Circulatory Systems
Blood/ Blood Pressure

Honors Biology
Chapter 7
p. 185-209

Open vs. Closed Circulatory

- Unicellular Organisms have single cavity for the exchange of oxygen, carbon dioxide, and food. (paramecium, Hydra, etc.)
- Open Circulatory System- no separation between blood and other fluids. Blood and others fluids surround organs. Moved around by heart contractions and body movements. (arthropods)
- Closed circulatory system- blood is confined to blood vessels. Vessels carry blood to all organs. (vertebrates)

2 Chambered Hearts

- Circulation will determine size and activity of organism.
- 2 Chamber hearts (fish)- single atrium accepts blood and single ventricle pumps blood to gills for gas exchange, then to digestive system to pick up nutrients, then to rest of body. Blood slows in the capillaries, but flow back to the heart is sped up by swimming.

3 Chambered Heart

- 3 chambered heart (amphibians and reptiles)- Two atria and only one ventricle. Blood is pumped to lungs then return to heart to be pumped to rest of body,(double circulation).
- Efficiency- Blood can be pumped effective to body.
- Inefficiency- Oxygenated and deoxygenated blood mix in the single ventricle. Oxygen level reaching body is low.

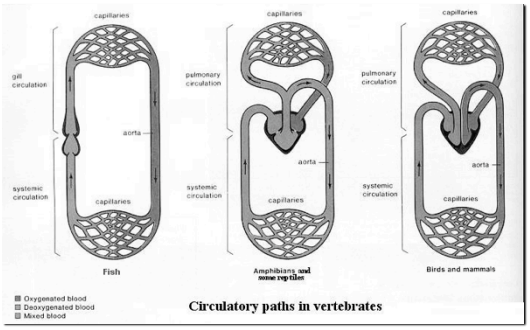
4 Chambered Heart

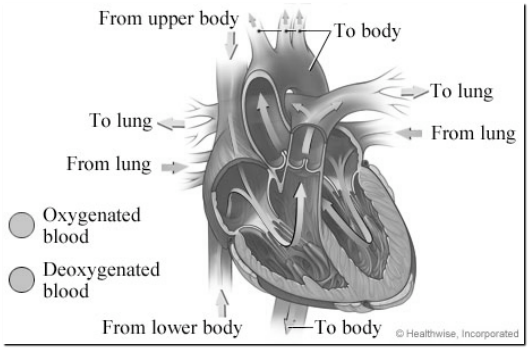
- 4 Chambered heart (Mammals, birds, crocodiles)- 2 atria and 2 ventricles, double circulation. Keeps oxygenated and deoxygenated blood separate. Can maintain vigorous metabolism.

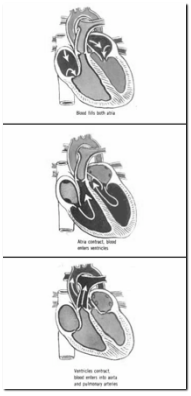
4 Chambered Heart

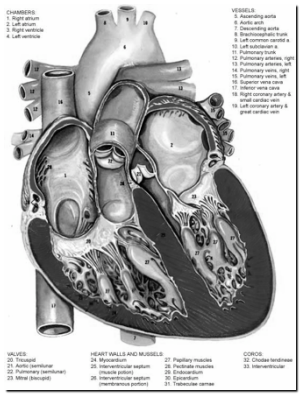
- Muscular pump for blood to circulate.
  - 2 atria- chambers that receive blood
  - 2 ventricles- chambers that pump blood away
- Deoxygenated blood returned to the right side, oxygenated pumped from the left side.

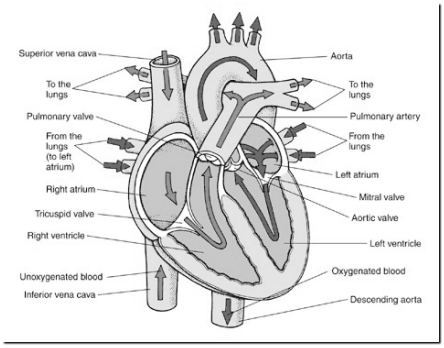
Sinoatrial node (pacemaker) located by the RA delivers electrical charge for heart to beat (72 bpm avg.)

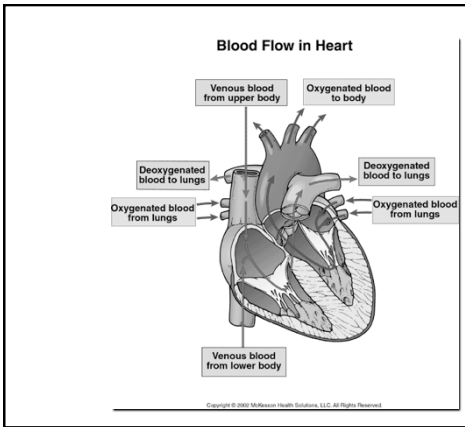

capillaries
gill circulation
aorta
systemic circulation
capillaries
Fish
pulmonary circulation
systemic circulation
Amphibians and some reptiles
pulmonary circulation
systemic circulation
Birds and mammals
Oxygenated blood
Deoxygenated blood
Mixed blood
Circulatory paths in vertebrates

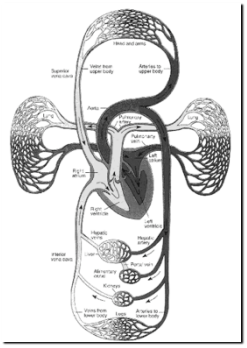

From upper body
To body
To lung
To lung
From lung
From lung
Oxygenated blood
Deoxygenated blood
From lower body
To body
© Healthwise, Incorporated

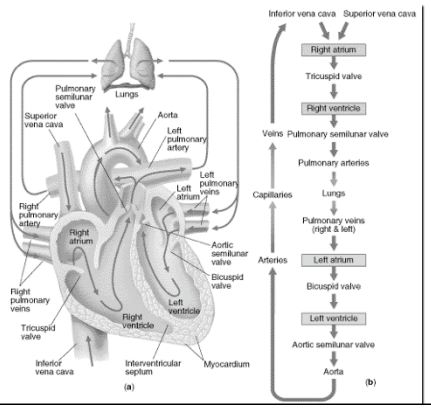




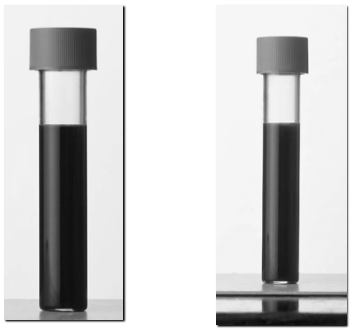

Superior vena cava
To the lungs
Pulmonary valve
From the lungs (to left atrium)
Right atrium
Tricuspid valve
Right ventricle
Unoxygenated blood
Inferior vena cava
Aorta
To the lungs
Pulmonary artery
From the lungs
Left atrium
Mitral valve
Aortic valve
Left ventricle
Oxygenated blood
Descending aorta


Blood Flow in Heart
Venous blood from upper body
Oxygenated blood to body
Deoxygenated blood to lungs
Deoxygenated blood to lungs
Oxygenated blood from lungs
Oxygenated blood from lungs
Venous blood from lower body





Blood is Red. Always.



Oxygenated Blood Deoxygenated Blood

Composition of Blood

- Red Blood Cell (Erythrocytes)
  - Carry oxygen (Hemoglobin)
  - Hemoglobin- protein with 4 Heme groups carries a Iron ion to bind to Oxygen.
  - Only live 120 days
  - Can't produce in the blood stream, Lose nuclei when mature, produce by bone marrow
  - Production of r.b.c. regulated by kidney

Composition of Blood

- White Blood Cells (Leukocytes)- defend against foreign organisms like bacteria.
  - Macrophage- special type of w.b.c that engulfs foreign bacteria.
  - Number of w.b.c increase when there is an infection.

Composition of Blood

- Plasma- fluid portion of blood
  - Water, proteins, ions, amino acids , sugars, hormones, etc.
  - Majority of waste CO_2 is carried by plasma
  - Absorbs digested food monomers to deliver to all parts of the body.

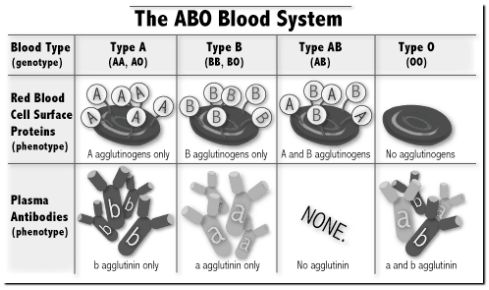
Composition of Blood

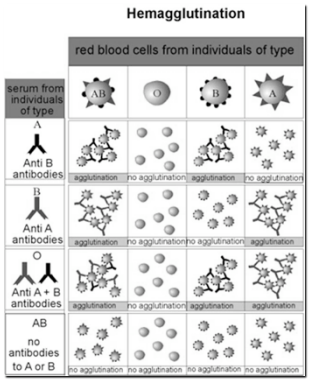
- Platelets- small fragments of cells that assist in the clotting of blood (coagulate)
  - Combine with protein netting at the site of the wound to help seal it.
  - Release enzymes that interact with plasma proteins (clotting factors) to begin a chain of reactions.

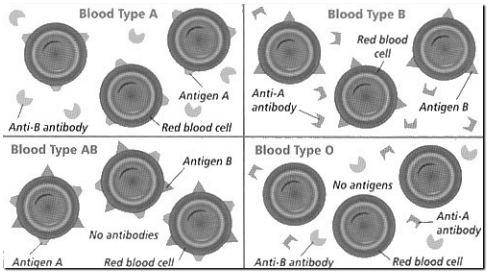
Blood Type

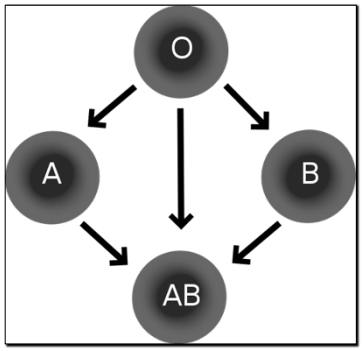
- http://www.snaples.com/ssnaples/bldtype.dir/bldtype.htm

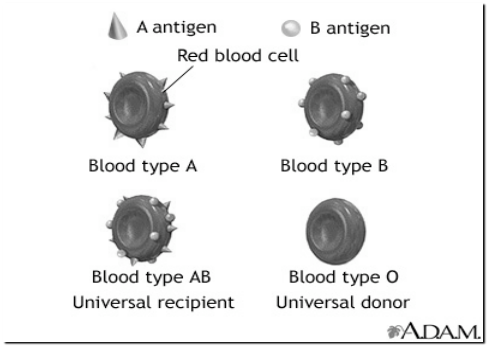
	Group A	Group B	Group AB	Group O
Red blood cell type	A	B	AB	O
Antibodies present	Anti-B	Anti-A	None	Anti-A and Anti-B
Antigens present	A antigen	B antigen	A and B antigens	None

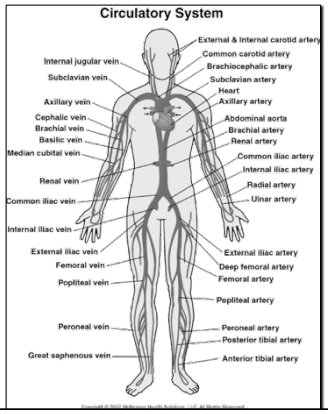


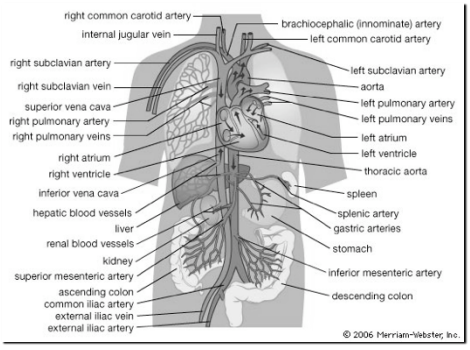










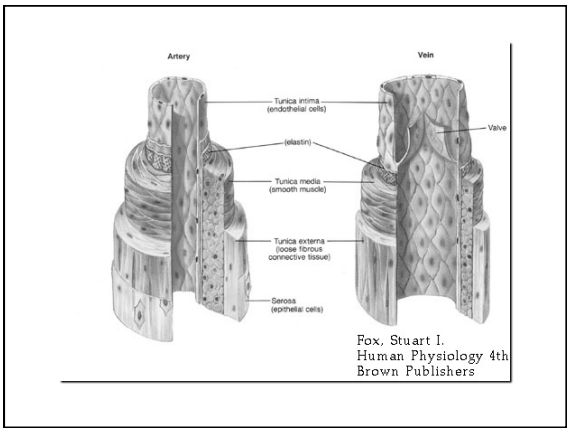


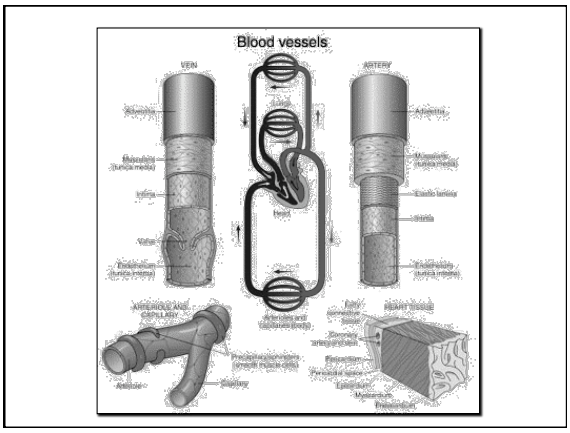
Arteries and Veins

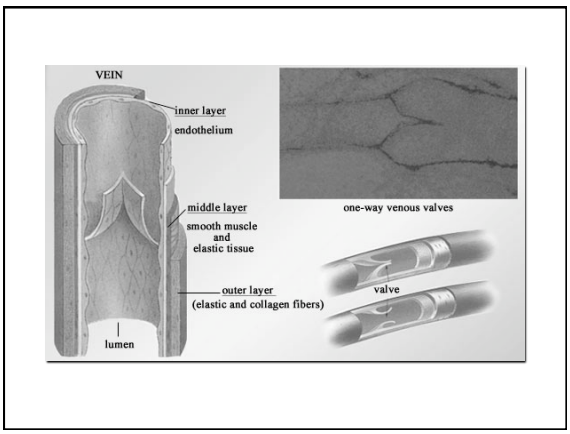
- Arteries carry blood away from the heart.
- Arteries are made of muscle and elastic tissue to allow the arteries to fill completely and resist increases in pressure from each ventricle contractions.
- During rest the elastic and muscle walls of arteries can contract to help push blood along and maintain blood pressure.
- The structure of arteries and signals from the nervous system allow us to control blood pressure and flow of blood.

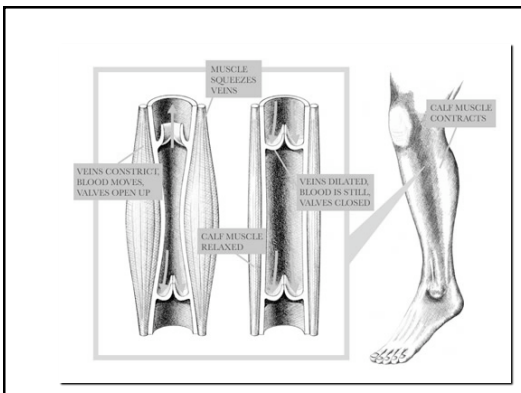
Arteries and Veins

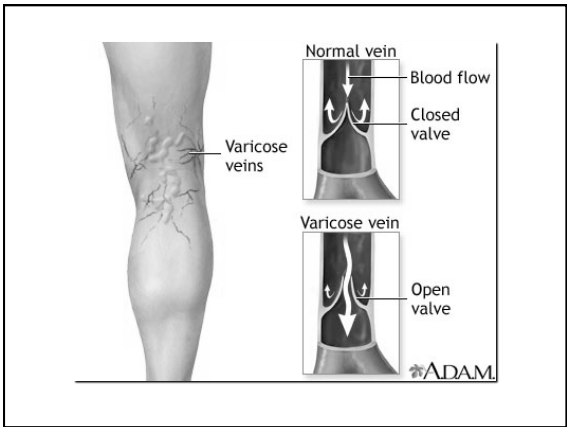
- Capillaries are small vessels that connect arteries and veins as blood is diffused to cells.
- Veins carry blood back to the heart under much less pressure than arteries.
- Veins have thinner walls with much less muscle and elastic tissue than arteries.
- Veins have valves to prevent backwards flow of blood.
- Contraction of skeletal muscles can help push blood back to the heart

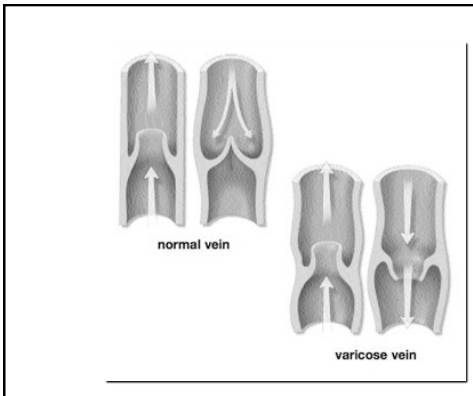

Artery
Vein
Tunica intima (endothelial cells)
Valve
(elastin)
Tunica media (smooth muscle)
Tunica externa (loose fibrous connective tissue)
Serosa (epithelial cells)
Fox, Stuart I.
Human Physiology 4th
Brown Publishers

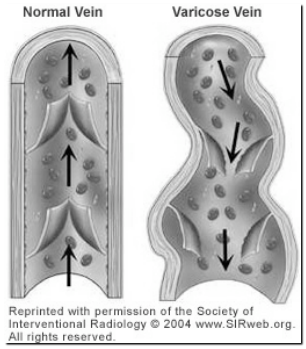

Blood vessels
VEIN
ARTERY


VEIN
inner layer
endothelium
middle layer
smooth muscle and elastic tissue
outer layer
(elastic and collagen fibers)
lumen
one-way venous valves
valve


MUSCLE SQUEEZES VEINS
VEINS CONSTRICT, BLOOD MOVES, VALVES OPEN UP
CALF MUSCLE RELAXED
VEINS DILATED, BLOOD IS STILL, VALVES CLOSED
CALF MUSCLE CONTRACTS

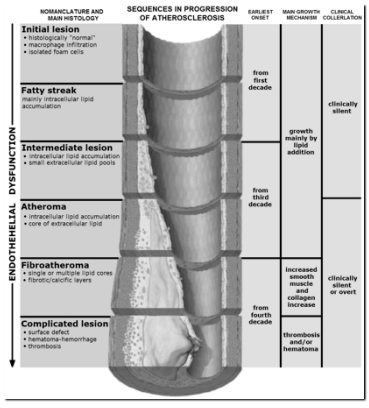

Normal vein
Blood flow
Closed valve
Varicose veins
Varicose vein
Open valve
A.D.A.M.


normal vein
varicose vein



Blood Pressure

- Blood Pressure is the force exerted by blood moving through blood vessels.
- Systolic- pressure exerted on the arteries when the heart pumps (ventricle contract)
- Diastolic- pressure exerted when heart relaxes (atrial filling)
  - Systolic/diastolic. Normal less than 120/80
- Hypertension- high blood pressure makes the heart work harder which can damage heart muscles and blood vessels. Can lead to atherosclerosis- hardening of the arteries or stroke.



Lymphatic System

- Intercellular (Interstitial) fluid is recycled by the lymphatic system.
- Lymph- fluid that contains specialized cells, water, large proteins, salts, etc.
- Lymph vessels have valves and carry lymph throughout the lymphatic system.
- Lymph Nodes, found throughout the body serves as traps or scanners for foreign particles. They contain white blood cells.
- Empties from two large lymph vessels into the blood stream at the heart- Thoracic Ducts

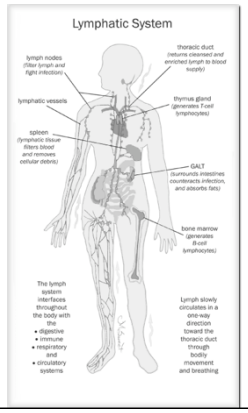
Lymphatic System

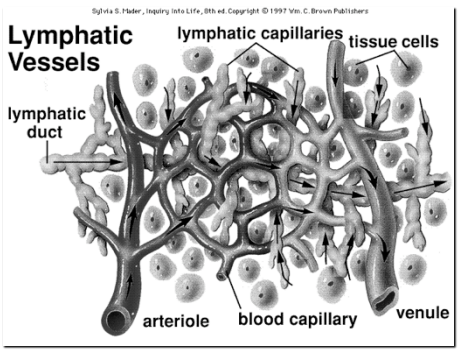
- No pump, contraction of skeletal muscle cells move lymph. 3L/day vs. 6200 L/day

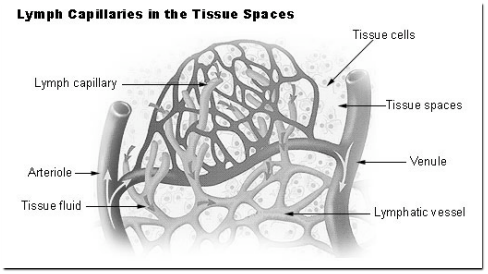
1. Responsible for the removal of interstitial fluid from tissues
2. Absorbs and transports fatty acids and fats to the circulatory system;
3. Transports immune cells to and from the lymph nodes.

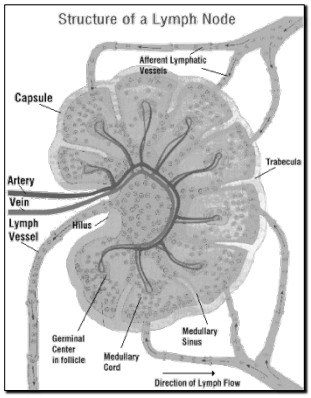
Lymphatic System

- The lymph transports antigen-presenting cells (APCs), to the lymph nodes where an immune response is stimulated.



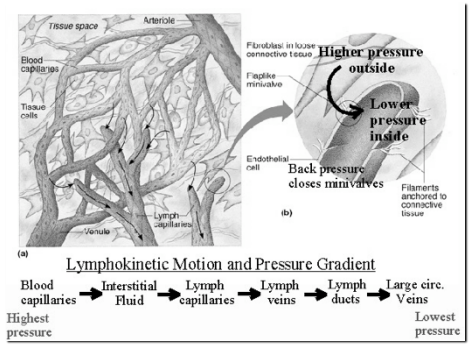


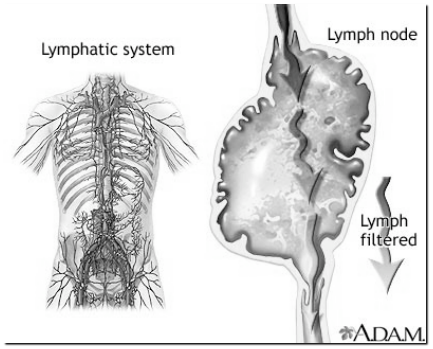




Lymphatic System

- Intercellular fluid is picked up by lymph capillaries and travels from the lymph vessels to at least one lymph node.
- Lymph nodes helps remove excess water from the tissues and destroys pathogens such as bacteria.
- Muscle contractions help move lymph through the lymphatic system since there is no pump.
- Filtered lymph will be deposited by the thoracic/ lymphatic ducts back into subclavian veins near the heart.
- Path of Lymph: Interstitial Fluid→ Lymph Capillaries→ Lymph Vessels→ Lymph Nodes→ Lymph Vessels→ Lymph/Thoaracic Duct→ Subclavian Veins





Blood Clotting

Coagulation- the clotting of blood is necessary to prevent massive loss of blood.

1. Platelets in our blood are inert until tissue damage.
2. Tissue damage reveals proteins- connective tissues that react with proteins on platelets.
3. Proteins cause platelets to become "sticky"
4. Platelets bind red blood cells and platelets. Forms a temporary clot.

Blood Clotting (Cont.)

5. Platelets release enzymes that interact with plasma proteins called clotting factors.
6. Clotting factors- series of proteins where productions of one catalyzes production of next. Clotting cascade.
7. Final product of clotting cascade is Clotting Factor X.
8. Ca^{+2} activates Clotting Factor X

Blood Clots (Cont.)

9. Clotting Factor X causes a shape change of Prothrombin into the active form of the enzyme Thrombin.
10. Thrombin- enzyme causes the soluble Fibrinogen to become insoluble- Fibrin.
11. Fibrin is insoluble threads (net) that catches red blood cells and platelets to form clot and stop bleeding.

Hemophilia

Hemophilia- genetic disorder that disrupts normal blood clotting.

Hemophilia A does not code for clotting factor VIII

Hemophilia B does not code for clotting factor IX.

Clotting cascade is disrupted.