

## Chapter 10 – The Circulatory & Lymphatic Systems

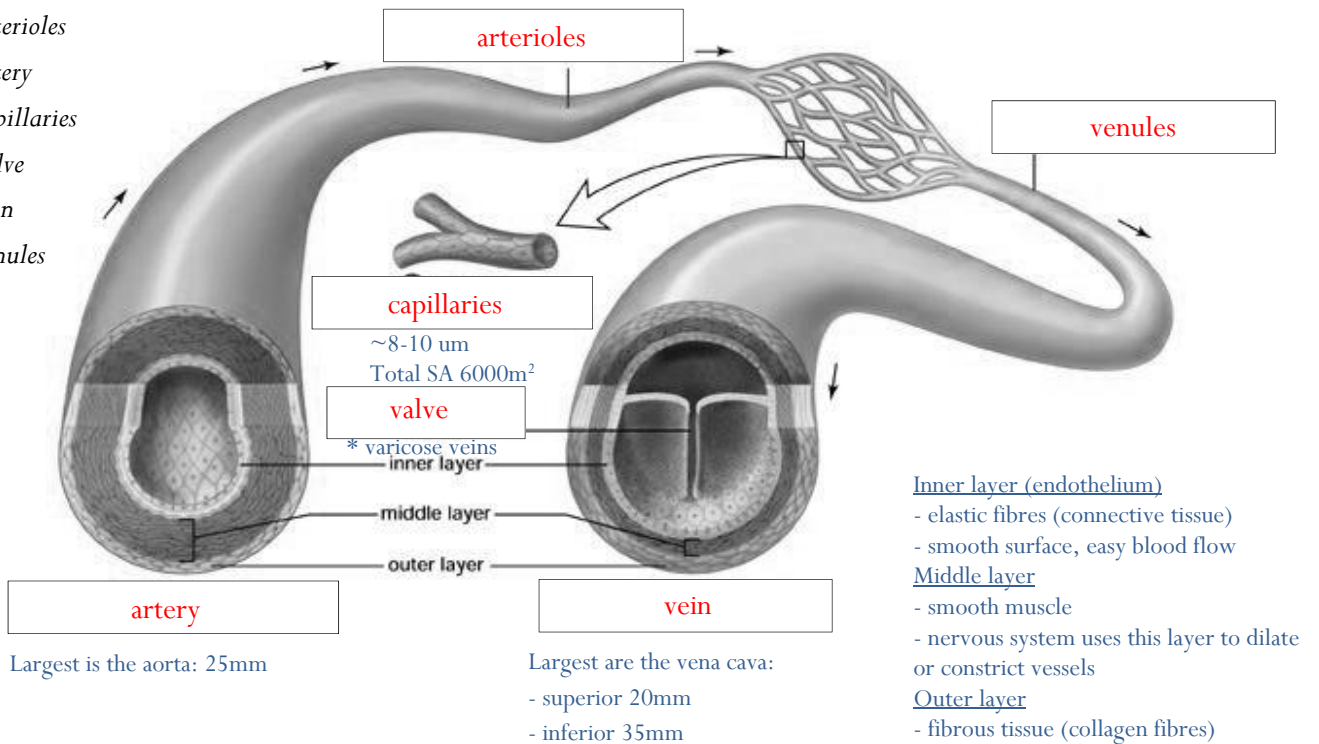
*Complete using BC Biology 12, pages 298 – 325*

**10.1 The Blood Vessels**

pages 298 - 299

1. Label the blood vessels in this diagram, using the following list of terms. Use Figure 10.1 to help if needed.

- arterioles
- artery
- capillaries
- valve
- vein
- venules

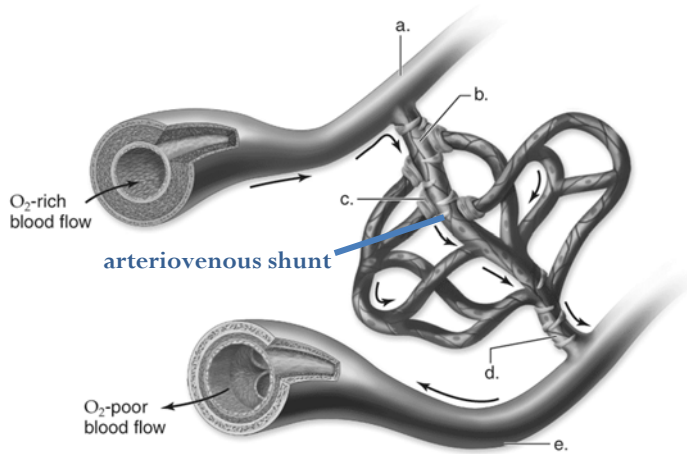


2. Match the statements to the terms: *artery, vein, capillary*

- |                     |  |
|---------------------|--|
| a. <u>Artery</u>    | Thickest walls   |
| b. <u>Vein</u>      | Has valves   |
| c. <u>Artery</u>    | Takes blood <b>away</b> from the heart   |
| d. <u>Vein</u>      | Takes blood <b>to</b> the heart  |
| e. <u>Capillary</u> | Exchanges CO <sub>2</sub> and O <sub>2</sub> with tissues  |
| f. <u>Vein</u>      | Nervous stimulation causes these to constrict during hemorrhaging; also act as a blood reservoir |

3. STRANGE BUT TRUE! The cornea of the eye is one region of the body that is nearly capillary-free. Why? Needs to be clear for light to pass through How do the cells in this region get nutrients? Diffusion from tears

4. Label the diagram below using Figure 10.2.



- a. artery \_\_\_\_\_
- b. arteriole \_\_\_\_\_
- c. precapillary sphincter \_\_\_\_\_
- d. venule \_\_\_\_\_
- e. ein \_\_\_\_\_

5. Explain how it is possible for blood to bypass capillary beds. Use the terms labelled in the figure above.

Precapillary sphincters are able to contract and re-route blood through the arteriovenous shunts. This sends blood directly from arteriole to venule, bypassing capillaries (as noted on the above diagram)

6. What is the term given to the sleepiness people may feel after eating? Postprandial somnolence  
 As recent evidence suggests it is not due to decreased blood supply to the brain, what is the suspected reason for this feeling? Hormones that are released by the digestive tract  
 What is the largest artery in the body? aorta  
 What is the largest vein in the body? vena cava (inferior specifically)

10.2 Blood

7. Blood is considered to be a liquid connective tissue.
8. Name the three broad functions of blood and give an example of each
- a. Transport : nutrients, wastes, gases as well as hormones
  - b. Regulatory : body temperature, blood pressure (plasma), blood pH (7.4)
  - c. Protective : fighting infections (white blood cells), clotting (platelets help decrease blood loss)
9. Plasma is mostly water (90-92%) and proteins (7-8%).
10. Place the correct plasma protein in the blank: *fibrinogen, albumin, lipo proteins, or all plasma proteins*
- a. lipoproteins transports cholesterol
  - b. fibrinogen helps blood clot
  - c. albumin transports bilirubin (breakdown product of hemoglobin)
  - d. all helps maintain the pH and osmotic pressure of the blood

11. The red blood cells, scientifically called erythrocytes, are made in the red bone marrow of the skull, the ribs, the vertebrae, and the ends of the long bones. Upon maturation, they are biconcave disks that lack a nucleus and contain hemoglobin (a red pigment). After about 120 days, red blood cells are destroyed in the liver and spleen.

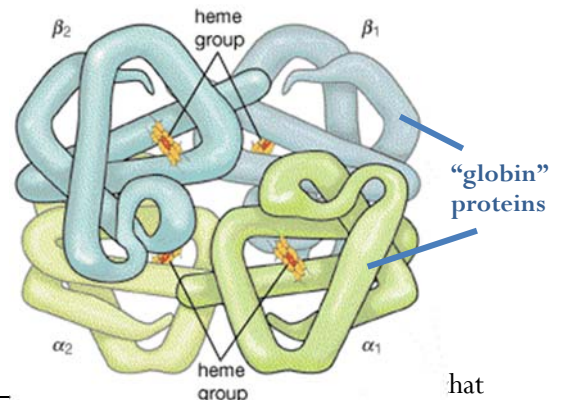
12. The condition of anemia is characterized by an insufficient number of red blood cells or not enough hemoglobin. What are three basic causes for this condition?

- (1) decreased production of red blood cells
- (2) loss of red blood cells from the body
- (3) destruction of red blood cells within the body

What is the most common type of anemia? Iron-deficiency anemia

13. Circle the items that describe hemoglobin correctly:

- a. each molecule contains three polypeptide chains
- b. each molecule contains four polypeptide chains**
- c. heme contains iron**
- d. globin contains iron
- e. makes leukocytes red
- f. makes erythrocytes red**
- g. becomes oxyhemoglobin when carrying oxygen**
- h. becomes deoxyhemoglobin when carrying oxygen



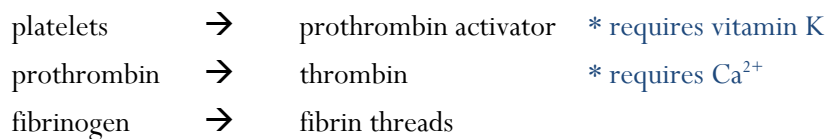
14. White blood cells, scientifically called leukocytes they are usually larger, have a nucleus, lack hemoglobin and without staining appear translucent. White blood cells fight infection and play a role in the development of immunity and the ability to resist diseases.

15. Name the two divisions of white blood cells.

- Granular: contain enzymes and proteins which help defend against microbes
- Agranular: also known as mononuclear cells and include the cells that are able to produce antibodies for long term immunity

16. Platelets, scientifically called thrombocytes, result from fragmentation of certain large cells called megakaryocytes, in the red bone marrow. They are involved in the process of blood clottings or coagulation.

17. The following shows the reactions that occur as blood clots:



Does the left-hand side or right-hand side list substances that are always present in the blood? left

Which substances function as enzymes? Prothrombin activator and thrombin

Which substance is the actual clot? Fibrin threads

18. Several nutrients are necessary for clotting to occur. Vitamin K is needed for the production of prothrombin. The element calcium is needed for conversion of prothrombin to thrombin. Hemophilia refers to a group of inherited clotting disorders caused by a deficiency in a clotting factor. The most common type, hemophilia A, accounts for about 90% of all cases and almost always occurs in males because the faulty gene is found on the X chromosome. Since females have 2 Xs they have a backup copy of the gene.

19. Complete the table below using Table 10.3 \*Not in order!

Body Fluids Related to Blood	
Name	Composition
Blood	Formed elements and plasma
Serum	Plasma minus fibrinogen
Lymph	Tissue fluid within lymphatic vessels
Plasma	Liquid portion of blood
Tissue fluid	Plasma minus most proteins

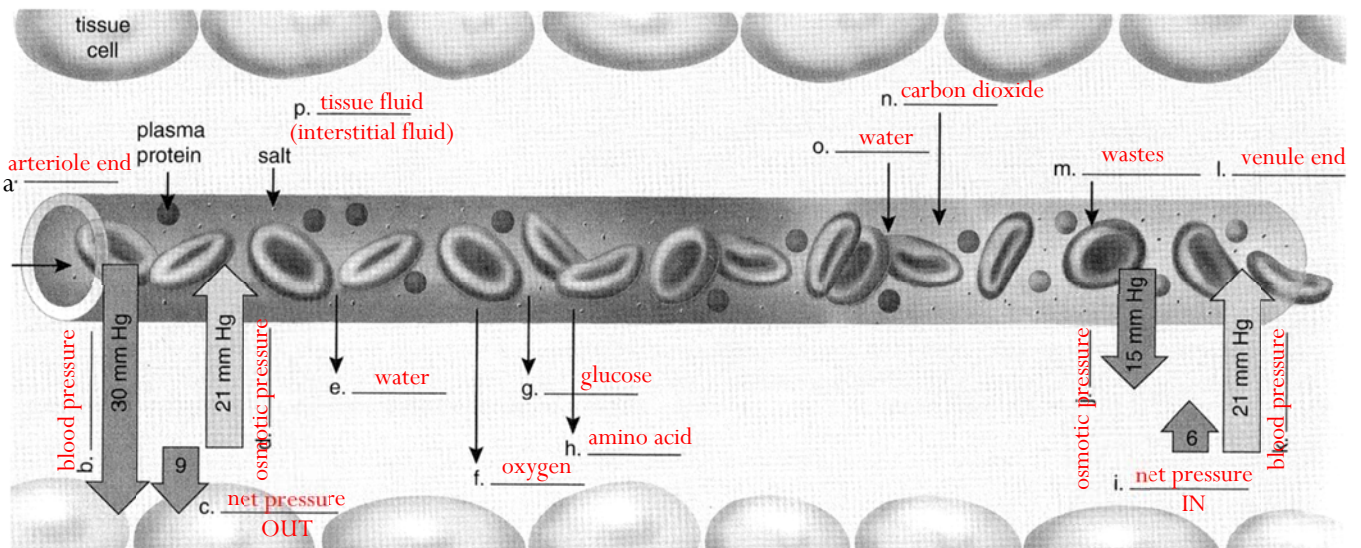
20. A stem cell is a cell that is ever capable of dividing and producing new cells that go on to differentiate into particular types of cells. Multipotent stem cells are known to be found in the bone marrow and have the ability to give rise to other stem cells for the various formed elements.

Why are researchers so interested in stem cells? Used to treat conditions and issues such as diabetes, heart disease, liver disease, or even brain disorders such as Alzheimer's

21. What is the benefit of using a person's own stem cells as opposed to using donor stem cells? Reduced chance of rejection

22. Label this diagram of capillary exchange using these terms:

- amino acid
- arterial end
- blood pressure (2)
- carbon dioxide
- glucose
- net pressure in
- net pressure out
- osmotic pressure (2)
- oxygen
- tissue fluid
- venous end
- wastes
- water (2)



23. Explain the diagram above. The movement of substances into and out of the blood is controlled by the pressure difference between the blood and the tissue fluid. At the arteriole end, the higher blood pressure helps “good” substances leave the blood and diffuse to the cells. At the venule end, the higher osmotic pressure helps put the “bad” materials back into the blood to get removed from the body.
24. Why is there excess tissue fluid, and what happens to it? less pressure pushing in at the venous end results in less water being reabsorbed and the excess is collected by the lymphatic capillaries as “lymph”. This is returned to the venous blood near the subclavian veins in the shoulder

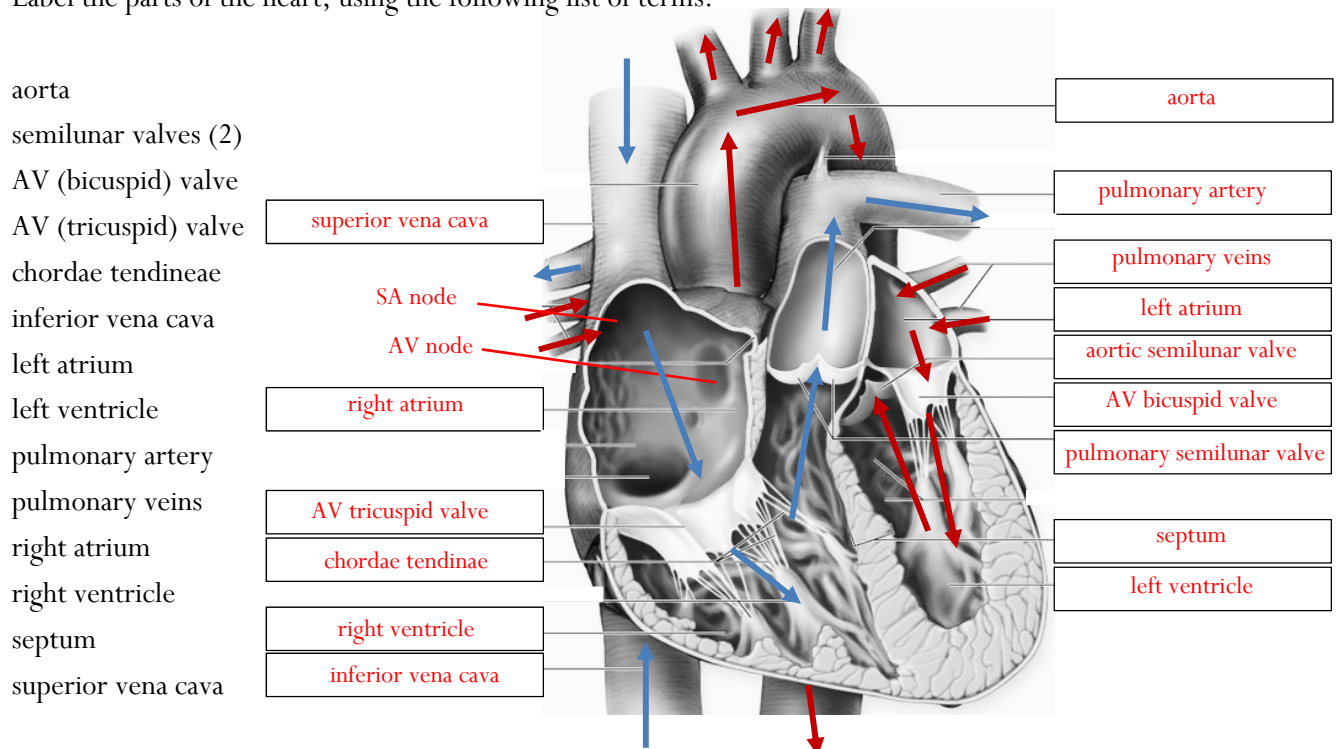
10.3 The Human Heart

pages 307 - 311

25. Distinguish between the **myocardium**, **pericardium** and **endocardium**.

- Myocardium: majority of heart, mainly cardiac muscle
- Pericardium: protective membrane surrounding the heart that has a lubricating fluid
- Endocardium: lines the inner surface of the heart, mainly connective and endothelial tissue

26. Label the parts of the heart, using the following list of terms.



27. Why is the left ventricle more muscular than the right ventricle? The left has the “harder” job of pumping blood to the ENTIRE body so it has to give a larger push initially. The right side only has to pump to the lungs which are in close proximity to the heart

28. Trace the path of blood...

- through the heart from the vena cava to the lungs. vena cava → right atrium → AV tricuspid valve → right ventricle → pulmonary semilunar valve → pulmonary trunk → pulmonary arteries → lungs
- the lungs to the aorta. lungs → pulmonary veins → left atrium → AV bicuspid valve → left ventricle → aortic semilunar valve → aorta

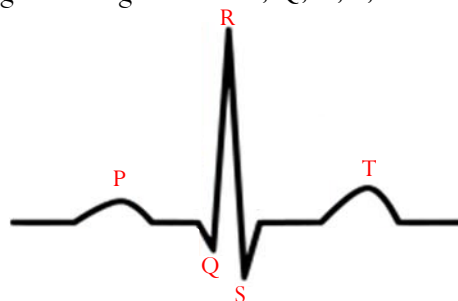
29. When the heart beats the two atria contract at the same time, then the two ventricles contract at the same time, then all of the chambers relax.
30. Fill in the following table with the words *systole* (contraction) and *diastole* (relaxation) to show what happens during the **0.85 seconds** of one heartbeat.

Cardiac Cycle		
Time	Atria	Ventricles
0.15 sec	systole	diastole
0.30 sec	diastole	systole
0.40 sec	diastole	diastole

31. When a heart beats, the familiar "lub-dup" sound occurs. This is best heard using a stethoscope. When the atria contract, this forces blood through the atrioventricular valves into the chambers called the ventricles. The closing of these valves is the **lub** sound. Next, the ventricles contract and force the blood into the arteries. Now the semilunar valves close, making the **dup** sound.
32. Match the phrases to these nodes: *SA node, AV node*
- a. SA node pacemaker
  - b. AV node contraction of ventricles
  - c. AV node base of right atrium near the septum
  - d. AV node Purkinje fibers

**\* Draw the SA and AV nodes onto the heart diagram on the last page**

33. Match the actions to these divisions of the nervous system: *parasympathetic system, sympathetic system*
- a. parasympathetic normal body functions
  - b. sympathetic active under times of stress
  - c. sympathetic releases norepinephrine to speed up heart
  - d. parasympathetic slows heart rate
34. Does the adrenal gland hormone, epinephrine, speed or slow the heart rate? speed up
35. What is the significance of each of the following in an electrocardiogram (ECG)?
- a. P wave atria contraction
  - b. QRS wave ventricle contraction
  - c. T wave ventricle relaxation
  - d. Label the following ECG diagram with P, Q, R, S, and T



36. Various types of abnormalities, known as arrhythmias, can be detected by an ECG.

Name the abnormalities or equipment based on the descriptions below.

- a. atrial fibrillation: most common type, results in a fast & irregular heartbeat
- b. palpitations: fluttering sensation in the heart as result of AF
- c. ventricular fibrillation: serious medical condition, commonly follows a heart attack by  
can be caused by injury or drug overdose
- d. automatic external defibrillators (AEDs): small devices used to determine whether a person is suffering  
from VF and if necessary to apply appropriate electrical shock

37. Name and distinguish between the two circuits of the circulatory system.

- **Pulmonary circuit: sends blood to the lungs to gain oxygen and remove carbon dioxide and returns to heart (right side of the heart)**
- **Systemic circuit: sends blood throughout the rest of the body (except lungs) and back to the heart (left side of the heart)**

38. Usually, arteries carry oxygenated blood and veins carry deoxygenated blood.

Name two vessels in which this is not the case.

- **Pulmonary artery and pulmonary vein**
- **Umbilical artery and umbilical vein (fetal circulation only)**

39. Trace the path of blood

To the left atrium:

right ventricle

a. pulmonary artery

lungs

b. pulmonary vein

left atrium

From the legs:

legs

c. iliac vein

d. inferior vena cava

right atrium

40. Trace the path of the blood

To the liver:

aorta

a. mesenteric artery

digestive tract

b. hepatic portal vein

liver

From the liver:

liver

c. hepatic vein

d. inferior vena cava

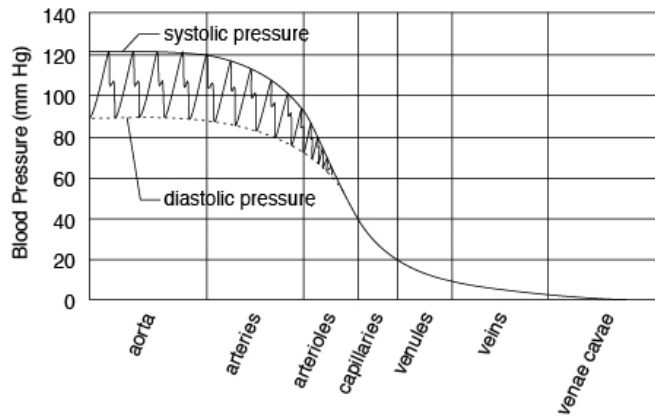
right atrium

41. Why are coronary arteries more likely to clog than other arteries?

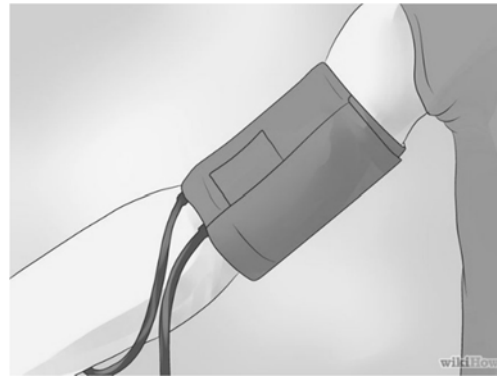
They have a very small diameter

42. Define **portal system**: blood circulation begins and ends in capillaries

The next three questions are based on this diagram. Use the space provided to answer them in complete sentences.



43. What force accounts for blood flow in arteries? strong squeeze from ventricles
44. Why does this force fluctuate? systole and diastole pressure from heartbeat
45. What causes the blood pressure and velocity to drop off? Distance from the heart, smaller diameter, plus higher total cross-sectional area.
46. Since there is little muscle surrounding the veins, what factors account for blood flow in the veins? contraction of skeletal muscles puts pressure on the veins
47. What keeps blood from flowing backward in veins? valves
48. A sphygmomanometer is the device used to measure blood pressure. Blood pressure is usually measured on the brachial artery. Why use this artery? Easy to get to, close to the heart, can be squeezed with no damage



## 10.5 Fetal Circulation

pages 314 - 315

49. Why does fetal circulation differ from regular circulation?  
Fetus does not use its lungs for gas exchange.
50. Much of the blood entering the right atrium is shunted into the left atrium through the foramen ovale (oval opening). Also, any blood that does enter the right ventricle and is pumped into the pulmonary trunk is shunted into the aorta by way of the ductus arteriosus (arterial duct).



51. Match each term to its correct description

*umbilical arteries*

*umbilical vein*

*ductus venosus*

*umbilicus*

- a. umbilicus navel
- b. ductus venosus (venous duct) connection of umbilical vein from liver to inferior vena cava
- c. umbilical vein takes nutrient and oxygen rich blood to the fetus
- d. umbilical arteries takes blood that has delivered its oxygen and nutrients back to the mother

52. Explain the function of the placenta.

Gas, nutrient and waste exchange between the fetal and maternal circulatory systems.

## 10.6 The Lymphatic System

pages 315 - 318

53. What is tissue fluid comprised of? Another term for this fluid is lymph.

Mostly water, plus solutes (i.e. nutrients, electrolytes, oxygen) derived from plasma and cellular products (e.g. hormones, enzymes, wastes) secreted by cells

54. Describe an *edema* and its causes.

Localized swelling caused by the accumulation of tissue fluid that has not been collected by the lymphatic system. It occurs if too much tissue fluid is made and/or if not enough is drained away.

55. Two primary lymphoid organs: thymus and red bone marrow

Two secondary lymphoid organs: lymph nodes and spleen

56. Why do physicians feel for the presence of swollen or tender lymph nodes?

Evidence that the body is fighting an infection

## 10.7 Innate & Adaptive Immunity

pages 318 - 321

Not specifically covered in this course but an interesting topic!

57. Complete the table. Your knowledge of the disorders will not be tested but rather is provided for interest sake.

Disorder	Description
Atherosclerosis	<p>Accumulation of soft masses of fatty materials beneath linings of arteries. What are these deposits called? <b>plaque</b></p> <p>What is the difference between a thrombus and an embolus? <b>thrombus – stationary clot</b> <b>embolus – clot that dislodges and moves in the blood</b></p>
Hypertension	<p>High blood pressure. What would be a high blood pressure reading for you? <b>130/90 mm Hg</b></p> <p>Name two types of medications used to treat high blood pressure.</p> <ul style="list-style-type: none"> <li>• <b>Diuretics (reduces blood volume)</b></li> <li>• <b>Vasodilators (dilates blood vessels)</b></li> </ul>
Heart valve disease	<p>Can occur as a birth defect or degenerate due to age or infections. What do they often get replaced by?</p> <ul style="list-style-type: none"> <li>• <b>Artificial valves</b></li> <li>• <b>Animal valves (usually pig) or from a deceased human</b></li> </ul>
Stroke	Arteriole in the brain bursts or is blocked by a blood clot.
Angina pectoris	Partial blockage of a coronary artery.
Heart attack	Complete blockage of a coronary artery. A portion of the heart muscle dies due to a lack of oxygen.
Aneurysm	Ballooning of the blood vessel, most often in the abdominal aorta or the arteries leading to the brain.

1. C                      8. B                      15. B                      22. A  
 2. A                      9. A                      16. B                      23. B  
 3. A                      10. D                      17. B                      24. D  
 4. B                      11. C                      18. A                      25. D  
 5. A                      12. D                      19. D                      26. C  
 6. B                      13. B                      20. D                      27. B  
 7. A                      14. C                      21. D

29. Composition of blood: Plasma plus formed elements (blood cells)  
 30. (a) Allows more flexibility, more room for hemoglobin (increased capacity to carry oxygen)  
 (b) Replication or protein synthesis  
 31. C                      32. A                      33. C                      34. D  
 35. Complete the table

	Red Blood Cells	White Blood Cells	Platelets
Other name	Erythrocytes	Leukocytes	Thrombocytes
Site of Production	Red Bone Marrow		
Structure & Appearance	Biconcave disks; no nucleus; has hemoglobin	Larger cells; have a nucleus; may have granules	Irregular; fragments of megakaryocytes
Function	carries oxygen and carbon dioxide	Destroy pathogens; involved in specific immunity	Helps in blood clotting

36. Decreased amount of oxygen causes increased production of red blood cells to carry oxygen  
 37. C                      38. B                      39. B                      40. D  
 41. C  
 43. Complete the table

Blood Vessel	Structure	Function
Artery	3 layers; thick middle layer; very elastic	Carry blood away from heart
Arteriole	3 layers; similar to arteries but smaller	Connects arteries to capillaries
Capillary	1 thin layer, very narrow, large S.A.	Exchange of gases, nutrients, and wastes with body tissues
Venule	3 layers; smaller version of veins	Connects capillaries to veins
Vein	3 layers; thin middle layer; has valves	Carry blood to the heart

44. Muscular organ that is able to pump blood to various regions. 4 chamber, double loop system is very efficient; protected and lubricated by the pericardium
45. Function of circulatory system with respect to each of the following
- (a) clotting helps blood clot to prevent excess bleeding
- (b) transport of gases, hydrogen ions, hormones, nutrients, wastes, and solutes around the body
- (c) pH balance buffers in blood maintain the blood pH around 7.4
- (d) thermoregulation regulates body temperature by controlling flow of blood to skin to disperse heat
- (e) protection from infection white blood cells fight against pathogens
46. Parts of the heart
- (A) aorta (I) inferior vena cava
- (B) pulmonary artery (J) atrioventricular tricuspid valve
- (C) left atrium (K) pulmonary semilunar valve
- (D) pulmonary veins (L) pulmonary veins
- (E) aortic semilunar valve (M) right atrium
- (F) atrioventricular bicuspid valve (N) superior vena cava
- (G) left ventricle (O) pulmonary arteries
- (H) right ventricle
47. Match the description to the blood vessel
- (a) 10 (f) 7 (k) 5 (p) 18
- (b) 13 (g) 1 (l) 15 \* (q) 2
- (c) 6 (h) 3 (m) 14
- (d) 16 (i) 11 (n) 4
- (e) 12 (j) 9 (o) 17
48. Distinguish between...
- (a) Artery carries blood AWAY from the heart  
Vein carries blood TO the heart
- (b) Atrium collects blood returning to the heart, thin walled  
Ventricle pumps blood out of the heart, muscular walls
- (c) Blood contained within blood vessels; transports gases, nutrients and wastes  
Interstitial Fluid outside of blood vessels; allows diffusion of materials to and from tissues
- (d) Plasma mainly water; liquid component of blood (55%)  
Formed elements red blood cells, white blood cells, platelets; solid component of blood (45%)
- (e) Tricuspid valve prevents blood from flowing back into the right atrium from the right ventricle  
Bicuspid valve prevents blood from flowing back into the left atrium from the left ventricle
- (f) Systemic circuit blood flow through the body (except the lungs); controlled by left side of heart  
Pulmonary circuit blood flow through the lungs to pick up O<sub>2</sub> and drop off CO<sub>2</sub>; right side of heart

- (g) Atrioventricular valve prevents backflow of blood into the atria from the ventricles  
Semilunar valve prevents backflow of blood into the ventricles once it leaves the heart
- (h) Intrinsic control internal control of heartbeat; SA and AV nodes in right atrium  
Extrinsic control external control of heartbeat; autonomic nervous system
- (i) Left side of heart collects blood coming back from lungs and sends it out to the body  
Right side of heart collects blood coming back from the body and sends it to the lungs

49. \_\_\_\_\_

52. \_\_\_\_\_

53. \_\_\_\_\_

59. \_\_\_\_\_

61. \_\_\_\_\_

62. \_\_\_\_\_

65. Match the description to the fetal circulatory feature

- |         |         |         |         |
|---------|---------|---------|---------|
| (a) ___ | (f) ___ | (k) ___ | (p) ___ |
| (b) ___ | (g) ___ | (l) ___ | (q) ___ |
| (c) ___ | (h) ___ | (m) ___ | (r) ___ |
| (d) ___ | (i) ___ | (n) ___ | (s) ___ |
| (e) ___ | (j) ___ | (o) ___ |         |

73. (a) Show your work

(b) Show your work

*Mark the review questions using the answer key on pages 544 - 546*