heart vessel

Cardiovascular System
Day 1

The cardiovascular system includes the heart, blood vessels, blood, and blood circulation.

Overview of the week

Functions of the heart
The various types of blood vessels
Characteristics of blood
Mechanism of Circulation
Lymphatic System

The Heart

Made of cardiac muscle.
Hollow, cone-shaped muscular organ.
Has four chambers

The size of the heart is dictated by the size of the overall animal

The heart straddles the midline, just dorsal to the sternum

The apex points ventrally to the left

Structure of the Heart

The heart is covered by a saclike membrane with three layers.

Pericardium- tough, fibrous external membrane

Two internal layers

Parietal- lining the pericardium

Visceral- (epicardium) covering the surface of the heart

upon

The space between the two internal layers is called the pericardial space (contains fluid)

The heart wall has three layers.

Epicardium (outer visceral layer)

Myocardium (heart cardiac muscle itself)

Endocardium (lines the chambers of the heart and covers its valves)

Chambers of the Heart

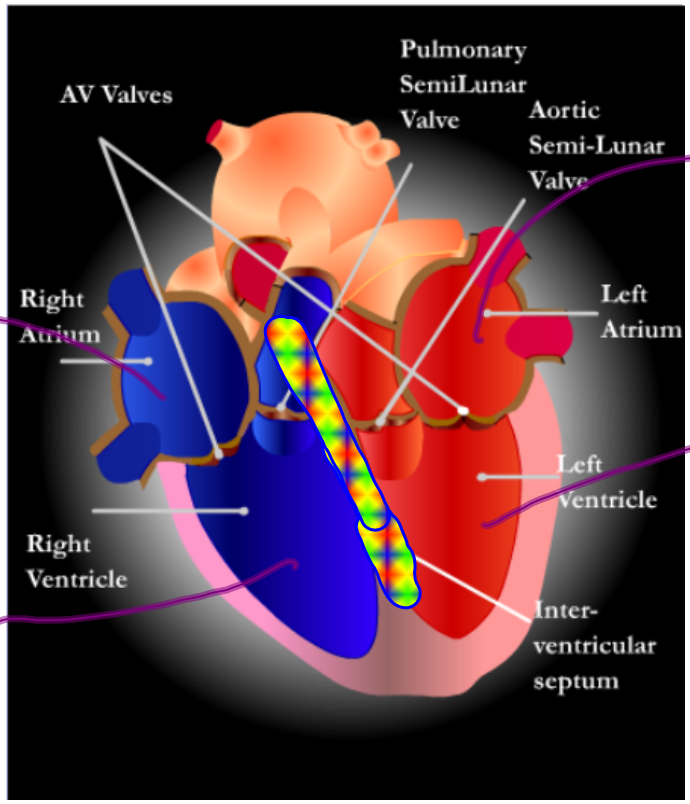
It has a left and right side

Each cranial chamber is called the atrium (artia-plural)

Interatrial septum- divides the atria

Each ventral chamber is called a ventricle

Interventricular septum- divides the ventricles



RA LA LV RV

http://facstaff.elon.edu/shouse/StudentPages/KyleKeenan/heart/heartdeflink.html

The atria have thin walls and are the receiving chambers of the heart.

The ventricles have thicker walls to pump the blood.

The right side receives the blood from the body and sends it to the lungs to be oxygenated.

body - heart - lungs

The left side receives the oxygenated blood and sends it to the tissues.

lungs → heart → body

The walls of the left ventricle are thicker then those of the right.

Why?

extra push

Valves

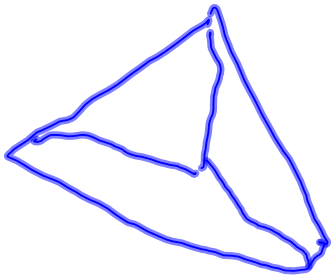
Between the artia and the ventricles have valves.

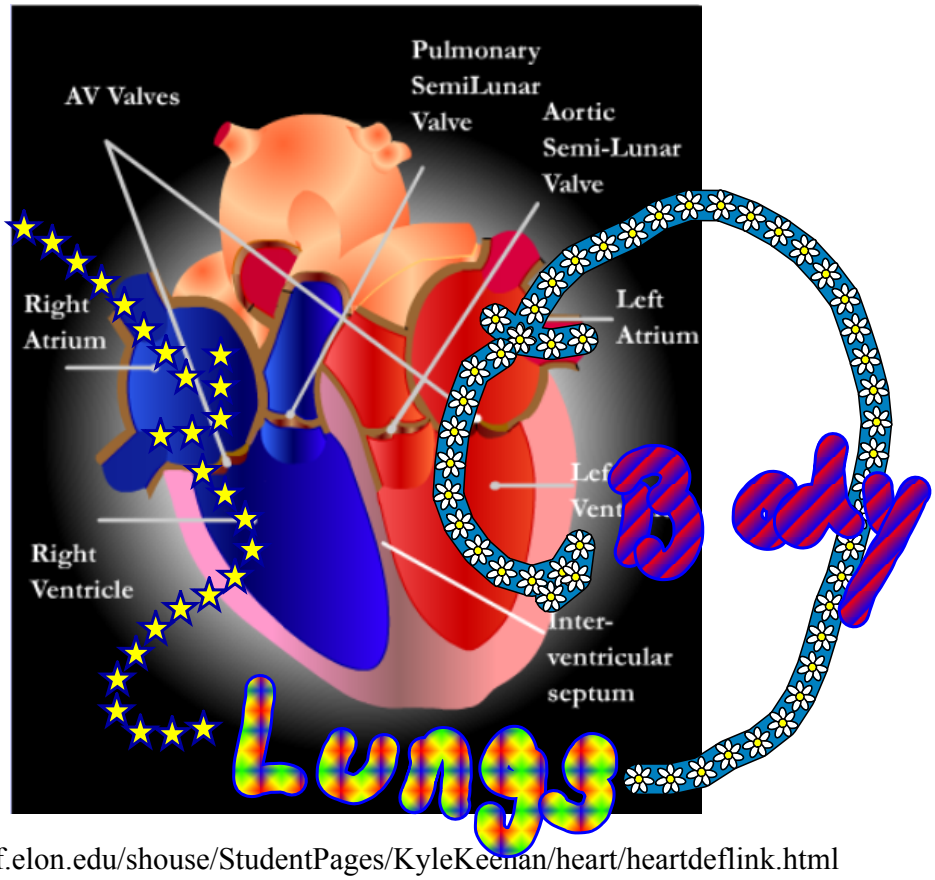
These are the atrioventricular valves which close to ensure that blood only flows in one direction. There should not be backflow into the atria

one-way

The left atrium and ventricle are divided by the mitral or bicuspid (__2__ flaps) valve.

The right atrium and ventricle are divded by the tricuspid (__3__ flaps) valve.





http://facstaff.elon.edu/shouse/StudentPages/KyleKeehan/heart/heartdeflink.html

There are also semilunar valves (half moon shaped) which prevent backflow of blood from the arties into the ventricles located at the base of the pulmonary artery and the aorta.

Conduction System

The heart begins to pump in utero.

SA node (sinoartial) aka pacemaker, consists of cells where the electrical impulses originate, produce atrial contractions, and force blood into the ventricle

AV node (atrioventricular) consists of the cells in which the electrical impulses continue down

Artioventricular bundle (bundle of His) which continues on as the Purkinje fibers (move the impulses to stimulate ventricular contractions)

Nerve Function in the Heart

Autonomic nervous system has two separate divisions that affect the heart

Parasympathetic- supply the SA and AV nodes, slow down the heart rate, reduces impulse conduction, and constricts the coronary arteries

Sympathetic- through cardiac nerves also affects the SA and AV nodes, increases the heart rate, dilates the coronary arteries

Cardiac Cycle

Includes the contraction (systole) and relaxation (diastole) or the chambers of the heart

All the chambers do not contract at the same time

The two atria contract together and then the two ventricles.

When the atria contract the blood is pushed into the ventricles through the bicuspid and tricuspid valves.

While these valves are open the semilunar valves are closed.

When the ventricles contract the bicuspid and tricuspid valves close to prevent backflow while the semilunar valves are open.

Types of blood Vessels

Three major types: arteries, veins, and capillaries

Arteries

Oxygenated blood is carried from the heart to all structures of the body

These are elastic tubes with three layers

Tunica intima (intimal layer) a lining of endothelium
Tunica media (medial layer) muscle layer
Tunica adventitia (tunica externa) the fibrous outer coat

Arterioles, Capillaries, and Venules

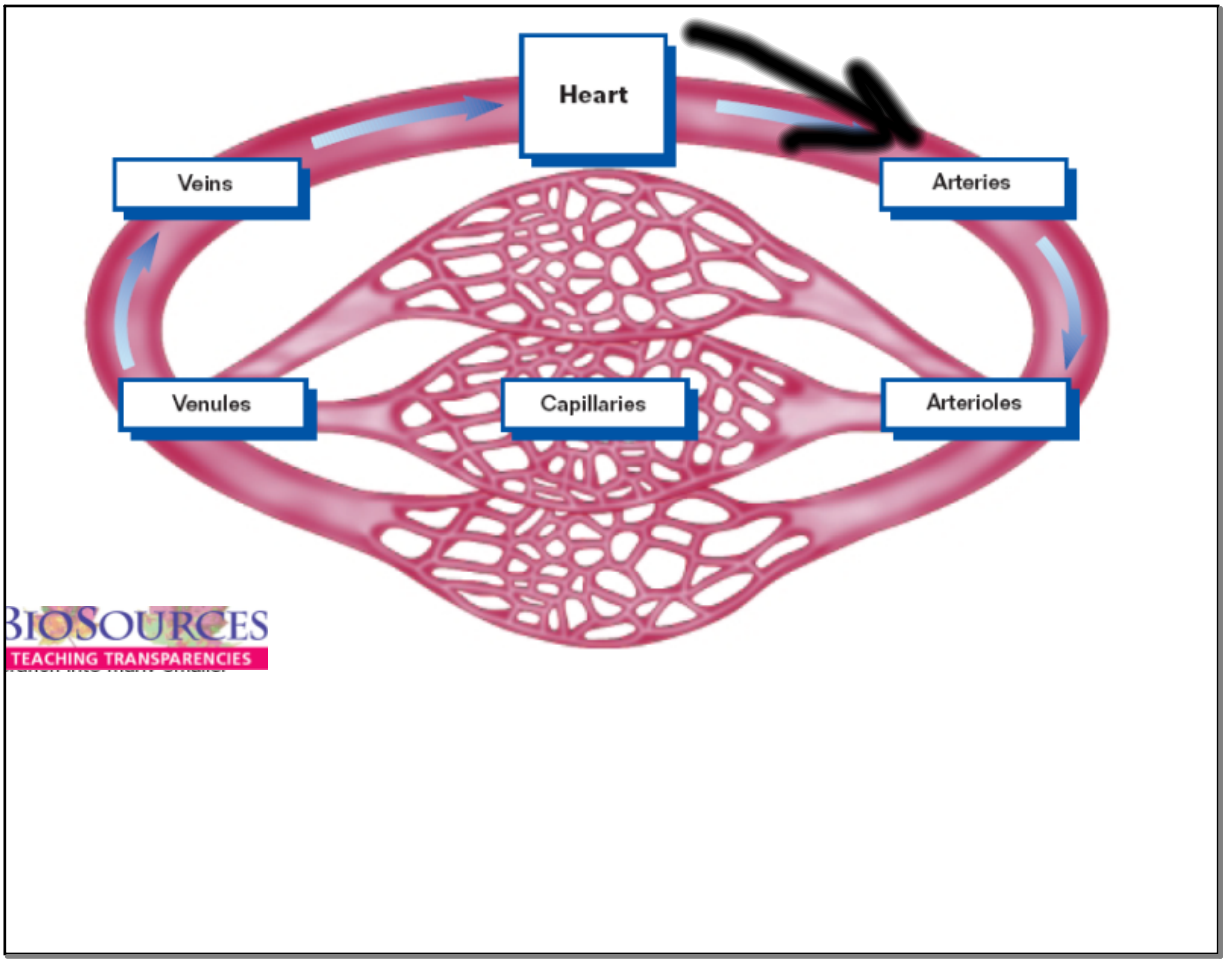
Arteries become smaller and smaller till they become arterioles (small arteries)

These feed the capillaries (billions of minute, thin walled vessels that communicate with other capillaries)

The capillaries distribute blood to the tissues.

$O_2 \rightarrow CO_2$

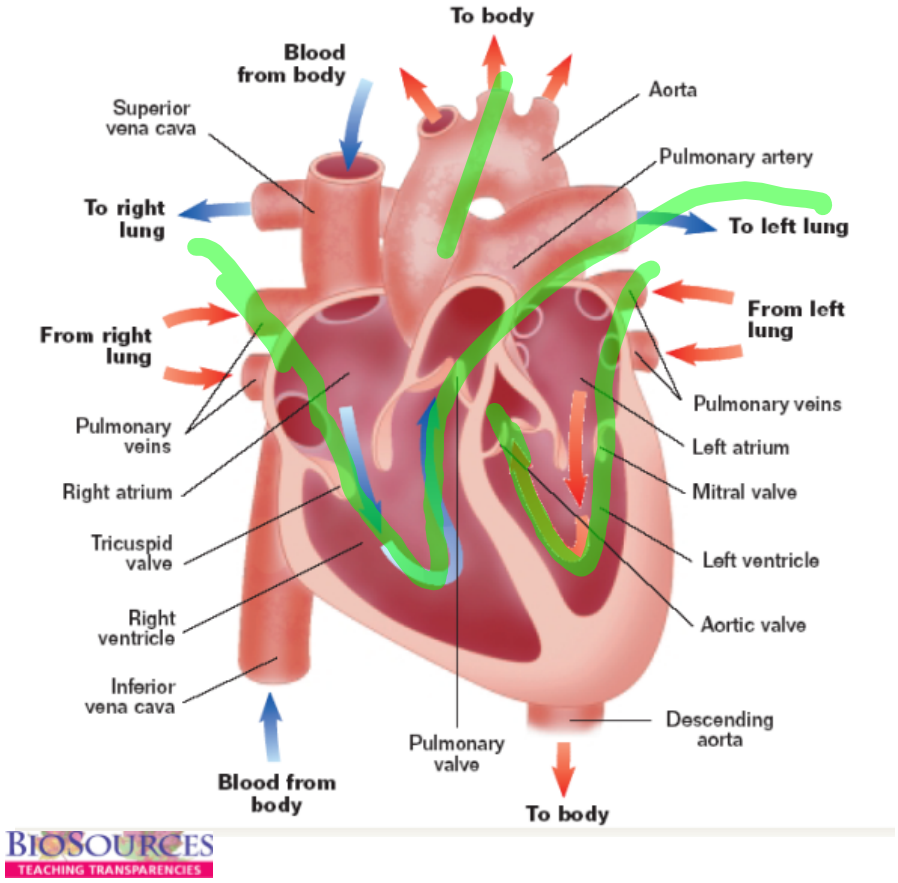
Other pick-up blood from the tissues (venules) and pass the blood back to the veins then the heart



Veins

Hollow tubes which are similar to the arteries but have thinner and less elastic walls.

They transport blood back to the heart. There are channels that help prevent backflow.



Cardiovascular System
Day 2

Blood

60% plasma (liquid)

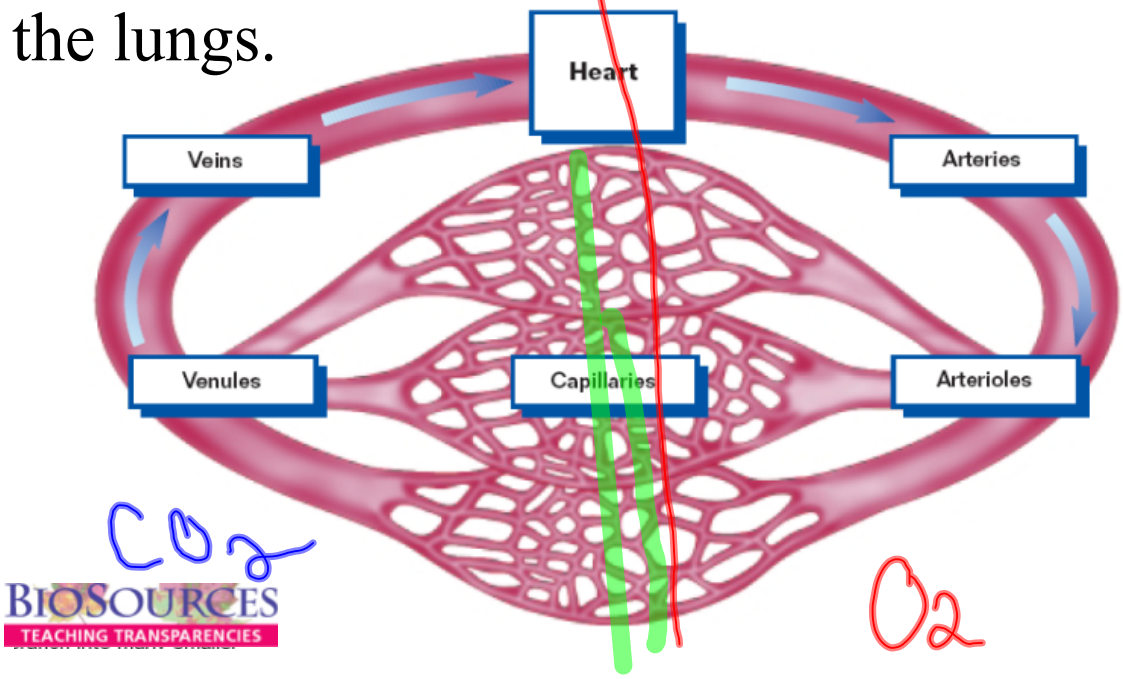
40% formed elements

Erythrocytes red cell

Leukocytes white cell

Platlets - thromocytes

Blood transport oxygen from the lungs to the body tissues and collects carbon dioxide from the tissues and expels it from the lungs.



Blood:

- Distributes nutrients
- Collects waste products of metabolism
- Delivers them to the excretory organs
- Carries hormones of the different ductless glands
- Maintains the fluid content of the tissues
- Serves as a temperature regulator for the body

The avg amount of blood in an adult varies by species.

Blood volume is a percentage of body weight.

It is usually 6% to 8%.

Blood is extremely viscous and somewhat sticky.

The color of blood varies from bright red (oxygenated) to dark purple-red (deoxygenated).

It is slightly alkaline (basic) and has a specific gravity slightly higher than water.

Plasma
Clear, straw-colored, liquid portion of blood.

Approximately 90% water and 10% solutes

One of the solutes is fibrinogen, important in blood clotting
Of the clotting elements and solutes are removed then it is called serum.
Other solutes are in the blood like nutrients (lipids, glucose, and amino acids), end products of metabolism (urea, creatinine, uric and lactic acids), gases (oxygen and carbon dioxide) and hormones, enzymes, and antibodies.

Blood Cells

Hemocytoblasts (undifferentiated stem cells) in which all blood cells start.

In young animals all bone marrow makes new blood.

In adults only red bone marrow makes blood.

Page 149 in the book is a wonderful chart

Erythrocytes

Extremely small, nonnucleated disks

They contain hemoglobin (heme- iron and globin- protein). This in combination with oxygen creates the red color. These are the oxygen carrying cells.

The avg life span of a erythrocytes in dogs is 120 days.

Not having enough iron, causes the reduction of hemoglobin and the number of red blood cells-anemia

Leukocytes

Much less numerous then erythrocytes, colorless, have nucleus.

There are two groups of leukocytes.

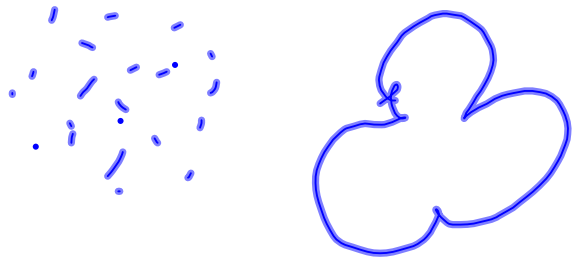
Granulocytes

Originate in bone marrow

Lobed nuclei

Cytoplasm with fine granules

Classified by staining characteristics



Neutrophils

Red and blue stain granules

Phagocytosis (engulfs invading organisms)

Eosinophils

Orange or yellow acid dye-staining granules

Detoxify foreign proteins from allergens and parasitic infections

Basophils

Purple

Function is not sure, but they could prevent coagulation clotting

Agranulocytes

Originate in lymphatic organs

No granules in cytoplasm

Round horseshoe shaped nucleus

Lymphocytes

Rounded nucleus

Phagocytosis function and antibody formation

Monocytes

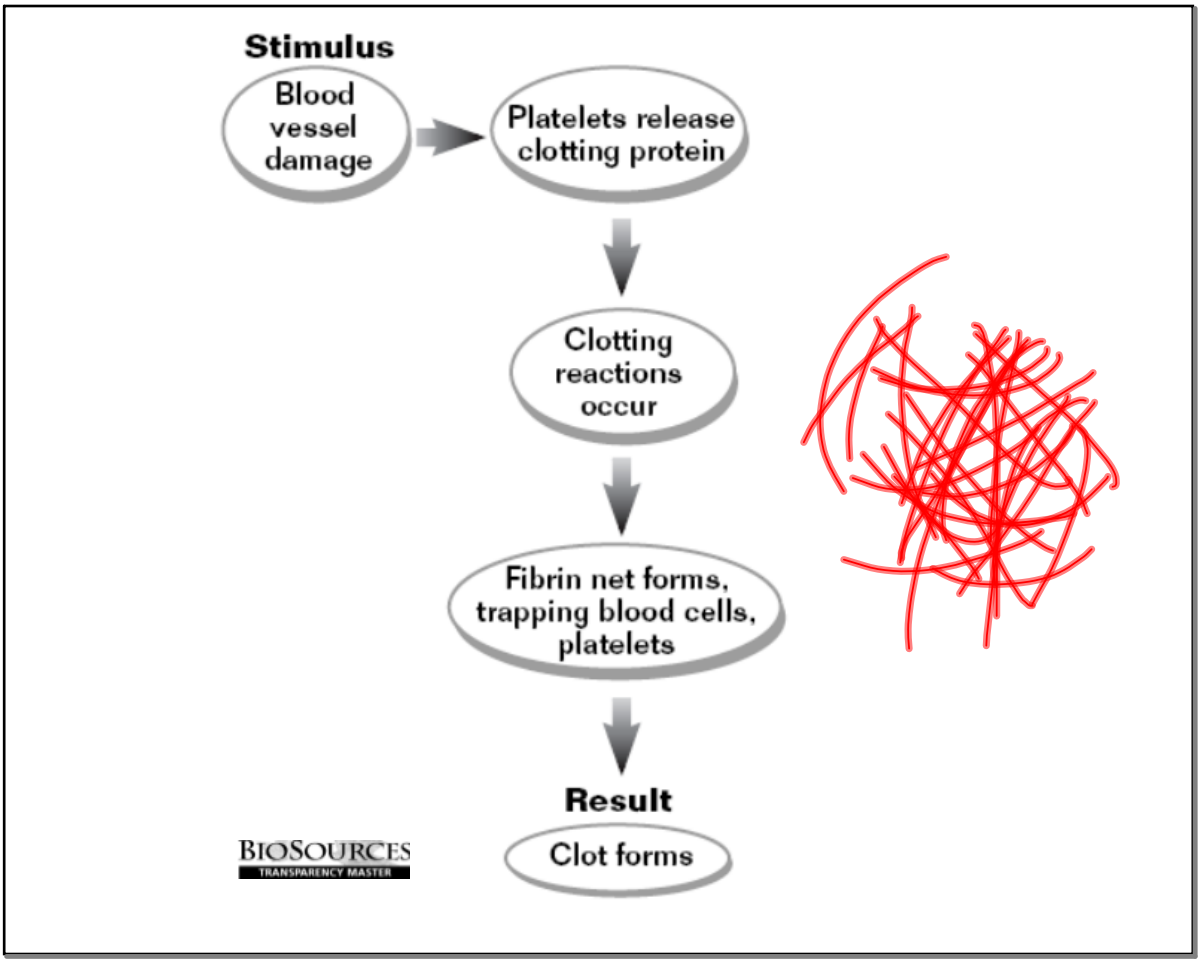
Horseshoe shaped nucleus

Phagocyotsis

Platelets and Clotting mechanism

Originate in bone marrow and are broken off pieces of cells that work as clotting mechanisms

Clotting is the result of a chemical reaction.
The platelets attach to the injured vessel and release substances.



Blood Grouping

Blood is grouped based on the antigens found on the membrane of the blood cells.

The number of blood groups varies from species to species.

Blood typing can be used for donors and recipients. Sometimes blood tying is used to identify breeding pairs. Some animals must be blood typed before being registered.

Blood Pressure

This is the force of the heart pushing the blood through the body.

Normal blood pressure varies from species to species.

human $\frac{120}{80}$

Systolic pressure is produced by the blood pressing against the walls of the arteries during the contraction of the ventricles.

Diastolic pressure is produced by the blood pressing against the walls of the arteries during the relaxation of the ventricles.

Pulse Pressure is the difference between the systolic and the diastolic.

Diastolic pressure is medically more important because it shows the least amount of pressure to which the artery walls are subjected.

Hypertension

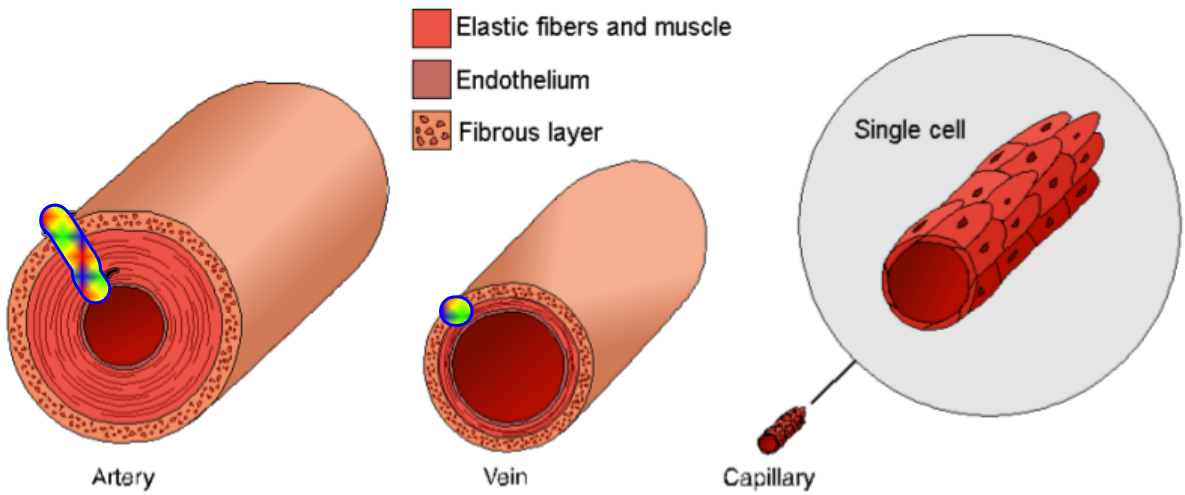
excessive

Hypotension

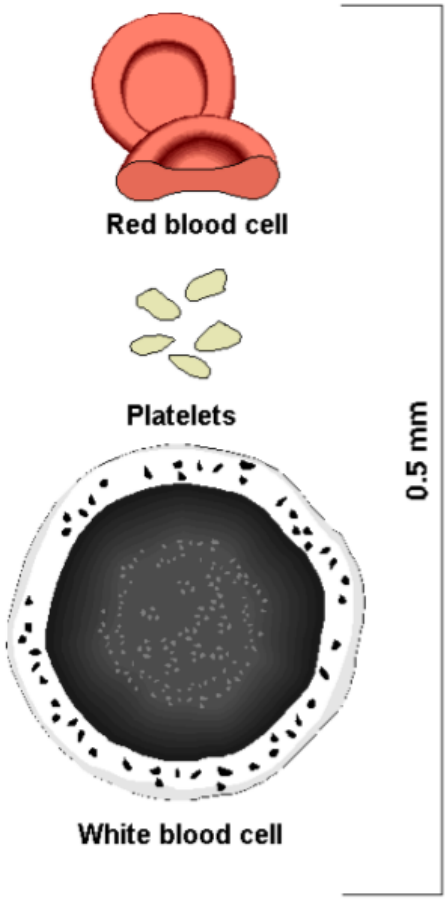
below

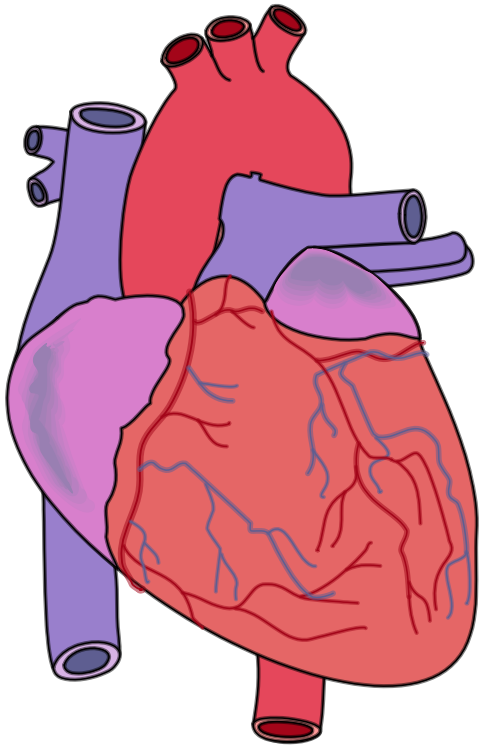
The Pulse

This is produced by the blood pumping out of the heart and into the aorta.



Cardiovascular System
Day 3

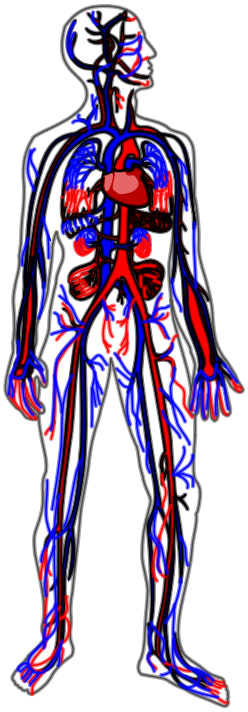




Circulation of the Blood

The blood circulates in a closed vascular system.

The basic circulation is called systemic circulation with two branches called the portal and pulmonary.



Systemic
The pathway for this is from the left ventricle to the aorta, arteries, arterioles, capillaries, venules, veins, and then to the right atrium.

Portal
Through the abdominal digestive organs to the liver by the portal vein.
The hepatic veins carry blood from the liver to the vena cava, which feeds into the right atrium. It is at the right atrium that the next circulation begins…..

Pulmonary

Blood moves from the right atrium to the right ventricle. When the right ventricle contracts the blood is forced into the pulmonary artery. There are two branches to this artery because one goes to each lung.

CO_2

arteries - away from heart, except = carry O_2

In the lungs carbon dioxide is discharged and oxygen is picked up. The oxygenated blood goes into the pulmonary veins which empty into the left atrium.

X Carries O_2

Pulmonary veins are the ONLY veins that carry oxygenated blood. All other veins carry the waste products.

Tracing the Circulation

Left Ventricle
Arteries
Arterioles
Capillaries of the Body Tissue
Venules
Veins
Right Atrium
Right Ventricle
Pulmonary Artery
Arterioles
Capillaries of the Lungs
Venules
Pulmonary Veins
Left Atrium
Left Ventricle

Major Blood Vessels of Circulation

The Arteries

Aorta- largest artery in the body, runs from the left ventricle of the heart

Aortic valve in between the left ventricle and aorta semi-lunar valve

Branches of the aorta

Coronary arteries- supply blood to the myocardial muscles

pertaining to the muscles of the heart

Brachiocephalic

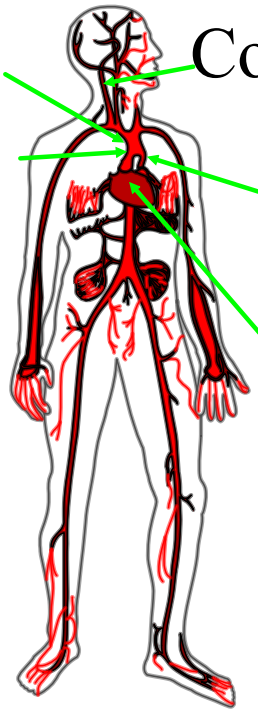
Right subclavian- support the right thoracic limb right arm

Right Common Carotid- supply the right side of the head

Left Common Carotid- left side of the head

Subclavian

Brachiocephalic



Common Carotid

Aorta

Coronary

Left Subclavian Artery- supply the left thoracic artery

Celiac Artery- supply the liver, spleen, and stomach

Cranial Mesenteric- small intestine

Renal-supply the kidney

Ovarian/Testicular- supplies the structure for which they are names

Caudal mesenteric-supply the large intestine

External iliac which become the femoral (hind leg)

Internal iliac- pelvic wall

Caudal- supply the tail

The Veins towards the ♡

Pulmonary veins (four of them) they are the only veins that carry oxygenated blood

Systemic and portal veins return blood from the rest of the body

Subclavian

Jugular

Brachiocephalic

Cranial vena cava

Deep veins

Superficial veins- near the surface

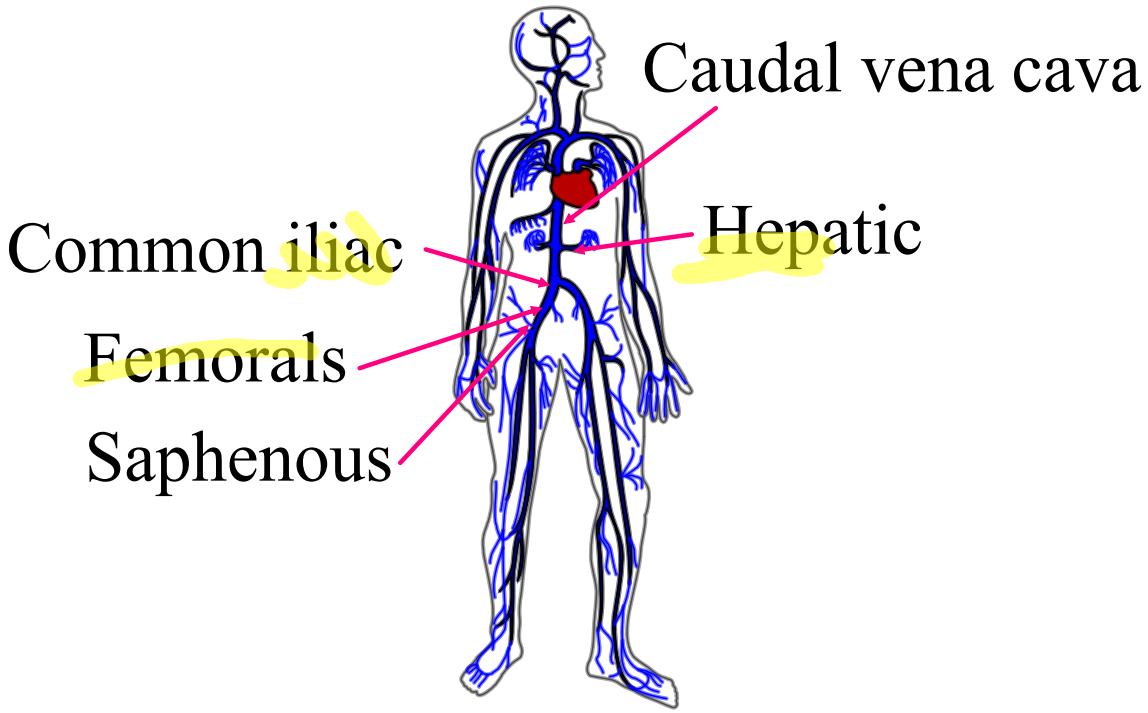
Internal jugular- deep veins that draw from the skull/brain empty into the subclavian

External jugular- superficial veins that draw from the skull/neck empty into the subclavian

Subclavian- deep veins that originate the auxiliary, scapular, and thoracic and cephalic

These empty into the brachiocephalic and from there into the cranial vena cava

Azygous drains most the chest wall and empties into the cranial vena cava which delivers to the right atrium



Saphenous to the Femorals, External iliac, Internal iliac, common iliac, caudal vena cava, finally into the right atrium

Portal veins takes feeds from the veins that drain the stomach, spleen, intestine, pancreas, and gall bladder.

After going throughout the liver it becomes the hepatic vein, caudal vena cava, then right atrium

Cardiovascular System
Day 4

The Lymphatic System

Considered part of the circulatory system because it is made up of fluid called lymph (comes from tissue fluids)

Lymph is an almost light colorless fluid rich in white blood cells and it circulates through the lymphatic vessels

The lymph organs include spleen, tonsils, and thymus

The Lymph Vessels

They resemble other vessels in the fact that they start with capillaries and then get to be larger and larger vessels.

They also have valves that prevent backflow.

The lymph vessel are connected to the vein by the lymphatic duct which empties into the subclavian veins.

The lymph vessels collect proteins and water which continually filter out of the blood into the tissues and then need to be returned to the blood.

The Lymph Glands

Lymph glands (nodes) are numerous sacs along the vessels.
They vary in size from dots to bean-sized.

They are identified by their location.

They filer and remove bacteria and malignant cells. Cancer cells

They can be inflamed or swollen with ingested bacteria or toxins.

They make lymphocytes and monocytes.

IMPORTANT SYSTEM FOR DEFENSE

The Spleen

A large, flatten, oval-shaped gland like organ.
Dark red in color
Located on the left side of the abdominal cavity.
The spleen enlarges during disease and increases in size with age.

Function:

Hemopoiesis- formation of lymphocytes, monocytes, and plasma cells

Phagocytosis- removal of destructive microorganisms

Storage for the splenic pulp

The Tonsils

These are three pairs of small, round, masses of lymphoid tissue that filter out bacteria or other foreign matter
They also form lymphocytes

Palatine- located at the back of the throat
Lingual- located at the root of tongue
Pharyngeal- located at the roof of the pharynx

The Thymus

Grayish, pink structure of lymph tissue, cranial to the heart

Important in Immune system because it produces cells that destroy foreign substances and forms lymphocytes.

Right Atrium
Tricuspid valve
Right ventricle
Semi lunar valve
Pulmonary artery
Arterioles in lungs
Capillaries in lungs
Venules in lungs
Pulmonary vein
Left atrium
Bicuspid valve
Left ventricle
Semi lunar valve
Aorta
Arterioles in body
Capillaries in body
Venules in body
Vein (cranial and caudal)