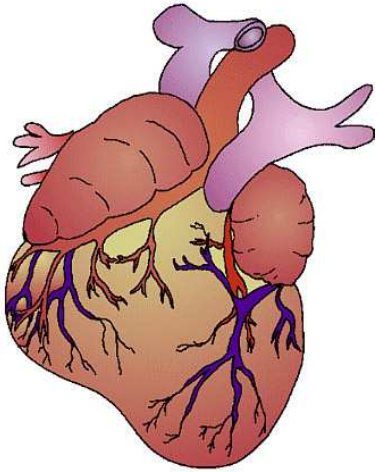
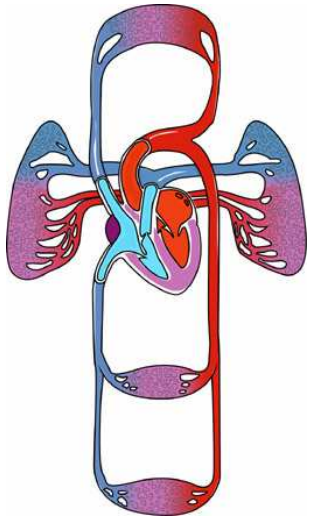
Chapter 19

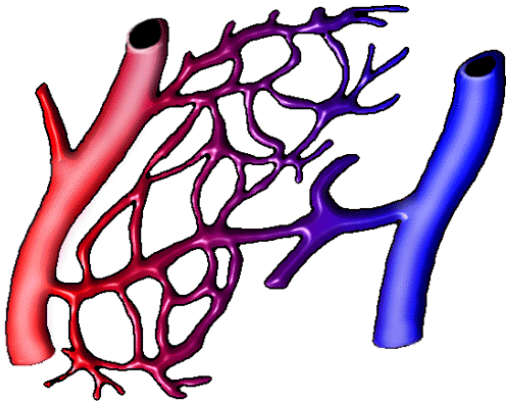
Circulation

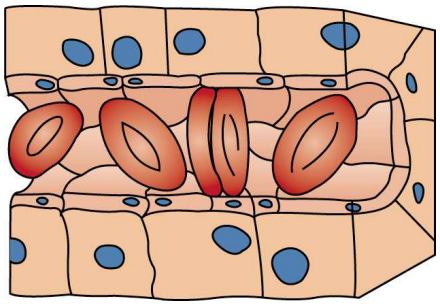
Circulatory System

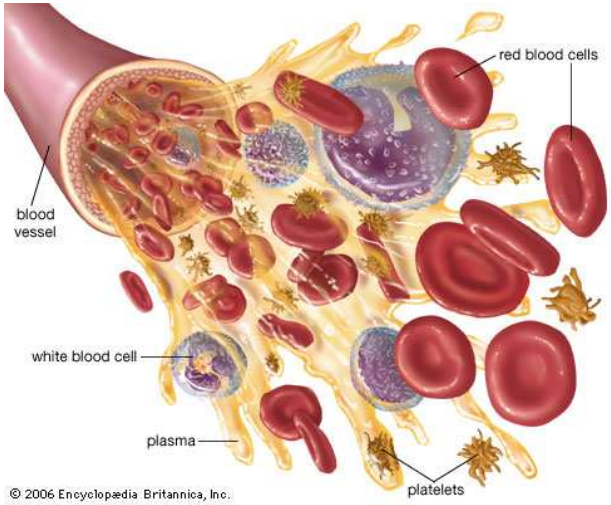
- A closed system
- Consisting of Heart, Arteries, Veins, Capillaries, Blood & the Lymphatic system











Blood Make up

- The blood is made up of **Plasma** and three main types of cells: **RBC** (red blood cells), **WBC** (white blood cells) and **platelets**.

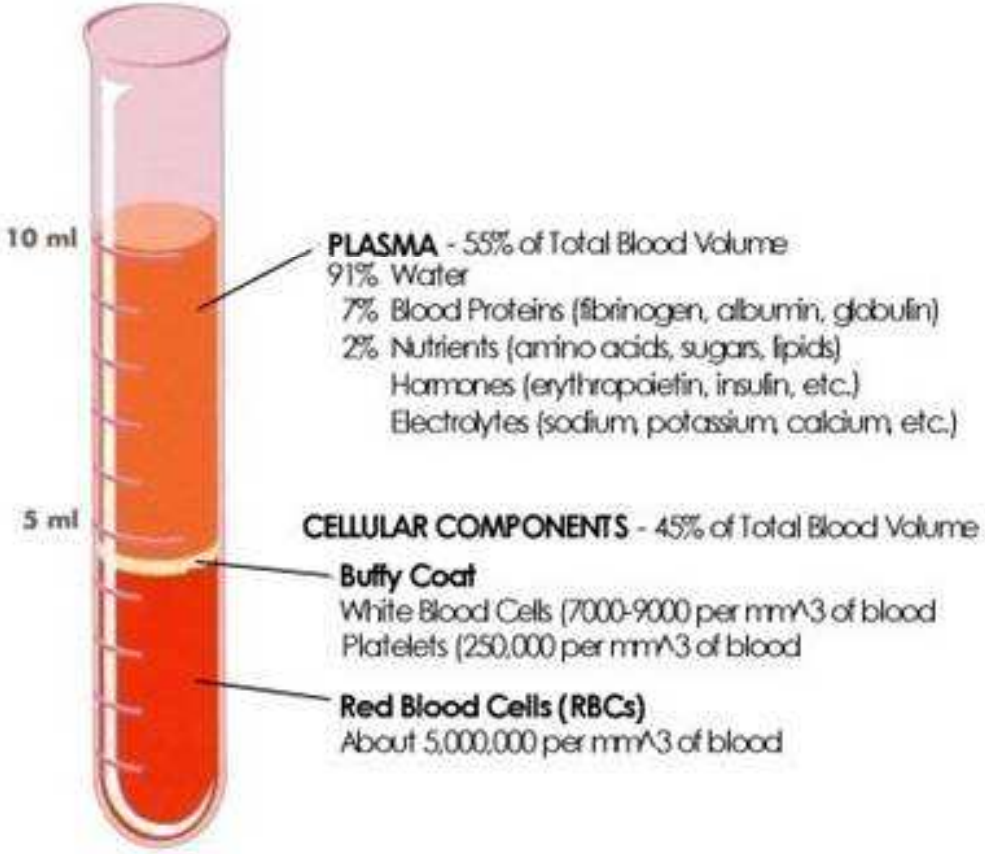
Plasma – is **91% water,** the yellowish fluid of the blood that carries all of the cells and materials which actually make up the substance we call “blood”

Yellow color from dissolved proteins – 3 types

(i) **Albumins** – transport hormones & fatty acids

(ii) **Globulins** – transport vitamins & help fight viral infections

(iii) **Fibrinogens** – cause blood to clot



Blood Make up

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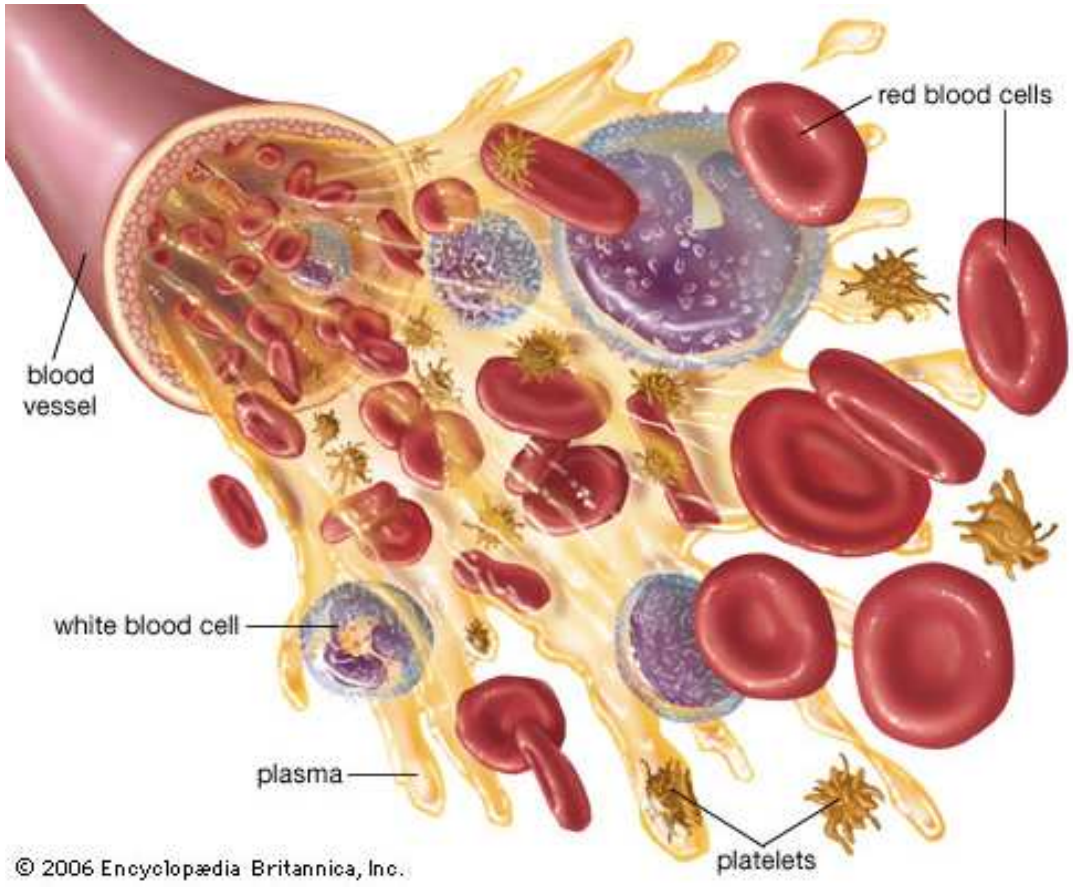
RBC: nonnucleated cells that contain an iron containing the molecule **hemoglobin** that carries the oxygen to the cells of the body.

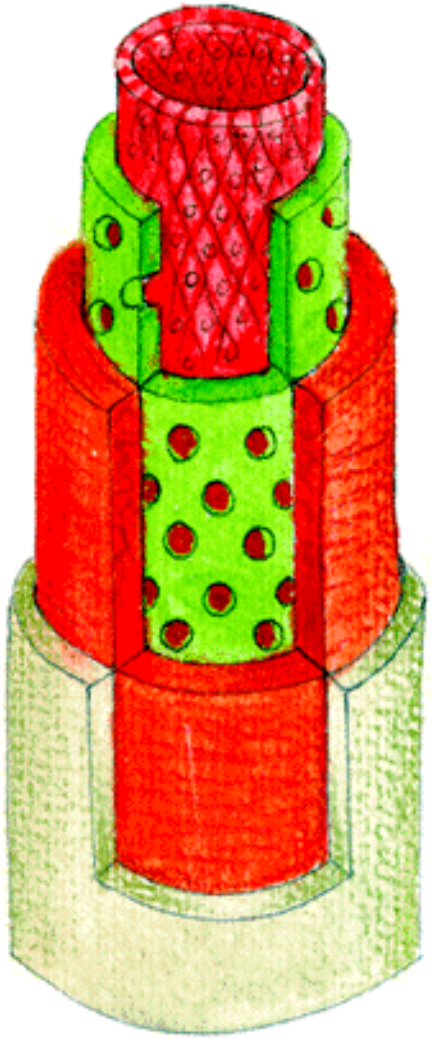
WBC: Several cell types that have nuclei & are involved in the immune system

Platelets are the RBC cell fragments involved in blood clotting. Also involved in clotting are long strands of protein called **fibrin**.



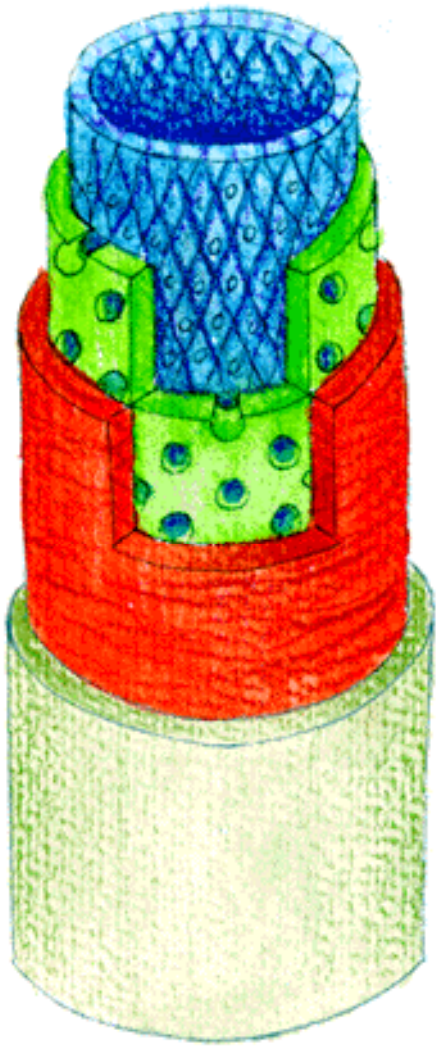
Arteries

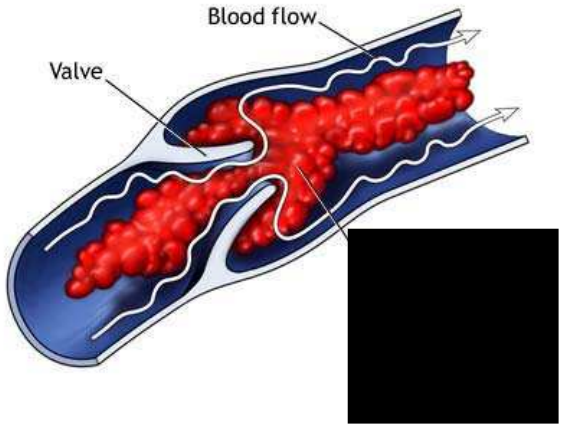
- 1. Carry blood **AWAY** from the heart
- 2. Branches into smaller and smaller vessels called **arterioles**
- 3. Thick walled vessel w/ layer of connective tissue and smooth muscle
- 4. Elastic: able to flex w/ each beat of the heart



Veins

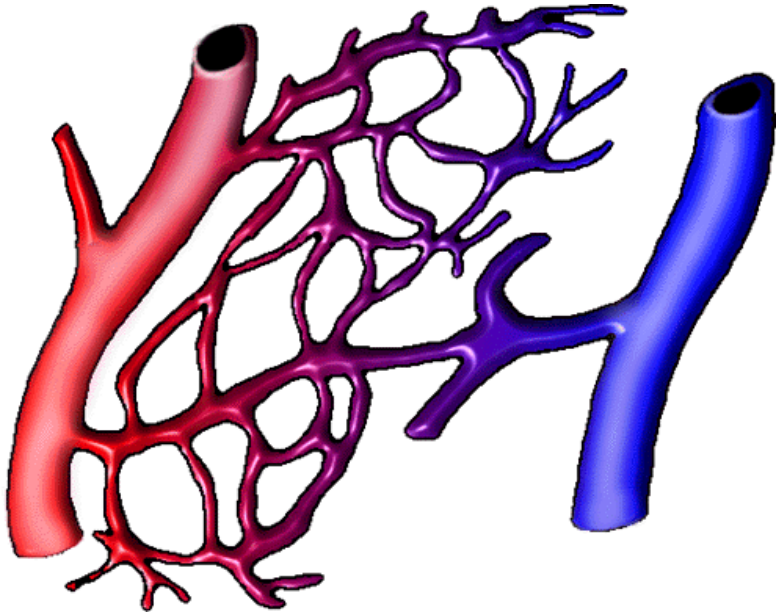
- Vessels that carry blood **back toward** the heart
- Thin walled w/ less connective and muscle tissue surrounding them
- Not very flexible
- Has "**one-way" valves** to help prevent blood from pooling in the extremities
- Smaller branches from capillaries get larger and larger forming **venules** which then form **veins**





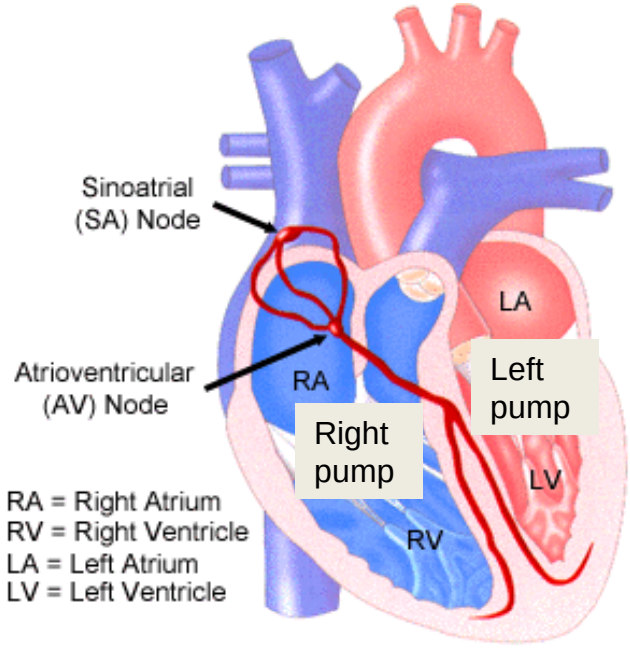
Capillaries

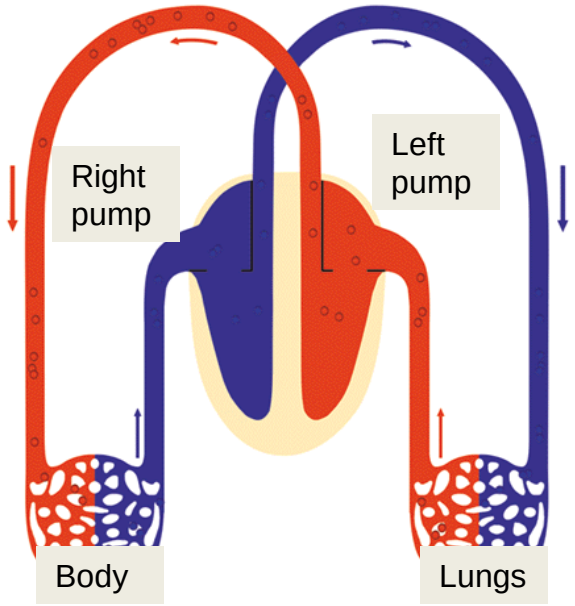
- 1. Arterioles and venules are connected by these microscopic vessels.
- 2. Vessels are small enough that red blood cells travel through in single file
- 3. Vessel walls not perfect seal and **leak** plasma into intercellular spaces (lymph)
- 4. Point where gas exchange (O_2 and CO_2), nutrients and wastes are exchanged



The Heart

- Cardiac Muscle tissue designed to contract
  - **SA Node** - Pacemaker of the heart – causes Atria to contract & sends impulse to:
  - **AV Node** – causes the Ventricles to contract
- Acts as a **duel pump**
  - **Right- collects low O_2 from body & pumps to lungs**
  - **Left – collects high O_2 from lungs & pumps to body**





4 chambered Heart Anatomy

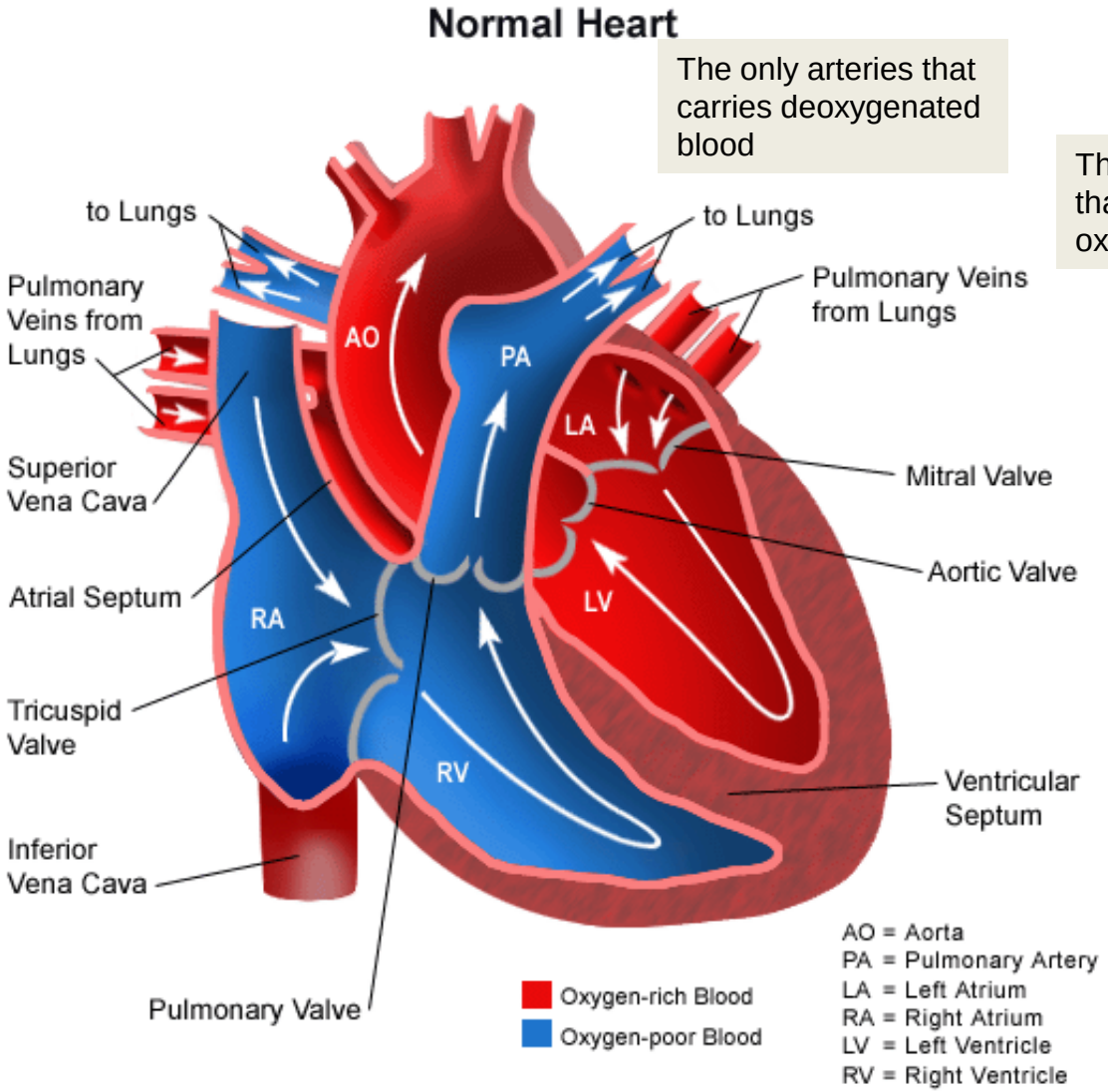
Right & Left Atria – AKA "Auricles" – Thin walled collectors of the incoming blood -simply pump to ventricles.

Right & Left Ventricles – the main power pumps of the heart. Thick walled separated by the Septum

4 flap-like valves keep the blood from falling backward and allows only one way movement

Need-To-Know Valves:

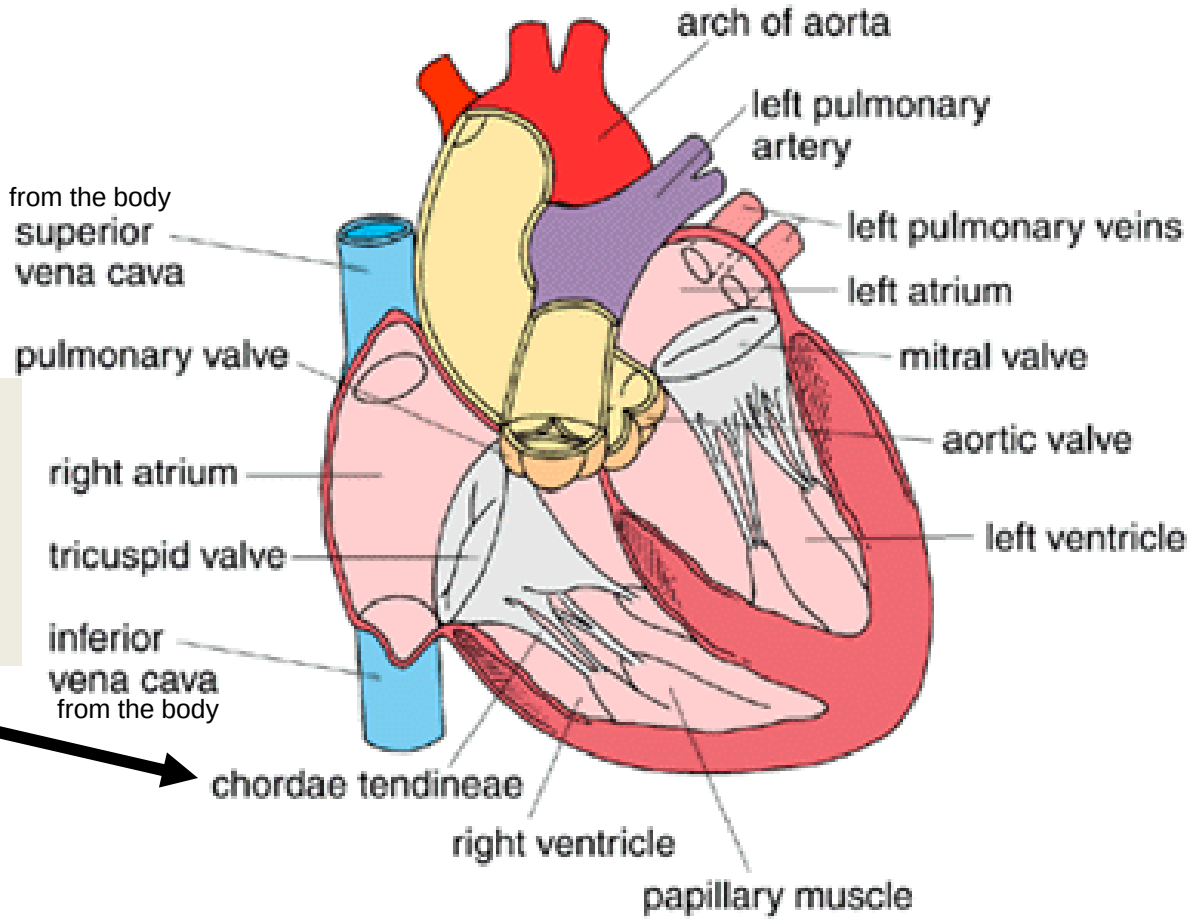
- **Tricuspid**
- **Bicuspid** (Mitral)
- **Semi Lunars** (2)



Heart Blood flow – (Need-to-Know)

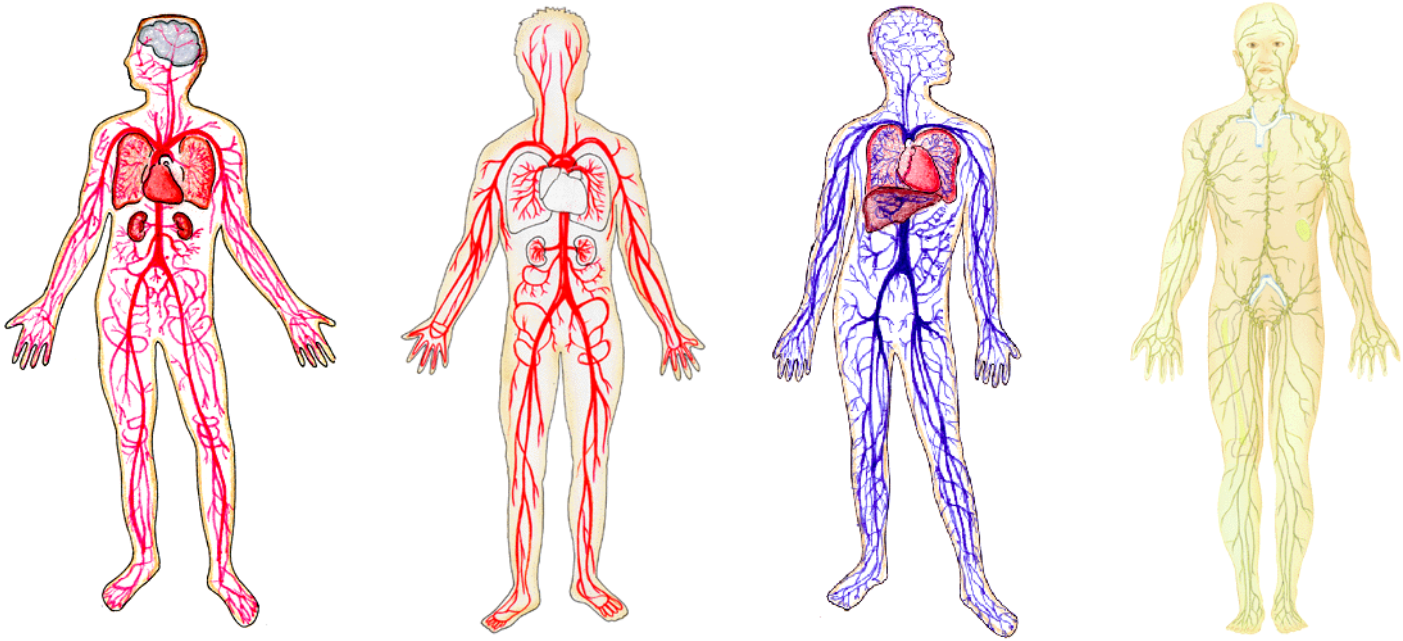
- Path of the blood: vena cava (superior & inferior) → rt atrium → tricuspid valve → rt ventricle → pulmonary semi lunar valve → pulmonary artery → lungs → pulmonary vein → left atrium → Bicuspid Valve (aka Mitral) → left ventricle →Aortic semi lunar valve → Aorta → body → back to the vena cava

Chordae tendineae – string-like structures inside the heart that attach the valves & allow to open & close properly



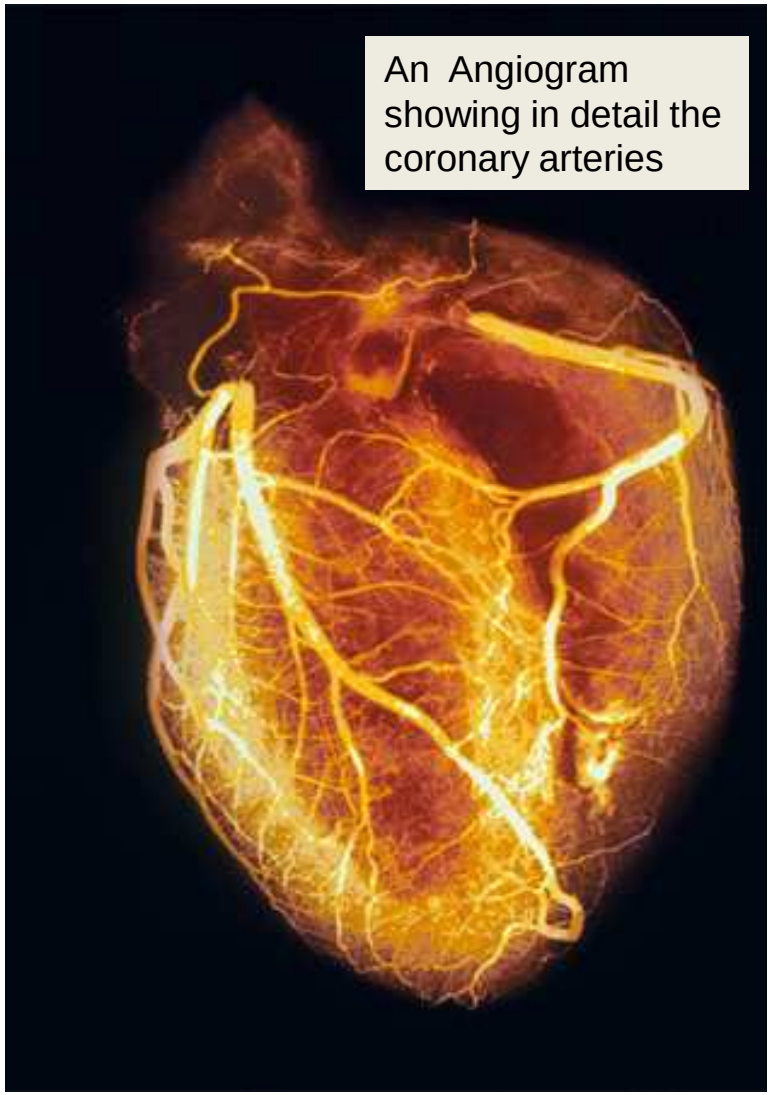
Blood Pathways

- Pulmonary, Systemic & Lymphatic Circulation
  - Pulmonary – takes blood to & from the Lungs (we'll talk in detail when we cover the respiratory system)
  - Systemic – takes blood to & from the rest of the body
  - Lymphatic – Sometimes include w/ the Immune System, sometimes considered its own system. It collects plasma (lymph) "leaked" from the capillaries, filters it & returns it to the blood.



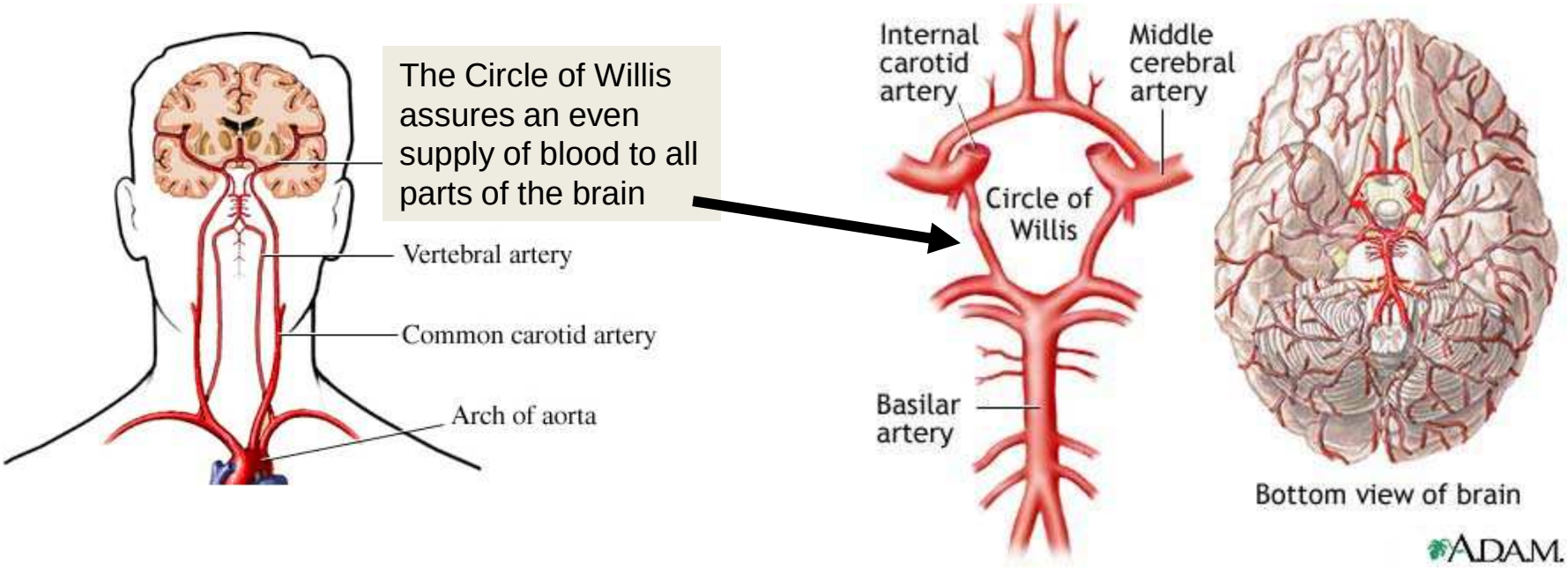
Systemic Circulation - Coronary

- **Coronary Circulation**: blood supplied to the heart itself
  - Very first two branches off the Aorta supply blood to the two coronary arteries
  - The coronary capillaries supply blood to all parts of the heart
  - The coronary veins dump the blood directly into the right atrium (all other venous blood enters the heart through the Vena Cava)



Systemic Circulation - Cerebral

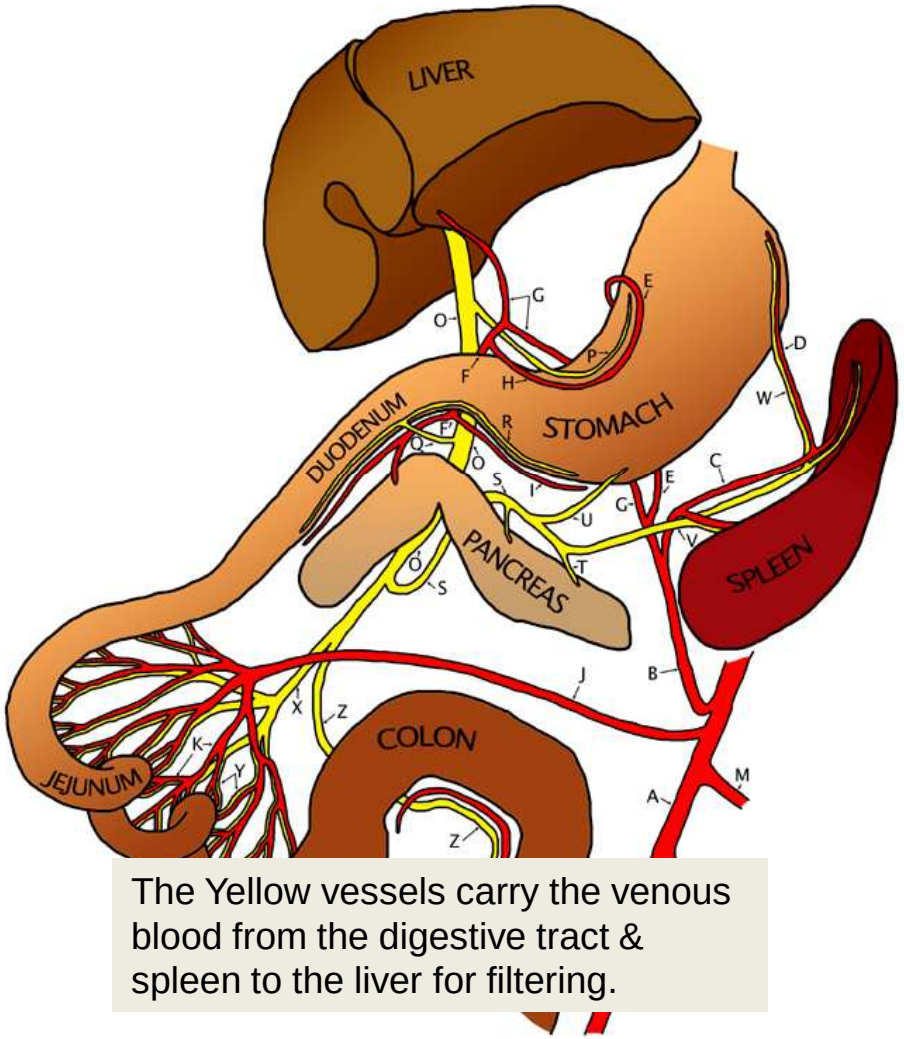
- **Cerebral Circulation**: Blood flow to the brain.
- Body's most important organ – gets blood first!
- Blood travels from the heart through the aortic arch and into the carotid arteries & the Vertebral Arteries.
- All of the arteries supplying blood to the brain arise from the aortic arch.
- These arterial systems join at the base of the brain to form the Circle of Willis.
  - In case there is a blockage or slowdown in blood from one of the main arteries the Circle of Willis assures an even blood flow to all parts of the brain.



Systemic Circulation Hepatic Portal

- **Hepatic Portal System**: carries the blood from the GI tract and spleen to the liver before it enters the inferior vena cava and the general circulation.

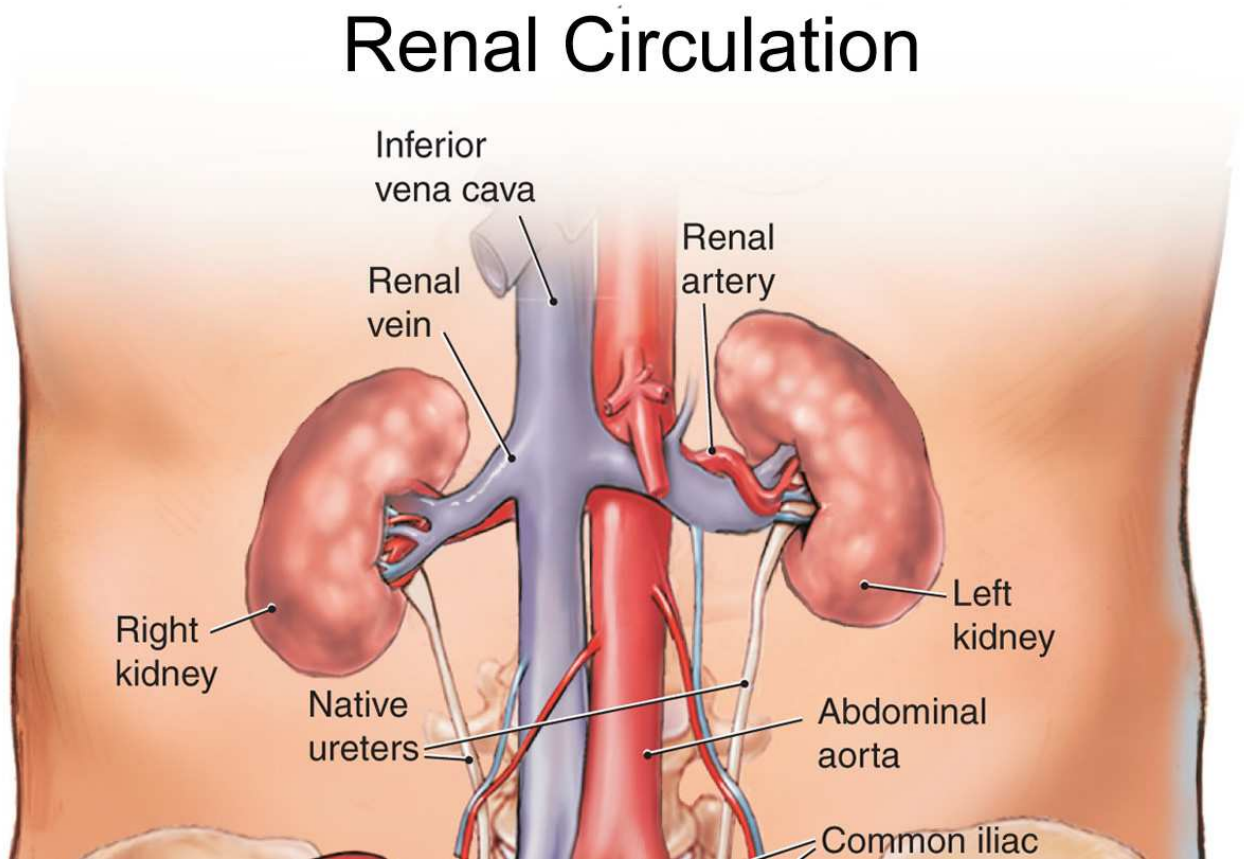
- This is needed because this blood has digestive end-products and absorbed toxins from the GI tract and bilirubin from hemoglobin destruction in the spleen. The liver is in charge of processing & filtering these substances.



The Yellow vessels carry the venous blood from the digestive tract & spleen to the liver for filtering.

Systemic Circulation - Renal

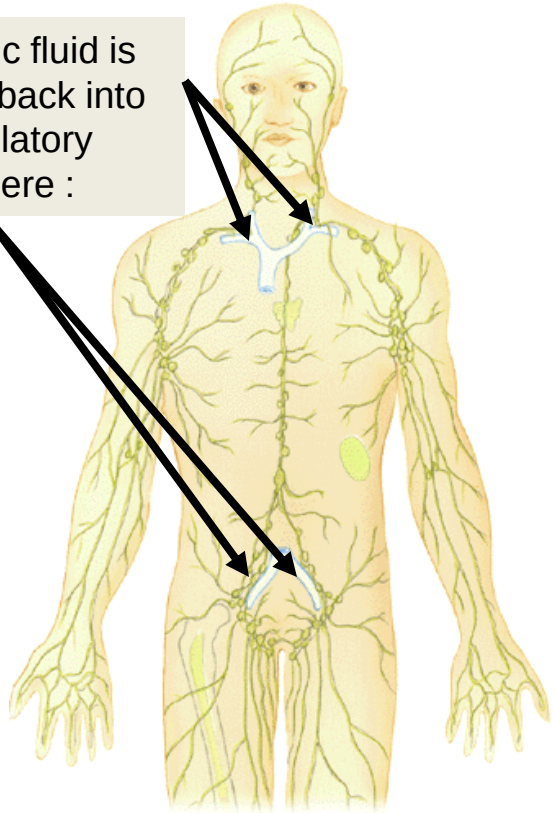
- **Renal Circulation**: Circulation to and through the kidneys
  - Kidneys require blood under high pressure, therefore receives blood from Aorta, it branches shortly after leaving the heart.

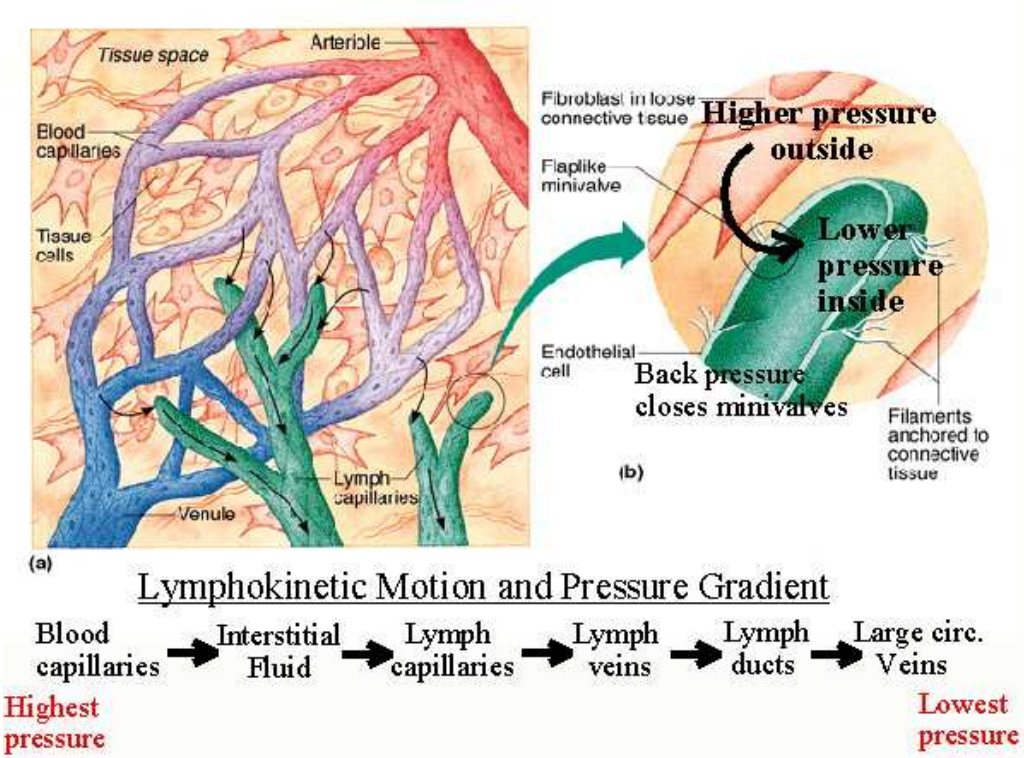


Lymphatic Circulation - Function

- **Lymphatic Circulation**: carries plasma back and dumps it into the veins.
  - Plasma leaks from the capillaries and "baths" the cells of the body.
  - The Excess fluid called **Lymph** and is collected in vessels that make up the lymphatic system.
  - Like veins, **lymphatic vessels** have valves which help move lymph thru the system
  - moves by muscle contractions and indirect squeezing, there is no pump that moves the lymph

Lymphatic fluid is dumped back into the Circulatory system here :





Lymphatic Circulation - Problems

- At times, disease, parasites or structural problems prevent the continuous flow of lymphatic fluid from returning to the blood stream:

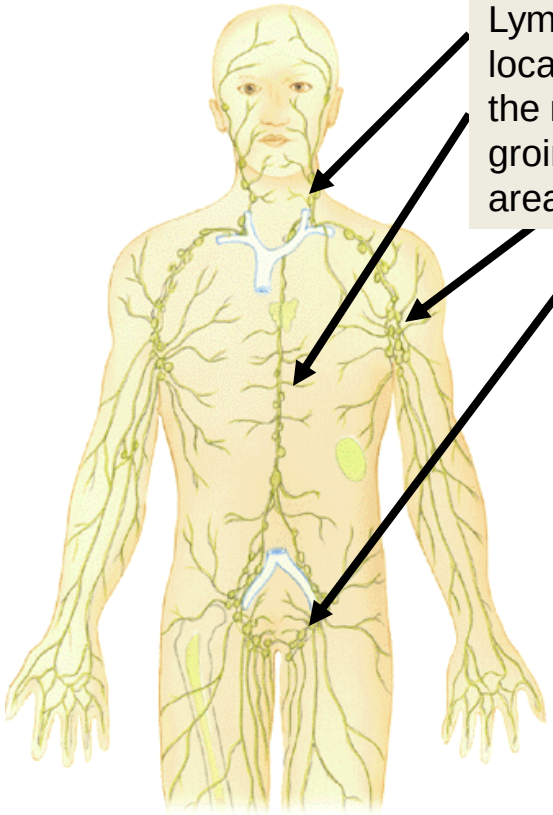
Tonsils infected by bacteria

Swollen lymph nodes

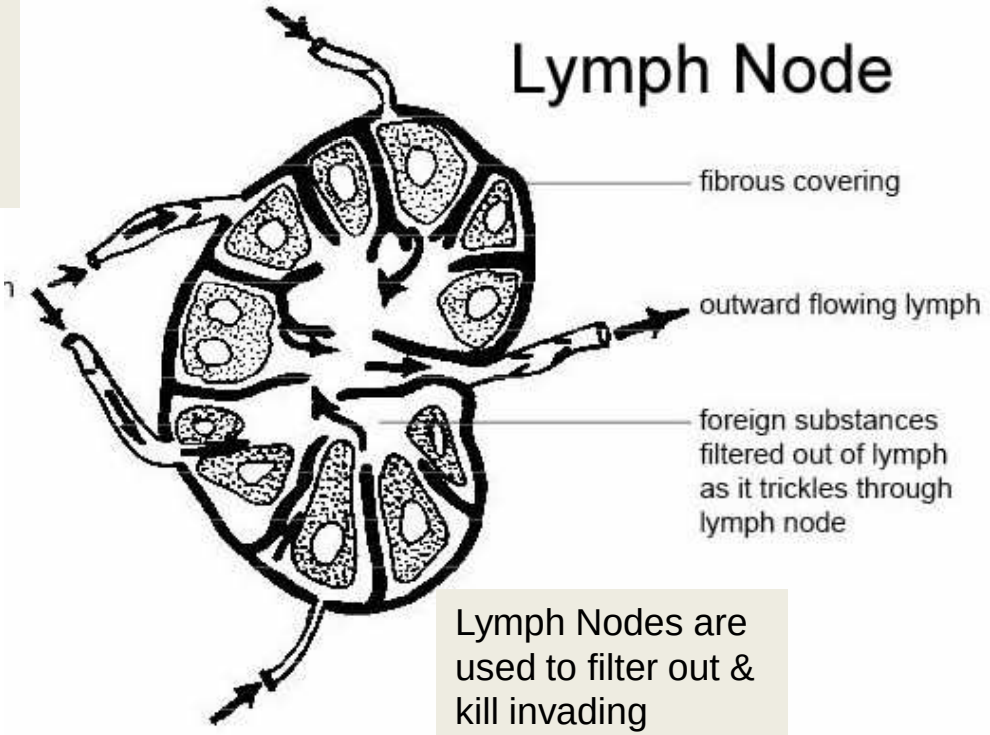
Elephantitis: caused by a parasite that severely blocks lymph vessels.

Lymphatic Circulation - Nodes

- **Lymph nodes** are collecting points usually found in the **armpit**, **groin, throat** and **Chest** regions that are filled w/ lymphocytes and are used to filter out, trap and then destroy bacteria and microorganisms that were collected.
- Lymph Nodes are like cotton balls in the lymph vessel that the lymph fluid pass through.The "cotton ball" filters the fluid clean.



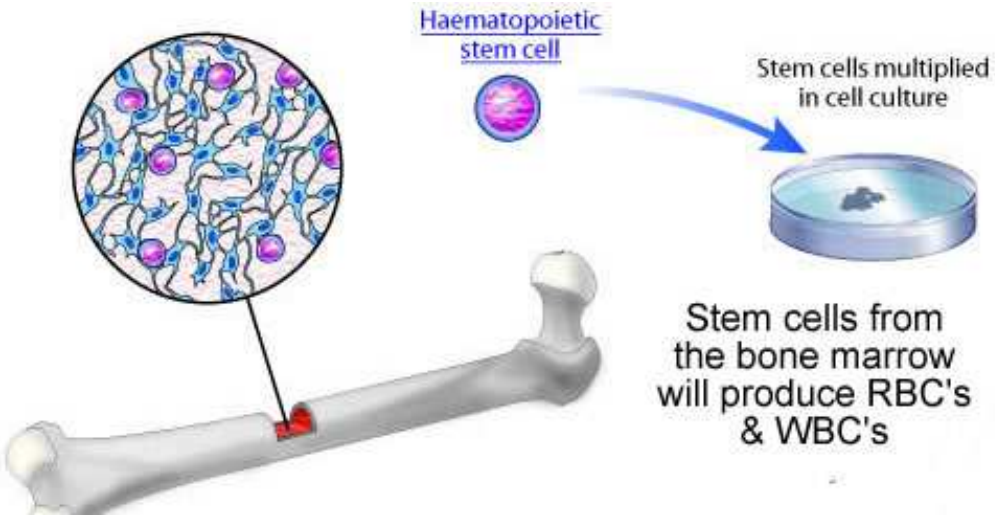
Lymph Nodes are located mainly in the neck, armpits, groin, and chest areas of the body

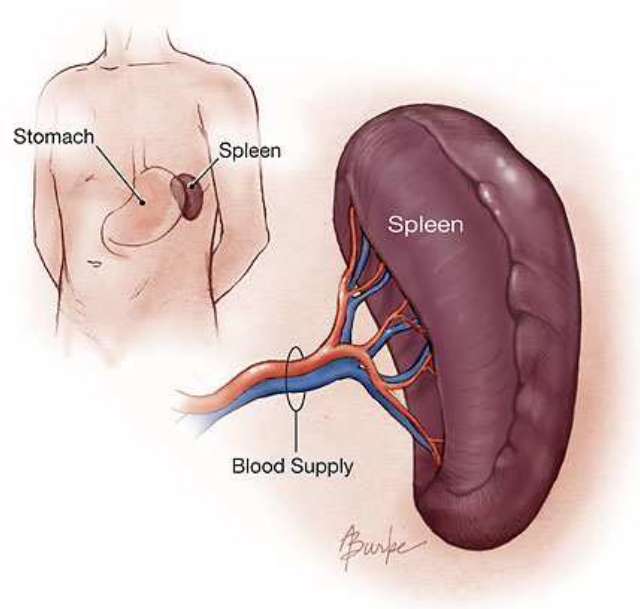


Lymph Nodes are used to filter out & kill invading disease agents

Accessory Circulatory Organs

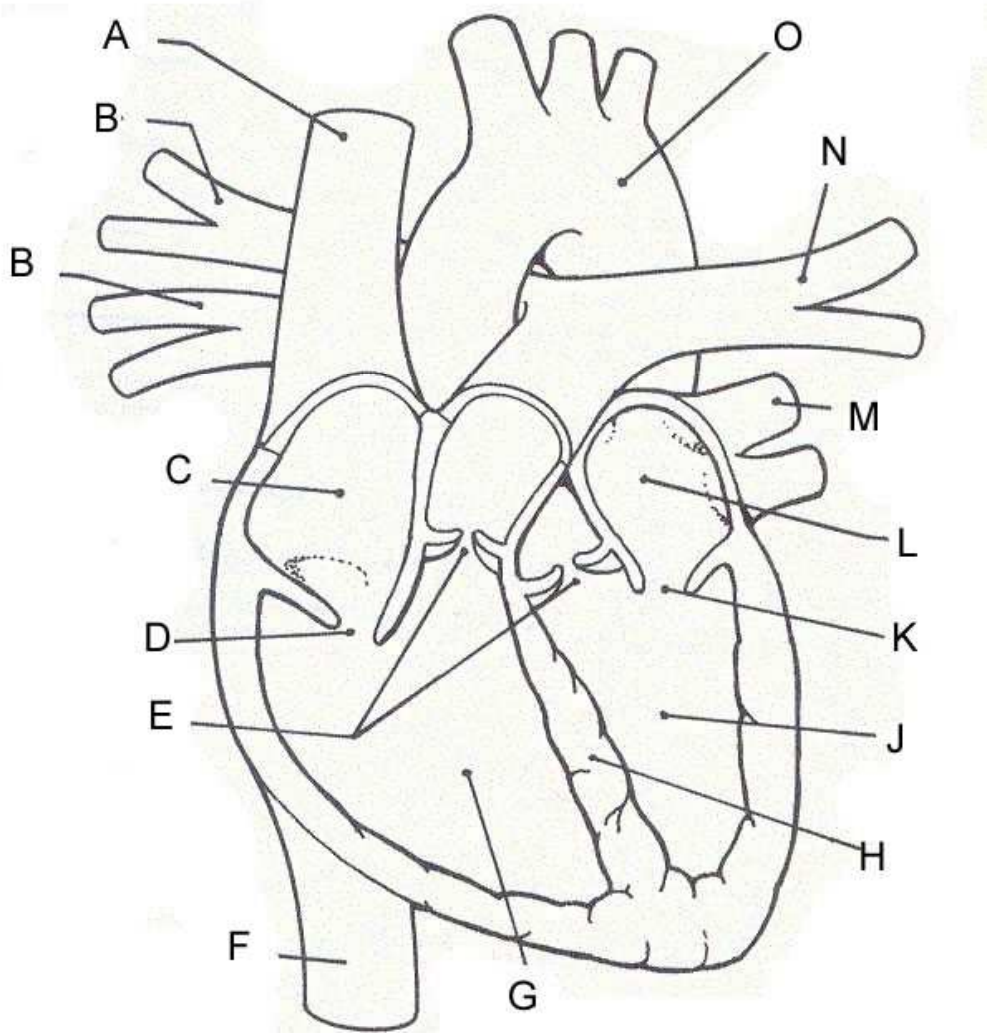
- **Bone Marrow** – The bone marrow—the sponge-like tissue found in the center of certain bones—contains stem cells that are the precursors of white blood cells, red blood cells, and platelets.
- **Spleen** - Helps cleanse the blood by destroying & removing damaged RBC fragments and platelets





Need-to-Knows

- Left Atrium
- Right Atrium
- Left Ventricle
- Right Ventricle
- Septum
- Aorta
- Superior Vena Cava
- Inferior Vena Cava
- Left Pulmonary Artery
- Pulmonary Vein
- Right Pulmonary Artery
- Tricuspid Valve
- Bicuspid Valve
- Mitral Valve
- Semi Lunar Valve



That’s all for Circulation!!

TTFN!