



INTRODUCTION TO CARDIOVASCULAR SYSTEM

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The Cardiovascular System

- ▶ Cardiovascular system is organ system that distributes blood to all parts of the body.
- ▶ Major function – transportation, using blood as the transport vehicle.
- ▶ This system carries oxygen, nutrients, cell wastes, hormones and other substances vital for body homeostasis to and from cells.
- ▶ The force to move blood around the body is provided by the pumping heart and blood pressure.

The Blood Vessels

- ▶ The cardiovascular system has three types of blood vessels:
- ▶ **Arteries (and arterioles)** carry blood away from the heart.
- ▶ **Capillaries** – where nutrient and gas exchange occur.
- ▶ **Veins (and venules)** – carry blood toward the heart.

- ▶ **The Arteries :**
- ▶ Arteries and arterioles take blood away from the heart.
- ▶ The largest artery is the aorta . The middle layer of an artery wall consists of smooth muscle that can constrict to regulate blood flow and blood pressure.
- ▶ Arterioles can constrict or dilate, changing blood pressure.

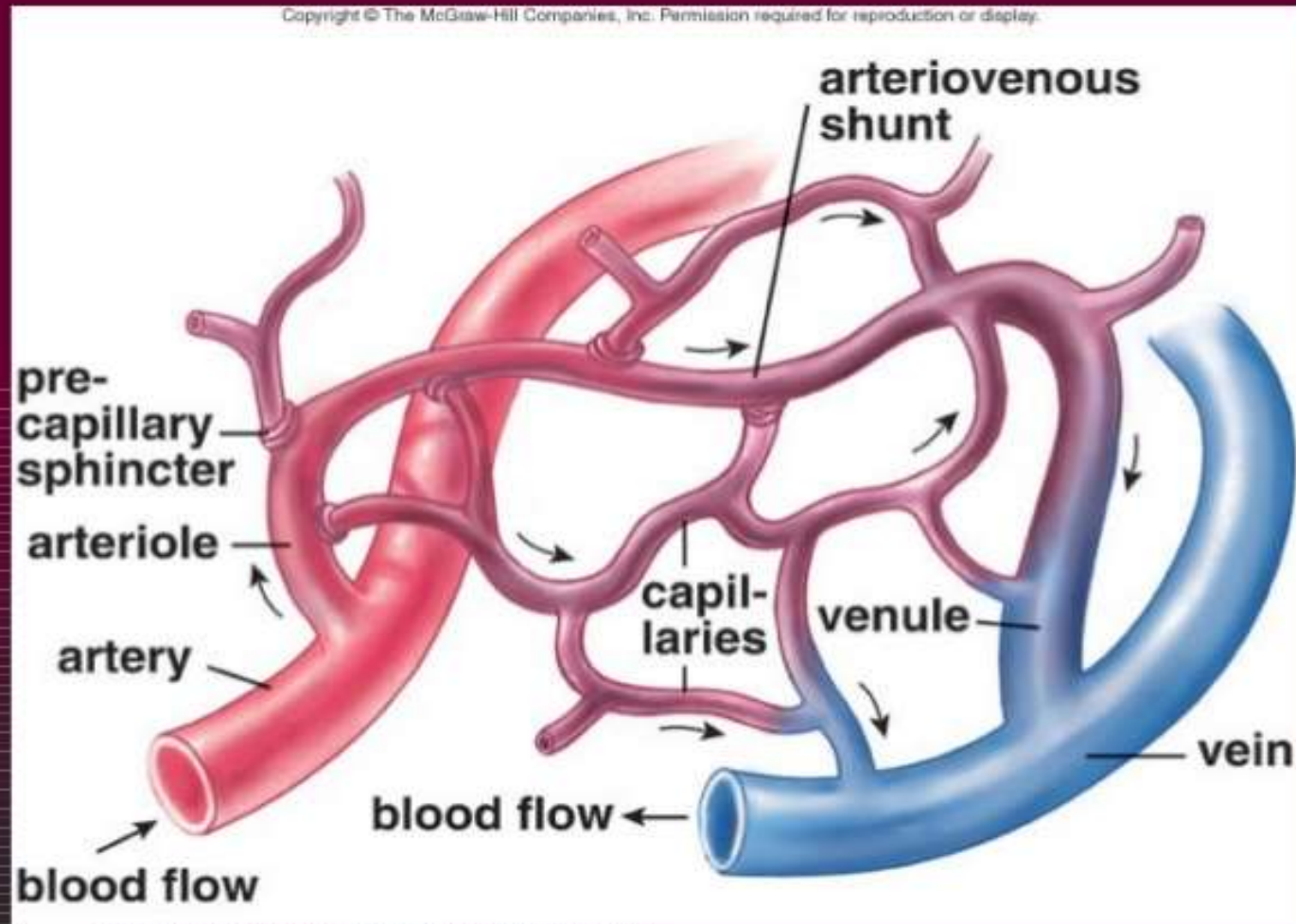
The Capillaries

- ▶ Capillaries have walls only one cell thick to allow exchange of gases and nutrients with tissue fluid.
- ▶ Capillary beds are present in all regions of the body but not all capillary beds are open at the same time.

The Veins

- ▶ Venules drain blood from capillaries, then join to form veins that take blood to the heart.
- ▶ Veins have much less smooth muscle and connective tissue than arteries.
- ▶ Veins often have valves that prevent the backward flow of blood when closed.
- ▶ Veins carry about 70% of the body's blood and act as a reservoir during hemorrhage.

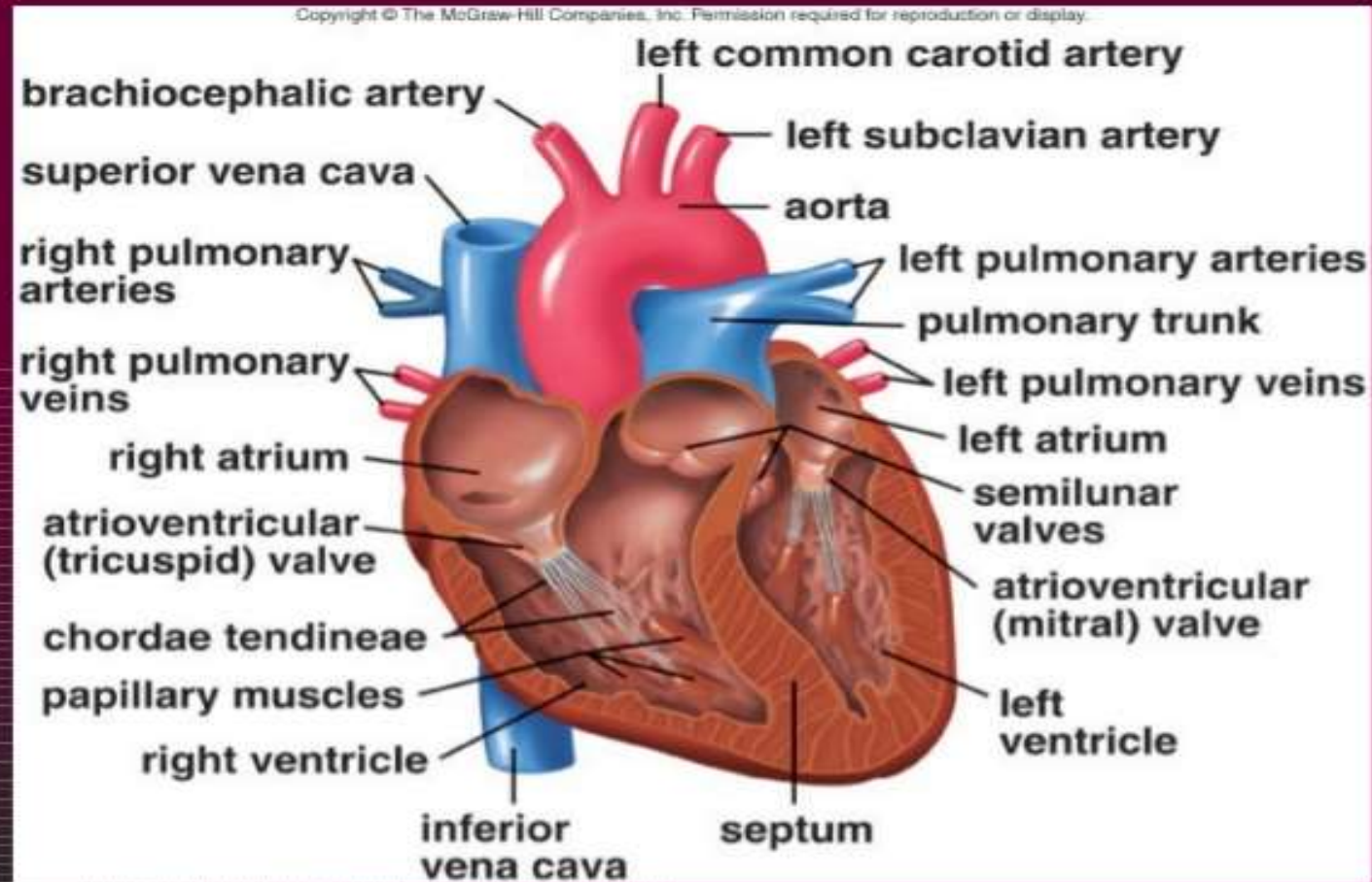
Anatomy of a capillary bed



The Heart

- ▶ The heart is a cone-shaped, muscular organ located between the lungs behind the sternum.
- ▶ The heart muscle forms the **myocardium** , with tightly interconnect cells of cardiac muscle tissue. The **pericardium** is the outer membranous sac with lubricating fluid.
- ▶ The heart has four chambers: two **atria** , and two lower, thick-walled **ventricles** . The **septum** is a wall dividing the right and left sides.
- ▶ **Atrioventricular valves** occur between the atria and ventricles – the **tricuspid valve** on the right and the **bicuspid valve** on the left.


Internal view of the heart



Passage of Blood Through the Heart

- ▶ Blood follows this sequence through the heart:

superior and inferior vena cava -> right atrium -> tricuspid valve -> right ventricle -> pulmonary semilunar valve -> pulmonary trunk and arteries to the lungs -> pulmonary veins leaving the lungs -> left atrium -> bicuspid valve -> left ventricle -> aortic semilunar valve -> aorta -> to the body

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- ▶ The pumping of the heart sends out blood under pressure to the arteries.
 - ▶ Blood pressure is greatest in the aorta; the wall of the left ventricle is thicker than that of the right ventricle and pumps blood to the entire body.
 - ▶ Blood pressure then decreases as the cross-sectional area of arteries and then arterioles increases.

The Heartbeat

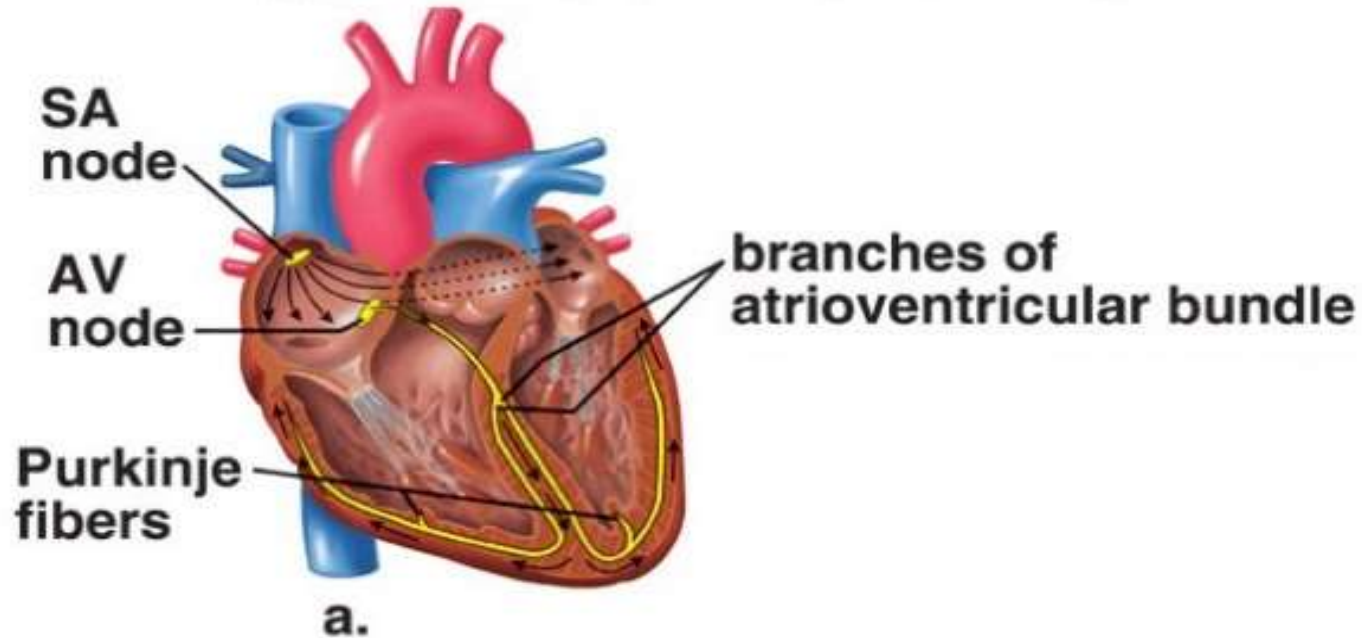
- ▶ Each heartbeat is called a cardiac cycle .
- ▶ When the heart beats, the two atria contract together, then the two ventricles contract; then the whole heart relaxes.
- ▶ Systole is the contraction of heart chambers; diastole is their relaxation.
- ▶ The heart sounds , lub-dup, are due to the closing of the atrioventricular valves, followed by the closing of the semilunar valves.

Intrinsic Control of Heartbeat

- ▶ The **SA (sinoatrial) node** , or pacemaker , initiates the heartbeat and causes the atria to contract on average every 0.85 seconds.
- ▶ The **AV (atrioventricular) node** conveys the stimulus and initiates contraction of the ventricles.
- ▶ The signal for the ventricles to contract travels from the AV node through the atrioventricular bundle to the smaller **Purkinje fibers** .

Conduction system of the heart

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Extrinsic Control of Heartbeat

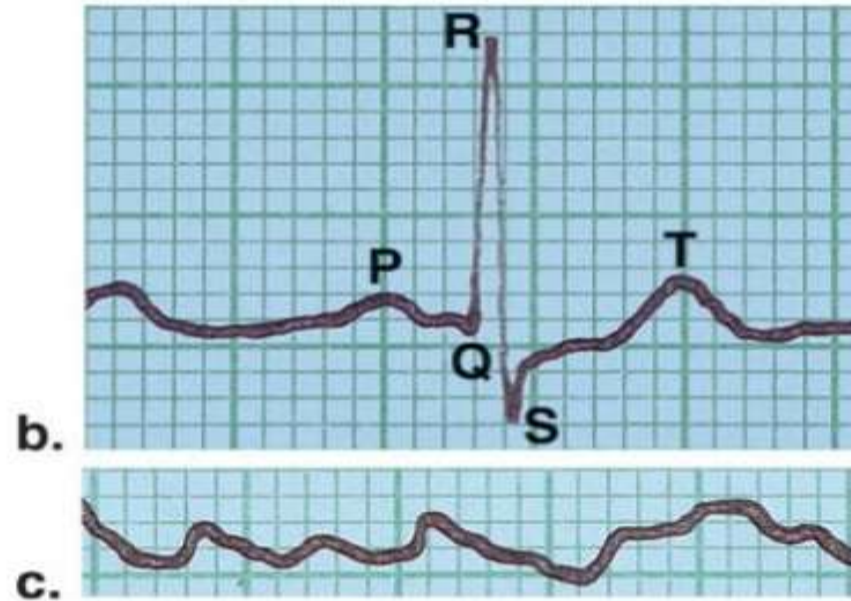
- ▶ A cardiac control center in the **medulla oblongata** speeds up or slows down the heart rate by way of the autonomic nervous system branches:
- ▶ **parasympathetic system** (slows heart rate) and the **sympathetic system** (increases heart rate).
- ▶ Hormones **epinephrine and norepinephrine** from the adrenal medulla also stimulate faster heart rate.

The Electrocardiogram

- ▶ An electrocardiogram (ECG) is a recording of the electrical changes that occur in the myocardium during a cardiac cycle.
- ▶ Atrial depolarization creates the **P wave** , ventricle depolarization creates the **QRS wave** , and repolarization of the ventricles produces the **T wave**.

Electrocardiogram

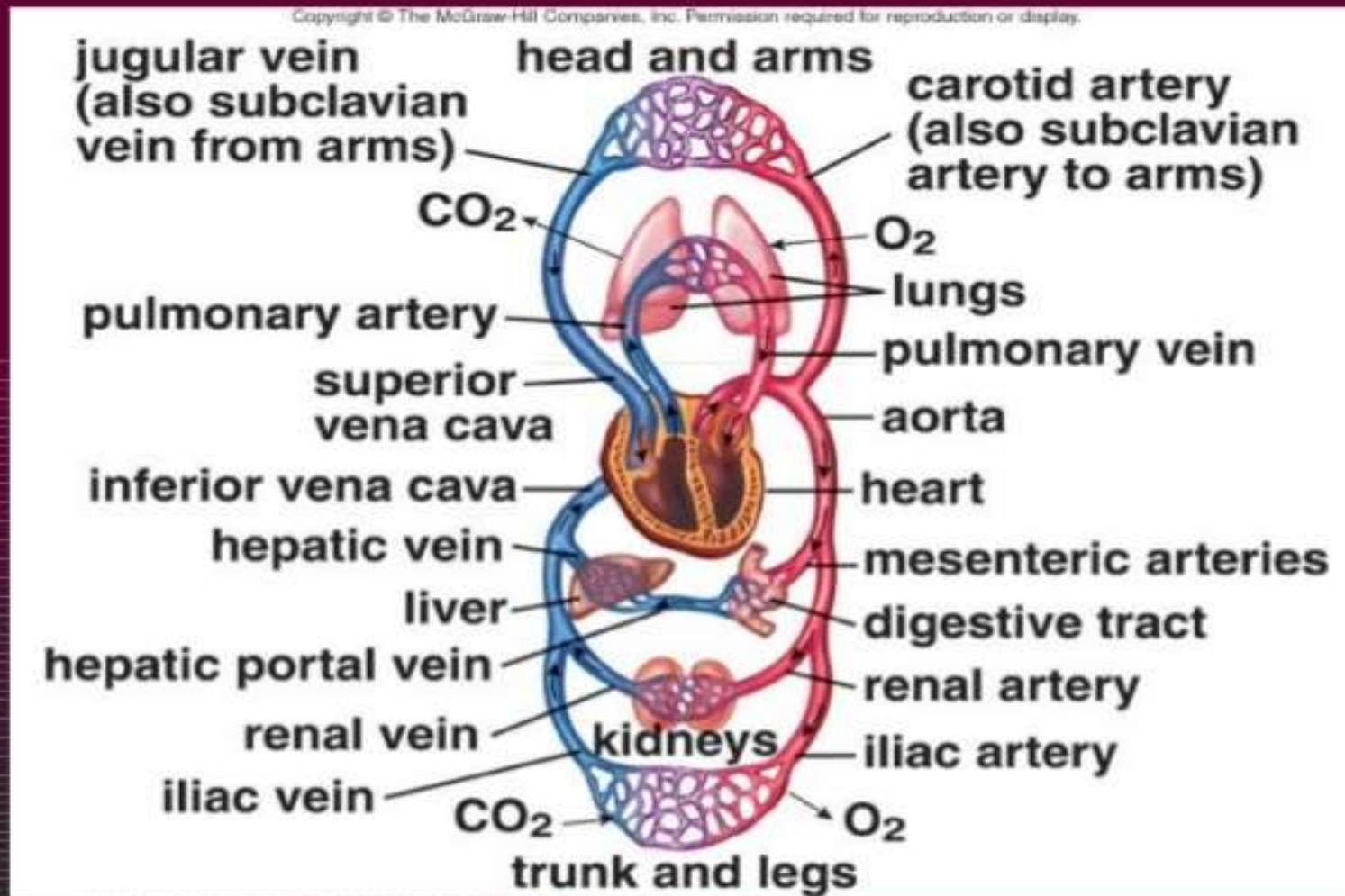
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The Vascular Pathways

- ▶ The cardiovascular system includes two circuits:
- ▶ Pulmonary circuit which circulates blood through the lungs, and Systemic circuit which circulates blood to the rest of the body. Both circuits are vital to homeostasis.
- ▶ **The Pulmonary Circuit :**
- ▶ The pulmonary circuit begins with the pulmonary trunk from the right ventricle.
- ▶ In the lungs, oxygen diffuses into the blood, and carbon dioxide diffuses out of the blood to be expelled by the lungs. Pulmonary veins return oxygen-rich blood to the left atrium.

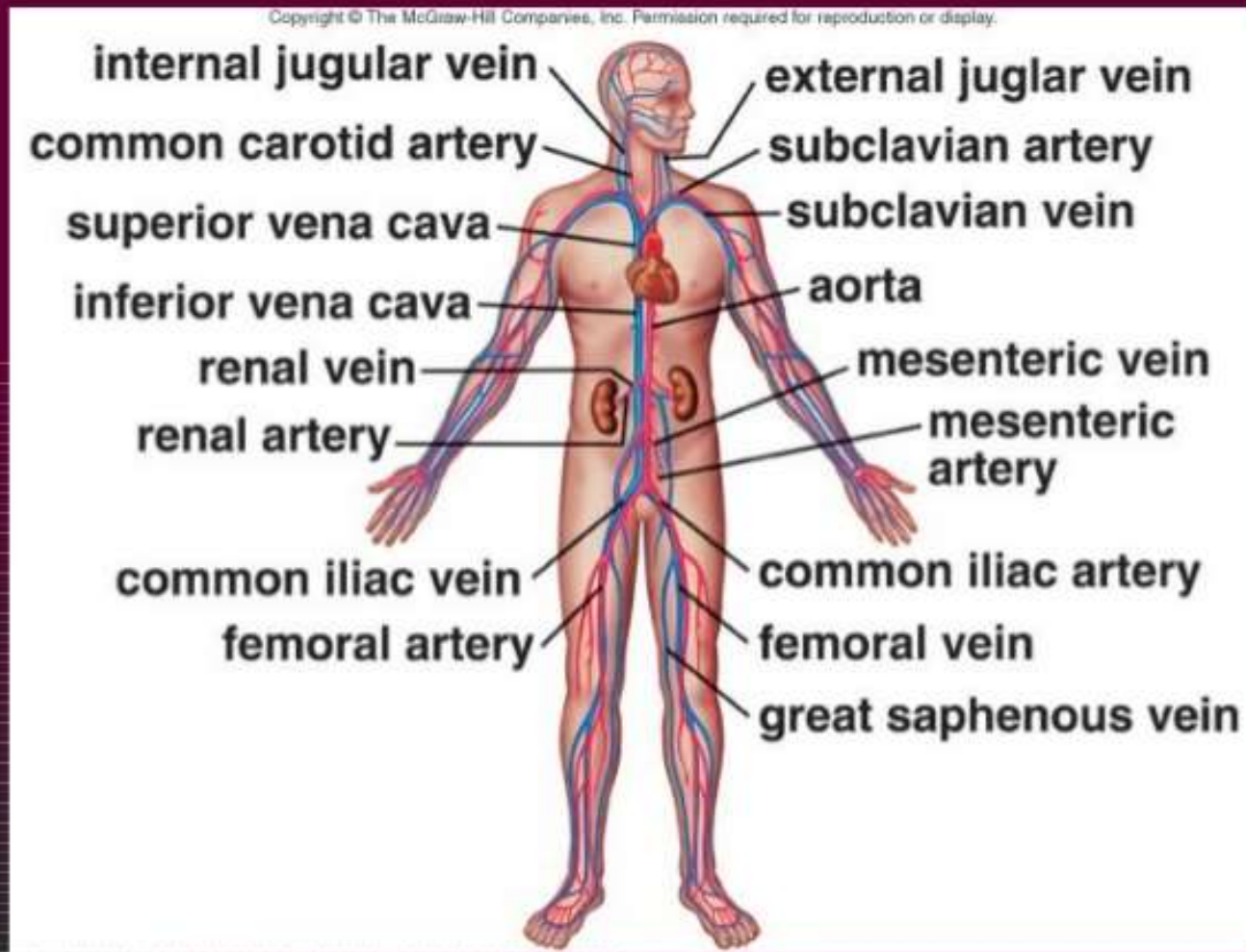
Cardiovascular system diagram



The Systemic Circuit

- ▶ The systemic circuit starts with the aorta carrying O₂-rich blood from the left ventricle. The aorta branches with an artery going to each specific organ.
- ▶ The vein that takes blood to the vena cava often has the same name as the artery that delivered blood to the organ.
- ▶ In the adult systemic circuit, arteries carry blood that is relatively high in oxygen and veins carry blood that is relatively low in oxygen and relatively high in carbon dioxide.
- ▶ The coronary arteries serve the heart muscle itself; they are the first branch off the aorta.

Major arteries and veins of the systemic circuit



Blood Flow

- ▶ The beating of the heart is necessary to homeostasis because it creates pressure that propels blood in arteries and the arterioles. Arterioles lead to the capillaries where nutrient and gas exchange with tissue fluid takes place.
- ▶ Blood Flow in Arteries
- ▶ Blood pressure due to the pumping of the heart accounts for the flow of blood in the arteries.
- ▶ Systolic pressure is high when the heart expels the blood.
- ▶ Diastolic pressure occurs when the heart ventricles are relaxing. Both pressures decrease with distance from the left ventricle because blood enters more and more arterioles and arteries.



▶ **Blood Flow in Capillaries :**

- ▶ Blood moves slowly in capillaries because there are more capillaries than arterioles.
- ▶ This allows time for substances to be exchanged between the blood and tissues.

▶ **Blood Flow in Veins :**

- ▶ Venous blood flow is dependent upon: skeletal muscle contraction, presence of valves in veins, and respiratory movements.
- ▶ Compression of veins causes blood to move forward past a valve that then prevents it from returning backward.
- ▶ Changes in thoracic and abdominal pressure that occur with breathing also assist in the return of blood.

Blood

- ▶ Blood separates into two main parts:
plasma and formed elements .
- ▶ **Plasma** accounts for 55% and formed elements 45% of blood volume.
- ▶ Plasma contains mostly water (90–92%) and plasma proteins (7–8%), but it also contains nutrients and wastes.
- ▶ Albumin is a large plasma protein that transports bilirubin; globulins are plasma proteins that transport lipoproteins.

Composition of blood

- ▶ The Red Blood Cells
- ▶ The White Blood Cells
- ▶ The Platelets
- ▶ Blood Clotting Factors, Twelve clotting factors in the blood help platelets form blood clots.

Capillary Exchange

- ▶ At the arteriole end of a capillary, water moves out of the blood due to the force of blood pressure .
- ▶ At the venule end, water moves into the blood due to osmotic pressure of the blood.
- ▶ Substances that leave the blood contribute to tissue fluid , the fluid between the body's cells.
- ▶ In the midsection of the capillary, nutrients diffuse out and wastes diffuse into the blood.
- ▶ Since plasma proteins are too large to readily pass out of the capillary, tissue fluid tends to contain all components of plasma except it has lesser amounts of protein.
- ▶ Excess tissue fluid is returned to the blood stream as lymph in lymphatic vessels .



- ▶ DATE ; 18-05-2020
- ▶ TIMINGS : 12:20 - 01:10 pm
- ▶ MEETING ID : 713 7942 7173
- ▶ PASSWORD : 9XFZDT