Cardiovascular System: Blood Vessels

A. Types of Blood Vessels
   - arteries - conducting vessels, away from the heart, highest pressure
   - arterioles - resistance vessels
   - capillaries - exchange vessels
   - venules - collecting vessels
   - veins - conducting vessels, back toward the heart, lowest pressure

B. Structure of Blood Vessels
   1. Arteries
      - thick-walled, elastic and muscular (high pressure)
      - 3 tunics:
         - tunica interna
           - endothelium
           - basement membrane
           - internal elastic lamina
         - tunica media
           - smooth muscle
           - elastic fibers
           - external elastic lamina
         - tunica externa
           - elastic and fibrous CT
      - elastic arteries (conducting arteries) - aorta and major branches off aorta
         - function as “pressure reservoirs”
      - muscular arteries (distributing arteries) - small to medium-sized arteries
         - smooth muscle → vasoconstriction / vasodilation adjusts blood flow to organs
   2. Arterioles
      - small diameter, muscular walls
      - tunica media is mostly smooth muscle → vasoconstriction / vasodilation
      - regulate blood flow to tissues and affect blood pressure (vascular resistance)
   3. Capillaries
      - microscopic
      - endothelium + basement membrane; no tunica media or externa
      - capillary networks:
        - arteriole → metarteriole → capillary bed → venule
        - precapillary sphincters (smooth muscle) control flow to individual capillaries
        - thoroughfare channel - direct route from arteriole to venule, bypasses capillaries
      - 3 types of capillaries:
        - continuous capillary
        - fenestrated capillary
        - sinusoid
   4. Venules
      - small diameter, thin walls
      - structure is intermediate between capillaries and veins
   5. Veins
      - relatively thin walls (low pressure)
      - thin tunica media, relatively thick tunica externa, no elastic laminae
      - distensible → “volume reservoirs” - most blood is contained in veins and venules
      - valves prevent backflow
      - skeletal muscle “pumps” help venous return to the heart
C. Circulatory Routes

1. Pulmonary circulation
   - carries deoxygenated blood to lungs to pick up $O_2$ and eliminate $CO_2$
   - low pressure/low resistance circuit
   - pulmonary arteries carry deoxygenated blood; pulmonary veins carry oxygenated blood

2. Systemic circulation
   - delivers oxygenated blood to body
   - high pressure/high resistance circuit
   - arteries branch off the aorta
   - arteries are arranged in parallel to different organs
     - anastomoses - connections between arteries → provide alternate routes for blood flow
   - veins drain into the superior and inferior vena cava

3. Hepatic portal circulation
   - portal system connects two capillary networks: GI tract and liver
   - veins draining the GI tract and spleen converge to form the hepatic portal vein
   - hepatic portal vein carries blood from GI organs (mostly small intestine) to the liver;
     liver gets the “first pass” of nutrient-rich blood from the GI tract

Study Questions

1. Describe the three tunics of an artery and identify the tissues that comprise them. How do these tunics differ in relative thickness between an artery and a vein?

2. Which blood vessels function as conducting vessels? Which vessels are the major resistance vessels? Which vessels are the exchange vessels?

3. Where is the blood pressure highest and where is it lowest in the vascular system?

4. Which part of the vascular system normally contains the most blood?

5. Distinguish between elastic arteries and muscular arteries. Which vessels function as “pressure reservoirs”, and why is this important?

6. Describe the structural features of veins that help return blood to the heart.

7. What is the function of smooth muscle in the regulation of blood flow to specific organs, tissues, and capillary beds?

8. Describe the three different types of capillaries and give a location for each
   - continuous capillary
   - fenestrated capillary
   - sinusoid