

## Chapter 21: Cardiovascular System: Peripheral Circulation and Regulation

### I. General Features of Blood Vessel Structure

#### A. General Pattern of Circulation

1. Ventricles pump blood into \_\_\_\_\_
2. These arteries branch repeatedly to form \_\_\_\_\_
3. The arteries undergo a gradual transition with decreased size:
  - a. From \_\_\_\_\_
  - b. To \_\_\_\_\_
4. Arteries are classified as:
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
  - c. \_\_\_\_\_
5. Blood flows from arterioles into \_\_\_\_\_
6. Why does most material exchange occur across capillary walls?
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
  - c. \_\_\_\_\_
7. Blood flows from the capillaries into \_\_\_\_\_
8. Compared to arteries the walls of veins are:
  - a. \_\_\_\_\_
  - b. Contain \_\_\_\_\_
  - c. Fewer \_\_\_\_\_
9. As veins project toward the heart they:
  - a. Increase \_\_\_\_\_
  - b. Decrease \_\_\_\_\_
  - c. Walls \_\_\_\_\_
10. Veins are classified as:
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
  - c. \_\_\_\_\_

## B. Capillaries

1. What is the endothelium? \_\_\_\_\_
  - a. What is it continuous with? \_\_\_\_\_
2. The capillary wall consists of \_\_\_\_\_
3. Outside the basement membrane is \_\_\_\_\_
4. Between the basement membrane and the endothelial cells are scattered cells called \_\_\_\_\_
5. What is the average diameter of a capillary? \_\_\_\_\_
6. How do red blood cells flow through capillaries? \_\_\_\_\_
7. Types of Capillaries
  - a. Classification is based on \_\_\_\_\_ & \_\_\_\_\_
  - b. Continuous capillaries
    1. Have a diameter of approximately \_\_\_\_\_
    2. Walls exhibit \_\_\_\_\_ endothelial cells
    3. \_\_\_\_\_ permeable to \_\_\_\_\_
  - c. Fenestrated capillaries
    1. Endothelial cells have \_\_\_\_\_
    2. What are the fenestrae? \_\_\_\_\_  
\_\_\_\_\_
    3. Fenestrated capillaries are \_\_\_\_\_ permeable
  - d. Sinusoidal capillaries
    1. \_\_\_\_\_ diameter than the other two types
    2. Basement membrane is \_\_\_\_\_
    3. Fenestrae are \_\_\_\_\_ than fenestrated capillaries
    4. Occur where \_\_\_\_\_ cross their walls
  - e. Sinusoids are \_\_\_\_\_
    1. Basement membrane is \_\_\_\_\_ & often \_\_\_\_\_
    2. Their structure suggests that \_\_\_\_\_
    3. What are closely associated with the sinusoid endothelium in the liver?  
\_\_\_\_\_
  - f. Venous sinuses are even \_\_\_\_\_ than \_\_\_\_\_

1. Occur primarily in \_\_\_\_\_
  2. Have \_\_\_\_\_ endothelial cells
- g. Substances cross the capillary walls by \_\_\_\_\_
1. Through \_\_\_\_\_
  2. Through \_\_\_\_\_
  3. Between \_\_\_\_\_
    - a. Lipid-soluble substances readily \_\_\_\_\_
    - b. Larger water-soluble substances must \_\_\_\_\_  
or \_\_\_\_\_
- h. Why are capillaries effective permeability barriers? \_\_\_\_\_  
\_\_\_\_\_

## 8. Capillary Network

- a. Blood is supplied to a capillary network by \_\_\_\_\_
- b. Blood is drained from a capillary network by \_\_\_\_\_
- c. What is an arterial capillary? \_\_\_\_\_
- d. What is a venous capillary? \_\_\_\_\_
- e. Blood flows from an arteriole through \_\_\_\_\_
- f. A thoroughfare channel connects the \_\_\_\_\_ to a \_\_\_\_\_
  1. Blood flow through a thoroughfare channel is \_\_\_\_\_
- g. Capillaries branch from the \_\_\_\_\_
  1. Blood flow in these branches is \_\_\_\_\_
  2. Blood flow is regulated by \_\_\_\_\_ which  
consist of \_\_\_\_\_ located at \_\_\_\_\_

## C. Structure of Arteries and Veins

### 1. General Features

- a. Consist of three layers, which are most apparent in the \_\_\_\_\_  
and least apparent in \_\_\_\_\_
- b. Which layer is in direct contact with the blood? \_\_\_\_\_
- c. What is the name of the outer layer? \_\_\_\_\_

d. Tunica Intima

1. This layer consists of:

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_
- d. \_\_\_\_\_

2. What separates the tunica intima from the tunica media?

\_\_\_\_\_

e. Tunica Media

1. Consists of:

- a. \_\_\_\_\_
- b. Also contains variable amounts of:
  - 1. \_\_\_\_\_
  - 2. \_\_\_\_\_

2. Functionally the smooth muscle regulates \_\_\_\_\_

a. Vasoconstriction

- 1. Is the result of muscle \_\_\_\_\_
- 2. \_\_\_\_\_ the diameter of the vessel
- 3. Results in \_\_\_\_\_ blood flow

b. Vasodilation

- 1. Is the result of muscle \_\_\_\_\_
- 2. \_\_\_\_\_ the diameter of the vessel
- 3. Results in \_\_\_\_\_ blood flow

3. What is the external elastic membrane? \_\_\_\_\_  
\_\_\_\_\_

f. Tunica Adventitia

1. Composed of \_\_\_\_\_ that varies from:

- a. \_\_\_\_\_ near the tunica media to
- b. \_\_\_\_\_ that \_\_\_\_\_

g. The relative thickness of each layer varies with \_\_\_\_\_

## 2. Large Elastic Arteries

- a. Have the \_\_\_\_\_
- b. Are also called \_\_\_\_\_
- c. Pressure is relatively \_\_\_\_\_ and fluctuates between \_\_\_\_\_ & \_\_\_\_\_ values
- d. Have a greater amount of \_\_\_\_\_ and a smaller amount of \_\_\_\_\_
- e. The elastic fibers are responsible for \_\_\_\_\_

## 3. Muscular Arteries

- a. Are often called \_\_\_\_\_
- b. Their walls are \_\_\_\_\_ compared to \_\_\_\_\_
  1. This is due to \_\_\_\_\_
- c. Frequently called \_\_\_\_\_ because \_\_\_\_\_
- d. Small muscular arteries are adapted for \_\_\_\_\_

## 4. Arterioles

- a. Transport blood from \_\_\_\_\_ to \_\_\_\_\_
- b. The smallest artery in which \_\_\_\_\_
- c. What is their diameter range? \_\_\_\_\_
- d. The arterioles are capable of \_\_\_\_\_

## 5. Venules and Small Veins

- a. Venules have a diameter of \_\_\_\_\_
- b. Structure is similar to \_\_\_\_\_
- c. Venules have a few \_\_\_\_\_ outside the endothelium
- d. The vessels are called small veins when:
  1. Diameter \_\_\_\_\_
  2. Smooth muscle \_\_\_\_\_
  3. Have a tunica adventitia composed of \_\_\_\_\_
- e. Venules collect blood from \_\_\_\_\_ and pass it to \_\_\_\_\_ that pass it to \_\_\_\_\_

## 6. Medium and Large Veins

- a. Medium veins collect blood from \_\_\_\_\_ and pass it to \_\_\_\_\_
- b. The large veins transport blood to \_\_\_\_\_
- c. What layer is predominant in large veins? \_\_\_\_\_

## 7. Valves

- a. Valves are found in veins having a diameter larger than \_\_\_\_\_
  1. \_\_\_\_\_ toward the heart
  2. \_\_\_\_\_ away from the heart
- b. Valves consist of:
  1. Folds \_\_\_\_\_
  2. Form two \_\_\_\_\_ that are \_\_\_\_\_ & \_\_\_\_\_ like the \_\_\_\_\_ of the heart
- c. The two folds \_\_\_\_\_ so that \_\_\_\_\_ the valves \_\_\_\_\_

## D. Vasa Vasorum

1. Found in vessels larger than \_\_\_\_\_ in diameter
2. Penetrate from the \_\_\_\_\_ to form a capillary network in
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_

## E. Arteriovenous Anastomoses

1. Allow blood to flow from \_\_\_\_\_ to \_\_\_\_\_ without passing \_\_\_\_\_
2. What is a glomus? \_\_\_\_\_
3. Naturally occurring arteriovenous anastomoses function in \_\_\_\_\_

## F. Nerves

1. The walls of most blood vessels are richly innervated by \_\_\_\_\_
  - a. \_\_\_\_\_ & \_\_\_\_\_ are innervated to the greatest extent
2. Sympathetic stimulation causes \_\_\_\_\_

3. Smooth muscle cells of blood vessels act as a \_\_\_\_\_
  - a. This is due to frequent \_\_\_\_\_
4. Stimulation of a few smooth muscle cells results in \_\_\_\_\_

#### G. Aging of the Arteries

1. The most significant age related changes occur in the:
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
  - c. \_\_\_\_\_
2. What is arteriosclerosis? \_\_\_\_\_
3. What is atherosclerosis? \_\_\_\_\_
  - a. The material is \_\_\_\_\_
  - b. Later it can be replaced with \_\_\_\_\_
4. In arteriosclerosis:
  - a. Tunica intima \_\_\_\_\_
  - b. Tunica media \_\_\_\_\_ because of \_\_\_\_\_
  - c. Fat \_\_\_\_\_ between the \_\_\_\_\_
    1. Produces a \_\_\_\_\_ that can bulge \_\_\_\_\_
  - d. In advanced arteriosclerosis \_\_\_\_\_ accumulate
5. Arteriosclerosis greatly increases \_\_\_\_\_

## II. Pulmonary Circulation

- A. The right ventricle pumps blood into the \_\_\_\_\_
- B. This vessel divides into the \_\_\_\_\_ & \_\_\_\_\_
  1. One to each \_\_\_\_\_
- C. After gas exchange occurs:
  1. \_\_\_\_\_ exit each lung
  2. Enter the \_\_\_\_\_

### III. Systemic Circulation: Arteries

#### A. Aorta

1. The part of the aorta leaving the left ventricle is called \_\_\_\_\_
  - a. What 2 arteries branch off this part of the aorta? \_\_\_\_\_ & \_\_\_\_\_
2. The aorta then arches \_\_\_\_\_ & to the \_\_\_\_\_ as the \_\_\_\_\_
  - a. What three major branches originate here:
    1. \_\_\_\_\_
    2. \_\_\_\_\_
    3. \_\_\_\_\_
3. The longest part of the aorta is called the \_\_\_\_\_
  - a. Which portion is the thoracic aorta? \_\_\_\_\_
  - b. Which portion is the abdominal aorta? \_\_\_\_\_
4. At its termination the aorta divides into \_\_\_\_\_

#### B. Coronary Arteries

1. Refer to Chapter 20.

#### C. Arteries to the Head and the Neck

1. What is the first branch off the aortic arch? \_\_\_\_\_
  - a. It branches at the level of the clavicle to form:
    1. \_\_\_\_\_
      - a. Transports blood to \_\_\_\_\_
    2. \_\_\_\_\_
      - a. Transports blood to \_\_\_\_\_
2. What is the second branch off the aortic arch? \_\_\_\_\_
  - a. Transports blood to \_\_\_\_\_
3. What is the third branch off the aortic arch? \_\_\_\_\_
  - a. Transports blood to \_\_\_\_\_
4. Each common carotid artery divides into:
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
5. What is the carotid sinus? \_\_\_\_\_

- 
- a. Why is it important? \_\_\_\_\_
  6. The external carotid arteries supply blood to \_\_\_\_\_
  7. Blood Supply to the Brain
    - a. Left and right vertebral arteries are branches of the \_\_\_\_\_
      1. Enter the cranial cavity through the \_\_\_\_\_
      2. They join together to form the \_\_\_\_\_
    - b. The basilar artery:
      1. Gives off branches to the \_\_\_\_\_ & \_\_\_\_\_
      2. Branches to form two \_\_\_\_\_
        - a. That supply blood to \_\_\_\_\_
    - c. The internal carotids enter the cranial cavity through \_\_\_\_\_
      1. They terminate by forming \_\_\_\_\_
        - a. That supply blood to \_\_\_\_\_
      2. Posterior branches are the \_\_\_\_\_
        - a. These connect to \_\_\_\_\_
      3. Anterior branches are the \_\_\_\_\_
        - a. That supply blood to \_\_\_\_\_
        - b. These arteries are connected by \_\_\_\_\_
    - d. Forms a complete circle at the base of the brain around the pituitary called \_\_\_\_\_ or \_\_\_\_\_

#### D. Arteries of the Upper Limb

1. One continuous artery in the upper limb has three names based on location:
  - a. Deep to the clavicle it is called \_\_\_\_\_
  - b. In the axilla it is called \_\_\_\_\_
  - c. Within the arm itself it is called \_\_\_\_\_
2. The brachial artery divides at the elbow to form:
  - a. \_\_\_\_\_ on the ulna side of the forearm
  - b. \_\_\_\_\_ on the radial side of the forearm
3. In the palm of the hand:
  - a. The ulnar artery forms \_\_\_\_\_

- b. The radial artery forms \_\_\_\_\_
- 4. Extending from the two palmar arches are \_\_\_\_\_
  - a. That supply blood to \_\_\_\_\_

E. Thoracic Aorta and Its Branches

- 1. Visceral branches supply blood to \_\_\_\_\_
- 2. Parietal branches supply blood to \_\_\_\_\_
  - a. The walls of the thorax are supplied by \_\_\_\_\_
  - b. What supplies blood to the diaphragm? \_\_\_\_\_

F. Abdominal Aorta and Its Branches

- 1. The three major unpaired visceral branches are:
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
  - c. \_\_\_\_\_
  - 1. Each has branches supplying \_\_\_\_\_
- 2. Paired visceral branches supply the \_\_\_\_\_, \_\_\_\_\_, & \_\_\_\_\_

G. Arteries of the Pelvis

- 1. At the level of the fifth lumbar vertebrae the aorta divides into two \_\_\_\_\_
- 2. Each of these divide into a:
  - a. \_\_\_\_\_ which supplies \_\_\_\_\_
  - b. \_\_\_\_\_ which supplies \_\_\_\_\_

H. Arteries of the Lower Limb

- 1. Based on location the external iliac artery becomes the:
  - a. \_\_\_\_\_ in the thigh which becomes the:
  - b. \_\_\_\_\_ behind the knee
    - 1. Below the knee it gives off a branch called \_\_\_\_\_
    - 2. It continues down the back of the leg as the \_\_\_\_\_
- 2. At the foot the anterior tibial artery becomes the \_\_\_\_\_
- 3. The posterior tibial artery gives off branches called:
  - a. \_\_\_\_\_ or \_\_\_\_\_
  - b. \_\_\_\_\_

- c. \_\_\_\_\_
1. The plantar arteries give off \_\_\_\_\_ to the \_\_\_\_\_

#### IV. Systemic Circulation: Veins

##### A. Three Major Veins Return Blood to Right Atrium

1. From the walls of the heart \_\_\_\_\_
2. From the head, neck, thorax, & upper limbs \_\_\_\_\_
3. From the abdomen, pelvis, & lower limbs \_\_\_\_\_

##### B. Veins Draining the Heart

1. Refer to Chapter 20.

##### C. Veins of the Head and Neck

###### 1. External Jugular Veins

- a. More \_\_\_\_\_ of the two veins
- b. Drain blood from \_\_\_\_\_
- c. Usually drain into \_\_\_\_\_

###### 2. Internal Jugular Veins

- a. Drain blood from \_\_\_\_\_
- b. Outside the cranial cavity they receive tributaries that drain \_\_\_\_\_
- c. Join the subclavian veins to form the \_\_\_\_\_

##### D. Veins of the Upper Limb

###### 1. Most of the blood from the upper limb drains through the:

- a. \_\_\_\_\_
- b. \_\_\_\_\_
- c. \_\_\_\_\_

###### 2. The basilic vein becomes the \_\_\_\_\_ in the axilla

- a. This vein then becomes the \_\_\_\_\_ at the first rib

###### 3. The cephalic vein drains into the \_\_\_\_\_

- ###### 4. Where is the median cubital vein? \_\_\_\_\_
- \_\_\_\_\_
- a. Why is it important? \_\_\_\_\_

5. Draining the forearm are:

a. \_\_\_\_\_ on the radial side of the forearm

b. \_\_\_\_\_ on the ulnar side of the forearm

1. These veins drain into the \_\_\_\_\_

#### E. Veins of the Thorax

1. The superior vena cava receives blood from three veins:

a. Right \_\_\_\_\_

b. Left \_\_\_\_\_

c. \_\_\_\_\_

2. Brachiocephalic veins receive blood from the anterior thoracic wall from:

a. \_\_\_\_\_

1. They receive blood from \_\_\_\_\_

3. The azygos vein receives blood from the posterior thoracic wall from:

a. \_\_\_\_\_ on the right

b. \_\_\_\_\_ or \_\_\_\_\_ on the left

#### F. Veins of the Abdomen and Pelvis

1. Blood from the posterior abdominal wall drains into \_\_\_\_\_

a. These empty into the superior vena cava via the:

1. \_\_\_\_\_ on the right

2. \_\_\_\_\_ on the left

2. The internal iliac veins drain the \_\_\_\_\_

3. The external iliac veins drain the \_\_\_\_\_

4. The internal iliac vein and external iliac vein join to form \_\_\_\_\_ which join to form \_\_\_\_\_

#### 5. Hepatic Portal System

a. What is a portal system? \_\_\_\_\_

6. The hepatic portal vein is formed by the union of:

a. \_\_\_\_\_ draining \_\_\_\_\_

b. \_\_\_\_\_ draining \_\_\_\_\_

1. \_\_\_\_\_ draining \_\_\_\_\_

2. \_\_\_\_\_ draining \_\_\_\_\_

- c. Also receives \_\_\_\_\_ before entering the liver
- 7. The hepatic portal vein empties blood into the liver sinusoids, which collect into \_\_\_\_\_, which empty into \_\_\_\_\_
- 8. The hepatic veins also receive blood from:
  - a. \_\_\_\_\_ draining the \_\_\_\_\_
- 9. Hepatic veins empty into the \_\_\_\_\_
- 10. What happens to nutrients in the liver? \_\_\_\_\_
- 11. What happens to toxins in the liver? \_\_\_\_\_

**G. Veins of the Lower Limb**

- 1. The deep veins of the leg are the:
  - a. Anterior \_\_\_\_\_
  - b. Posterior \_\_\_\_\_
    - 1. These veins unite just inferior to the knee forming \_\_\_\_\_
- 2. The popliteal vein becomes the \_\_\_\_\_ as it passes through the thigh and then become the \_\_\_\_\_
- 3. \_\_\_\_\_ or \_\_\_\_\_ empty into the posterior tibial veins
- 4. The great saphenous vein:
  - a. Originates \_\_\_\_\_
  - b. Ascends \_\_\_\_\_
  - c. Empties into \_\_\_\_\_
- 5. The small saphenous vein:
  - a. Begins \_\_\_\_\_
  - b. Ascends \_\_\_\_\_
  - c. Empties into \_\_\_\_\_

**V. Dynamics of Blood Circulation**

**A. Laminar and Turbulent Flow in Vessels**

- 1. What is laminar flow? \_\_\_\_\_  
\_\_\_\_\_
- a. Which layer moves slowest? \_\_\_\_\_
- b. Which layer moves fastest? \_\_\_\_\_

2. What causes turbulent flow? \_\_\_\_\_  
\_\_\_\_\_

#### B. Blood Pressure

1. Define blood pressure: \_\_\_\_\_

2. What is a mercury manometer? \_\_\_\_\_

a. Pressure of 100 mm Hg. means \_\_\_\_\_

3. Why is the auscultatory method used to measure blood pressure? \_\_\_\_\_  
\_\_\_\_\_

4. What is a sphygmomanometer? \_\_\_\_\_

5. What are Korotkoff sounds? \_\_\_\_\_

6. The process of measuring the blood pressure involves:

a. Inflating blood pressure cuff until \_\_\_\_\_

b. Deflating cuff until the first Korotkoff sound is heard:

1. Blood is flowing through the constricted area during \_\_\_\_\_

2. The pressure that this occurs at is recorded as \_\_\_\_\_

c. Continuing to deflate cuff until no sound is heard:

1. Continuous \_\_\_\_\_ has been reestablished

2. The pressure that this occurs at is recorded as \_\_\_\_\_

#### C. Blood Flow

1. Blood flow is usually reported in \_\_\_\_\_

2. Blood flow in a vessel is proportional to \_\_\_\_\_

a. If the pressure at point 1 and point 2 are the same \_\_\_\_\_

b. The greater the pressure difference \_\_\_\_\_

c. Flow always occurs from a \_\_\_\_\_ to a \_\_\_\_\_ pressure

3. What is resistance? \_\_\_\_\_

a. As resistance increases \_\_\_\_\_

b. As resistance decreases \_\_\_\_\_

4. What is the mathematical formula for blood flow? \_\_\_\_\_

#### D. Poiseuille's Law

1. What does Poiseuille's Law express? \_\_\_\_\_

2. Resistance to flow dramatically decreases when \_\_\_\_\_

- a. Because flow is proportional to \_\_\_\_\_
- 3. What effect does increased viscosity have on flow? \_\_\_\_\_
- 4. What effect does increased vessel length have on flow? \_\_\_\_\_

E. Viscosity

- 1. What does viscosity measure? \_\_\_\_\_
- 2. As the viscosity of a liquid increases \_\_\_\_\_
- 3. Compared to distilled water blood has a viscosity of \_\_\_\_\_
- 4. What is the hematocrit? \_\_\_\_\_
- 5. How does hematocrit effect the viscosity of the blood? \_\_\_\_\_

F. Critical Closing Pressure and Laplace's Law

- 1. What is critical closing pressure? \_\_\_\_\_
- 2. Laplace's Law
  - a. States that \_\_\_\_\_
  - b. Helps explain \_\_\_\_\_
    - 1. As the pressure in a vessel decreases \_\_\_\_\_
    - 2. If the pressure decreases below the minimum requirement \_\_\_\_\_
    - 3. As the pressure in a vessel increases \_\_\_\_\_
  - c. The formula is \_\_\_\_\_
  - d. As the diameter of a vessel increases \_\_\_\_\_
    - 1. Why is this important in aneurysms? \_\_\_\_\_

G. Vascular Compliance

- 1. What is compliance? \_\_\_\_\_
- 2. The more easily a vessel wall stretches \_\_\_\_\_
- 3. If the pressure increases a small amount:
  - a. Vessels with a large compliance \_\_\_\_\_
  - b. Vessels with a small compliance \_\_\_\_\_
- 4. Which human blood vessels have the greatest compliance? \_\_\_\_\_
  - a. These vessels can act as \_\_\_\_\_ for blood

## VI. Physiology of Systemic Circulation

### A. Cross-Sectional Area of Blood Vessels

1. Total cross-sectional area is the result of determining \_\_\_\_\_ multiplied by \_\_\_\_\_
2. The aorta has a cross-sectional area of \_\_\_\_\_
3. Although capillaries are minute there are millions of them so there total cross-sectional area is \_\_\_\_\_
4. When cross-sectional area is small, blood flow is \_\_\_\_\_
5. When cross-sectional area is large, blood flow is \_\_\_\_\_

### B. Pressure and Resistance

1. What causes the decrease in arterial pressure? \_\_\_\_\_  
\_\_\_\_\_

### C. Pulse Pressure

1. What is pulse pressure? \_\_\_\_\_
2. What two major factors influence pulse pressure?
  - a. \_\_\_\_\_
  - b. \_\_\_\_\_
3. How does a change in stroke volume effect pulse pressure? \_\_\_\_\_  
\_\_\_\_\_
4. As arteries age they become \_\_\_\_\_
  - a. This results in \_\_\_\_\_ systolic pressure & \_\_\_\_\_ pulse pressure
5. The pulse pressure caused by left ventricular ejection produces a \_\_\_\_\_  
\_\_\_\_\_
  - a. This can be felt in peripheral arteries and used to determine \_\_\_\_\_
6. Dampening of the pulse results in capillaries receiving blood at a steady \_\_\_\_\_  
\_\_\_\_\_

### D. Capillary Exchange and Regulation of Interstitial Fluid Volume

1. What is capillary exchange? \_\_\_\_\_
2. The most important process for capillary exchange is \_\_\_\_\_
3. Net filtration pressure (NFP) is \_\_\_\_\_
  - a. Mathematically it is  $NFP =$  \_\_\_\_\_

4. Net hydrostatic pressure is the difference \_\_\_\_\_  
\_\_\_\_\_

  - a. Blood pressure results from \_\_\_\_\_
  - b. Interstitial fluid pressure is \_\_\_\_\_

5. Net osmotic pressure is the difference \_\_\_\_\_  
\_\_\_\_\_

  - a. Blood colloid osmotic pressure is \_\_\_\_\_
  - b. Interstitial colloid osmotic pressure is \_\_\_\_\_

6. At the arterial end of capillaries fluid moves out of the capillary because  
\_\_\_\_\_
7. At the venous end of capillaries fluid moves into the capillary because  
\_\_\_\_\_
8. The volume of interstitial fluid is kept within a narrow range by:
  - a. Exchange \_\_\_\_\_
  - b. Movement \_\_\_\_\_

#### E. Functional Characteristics of Veins

1. What is venous tone? \_\_\_\_\_
2. Increased sympathetic stimulation causes:
  - a. Increases \_\_\_\_\_ by \_\_\_\_\_
  - b. Increases \_\_\_\_\_ return and \_\_\_\_\_ causing \_\_\_\_\_
3. Decreased sympathetic stimulation causes:
  - a. Decreases \_\_\_\_\_ allowing \_\_\_\_\_
  - b. Decreases \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_
4. Contraction of skeletal muscle \_\_\_\_\_ the veins
  - a. Forces blood \_\_\_\_\_

#### F. Blood Pressure and the Effect of Gravity

1. What effect does standing have on pressure in the venules of the feet?  
\_\_\_\_\_
2. The major effect of prolonged standing without movement is \_\_\_\_\_

## VII. Control of Blood Flow in Tissues

### A. Local Control of Blood Flow by the Tissues

1. In most tissues, blood flow is proportional to \_\_\_\_\_
    - a. Increases in response to \_\_\_\_\_ oxygen demand
    - b. Increases in response to \_\_\_\_\_ metabolic end products
  2. Blood flow does serve other purposes:
    - a. In the skin \_\_\_\_\_
    - b. In the kidney \_\_\_\_\_
    - c. In the liver \_\_\_\_\_
  3. Functional Characteristics of the Capillary Bed
    - a. Innervation of the metarterioles and precapillary sphincters is \_\_\_\_\_
    - b. Vasodilator Substances
      1. Produced as \_\_\_\_\_
      2. Diffuse to \_\_\_\_\_, \_\_\_\_\_, & \_\_\_\_\_
        - a. Cause these structures to \_\_\_\_\_
      3. Vasodilator substances include: \_\_\_\_\_  
\_\_\_\_\_
      4. How does lack of nutrients cause vasodilation? \_\_\_\_\_  
\_\_\_\_\_
      5. What is vasomotion? \_\_\_\_\_
    - c. Autoregulation of Blood Flow
      1. What is autoregulation? \_\_\_\_\_
      2. Increased blood flow occurs when:
        - a. Need for \_\_\_\_\_ & buildup of \_\_\_\_\_ cause
        - b. \_\_\_\_\_
    - d. Long-Term Local Blood Flow
      1. If the metabolic activity of a tissue remains elevated for a long period:
        - a. Diameter \_\_\_\_\_
      2. If oxygen levels remain elevated in a tissue \_\_\_\_\_
- ### B. Nervous and Hormonal Regulation of Local Circulation
1. Nervous control of arterial blood pressure is important \_\_\_\_\_

- 
2. Blood pressure must be adequate to move blood through capillaries:
    - a. While \_\_\_\_\_
    - b. During \_\_\_\_\_
    - c. In response \_\_\_\_\_
  3. Nervous regulation shunts blood \_\_\_\_\_
  4. Which part of the autonomic nervous system is most important in controlling blood flow? \_\_\_\_\_
  5. Where is the vasomotor center? \_\_\_\_\_
  6. Peripheral blood vessels are partially constricted at all times due to:  
\_\_\_\_\_
    - a. This condition of the vessels is referred to as \_\_\_\_\_
  7. Vasoconstriction results from \_\_\_\_\_
  8. Vasodilation results from \_\_\_\_\_
  9. What areas of the brain can effect the vasomotor center? \_\_\_\_\_  
\_\_\_\_\_
  10. Norepinephrine binds to \_\_\_\_\_ receptors and causes \_\_\_\_\_
  11. Epinephrine binds to \_\_\_\_\_ receptors and causes \_\_\_\_\_

### VIII. Regulation of Mean Arterial Pressure

#### A. Mean Arterial Pressure (MAP)

1. MAP is slightly less than \_\_\_\_\_
2. What is peripheral resistance? \_\_\_\_\_
3. MAP is proportional to \_\_\_\_\_ times \_\_\_\_\_
4. Mathematically MAP is represented as \_\_\_\_\_
  - a. Increasing any of these factors \_\_\_\_\_ blood pressure
  - b. Decreasing any of these factors \_\_\_\_\_ blood pressure

#### B. Short-Term Regulation of Blood Pressure

1. Baroreceptor Reflexes
  - a. Important in regulating blood pressure on \_\_\_\_\_
    1. Detect even \_\_\_\_\_

2. Respond \_\_\_\_\_
- b. What are baroreceptors sensitive to? \_\_\_\_\_
  1. Where are they located? \_\_\_\_\_  
\_\_\_\_\_
- c. The carotid sinus reflex is activated by \_\_\_\_\_
- d. The aortic arch reflex is activated by \_\_\_\_\_
- e. Normal blood pressure \_\_\_\_\_ the arterial wall so that  
\_\_\_\_\_
- f. In response to a sudden increase in blood pressure:
  1. Frequency of action potentials \_\_\_\_\_
  2. Action potentials influence the \_\_\_\_\_ & \_\_\_\_\_  
centers of the \_\_\_\_\_
  3. The vasomotor center responds by:
    - a. \_\_\_\_\_
    - b. Which causes peripheral vessels to \_\_\_\_\_
  4. The cardioresgulatory center responds by:
    - a. \_\_\_\_\_
    - b. Heart rate \_\_\_\_\_ & blood pressure \_\_\_\_\_
- g. In response to a sudden decrease in blood pressure:
  1. Frequency of action potentials \_\_\_\_\_
  2. Action potentials influence the \_\_\_\_\_ & \_\_\_\_\_  
centers of the \_\_\_\_\_
  3. The vasomotor center responds by:
    - a. \_\_\_\_\_
    - b. Which causes peripheral vessels to \_\_\_\_\_
  4. The cardioresgulatory center responds by:
    - a. \_\_\_\_\_ and
    - b. Is accompanied by \_\_\_\_\_
    - c. Heart rate \_\_\_\_\_ & stroke volume \_\_\_\_\_
  5. Blood pressure \_\_\_\_\_

- h. How long does it take for the baroreceptors to adapt to any new sustained blood pressure? \_\_\_\_\_
2. Adrenal Medullary Mechanism
- a. The mechanism is activated when \_\_\_\_\_  
\_\_\_\_\_
1. Examples are:
- Large \_\_\_\_\_
  - Sudden \_\_\_\_\_
  - Other \_\_\_\_\_
- b. The adrenal medullary mechanism results from stimulation \_\_\_\_\_  
\_\_\_\_\_
1. The adrenal medulla releases \_\_\_\_\_ & smaller amounts of \_\_\_\_\_ causing:
- Increased \_\_\_\_\_
  - Increased \_\_\_\_\_
  - \_\_\_\_\_ in blood vessels to skin and viscera
  - Epinephrine can \_\_\_\_\_
- c. The mechanism is \_\_\_\_\_ & \_\_\_\_\_
3. Chemoreceptor Reflexes
- a. Where are the carotid bodies? \_\_\_\_\_
- b. Where are the aortic bodies? \_\_\_\_\_
- c. When oxygen availability decreases in the chemoreceptor cells:
- Frequency \_\_\_\_\_
  - Stimulates \_\_\_\_\_
  - Resulting in \_\_\_\_\_
  - Normally don't respond \_\_\_\_\_
- d. The chemoreceptor cells are also stimulated by:
- Increased \_\_\_\_\_
  - Increased \_\_\_\_\_
- e. Increased vasomotor tone:
- Increases \_\_\_\_\_

2. Increases blood flow through tissues in which \_\_\_\_\_
4. Central Nervous System Ischemic Response
- a. What is the central nervous system ischemic response? \_\_\_\_\_  
\_\_\_\_\_
  - b. Reduced blood flow to the medulla results in:
    1. Reduced \_\_\_\_\_
    2. Increased \_\_\_\_\_
    3. Reduced \_\_\_\_\_
      - a. This strongly stimulates the \_\_\_\_\_
      - b. Which causes \_\_\_\_\_
      - c. Systemic blood pressure \_\_\_\_\_
      - d. Increases \_\_\_\_\_
  - c. If severe ischemia lasts longer than a few minutes \_\_\_\_\_  
\_\_\_\_\_
  1. Vasomotor center becomes inactive & \_\_\_\_\_
  - d. Prolonged ischemia of the medulla oblongata leads to \_\_\_\_\_  
\_\_\_\_\_

### C. Long-Term Regulation of Blood Pressure

1. Renin-Angiotensin-Aldosterone Mechanism
  - a. This mechanism helps regulate \_\_\_\_\_
  - b. Can also influence \_\_\_\_\_
  - c. The kidneys release an enzyme called \_\_\_\_\_
  - d. What structure releases renin? \_\_\_\_\_
  - e. Where is angiotensinogen synthesized? \_\_\_\_\_
  - f. What does renin do to angiotensinogen? \_\_\_\_\_
  - g. The fragment is called \_\_\_\_\_
  - h. What enzyme is found in the lungs? \_\_\_\_\_
    1. This enzyme converts \_\_\_\_\_ to  
\_\_\_\_\_ or \_\_\_\_\_
  - i. Angiotensin II causes vasoconstriction in \_\_\_\_\_ & \_\_\_\_\_
    1. Increasing \_\_\_\_\_ & \_\_\_\_\_

- j. Angiotensin II also stimulates the adrenal cortex to release \_\_\_\_\_
- k. Aldosterone acts on the kidneys to:
  - 1. Increase \_\_\_\_\_
  - 2. Increase \_\_\_\_\_
  - 3. If ADH is present increase \_\_\_\_\_
    - a. This conserves water to \_\_\_\_\_
- l. Angiotensin II also increases the \_\_\_\_\_, \_\_\_\_\_, & \_\_\_\_\_
- m. Renin secretion is stimulated by \_\_\_\_\_
- n. Renin secretion decreases in response to \_\_\_\_\_
- 2. Vasopressin (ADH) Mechanism
  - a. Baroreceptors detect decreases in blood pressure and stimulate release \_\_\_\_\_ from \_\_\_\_\_
  - b. ADH acts directly on blood vessels to cause \_\_\_\_\_
  - c. ADH also acts on the kidneys to decrease \_\_\_\_\_
    - 1. This helps to maintain \_\_\_\_\_
  - d. ADH is also released in response to \_\_\_\_\_ in solute concentration
- 3. Atrial Natriuretic Mechanism
  - a. Where does atrial natriuretic hormone come from? \_\_\_\_\_
  - b. What causes its release? \_\_\_\_\_
  - c. Functionally atrial natriuretic hormone:
    - 1. Acts on the kidneys to:
      - a. Increase \_\_\_\_\_
      - b. \_\_\_\_\_ loss in the urine
        - 1. Causes the blood volume to \_\_\_\_\_ which \_\_\_\_\_ venous return
    - 2. Also \_\_\_\_\_ arteries and veins
      - a. Results in a decrease in \_\_\_\_\_
    - 3. Both effects cause a \_\_\_\_\_
- 4. Fluid Shift Mechanism
  - a. The fluid shift mechanism occurs in response to \_\_\_\_\_

- b. As blood pressure increases \_\_\_\_\_
    - 1. Helps prevent development of \_\_\_\_\_
  - c. As blood pressure falls \_\_\_\_\_
    - 1. Resists \_\_\_\_\_
  - d. Blood pressure is \_\_\_\_\_ because interstitial \_\_\_\_\_
5. Stress-Relaxation Response
- a. When blood volume suddenly declines:
    - 1. Blood pressure \_\_\_\_\_
    - 2. Causing \_\_\_\_\_
    - 3. In response the smooth muscle cells \_\_\_\_\_ reducing the \_\_\_\_\_ & resisting \_\_\_\_\_
  - b. When blood volume increases rapidly:
    - 1. Blood pressure \_\_\_\_\_
    - 2. In response smooth muscle cells \_\_\_\_\_
    - 3. Resulting in \_\_\_\_\_