CARDIOVASCULAR PHYSIOLOGY

CAPILLARY CIRCULATION

DR. ABEER A. AL-MASRI

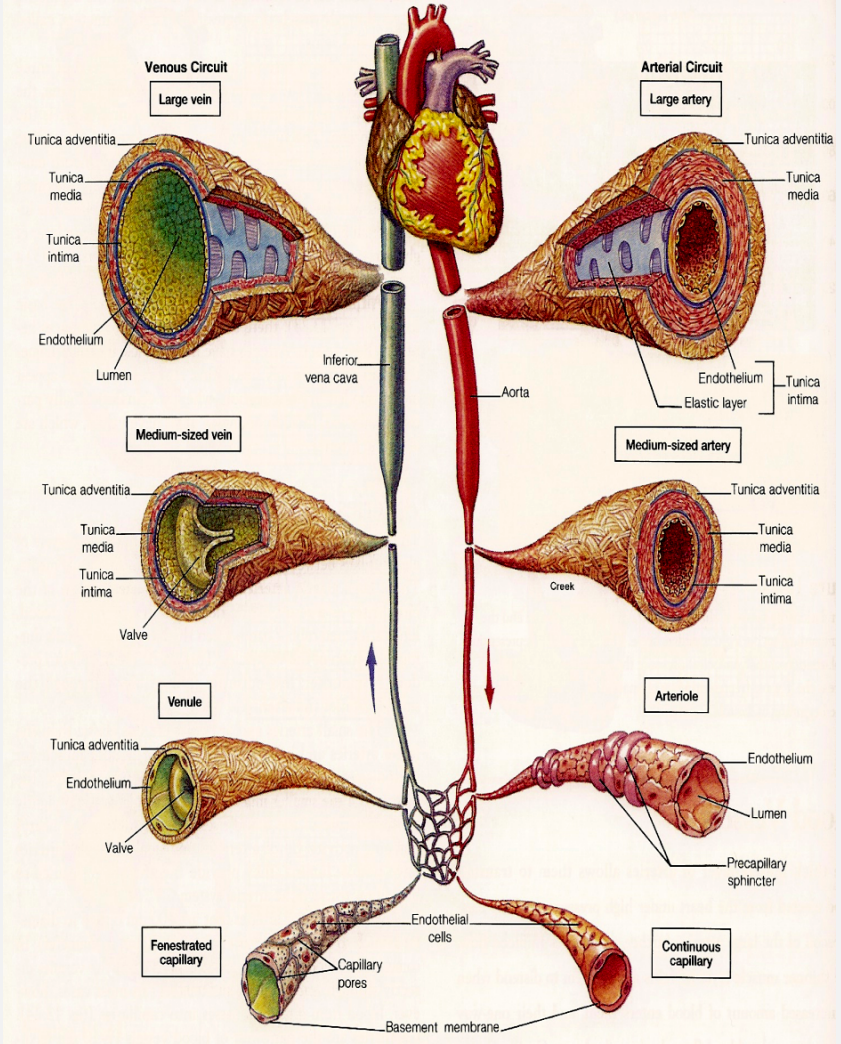
A. PROFESSOR & CONSULTANT

CARDIOVASCULAR PHYSIOLOGIST

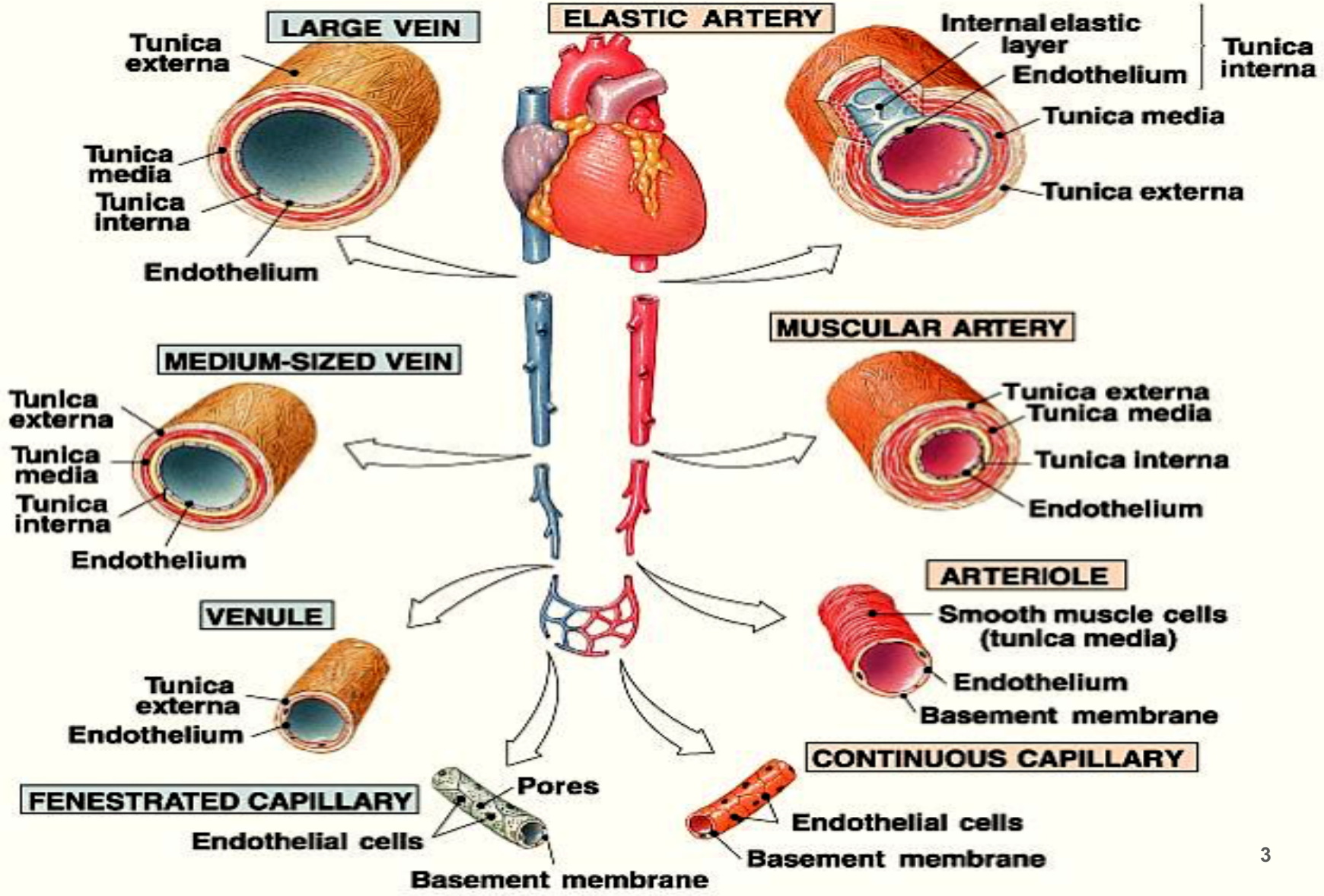
FACULTY OF MEDICINE, KSU

CLASSIFICATION OF THE VASCULAR SYSTEM

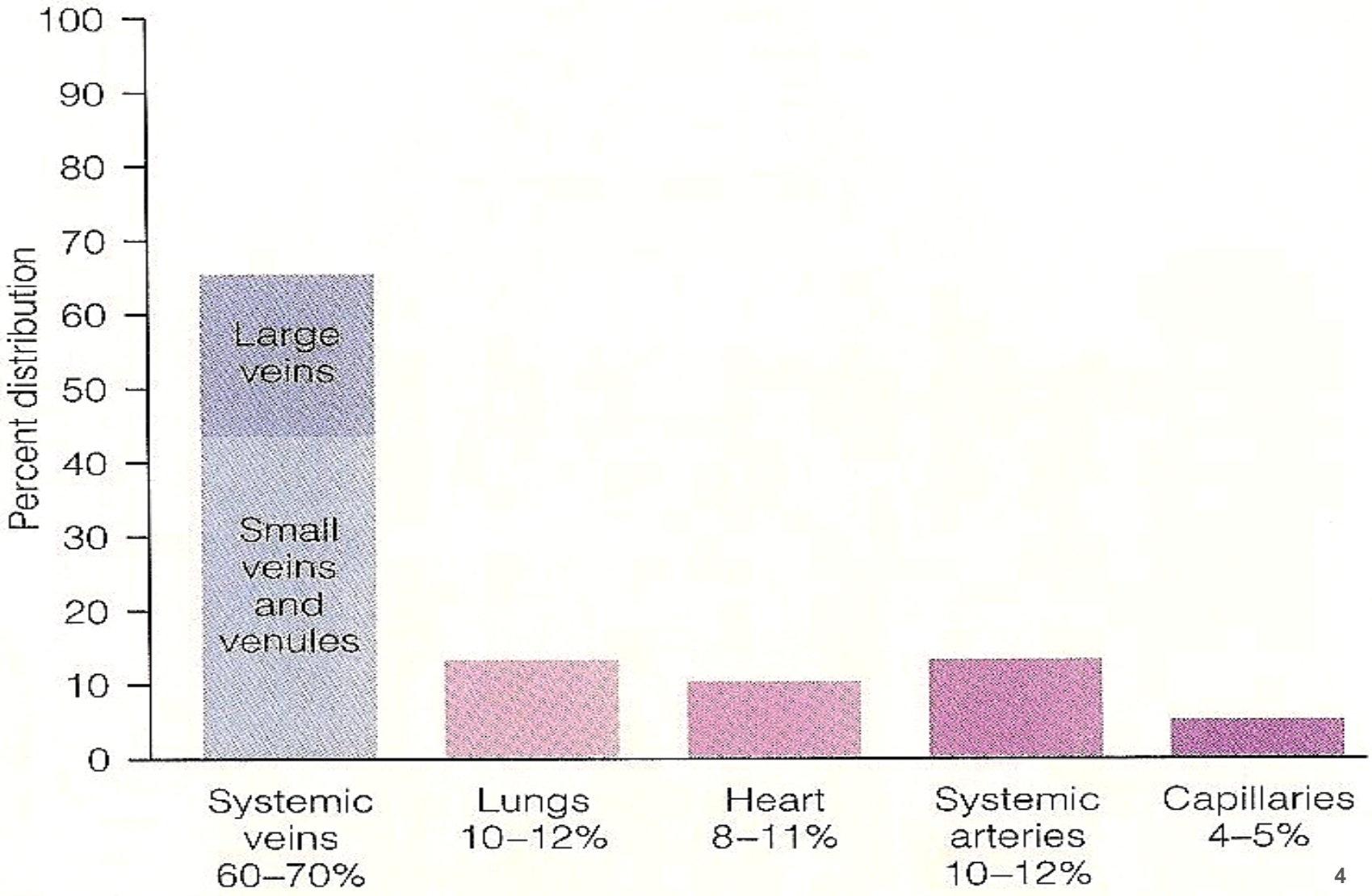
1. **Aorta**
   … (elastic recoil)
2. **Arteries**
   … (muscular, low resistance vessels)
3. **Arterioles**
   … (high resistance vessels)
4. **Capillaries**
   … (exchange vessels)
5. **Venules**
6. **Veins**
   … (capacitance vessels)



BLOOD VESSEL COMPARISON

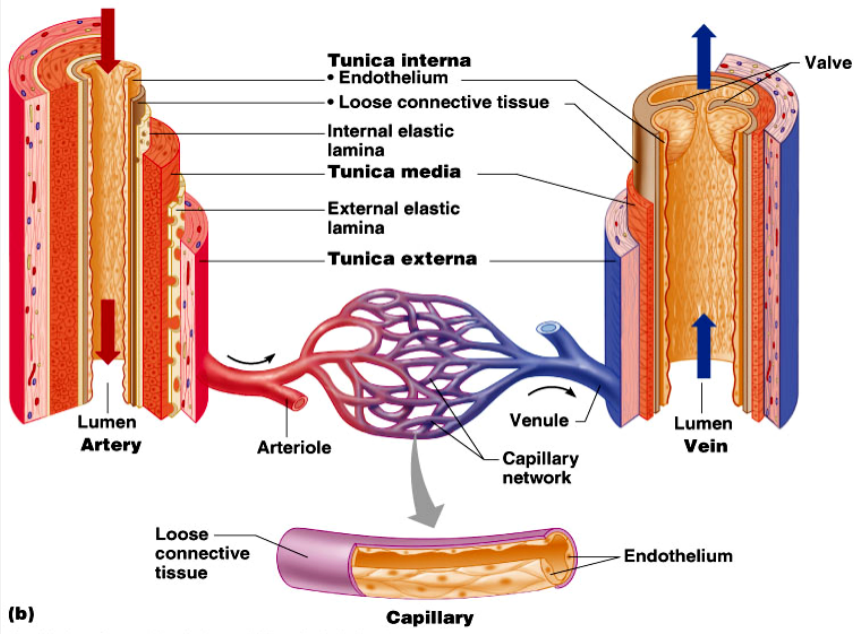


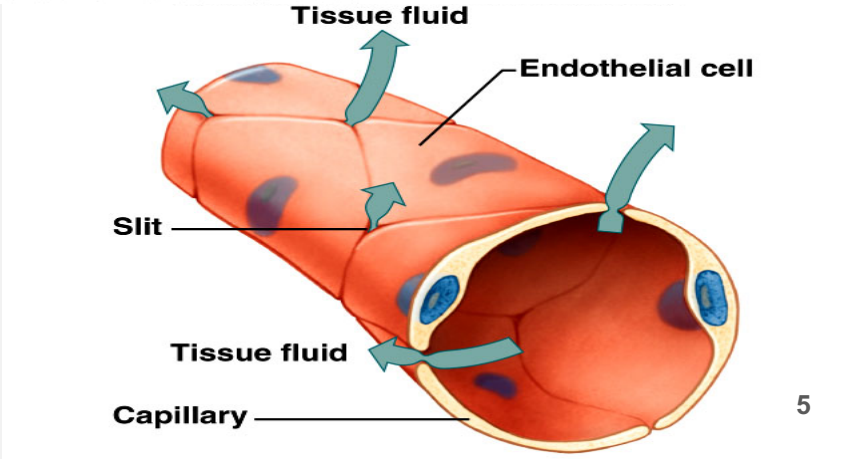
DISTRIBUTION OF BLOOD WITHIN THE CIRCULATORY SYSTEM AT REST



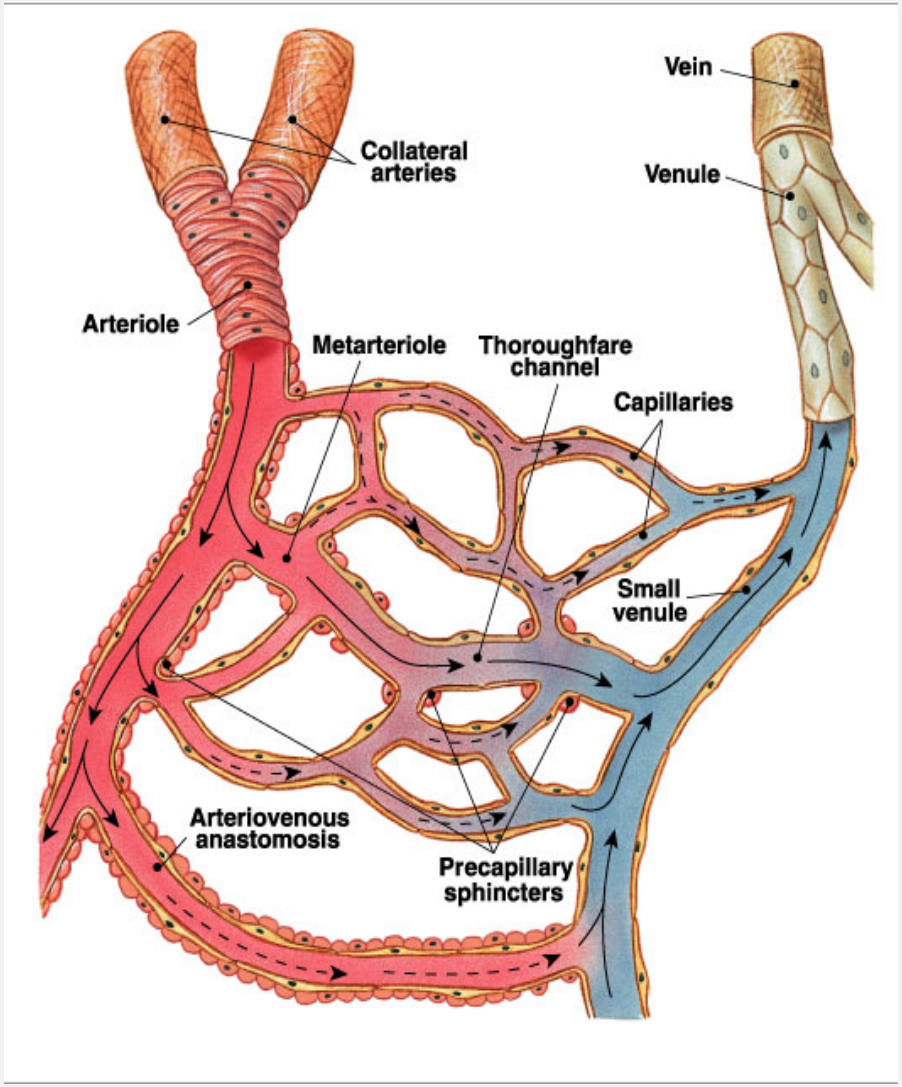
CAPILLARIES

- Smallest blood vessels.
  - One endothelial cell thickness.
- Exchange vessels.
  - Provide direct access to cells.
  - Most permeable.
  - Permits exchange of nutrients & wastes.

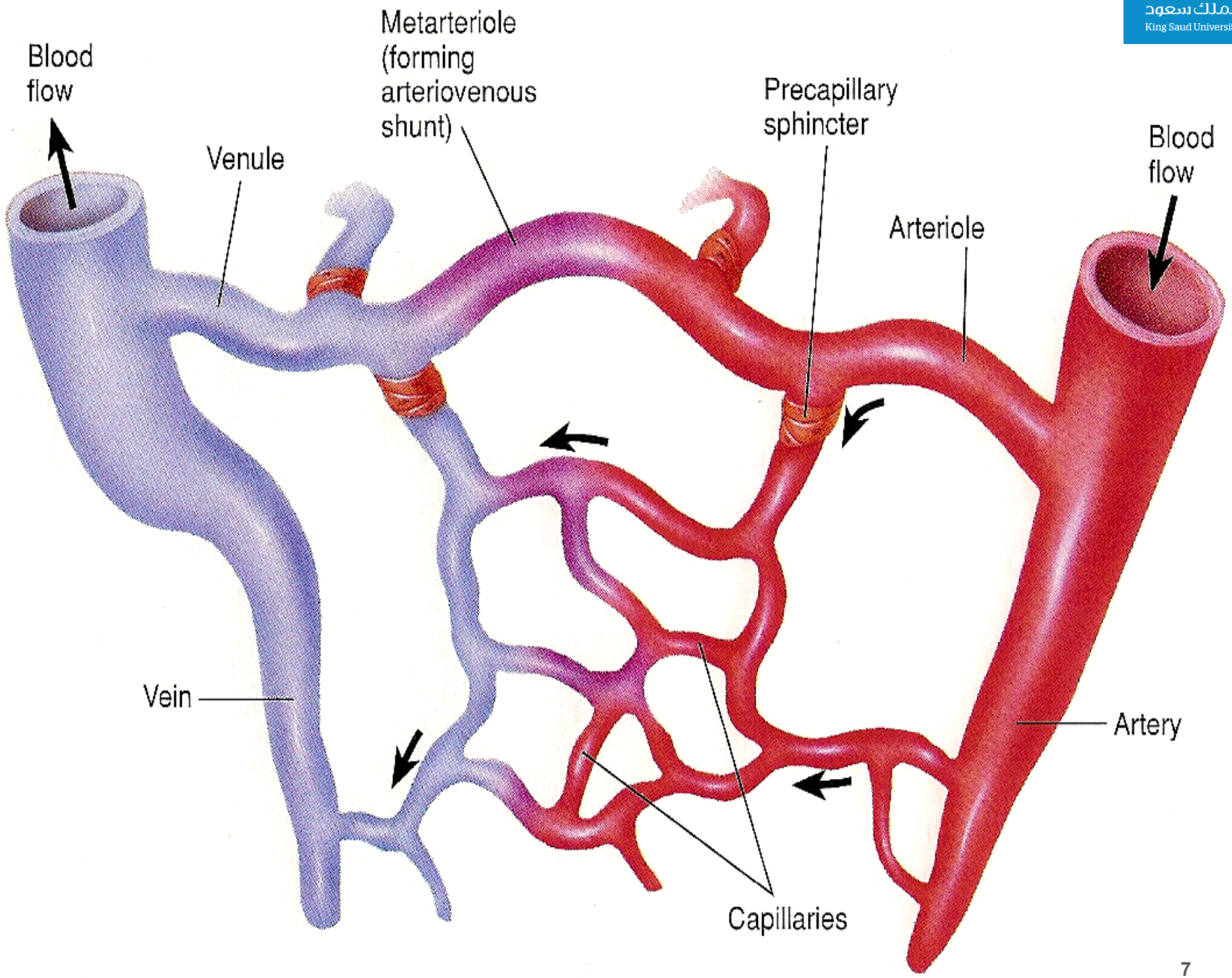




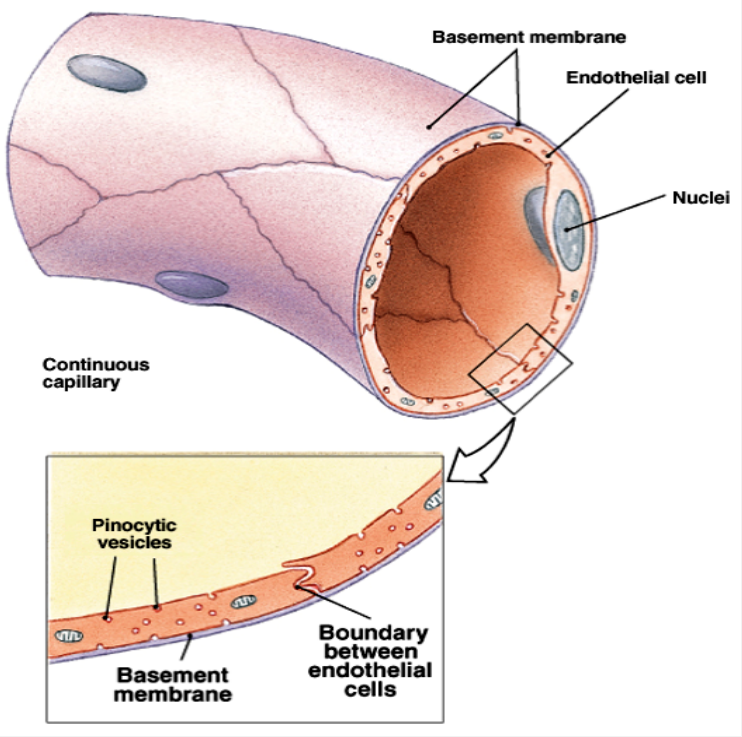
CAPILLARY NETWORK

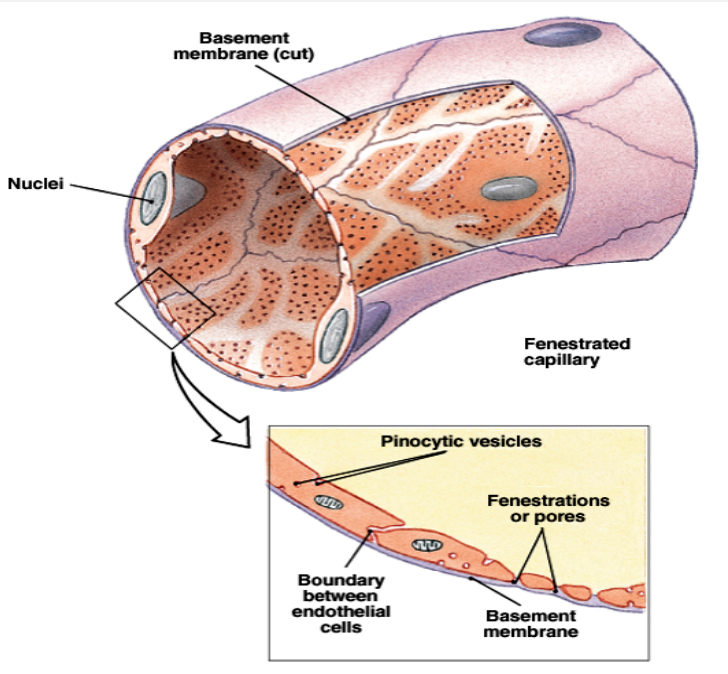


- Blood flows from arterioles through metarterioles, then through capillary network
- Venules drain network
- Smooth muscle in arterioles, metarterioles, precapillary sphincters regulates blood flow


Blood flow
Metarteriole (forming arteriovenous shunt)
Precapillary sphincter
Blood flow
Venule
Arteriole
Vein
Artery
Capillaries

TYPES OF CAPILLARIES

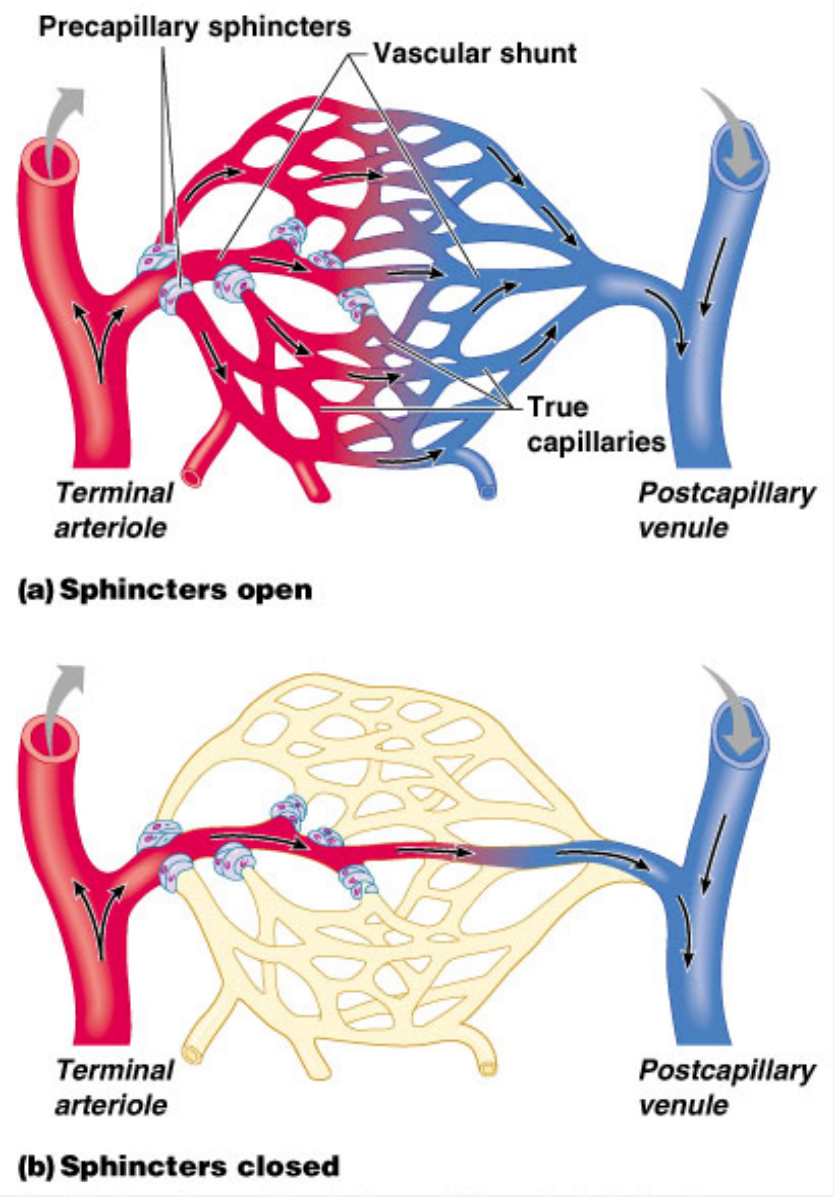




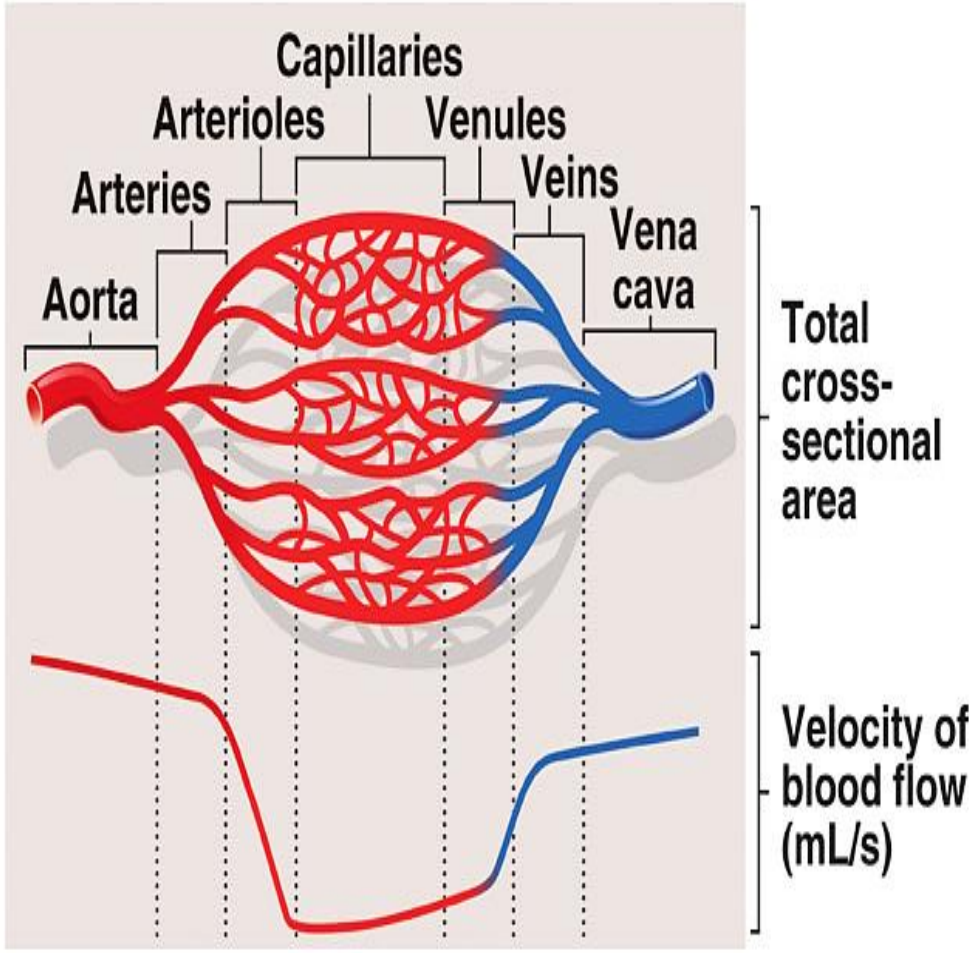
- **Types are classified by diameter/permeability:**
  - **Continuous**
    - Do not have fenestrae.
  - **Fenestrated**
    - Have pores.
  - **Sinusoidal**
    - Large diameter with large fenestrae.

Capillary Beds

- **Capillary beds 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



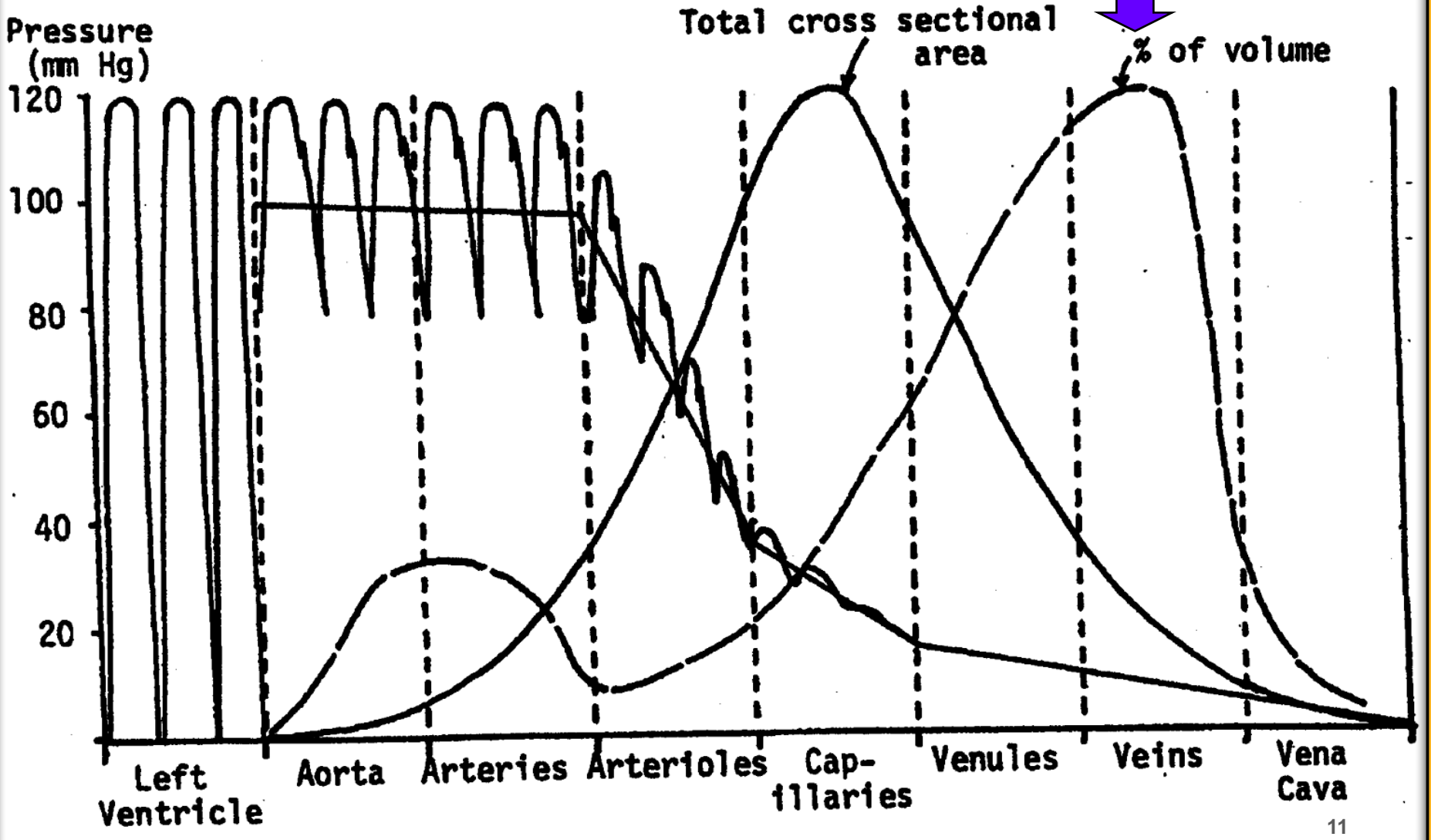
CROSS-SECTIONAL AREA



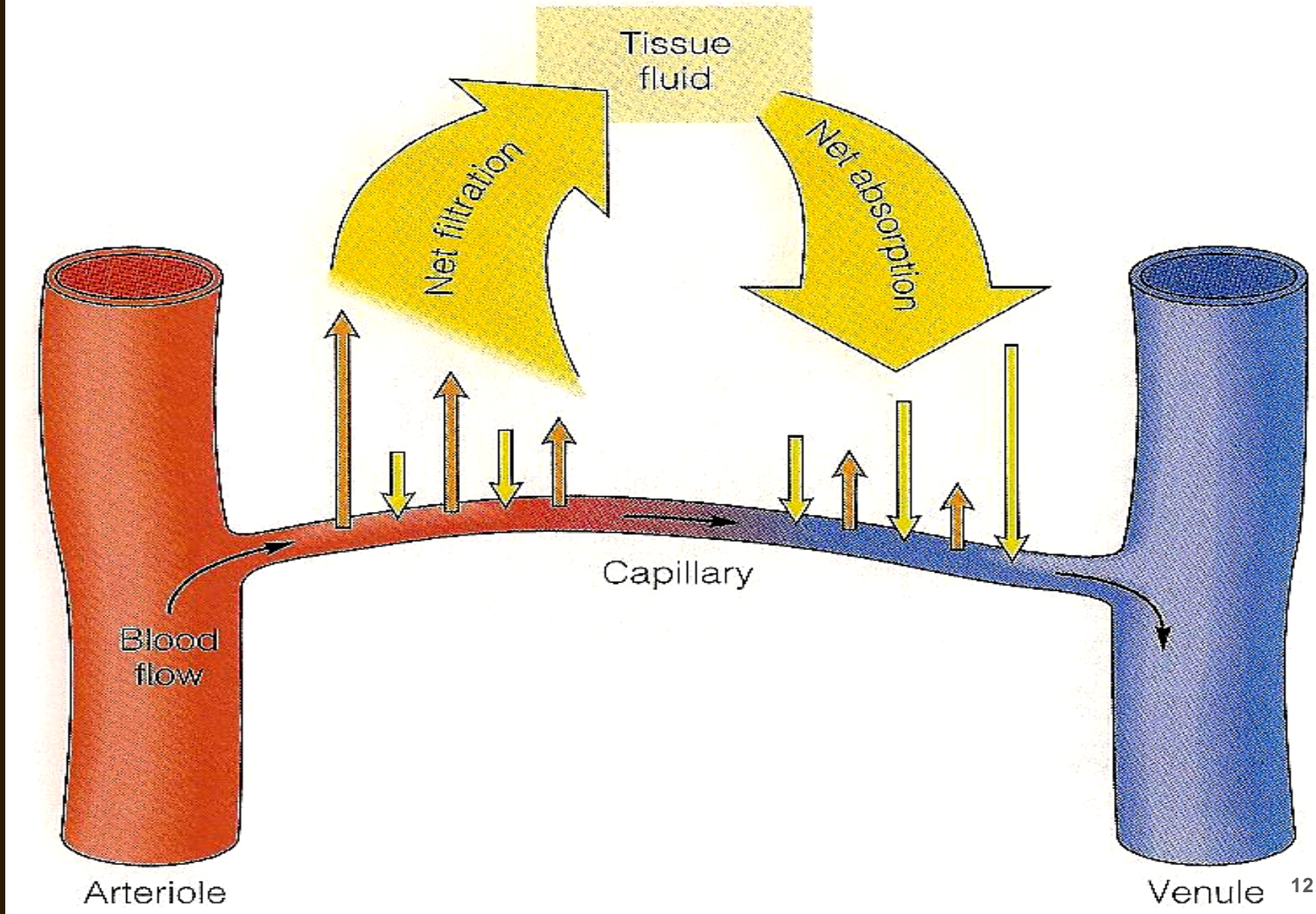
- As diameter of vessels decreases, the total cross-sectional area increases & velocity of blood flow decreases.
- Much like a stream that flows rapidly through a narrow gorge but flows slowly through a broad plane.

Total Cross Sectional Area

Capacity Vessels



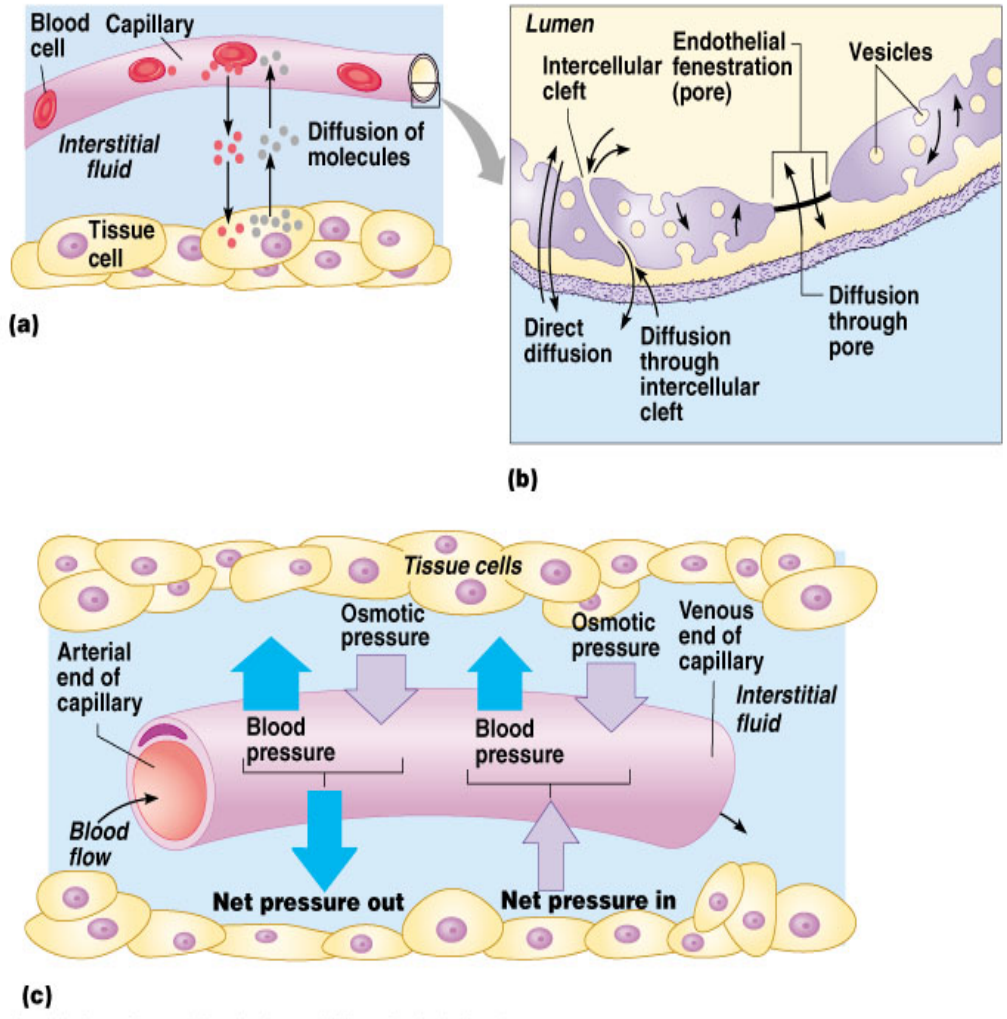
EXCHANGE OF FLUID BETWEEN CAPILLARIES AND TISSUES



CAPILLARY EXCHANGE AND INTERSTITIAL FLUID VOLUME REGULATION

- Blood pressure, capillary permeability & osmosis affect movement of fluid from capillaries.
- A net movement of fluid occurs from blood into tissues.
- Fluid gained by tissues is removed by lymphatic system.

Diffusion at Capillary Beds (Fluid Balance)



Outward Forces:

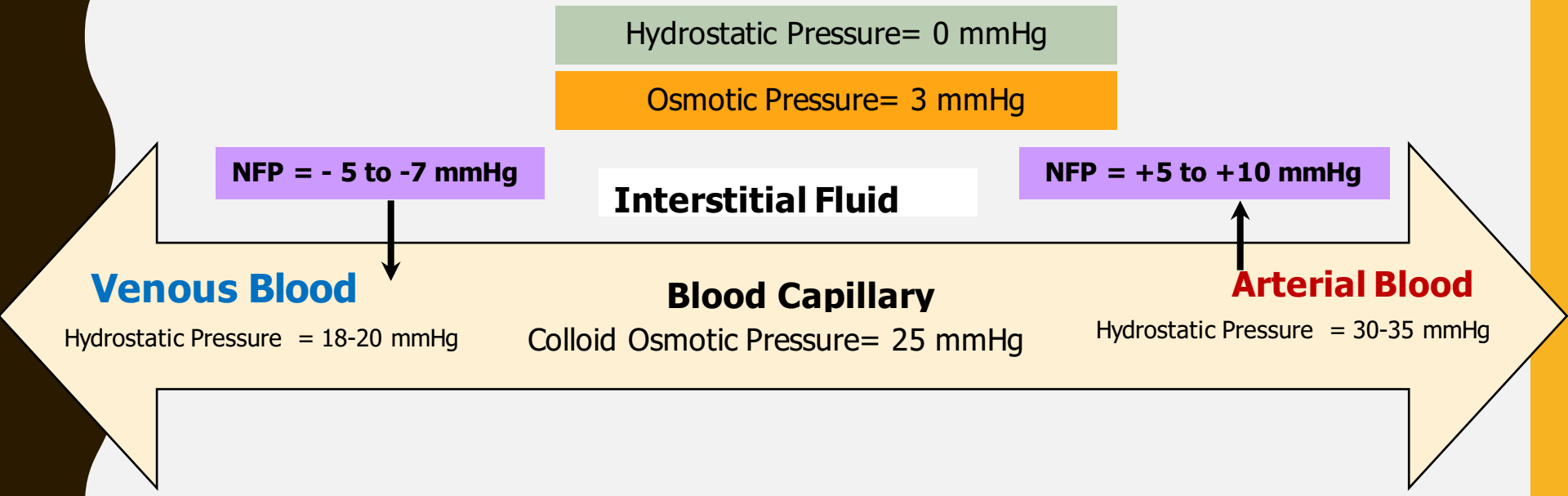
1. **Capillary blood pressure** (P_c = 30-35 to 10-15 mmHg)
2. **Interstitial fluid pressure** (P_{IF} = 0 mmHg)
3. **Interstitial fluid colloidal osmotic pressure** (μ_{IF} = 3 mmHg)

TOTAL = 38 to 18 mmHg

Inward Force:

1. **Plasma colloidal osmotic pressure** (μ_C = 25- 28 mmHg)

FLUID FILTRATION & REABSORPTION IN NORMAL MICROCIRCULATION

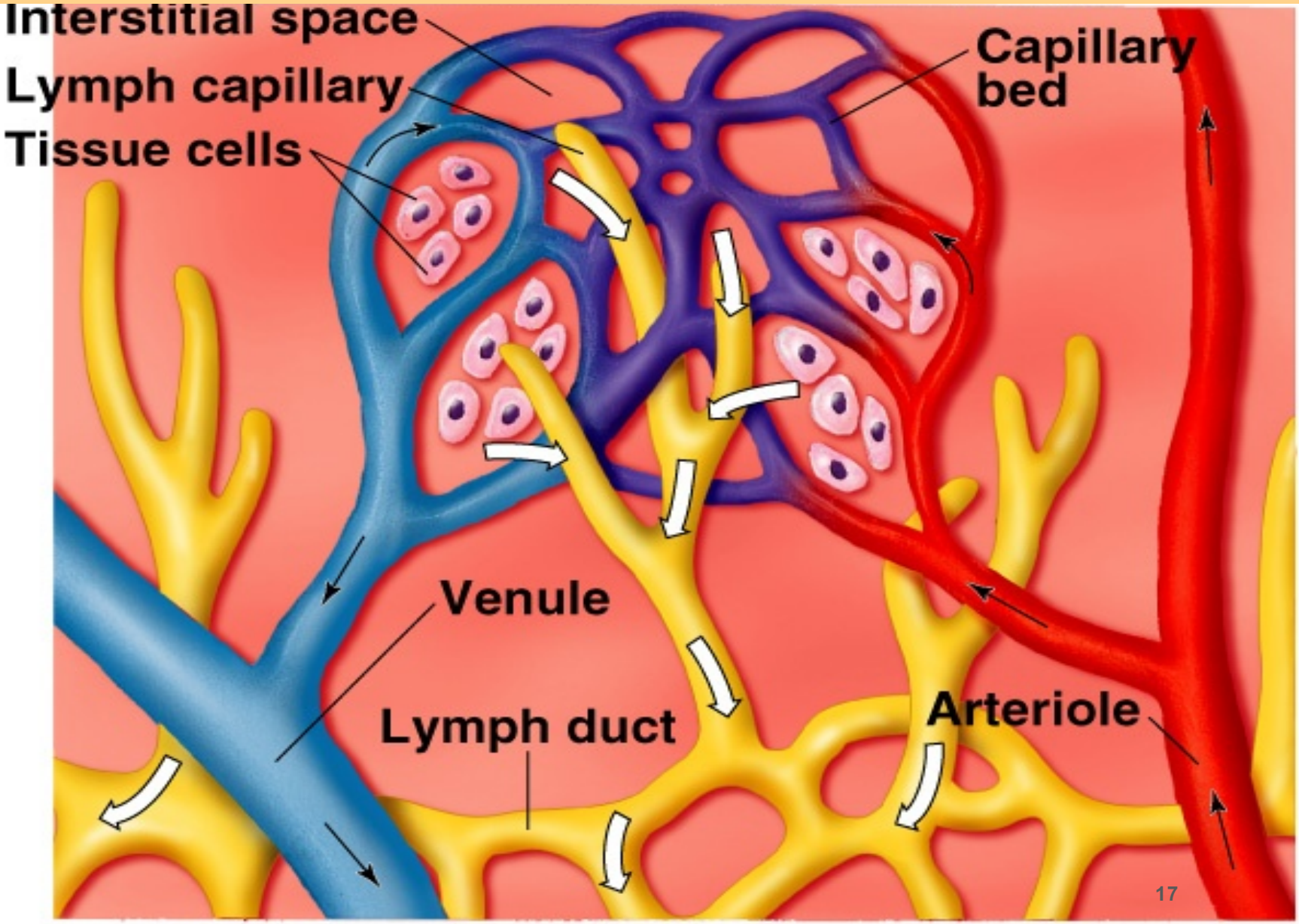


- **At arterial end:**
  - Water moves **out** of the capillary with a NFP of +5 to +10 mmHg.
  - Hydrostatic pressure dominates at the arterial end & net fluid flows out of the circulation.
- **At venous end:**
  - Water moves into the capillary with a NFP of -5 to -7 mmHg.
  - Oncotic pressure dominates at the venous end & net fluid will flow into the bloodstream.

LYMPHATIC SYSTEM

- Lymphatic vessels present b/w capillaries.
- **3 basic functions:**
  - Drain excess interstitial (tissue) fluid back to the bl, in order to maintain original bl volume.
  - Transports absorbed fat from small intestine to the bl.
  - Helps provide immunological defenses against pathogens.

LYMPHATIC SYSTEM




Thank You