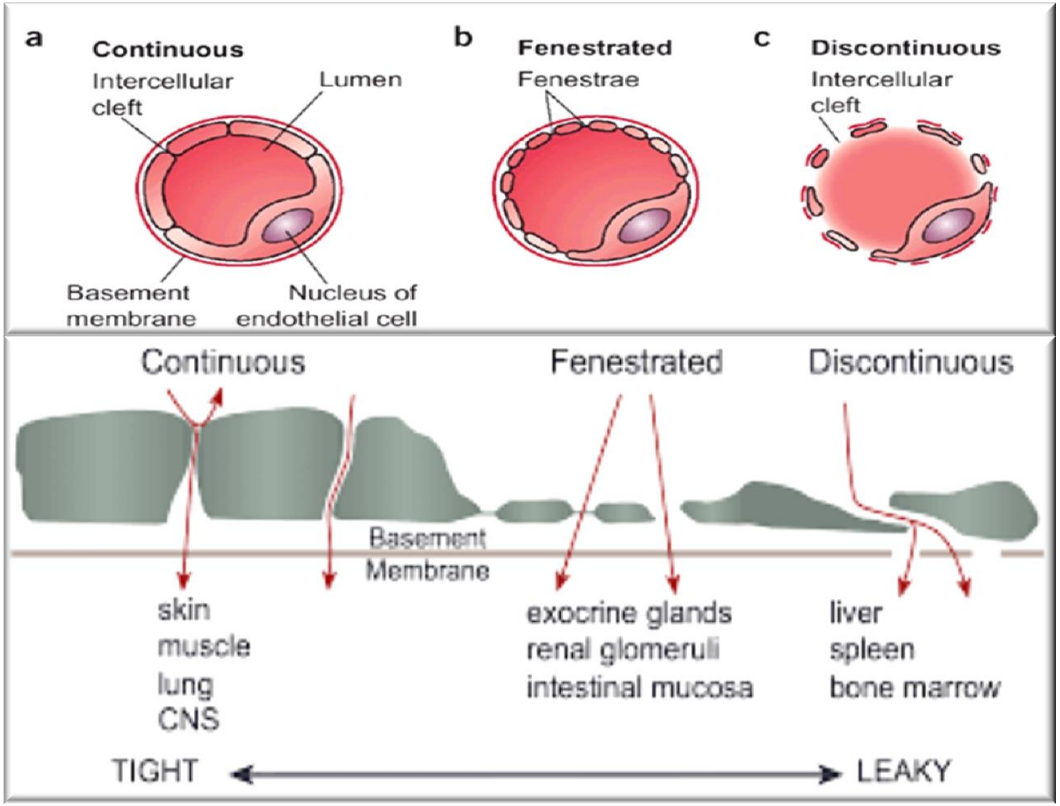
Sinusoidal Capillaries

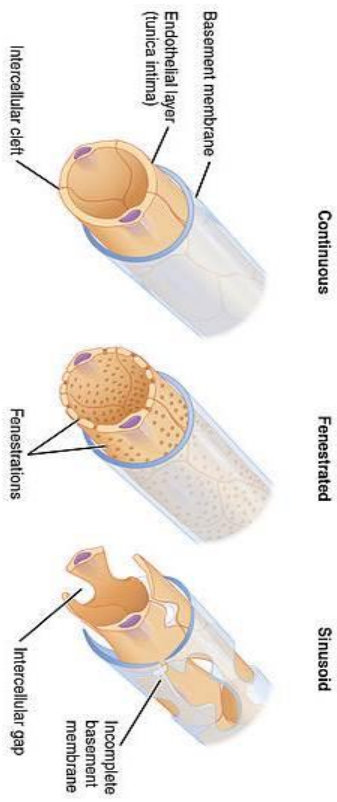
Large diameter with fenestrae. Liver, spleen, bone marrow, lymphoid tissue, some endocrine glands.

- Rate of blood flow through each tissue capillary bed
- Capillary pressure within the capillaries
- Rate of transfer of substances between the blood of the capillaries and the surrounding interstitial fluid.

Guyton and Hall, pp 190

TYPES OF CAPILLARIES





FORCES AT THE ARTERIAL END OF THE CAPILLARY

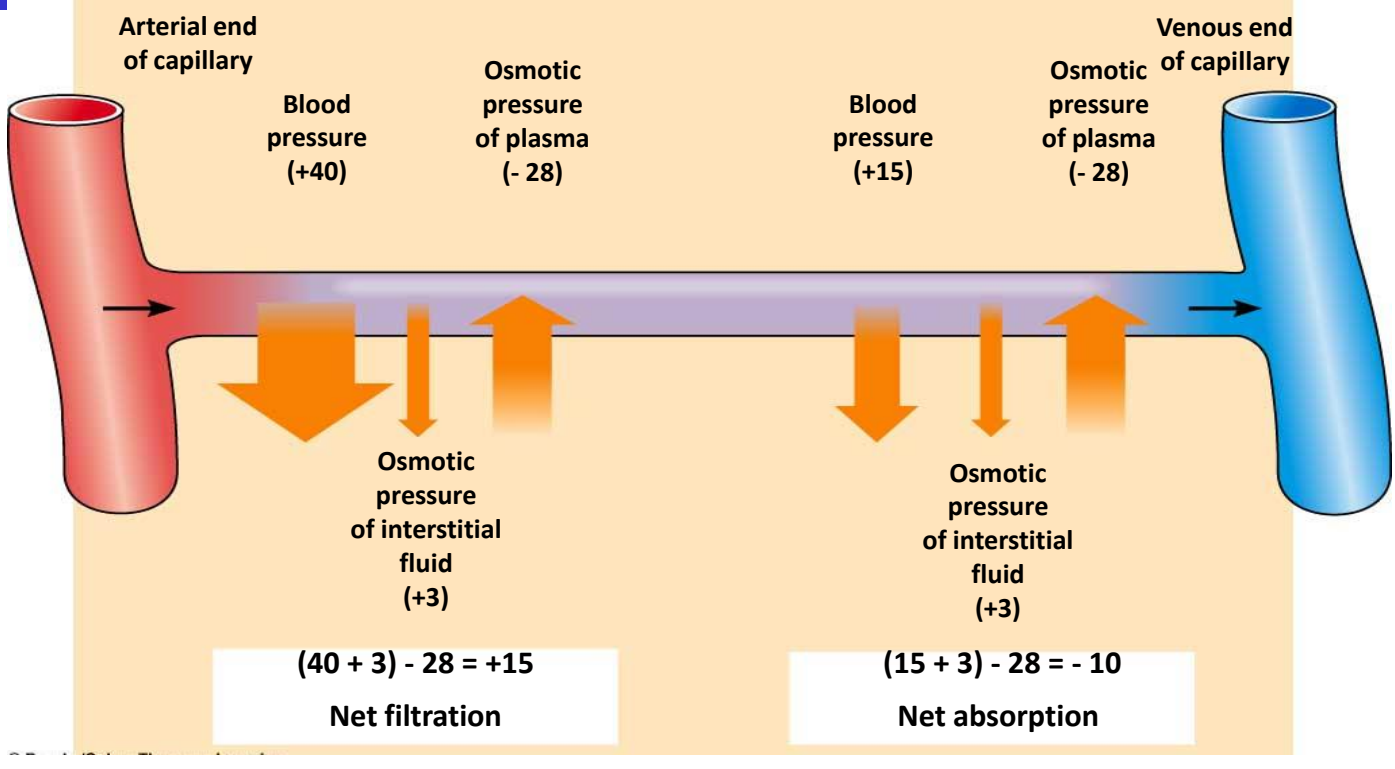
Net filtration pressure at the arterial end of the capillary: 13 mmHg. Move fluid outward through the capillary pores.

13 mmHg filtration pressure causes on average about 1/200 of the plasma in the flowing blood to filter out of the arterial ends of the capillaries into the interstitial spaces

Forces Tending to Move Fluid Outward	
Capillary pressure (arterial end of capillary)	30
Negative interstitial free fluid pressure	3
Interstitial fluid colloid osmotic pressure	8
TOTAL OUTWARD FORCE	41
Forces Tending to Move Fluid Inward	
Plasma colloid osmotic pressure	28
TOTAL INWARD FORCE	28
Summation of Forces	
Outward	41
Inward	28
NET OUTWARD FORCE (AT ARTERIAL END)	13

(Guyton and Hall, 196)

FORCES AT THE ARTERIAL END OF THE CAPILLARY



CLINICAL SIGNIFICANCE OF CAPILLARY FILTRATION

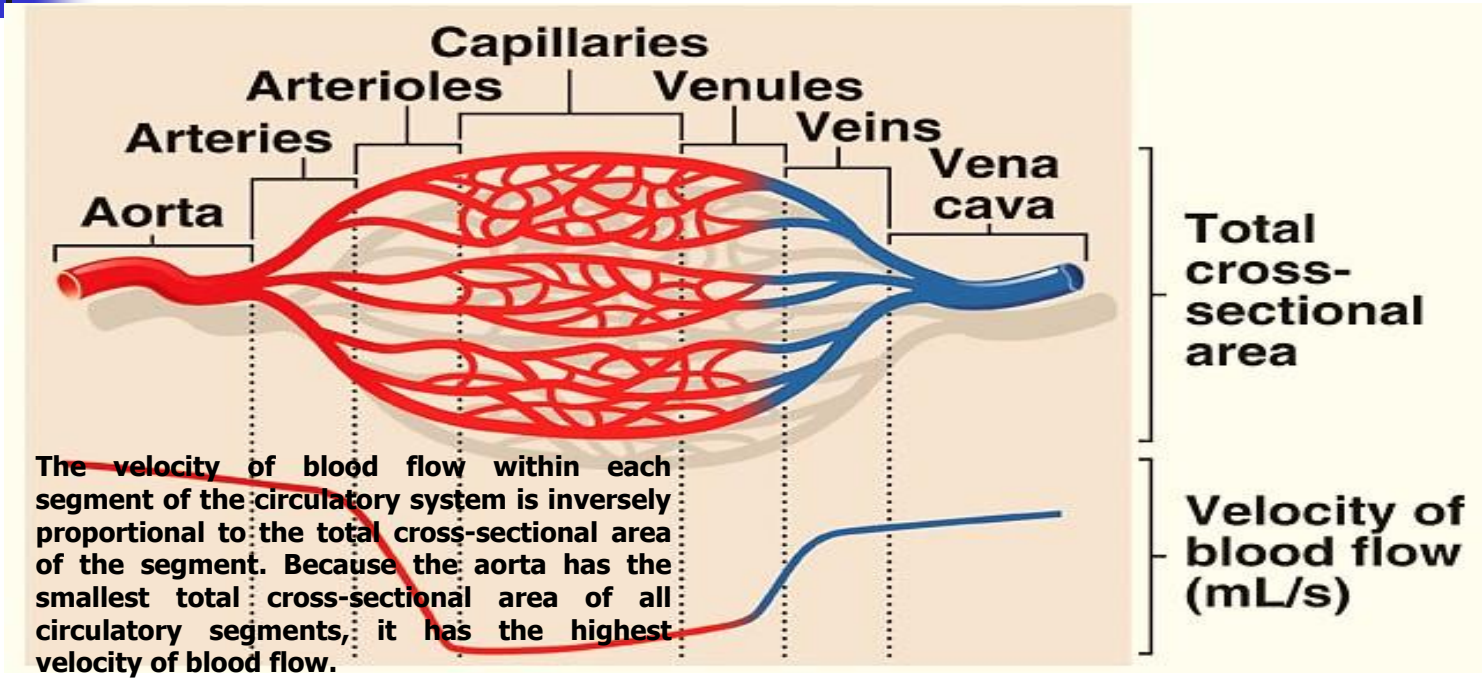
- **Blood loss:** Vasoconstriction of arterioles → decrease capillary hydrostatic pressure. Osmotic pressure of plasma proteins favours absorption of interstitial fluid →↑ blood volume.

- **Congestive heart failure:** Venous pressure rises → build-up of blood in capillaries →↑ capillary hydrostatic pressure →↑ filtration → oedema.

- **Hypoproteinemia** (Starvation, liver disease) → ↓ plasma protein colloid osmotic pressure → loss of fluid from capillaries → oedema.

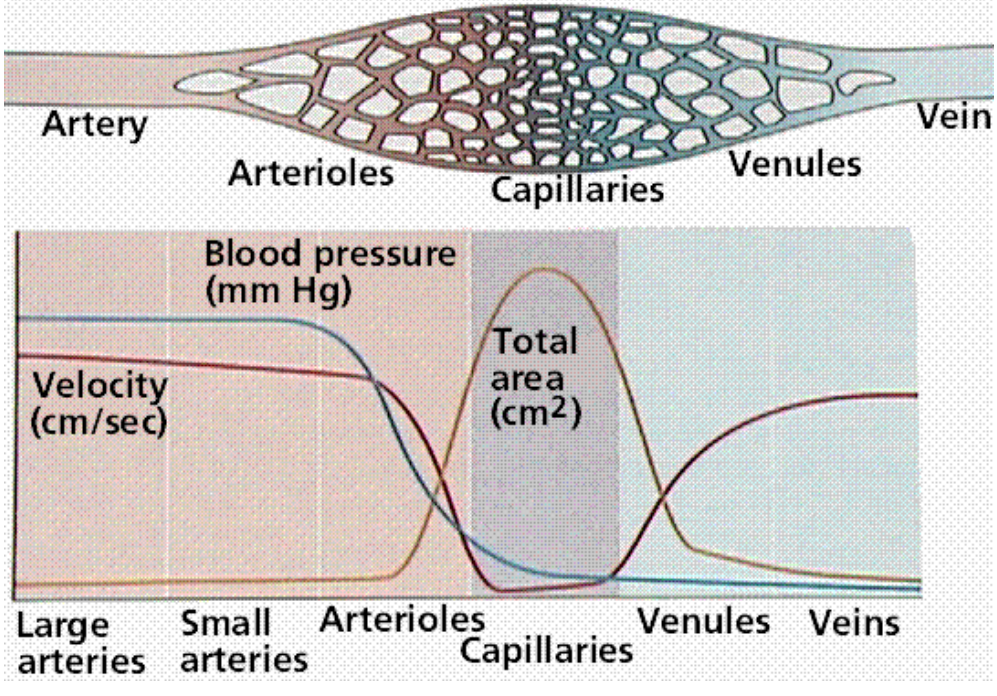
- **Inflammation:** The gaps between the endothelial cells increase because of the inflammatory mediators →↑ movement of proteins into the interstitium → oedema.

DIAMETER AND BLOOD FLOW



As diameter of vessels ↓, the total cross-sectional area ↑ & velocity of blood flow ↓

DIAMETER AND BLOOD FLOW



As diameter of vessels ↓, the total cross-sectional area ↑ & velocity of blood flow ↓

THANK YOU