

11 Blood

I. Behavioral Objectives

Students should be able to

1. state the components of blood, their function, and their source;
2. describe the transport in general of gases and other molecules;
3. describe the structure of red cells and their life cycle;
4. draw and explain a diagram depicting capillary exchange within the tissues;
5. give three equations in the proper order to describe the process of blood clotting;
6. classify white cells and describe the structure and function of neutrophils and lymphocytes;
7. define immunity and describe how it is acquired and how it functions;
8. list the four major types of blood and describe how blood is typed and who can give blood to whom;
9. describe the possible Rh complications of pregnancy.

II. Pretest

1. The smallest of the white cells is the _____, which has a _____ nucleus and makes _____.
2. Oxygen is transported about the body in combination with _____.
3. At the arterial side of a capillary, _____ aids the passage of water out of the blood. At the venous side, _____ aids the passage of water into the blood.
4. Small organic molecules such as glucose are transported in the _____ portion of blood.
5. Blood clotting is dependent on both a formed element, _____, and two proteins in the blood, _____ and _____.
6. White cells are divided into the _____ and the _____; the latter have granules in the cytoplasm.
7. Antibodies are _____ molecules, which combine with antigens.
8. Neutrophils function by _____ bacteria.
9. Blood type AB has _____ antigens on the red cells and _____ antibodies in the plasma.
10. An Rh negative woman may form _____ that destroy her Rh positive baby's red cells.

III. Definitions

Define these terms:

1. formed elements (p. 227) _____
2. hemoglobin (p. 229) _____
3. anemia (p. 232) _____
4. carbonic anhydrase (p. 234) _____

5. filtration (p. 234) _____
6. coagulation (p. 236) _____
7. agranulocytes (p. 237) _____
8. polymorphonuclear (p. 237) _____
9. antigen (p.239) _____
10. agglutination (p. 239) _____

IV. Study Questions

1. Blood components. Fill in the second column of the table below by noting the source for each of these components. Fill in the third column by stating the function.

Blood Components	Source	Function
<i>Formed Elements:</i>	_____	_____
Red cells		
White cells		
Platelets		
<i>Plasma:</i>	_____	_____
Water		
<i>Proteins:</i>		_____
Albumin		
Globulin		
Fibrinogen		
Glucose		
Amino acids		
Oxygen		
Carbon dioxide		
Urea		
Salt		
Hormones		

2. Blood clotting. These are the reactions that occur when blood clots. Put a check (✓) beside those substances that are always present in the blood. Put an (X) beside those substances that arise after blood begins the process of clotting. Put a star (★) beside those substances that act as enzymes. Underline the words that indicate the actual clot.

_____ platelets → thromboplastin _____
 _____ prothrombin → thrombin _____
 _____ fibrinogen → fibrin threads _____

3. Life cycle of red cells. The red cells, scientifically called _____, are made in the _____ . Upon maturation they are small, biconcave disks that lack a _____, but they are filled with the complex protein called _____, which transports _____ about the body. After about 120 days, red cells are destroyed in the _____ or _____.

4. Life cycle of white cells.

- a. Most white cells, scientifically called _____, are made in the _____, but lymphocytes are also made in the _____.
- b. White cells are divided into two types, the _____ and the _____.
- c. Leukocytes with many-lobed nuclei are therefore called _____.
- d. Fill in the table below, which contrasts the neutrophil with the lymphocyte.

Neutrophil	Lymphocyte
(1) polymorphonuclear	
(2)	agranular
(3) phagocytic	
(4)	made in lymphoid tissue

- e. The two ways that white cells fight infection are

(1) _____
 (2) _____

- f. Which of these is associated with immunity?

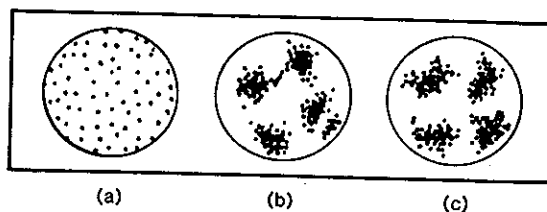
5. Blood typing. Blood typing is based on an antigen-antibody reaction, which takes place when an antigen of the same type letter is brought into contact with an antibody of the same type letter. The antigen-antibody reaction causes clumping or agglutination of the red cells that contain the antigen. Your blood is typed according to the type of antigen present on your red cells. In the plasma, antibodies present will not be of the same type letter as the antigen. Why not?

Below is a table indicating the blood types. Fill in the third and fourth columns by using this formula: The donor's antigen(s) must not be of the same type letter as the recipient's antibody (antibodies).

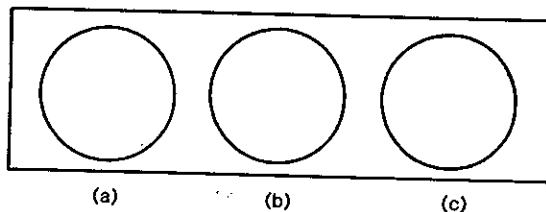
Blood Type Antigen	Antibody	Can Receive from	Can Donate to
A	b	a.	b.
B	a	c.	d.
AB	—	e.	f.
O	a,b	g.	h.

- i. Which blood type theoretically could be given to anyone? _____
- j. Which blood type theoretically could receive blood from anyone? _____
6. Rh factor. The Rh factor is also an antigen. If you are Rh+, you have the antigen. If you are Rh-, you do not have the antigen. The Rh factor is important during pregnancy. If the mother is Rh- and the father is Rh+, the child may be Rh+. In that case, during the process of birth some of the baby's blood may enter the bloodstream of the mother. She now makes antibodies against this factor, and if the next fetus is Rh+, her antibodies may cross the placenta to attack the fetus' blood. Which of these combinations is the one which causes difficulty?
- Rh+ mother and Rh- father
 - Rh- mother and Rh- father
 - Rh+ mother and Rh+ father
 - Rh- mother and Rh+ father
7. Blood typing. Assume that this is an experimental procedure to determine blood type. A sample of the patient's blood and a drop of anti-A has been placed at location (a), patient's blood and anti-B are at location (b), and patient's blood and anti-Rh are at location (c).

If the patient has B+ blood, these would be the results:

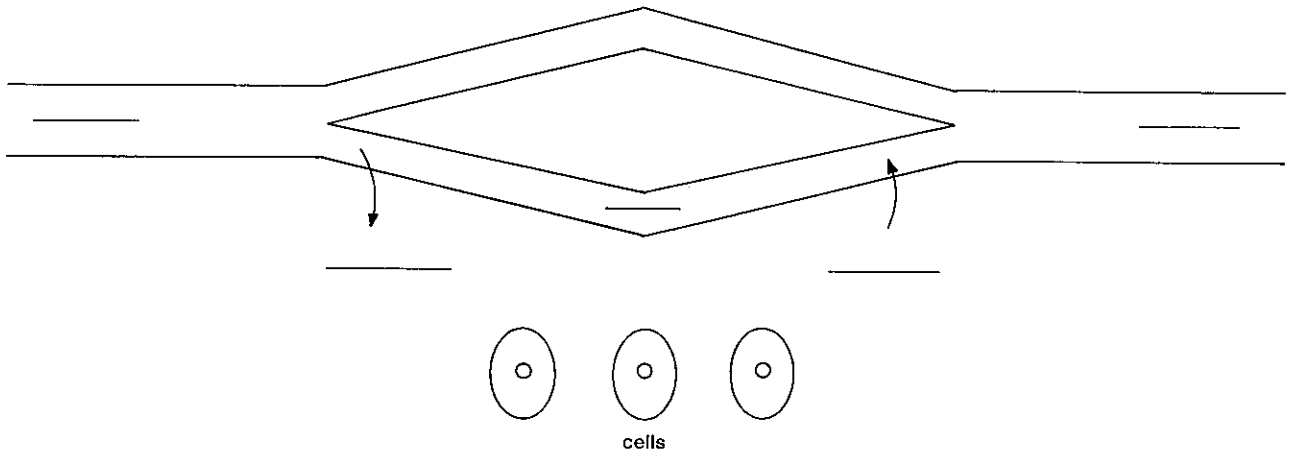


What would be the results if the patient had AB- blood?



8. Capillary bed. The capillaries are the most important part of the circulatory system because _____

Diagram of a capillary bed.



On the diagram of the capillary bed:

- Label the arteriole, capillary, and venule.
- Write in *blood pressure* on the side of the bed where it is most significant, and *osmotic pressure* on the side where it is most significant.
- On the appropriate line in the diagram, write in one of these numbers to show where you would expect these components of blood to be found.
 - Blood: plasma + formed elements
 - Nutrient molecules (for example, oxygen and glucose) + water
 - Waste molecules (for example, ammonia and carbon dioxide) + water
 - Formed elements + proteins
 - Blood: plasma + formed elements
- Add the words *tissue fluid* where appropriate and draw in a lymph capillary and vessel.

V. Posttest

- Which of the following is not a blood protein?
 - collagen
 - prothrombin
 - albumin
 - fibrinogen
 - globulin
- Which of these is a function of blood proteins?
 - maintain osmotic pressure
 - aid in maintenance of pH
 - fight infection
 - contribute to blood clotting
 - all of these
- The best definition for plasma is
 - the same as tissue fluid
 - the liquid remaining after blood clots
 - the liquid part of blood
 - all of these

4. Which of these is not a valid contrast between red cells and white cells?

red white

- a. erythrocyte—leukocyte
 - b. numerous—less numerous
 - c. lacks nucleus—has nucleus
 - d. phagocytic—motile
5. A person with blood type O
- a. lacks antigens on the red cells
 - b. lacks antigens in the plasma
 - c. both of these
 - d. lacks the Rh factor
6. The last step in blood clotting
- a. requires calcium ions
 - b. occurs outside the bloodstream
 - c. converts thrombinogen to thrombin
 - d. converts fibrinogen to fibrin
7. At a capillary
- a. glucose and oxygen exit from the venous end, and ammonia and carbon dioxide enter at the arterial end
 - b. glucose and ammonia exit from the arterial end, and oxygen and carbon dioxide enter at the venous end
 - c. blood pressure increases as the cross-sectional area increases
 - d. glucose and oxygen exit from the arterial end, and ammonia and carbon dioxide enter at the venous end
8. In which way is a neutrophil like a lymphocyte?
- a. They both produce antibodies.
 - b. They are both phagocytic.
 - c. They are both made in lymphoid tissue.
 - d. They both have a many-lobed nucleus.
 - e. They are both white cells.
 - f. all of these
9. Which of these characterizes anemia?
- a. low red blood cell count and/or low hemoglobin
 - b. a viral infection
 - c. a congenital disease
 - d. all of these
10. An Rh positive fetus being carried by an Rh negative mother
- a. develops antibodies to the mother's blood
 - b. develops antigens to the mother's blood
 - c. may have its red cells attacked by antibodies made by the mother
 - d. may have its red cells attacked by antigens made by the mother
11. Water leaves capillaries at their arteriole ends because
- a. osmotic pressure gradients are in opposite directions
 - b. blood pressure is greater than the osmotic pressure
 - c. a gradient is established for passive diffusion
 - d. osmotic pressure is always greater than blood pressure
 - e. *b* and *d*
12. Water reenters capillaries at their venule ends due to
- a. active transport from interstitial fluid
 - b. a protein concentration gradient
 - c. increasing blood pressure
 - d. increasing hemoglobin production

13. The agglutination of red blood cells occurs whenever
- appropriate antibodies bind with antigens on red cells
 - a person receives a blood transfusion from someone with an incompatible blood type
 - complementary antibodies combine
 - blood cells are destroyed by leukocytes
 - a* and *b*

In questions 14–16, fill in each blank with the proper term.

14. _____ is a red iron-containing pigment in blood that combines with and transports oxygen.
15. _____ is a foreign substance, usually a protein, that combines with antibodies.
16. _____ is a clumping of cells, particularly in reference to red cells involved in an antigen-antibody reaction.

10 Circulation

I. Behavioral Objectives

Students should be able to

1. name and describe the structure and function of blood vessels;
2. name the parts of the heart and trace the path of blood through the heart;
3. describe the heartbeat and the intrinsic mechanism for controlling the heartbeat;
4. label and explain a normal electrocardiogram;
5. name the parts of the circulatory system and trace the path of blood in general and specifically to any organ in the body;
6. describe the location, operation, and function of valves in the vessels and the heart;
7. describe the structure and function of the lymphatic system including the lymph vessels;
8. describe the factors that control the flow of blood in the arteries, capillaries, and veins;
9. discuss the factors that contribute to heart and circulatory disease.

II. Pretest

1. The major systemic artery in the body is the _____.
2. The systemic system begins with the _____ of the heart and ends with the _____ of the heart.

3. Contraction of the heart is called _____ and just following contraction blood pressure is at its _____.
4. The S-A node is often called the _____.
5. The first wave in an electrocardiogram occurs during the contraction of the _____, while the second occurs during the contraction of the _____.
6. A vein is a blood vessel that takes blood to _____.
7. Movement of blood in the veins is aided by _____.
8. Capillaries are tiny vessels with _____ walls facilitating the exchange of molecules.
9. The vessels that serve the kidney are called _____ vessels.
10. The lymph vessels begin in the tissues and eventually join the _____.
11. Two factors that may contribute to the medical condition termed *hypertension* are _____ and _____.
12. A stroke occurs when brain cells are denied _____.

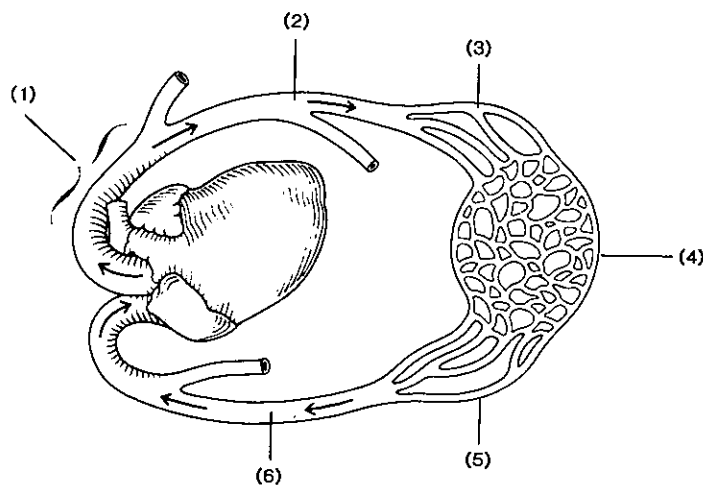
III. Definitions

Define these terms:

1. pulse (p. 215) _____
2. blood pressure (p. 216) _____
3. hyper-, hypotension (p. 216) _____
4. lacteals (p. 218) _____
5. thrombus (p. 220) _____
6. embolism (p. 220) _____
7. stroke (p. 220) _____
8. coronary thrombosis (p. 220) _____
9. angina (p. 220) _____
10. varicose veins (p. 221) _____

IV. Study Questions

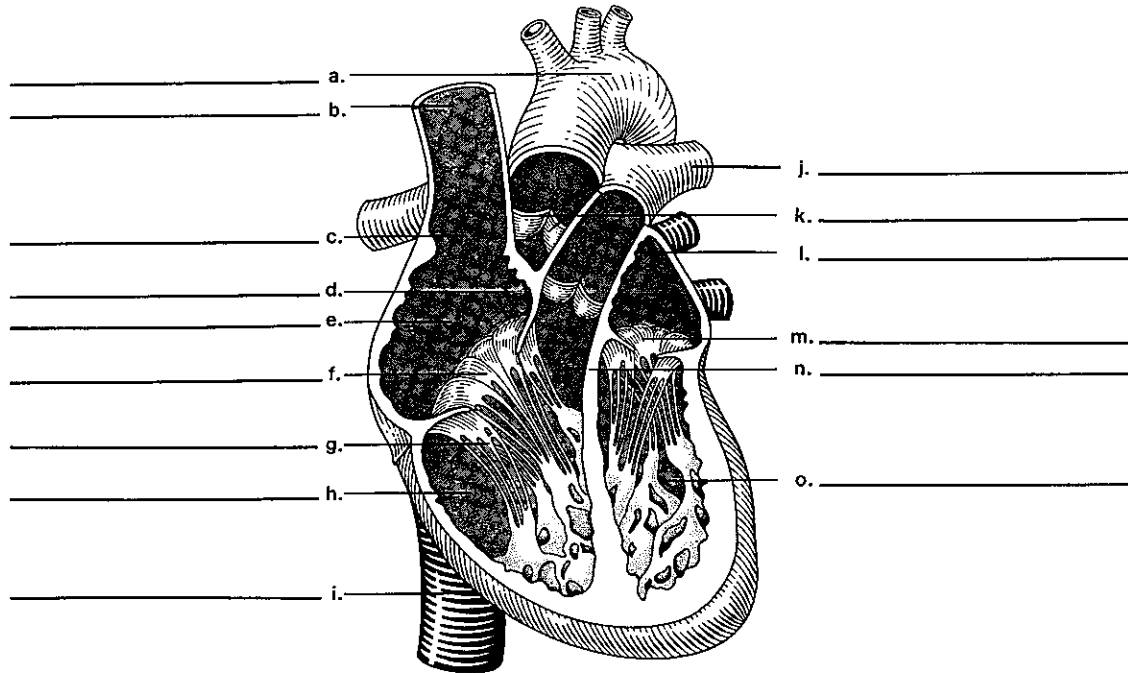
1. a. General circulation. Label the parts of the circulatory system in this diagram.



- b. What is the correct definition of an artery? _____

- c. What is the correct definition of a vein? _____

- d. Key: artery
 vein
 capillary
- (1) Which of these has the thickest walls? _____
- (2) Which of these has valves? _____
- (3) Which of these has the most cross-sectional area? _____
2. Label this diagram of the heart.



3. Trace the path of blood through the heart
- a. from the vena cava to the lungs _____

- b. from the lungs to the aorta _____

4. Heartbeat, cycle, and sounds.
- a. The heart beats 72 times a minute. Actually, what happens is that the _____ node initiates the contraction of the _____ (chambers). The nervous stimulus is picked up by the _____ node, and this initiates the contraction of the _____ (chambers). When the chambers are not actually contracting, they are relaxing. Contraction is scientifically termed _____, and resting is termed _____.
- b. Fill in the chart below with the words systole and diastole to show what happens during the 0.85 seconds of one heartbeat.

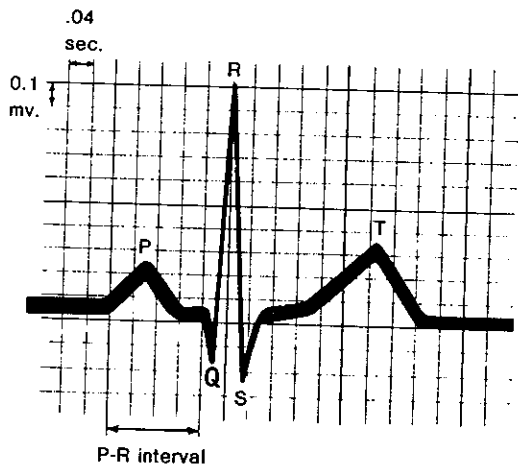
Time	Atria	Ventricles
0.15 sec.		
0.30 sec.		
0.40 sec.		

c. Heart sounds.

When the atria contracts, this forces the blood through the _____ valves into the _____. The closing of these valves is the lub sound. Next the ventricles contract and force the blood into the arteries. Now the _____ valves close, and this is the Dupp sound. A heart murmur is caused by _____.

d. Electrocardiogram. Of what significance is the

P wave? _____
QRS wave? _____
T wave? _____



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5. a. Using the diagram of the circulatory system in figure 10.10 of the text, trace the path of blood from the left ventricle to the legs and from the legs to the right atrium.

to the legs _____
 from the legs _____

b. Trace the path of blood from the aorta to the liver and from the liver to the vena cava.

aorta to liver _____
 from liver to vena cava _____

6. Lymphatic system.

a. Where does the lymphatic system begin and end? _____

b. What is lymph? _____

c. What are lymph nodes? _____

d. What are lacteals? _____

e. Give three functions of the lymphatic system.

(1) _____

(2) _____

(3) _____

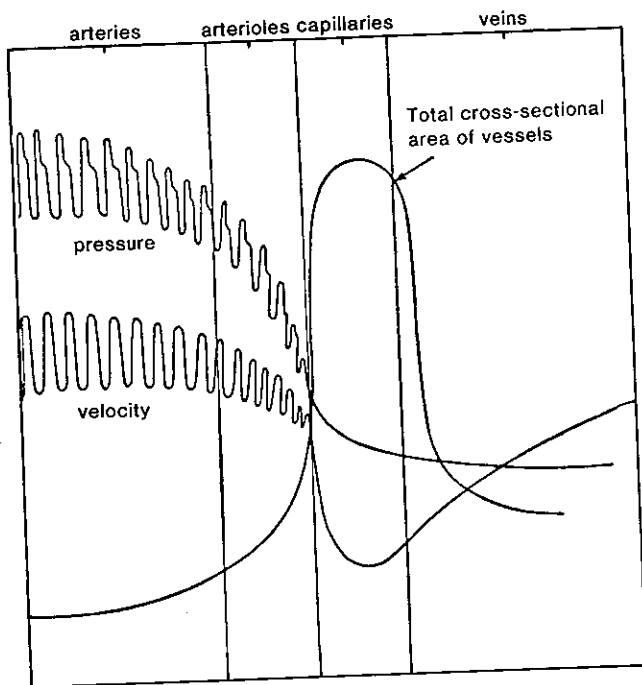
Below is a diagram that describes the pressure and velocity of the blood in different parts of the cardiovascular system:

a. What force accounts for blood flow in arteries? _____

b. Why does this force fluctuate as described in the diagram? _____

c. What causes the pressure and velocity to drop off as the diagram shows it does? _____

d. What accounts for blood flow in venules and veins? _____



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8. Circulatory disorders.

a. Name six factors that may contribute to hypertension. _____

b. Hypertension has been associated with what two blood vessel disorders? _____

c. Eventually the disorders mentioned in *b* may lead to thromboembolism, a condition that can result in a _____

or _____

V. Posttest

1. All arteries carry oxygenated blood and all veins carry blood low in oxygen.
 - a. true
 - b. false
2. The vena cava
 - a. carries blood to the right atrium
 - b. carries blood away from the right atrium
 - c. joins with the aorta
 - d. has a high blood pressure
3. Blood pressure falls off drastically in the capillaries because
 - a. the capillaries contain valves
 - b. the capillaries collect lymph
 - c. of the large cross-sectional area of the capillaries
 - d. all of these
4. Which of these correctly traces the path of blood from the left ventricle to the head?
 - a. left ventricle, subclavian artery, head
 - b. left ventricle, pulmonary artery, head
 - c. left ventricle, aorta, carotid artery, head
 - d. left ventricle, vena cava, jugular vein, head
5. When the atria are contracting, the ventricles are
 - a. contracting
 - b. relaxing
 - c. in diastole
 - d. in systole
 - e. *a* and *c*
 - f. *b* and *c*
 - g. *b* and *d*
6. Lymph veins
 - a. are strong and muscular
 - b. exchange molecules with cells
 - c. contain valves
 - d. contain blood
 - e. *c* and *d*
7. Blood pressure
 - a. is the same in all blood vessels
 - b. is highest in the aorta
 - c. is measured by taking an EKG
 - d. never rises above normal
8. The major portion of the circulatory system is called the
 - a. systemic system
 - b. pulmonary system
 - c. hepatic portal system
 - d. coronary system
9. The chamber of the heart that receives blood from the pulmonary veins
 - a. is the right atrium
 - b. is the left atrium
 - c. contains oxygenated blood
 - d. contains deoxygenated blood
 - e. *a* and *c*
 - f. *b* and *c*
 - g. *b* and *d*

0. The S-A node
- a. only works when it receives a nerve impulse
 - b. is located in the left atrium
 - c. initiates the heartbeat
 - d. all of these
1. The coronary arteries carry blood
- a. from the aorta to the heart tissues
 - b. from the heart to the brain
 - c. directly to the heart from the pulmonary circuit
 - d. from the lungs directly to the left atrium
2. Blood returning to the heart from the small intestine passes first to the _____ then to the _____.
- a. posterior vena cava; right atrium
 - b. anterior vena cava; lungs
 - c. hepatic portal vein; liver
 - d. pulmonary vein; pulmonary artery
13. The lymphatic system is similar to the venous portion of the circulatory system in that
- a. it is a completely continuous and separate system.
 - b. it relies on surrounding muscle tissues to return fluid to the vessels.
 - c. phagocytic cells are concentrated in nodal areas.
 - d. a and c
14. If a person with atherosclerosis were to experience a sudden and rapid rise in blood pressure, the most likely outcome would be
- a. a pulmonary embolism.
 - b. a heart attack.
 - c. a thrombus.
 - d. a stroke.
 - e. b and d

In 15-17, fill in each blank with the proper term.

15. _____ is a lymph vessel in a villus of the intestinal wall of mammals.
16. _____ is a blood clot that remains in the blood vessel where it formed.
17. _____ is low blood pressure.