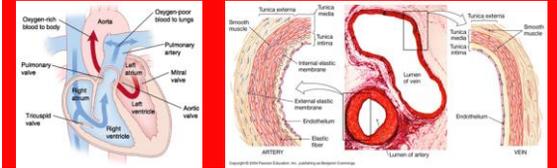




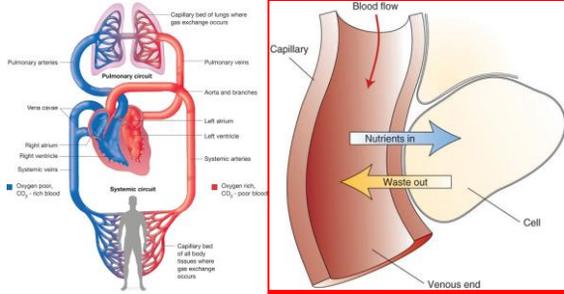
# Human Physiology

## 6.2- The Blood System



**Essential idea:**

- The blood system continuously transports substances to cells and simultaneously collects waste products.



**Nature of science:**

- Theories are regarded as uncertain
  - William Harvey overturned theories developed by the ancient Greek philosopher Galen on movement of blood in the body. (1.9)
    - Blood is recycled through the heart.
    - Flow is unidirectional.
    - Predicted existence of capillaries to connect arteries and veins.

**Applications and Skills**

- Application: William Harvey's discovery of the circulation of the blood with the heart acting as the pump.
  - Claudius Galen's (129-216AD) theory of the physiology of the circulatory system endured until 1628
    - Blood is formed in the liver and is then carried by the veins to all parts of the body.
    - It is used up as nutriment or is transformed into flesh and other substances.
    - A small amount of blood seeps through the lungs between the pulmonary artery and pulmonary veins, thereby becoming mixed with air.
    - It then seeps from the right to the left ventricle of the heart through minute pores in the wall separating the two chambers.

**Theory of knowledge:**

- Our current understanding is that emotions are the product of activity in the brain rather than the heart.
- Is knowledge based on science more valid than knowledge based on intuition?

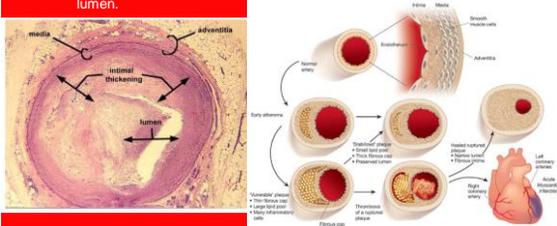
"The intuitive mind is a sacred gift and the rational mind is a faithful servant. We have created a society that honors the servant and has forgotten the gift."  
 —Albert Einstein—

**Understandings**

- Arteries convey blood at high pressure from the ventricles to the tissues of the body.
  - Ventricles pump blood from heart into arteries.
  - Arteries contain thick walls of muscle and elastic fibers.
  - Carry high pressure blood.
  - Coronary arteries supply the heart with oxygen.

## Applications and Skills

- Application: Causes and consequences of occlusion of the coronary arteries.
  - Atherosclerosis
    - Fatty tissue (atheroma) build up.
    - LDLs (low density lipoproteins) accumulate and phagocytes are attracted.
    - Phagocytes grow large and are encapsulated creating a narrowing of the lumen.



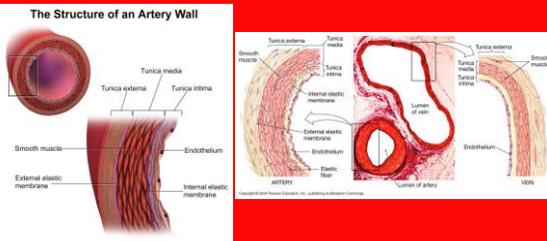
## Applications and Skills

- Application: Causes and consequences of occlusion of the coronary arteries.
  - Factors
    - High LDLs
    - Chronic high levels of glucose (obesity or diabetes)
    - Chronic high blood pressure (smoking or stress)
    - High trans fat diet (damages endothelium)
    - Microbes
      - Chlamydia pneumoniae* (infect artery wall)
      - Trimethylamine N-oxide (TMAO) production in intestines by bacteria.



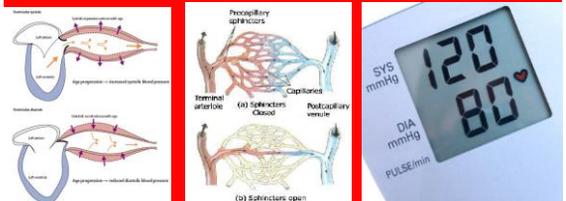
## Understandings

- Arteries have muscle cells and elastic fibres in their walls.
  - Tunica externa: outer tough connective tissue.
  - Tunica media: smooth muscle and elastin fibers.
  - Tunica intima: smooth endothelium tissue.



## Understandings

- The muscle and elastic fibres assist in maintaining blood pressure between pump cycles.
  - Peak pressure is systolic (120 mm Hg average)
  - Recoil pressure of arterial walls is diastolic (80 mm Hg average)
  - Produces a continuous pulsating flow of blood.
  - Vasoconstriction of circular muscle can increase blood pressure.
  - Arterioles can control flow by vasoconstriction and vasodilatation.



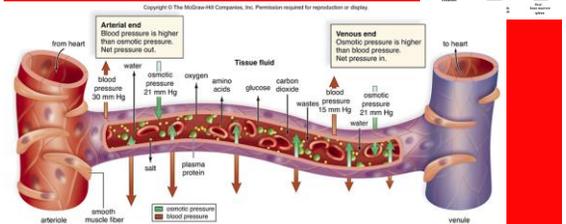
## Understandings

- Blood flows through tissues in capillaries. Capillaries have permeable walls that allow exchange of materials between cells in the tissue and the blood in the capillary.
  - Narrowest blood vessels (10um diameter).
  - Every tissue except lens and cornea.
  - One thin epithelium layer.
  - Pores are between cells.
  - Permeability varies with tissue.



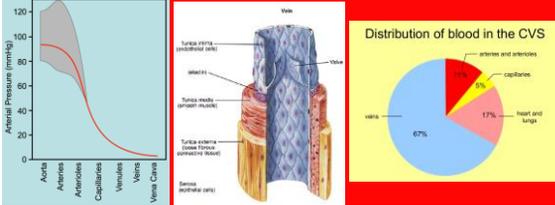
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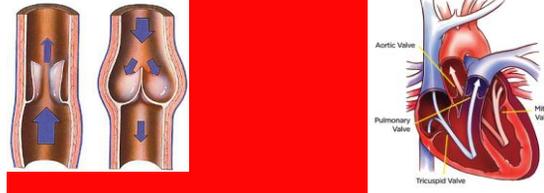
## Understandings

- Veins collect blood at low pressure from the tissues of the body and return it to the atria of the heart.
  - Low pressure(3-12 mm Hg)
  - Thinner walled than arteries.
  - Able to dilate more (80% sedentary blood held in veins).
  - Blood drains body by gravity and muscular contraction back to right atrium of the heart.



## Understandings

- Valves in veins and the heart ensure circulation of blood by preventing backflow.
  - One way valves in veins point back to heart.
  - Body movements push blood into next section.
  - Tricuspid valve is between right atrium and ventricle.
  - Bicuspid valve is between left atrium and ventricle.



## Applications and Skills

- Skill: Identification of blood vessels as arteries, capillaries or veins from the structure of their walls. (pg 294)

- Sketch the structure of an artery, vein, and capillary from a slide.
- Identify the layers.
- Use the chart to help identify your features.

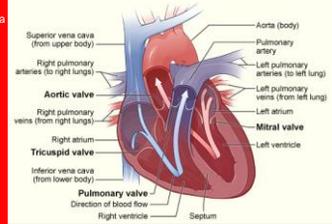
	Artery	Capillary	Vein
<b>Diameter</b>	Larger than 10 µm	Around 10 µm	Variable but not much larger than 10 µm
<b>Relative thickness of wall and diameter of lumen</b>	Relatively thick wall and narrow lumen	Extremely thin wall	Relatively thin wall with a variable but often wide lumen
<b>Number of layers in wall</b>	Three layers; tunica externa, media, and intima; May be subdivided to form more layers	Only one layer (intima); an endothelium of a single layer of very thin cells	Three layers; tunica externa, media, and intima
<b>Muscle and elastic fibers in the wall</b>	Abundant	None	Small amounts
<b>Valves</b>	None	None	Present in many veins

## Applications and Skills

- Skill: Recognition of the chambers and valves of the heart and the blood vessels connected to it in dissected hearts or in diagrams of heart structure.

- Identify:

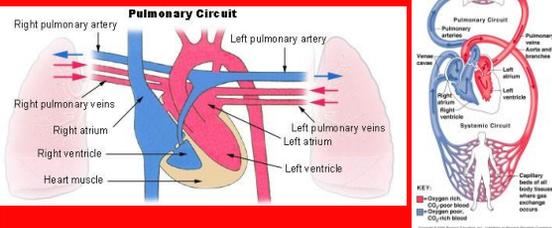
- Inferior and Superior Vena Cava
- Right Atrium
- Tricuspid Valve
- Right Ventricle
- Pulmonary Valve (semilunar)
- Pulmonary Artery
- Pulmonary Veins(4)
- Left Atrium
- Bicuspid Valve (mitral)
- Left Ventricle
- Aortic Valve (semilunar)
- Aorta
- Coronary Arteries and Veins
- Coronary Sinus



- Color code blue and red to identify oxygen level.
- Use arrows to show direction of flow.

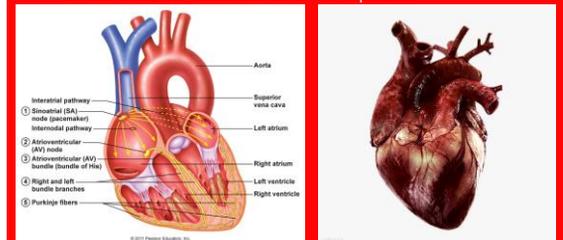
## Understandings

- There is a separate circulation for the lungs.
  - The pulmonary circuit pumps blood to and from the lungs.
  - Lower pressure than in systemic system.
  - Pulmonary artery carries deoxygenated blood to.
  - Pulmonary veins return blood to left atrium.



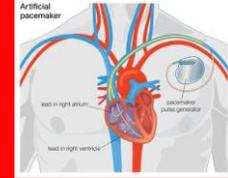
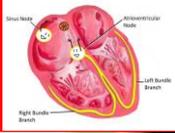
## Understandings

- The heart beat is initiated by a group of specialized muscle cells in the right atrium called the sinoatrial node.
  - Cardiac cells are self-contracting (myogenic)
  - Adjacent membranes trigger depolarization.
  - SA node beats the fastest and are first to depolarize.



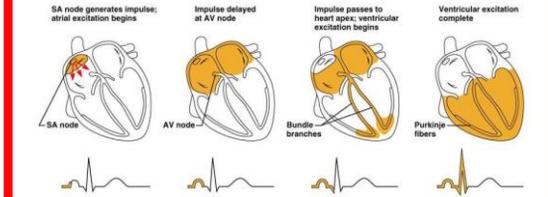
## Understandings

- The sinoatrial node acts as a pacemaker.
  - Defected SA node can be artificially replaced.



## Understandings

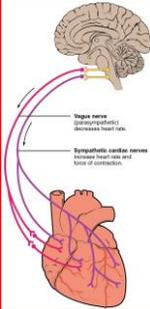
- The sinoatrial node sends out an electrical signal that stimulates contraction as it is propagated through the walls of the atria and then the walls of the ventricles.
  - SA nodes sends electrical signal through fibers of the atria.
  - Atria contract as a unit (less than 1/10<sup>th</sup> of a second).
  - A 0.1 second delay occurs (AV node).
  - Ventricles contract.



## Understandings

- The heart rate can be increased or decreased by impulses brought to the heart through two nerves from the medulla of the brain.

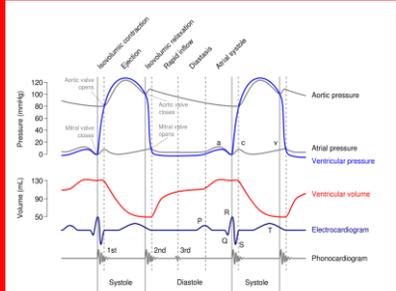
- Cardiovascular center in medulla signals SA node with two branches.
- One branch (sympathetic) increases rate.
- One branch (parasympathetic) decreases rate.
- Low blood pressure, low O<sub>2</sub>, low pH, signal rate increase.
- High blood pressure, high O<sub>2</sub>, high pH, signal rate decrease.



Regulation of Heart Rate	
<b>Increased Heart Rate</b>	<b>Decreased Heart Rate</b>
1. Sympathetic nervous system	1. Parasympathetic nervous system
+ Crisis	+ High blood pressure or blood volume
+ Low blood pressure	2. Hormones
	+ Epinephrine
	+ Thyroxine
2. Exercise	3. Decreased venous return
3. Decreased blood volume	4. Decreased blood volume

## Applications and Skills

- Application: Pressure changes in the left atrium, left ventricle and aorta during the cardiac cycle. (pg. 300; DBQ 301)



## Understandings

- Epinephrine increases the heart rate to prepare for vigorous physical activity.
  - Epinephrine (adrenaline) signals SA node to speed up.
  - Produced in adrenal glands but signaled by brain for release.
  - "Fight or Flight"

End

