10.1 The Blood Vessels

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. Artery Thickest walls
   b. Vein Has valves
   c. Artery Takes blood away from the heart
   d. Vein Takes blood to the heart
   e. Capillary Exchanges CO₂ and O₂ with tissues
   f. Vein 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.

![Diagram of arteriovenous shunt]

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)

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: fights 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, lipoproteins, 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, 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:
   - platelets → prothrombin activator * requires vitamin K
   - prothrombin → thrombin * requires Ca^{2+}
   - fibrinogen → fibrin threads

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!*

<table>
<thead>
<tr>
<th>Body Fluids Related to Blood</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
</tr>
<tr>
<td>Blood</td>
</tr>
<tr>
<td>Serum</td>
</tr>
<tr>
<td>Lymph</td>
</tr>
<tr>
<td>Plasma</td>
</tr>
<tr>
<td>Tissue fluid</td>
</tr>
</tbody>
</table>

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)

![Diagram of capillary exchange](image-url)

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[Diagram of capillary exchange](image-url)
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

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.

   aorta
   semilunar valves (2)
   AV (bicuspid) valve
   AV (tricuspid) valve
   chordae tendineae
   inferior vena cava
   left atrium
   left ventricle
   pulmonary artery
   pulmonary veins
   right atrium
   right ventricle
   septum
   superior vena cava

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...
   a. 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
   b. 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.

<table>
<thead>
<tr>
<th>Cardiac Cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time</td>
</tr>
<tr>
<td>0.15 sec</td>
</tr>
<tr>
<td>0.30 sec</td>
</tr>
<tr>
<td>0.40 sec</td>
</tr>
</tbody>
</table>

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

10.4 The Vascular Pathways

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: From the legs:
right ventricle legs
a. pulmonary artery lungs
   c. iliac vein
b. pulmonary vein left atrium
d. inferior vena cava

40. Trace the path of the blood

To the liver: From the liver:
aorta liver
a. mesenteric artery digestive tract
c. hepatic vein
d. inferior vena cava
b. hepatic portal vein liver
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
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.

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)** between the two atria. 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.

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

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.

<table>
<thead>
<tr>
<th>Disorder</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atherosclerosis</td>
<td>Accumulation of soft masses of fatty materials beneath linings of arteries. What are these deposits called? plaque&lt;br&gt;What is the difference between a thrombus and an embolus? thrombus – stationary clot&lt;br&gt;embolus – clot that dislodges and moves in the blood</td>
</tr>
</tbody>
</table>
| Hypertension      | High blood pressure. What would be a high blood pressure reading for you? 130/90 mm Hg<br>Name two types of medications used to treat high blood pressure.  
  • Diuretics (reduces blood volume)<br>  • Vasodilators (dilates blood vessels) |
| Heart valve disease | Can occur as a birth defect or degenerate due to age or infections. What do they often get replaced by?  
  • Artificial valves<br>  • Animal valves (usually pig) or from a deceased human |
| 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.                                         |
Chapter 10 Review Questions

1. C
2. A
3. A
4. B
5. A
6. B
7. A
8. B
9. A
10. B
11. C
12. D
13. B
14. C
15. B
16. B
17. B
18. A
19. A
20. D
21. D
22. A
23. B
24. D
25. D
26. C
27. B
28. C
29. A
30. D
31. C
32. A
33. C
34. D
35. Complete the table

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

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

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

(B) pulmonary artery

(C) left atrium

(D) pulmonary veins

(E) aortic semilunar valve

(F) atrioventricular bicuspid valve

(G) left ventricle

(H) right ventricle

(I) inferior vena cava

(J) atrioventricular tricuspid valve

(K) pulmonary semilunar valve

(L) pulmonary veins

(M) right atrium

(N) superior vena cava

(O) pulmonary arteries

47. Match the description to the blood vessel

(a) 10

(b) 13

(c) 6

(d) 16

(e) 12

(f) 7

(g) 1

(h) 3

(i) 11

(j) 9

(k) 5

(l) 15 *

(m) 14

(n) 4

(o) 17

48. Distinguish between...

(a) Artery carries blood AWAY from the heart

(b) Atrium collects blood returning to the heart, thin walled

(c) Blood contained within blood vessels; transports gases, nutrients and wastes

(d) Plasma mainly water; liquid component of blood (55%)

(e) Tricuspid valve prevents blood from flowing back into the right atrium from the right ventricle

(f) Systemic circuit blood flow through the body (except the lungs); controlled by left side of heart

(g) Pulmonary circuit blood flow through the lungs to pick up O₂ and drop off CO₂; 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) ___ (l) ___ (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