Blood Vessels and Circulation Student Objectives:

Chapter 20 textbook and Laboratory Manual

- Compare and contrast structural and functional differences found in health and disease
- Apply critical thinking skills in various anatomical and physiological situations
- Distinguish among the types of blood vessels on the basis of their structure and function
- Describe the structural differences between arteries, capillaries, and veins
- Describe how and where fluid and dissolved materials enter and the cardiovascular system
- Explain the mechanisms that regulate blood flow through arteries, capillaries, and veins
- Describe the factors that influence blood flow and how blood pressure is regulated
- Discuss the mechanisms and various pressures involved in the movement of fluids between capillaries and interstitial spaces
- Describe how central and local control mechanisms interact to regulate blood flow and pressure in tissues
- Explain how the activities of the cardiac, vasomotor, and respiratory centers are coordinated to control blood flow through the tissues

- Identify layers or tunics present in a transverse section of an artery and vein
- Identify a cross sectional view of an artery and vein when provided with a microscopic view

- Identify the major arteries and veins of the systemic circulation on models or charts
- Identify the major vessels of the cerebral arterial circle (circle of Willis), pulmonary circulation, and hepatic portal system on models or charts
- Trace the blood flow through the cardiovascular system

Terms for review:
- Recall the definitions of the following terms
  Arteries
  Veins
  Systemic circulation
  Pulmonary circulation
  Osmotic pressure

  Hydrostatic pressure
  Plasma
  Hypoxia
  Embolism

Terms:
- Define the following terms
  Vasoconstriction
  Vasodilation
  Lumen
  Flow
  Perfusion
  Total flow

  Hemodynamics
  Blood pressure
  Angiogenesis
  Ischemia
  Vasomotion

Clinical Disorders:
- Syncope
- Arteriosclerosis
- Atherosclerosis
- Hypertension
- Hypotension

  Varicose veins
  Transient ischemic attacks (TIAs)
  Stroke (cerebrovascular accident, CVA)
  Aneurysm

I. Anatomy
   A. structure of vessel walls (histology)
      1. tunica externa
a. vasa vasorum  
2. external elastic lamina  
3. tunica media  
4. internal elastic lamina  
5. tunica interna (intima)  
   a. simple squamous epithelium  
   b. basement membrane  
6. lumen  

B. arteries  
1. functions  
2. types  
   a. elastic (conducting, large) arteries  
   b. muscular (distributing, medium) arteries  
   c. arterioles (resistance, small arteries)  
      i. metarterioles  
         • precapillary sphincters  
3. functions of each type  
4. arterial sense organs  
   a. carotid sinuses  
   b. carotid bodies  
   c. aortic bodies  

C. capillaries  
1. function  
2. structure  
   a. simple squamous epithelium  
   b. basement membrane  
3. types  
   a. continuous  
      i. intercellular clefts  
   b. fenestrated  
   c. sinusoids (discontinuous capillaries)  
4. capillary beds  
   a. precapillary sphincters  

D. anastomoses  

E. veins  
1. functions  
2. valves  
3. types  
   a. venules  
   b. small veins  
   c. medium veins  
   d. large veins  
4. varicose veins  

F. blood distribution  

II. Physiology  
A. hemodynamics – factors affecting circulation  
1. Pressure  
   a. Cardiac output  
   b. Blood volume  
   c. Resistance  
   d. Blood pressure  
      i. systolic pressure
2. Peripheral resistance
   a. Blood viscosity
   b. Vessel length
   c. Vessel radius
3. Velocity of blood flow

III. Regulation
A. Purpose
B. Mechanisms of control
   1. Autoregulation
   2. Neural control
      a. medulla oblongata
      b. sympathetic versus parasympathetic
      c. baroreflex
      d. chemoreflex
      e. medullary ischemic reflex
      f. hypothalamus
   3. Hormonal control
      a. angiotensin II
      b. aldosterone
      c. antidiuretic hormone (ADH)
      d. epinephrine and norepinephrine
      e. natriuretic peptides
         i. brain natriuretic peptide (BNP)
         ii. atrial natriuretic peptide (ANP)

IV. Capillary exchange
A. Routes of exchange
   1. Intercellular clefts
   2. Endothelial cells
   3. Transcytosis
   4. Fenestrations (filtration pores)
B. Mechanisms of exchange
   1. Diffusion
   2. Vesicular transport
      a. Transcytosis
         i. Endocytosis
         ii. Exocytosis
   3. Filtration and reabsorption
      a. Capillary pressures
         i. Blood hydrostatic pressure (BHP) – Blood pressure
         ii. Interstitial fluid hydrostatic pressure (IFHP)
         iii. Blood colloidal osmotic pressure (BCOP)
         iv. Interstitial fluid osmotic pressure (IFOP)
         v. Tissue fluid colloidal osmotic pressure
         vi. Net filtration pressure (NFP)
         vii. Arterial end
            • Net filtration
         viii. Venous end
            • Net reabsorption
C. Edema
a. increased capillary filtration  
b. reduced capillary reabsorption  
c. obstructed lymphatic drainage  
d. pathological consequences  

V. venous return  
A. mechanisms  
1. pressure gradient  
2. gravity  
3. skeletal muscle pump  
4. thoracic (respiratory) pump  
5. cardiac suction  
B. venous pooling  

VI. circulatory shock  
A. types  
1. cardiogenic shock  
2. low venous return (LVR) shock  
   a. hypovolemic shock  
   b. obstructed venous return shock (obstructive shock)  
   c. venous pooling (vascular) shock  
      i. neurogenic shock  
3. combined  
   a. septic shock  
   b. anaphylactic shock  
B. response  
1. compensated shock  
2. decompensated shock
VII. Major arteries and veins - Know these vessels on models and diagrams

Know the Systemic arteries on models and diagrams
- Ascending aorta
- R/L coronary arteries
- Aortic arch
- Brachiocephalic trunk
- L common carotid artery
- L subclavian artery
- R common carotid artery
- R subclavian artery
- Descending aorta

Know the major arteries supplying the head on models and diagrams
- External carotid arteries (anterior)
- Internal carotid arteries
- Vertebral arteries
- Basilar artery
- Circle of Willis (cerebral arterial circle)

Know the major arteries of the upper extremities on models and diagrams
- Subclavian arteries
- Axillary arteries
- Brachial arteries
- Radial arteries
- Ulnar arteries
- Palmar branches (deep and superficial)

Know the major arterial branches of the descending aorta on models and diagrams
- Thoracic aorta
- Abdominal aorta
- Celiac trunk
- L gastric artery
- Splenic artery
- Common hepatic artery
- Superior mesenteric artery
- R/L suprarenal arteries
- R./L renal arteries
- R/L gonadal arteries
- Inferior mesenteric artery
- R/L common iliac arteries

Know the major arteries of the pelvis and legs on models and diagrams
- Internal iliac arteries
- External iliac arteries
- Femoral arteries
- Popliteal arteries
- Anterior tibial arteries
- Posterior tibial arteries
- Fibular arteries
Know the major veins of the body on models and diagrams
Superior vena cava
R/L Brachiophealic veins
Internal jugular veins
External jugular veins
Vertebral veins
Subclavian veins
Cephalic veins
Axillary veins
Brachial veins
Basilic veins
Median cubital
Radial veins
Ulnar veins
Inferior vena cava
Hepatic veins
Suprarenal veins
Renal veins
R/L gonadals
Common iliac veins
Internal iliac veins
External iliac veins
Great saphenous vein
Femoral veins
Popliteal veins
Anterior tibial veins
Posterior tibial veins
Fibular (peroneal) veins
Small saphenous

Know the path of blood for pulmonary and systemic circulation
Pulmonary trunk
R/L pulmonary arteries
Lobar arteries
Pulmonary veins

Know the path of blood for the hepatic portal circulation
Inferior mesenteric vein
Splenic vein
Superior mesenteric vein
Left gastric vein
Hepatic portal vein