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Cardiac Anatomy & Physiology

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Location of the Heart

- Hollow muscular organ
- Located in the middle of the thoracic cavity
- Surrounded by pericardium
- Attached to thorax via great vessels



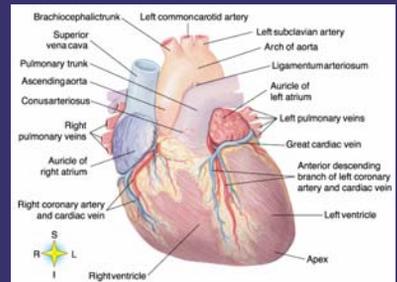
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Location of the Heart

- Apex (bottom)
 - Formed by tip of left ventricle
- Base (top)
 - Approximately 2nd intercostal space
- Anterior surface
 - Consists primarily of right ventricle
- Inferior (diaphragmatic) surface
 - Formed by right and left ventricles, predominantly left

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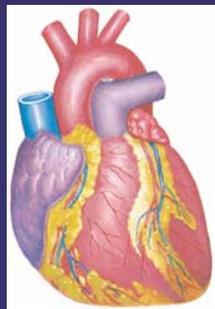
Location of the Heart



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Size and Shape of the Heart

- Cone-shaped muscular organ
- Adult heart is approximately:
 - 5 inches (12 cm) long
 - 3.5 inches (9 cm) wide
 - 2.5 inches (6 cm) thick
 - About the size of a man's fist



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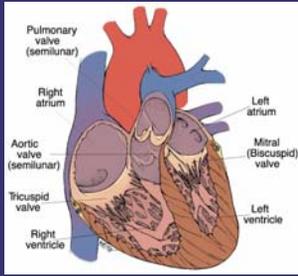
Size and Shape of the Heart



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Heart Chambers

- The heart is divided into four cavities or chambers
- Functions as a two-sided pump
 - Two upper chambers = right and left atria
 - Two lower chambers = right and left ventricles



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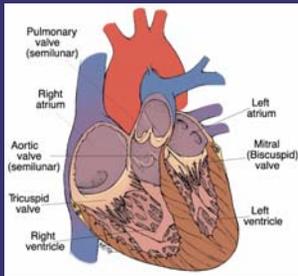
Heart Chambers

- Right side of the heart
 - Low-pressure system
 - Pumps venous blood to the lungs
- Left side of the heart
 - High-pressure system
 - Pumps arterial blood into the systemic circulation

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Atria

- Thin-walled, low-pressure chambers that receive blood
- Interatrial septum separates right and left atria
- "Atrial kick"



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Ventricles

- Pump blood to lungs and systemic circulation
- Interventricular septum separates right and left ventricles
- Left ventricle
 - High-pressure chamber

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Layers of the Heart

- The heart wall is made up of three tissue layers:
 - Endocardium
 - Myocardium
 - Epicardium

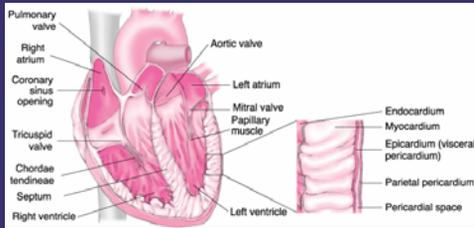
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Layers of the Heart

- Endocardium
 - Innermost layer
 - Lines inner chambers, valves, chordae tendinae, and papillary muscles
 - Continuous with innermost layer of arteries, veins, and capillaries

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Layers of the Heart



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Layers of the Heart

- Myocardium
 - Middle layer
 - Thick, muscular layer
 - Responsible for pumping action

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Layers of the Heart

- Epicardium
 - Also called the visceral layer of the serous pericardium
 - External layer of the heart
 - Includes blood capillaries, lymph capillaries, nerve fibers, and fat

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Layers of the Heart

- Pericardium
 - Double-walled sac that encloses the heart
 - Fibrous parietal pericardium
 - Rough outer layer of the pericardial sac
 - Serous pericardium
 - Pericardial space
 - Contains approximately 10 mL of serous fluid

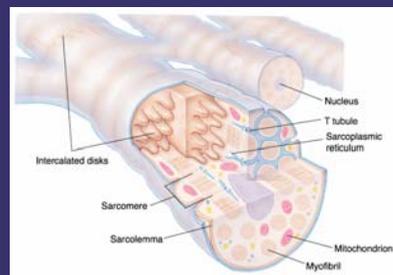
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Cardiac Muscle

- Walls of the heart are formed by cardiac muscle fibers
 - Sarcolemma
 - Myofibrils

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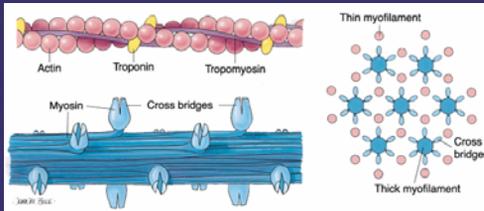
Cardiac Muscle



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Cardiac Muscle

- Each sarcomere contains two types of protein filaments: actin and myosin



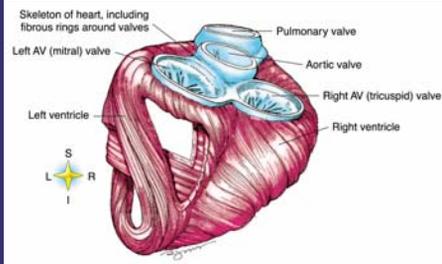
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Cardiac Muscle

- Cardiac muscle fibers fit together tightly at junctions called intercalated disks
 - Intercalated disks form gap junctions
 - Function as electrical connections
 - Allow cells to conduct electrical impulses rapidly

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Valves of the Heart



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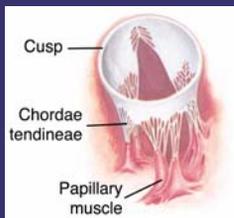
Heart Valves

- Heart contains four valves
 - Two sets of atrioventricular (AV) valves
 - Two sets of semilunar valves
- Function
 - Ensure blood flows in one direction through heart chambers
 - Prevent backflow of blood

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Atrioventricular (AV) Valves

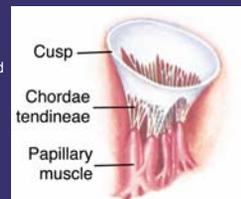
- AV valves separate atria from ventricles
- Tricuspid valve
 - Lies between right atrium and right ventricle
 - Consists of three separate leaflets
 - Larger in diameter and thinner than mitral valve



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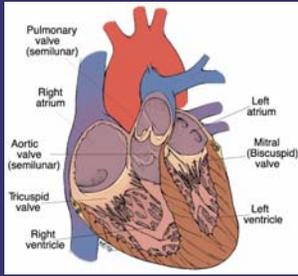
Atrioventricular (AV) Valves

- Mitral (bicuspid) valve
 - Has only two cusps
 - Lies between left atrium and left ventricle



Atrioventricular (AV) Valves

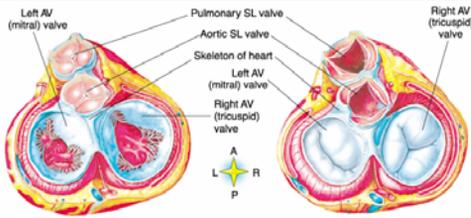
- Cusps of AV valves are attached to chordae tendineae
 - “Heart strings”
 - Originate from papillary muscles
 - Serve as anchors



Semilunar Valves

- Prevent backflow of blood from the aorta and pulmonary arteries into the ventricles during diastole
 - Pulmonic valve
 - Aortic valve

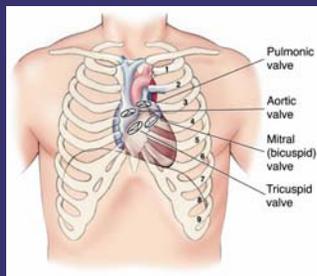
Semilunar Valves



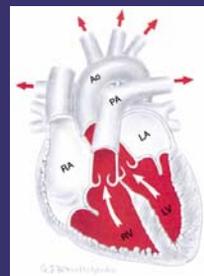
Semilunar Valves

- Pulmonic valve
 - Prevents backflow of blood into right ventricle
- Aortic valve
 - Prevents backflow of blood into left ventricle

Semilunar Valves



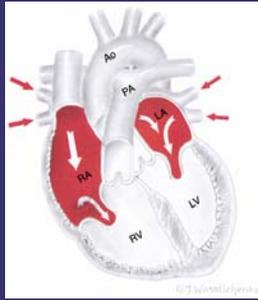
Blood Flow Through the Heart



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Cardiac Cycle

- Systole -
Period during which the chamber is contracting and blood is being ejected



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Cardiac Cycle

- Diastole
– Period of relaxation during which the chamber is filling

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The Heart as a Pump

- Venous return
– Most important factor determining amount of blood pumped by heart

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Cardiac Output

- Cardiac output is the volume of blood ejected from the heart over 1 minute
– Because the ventricles contract almost simultaneously, their cardiac outputs are normally equal

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Cardiac Output

- Cardiac output (CO) equals stroke volume (SV) multiplied by heart rate (HR)
– $CO = SV \times HR$
- Cardiac output is affected by a change in heart rate OR stroke volume

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Decreased Cardiac Output

- Cold, clammy skin
- Color changes in skin/mucous membranes
- Dyspnea
- Orthopnea
- Crackles (rales)
- Changes in mental status
- Changes in blood pressure
- Dysrhythmias
- JVD
- Fatigue
- Restlessness

Right Coronary Artery

Coronary Artery and its Branches	Portion of Myocardium Supplied	Portion of Conduction System Supplied
<ul style="list-style-type: none"> • Posterior descending • Right marginal 	<ul style="list-style-type: none"> • Right atrium • Right ventricle • Inferior wall of left ventricle • Posterior wall of left ventricle • Posterior 1/3 of interventricular septum 	<ul style="list-style-type: none"> • SA node (50% to 60% of population) • AV node (85% to 90%) • Proximal portion of bundle of His • Posterior-inferior fascicle of left bundle branch

Left Coronary Artery

Coronary Artery and its Branches	Portion of Myocardium Supplied	Portion of Conduction System Supplied
Left anterior descending	<ul style="list-style-type: none"> • Anterior and part of the lateral surface of the left ventricle • Anterior 2/3 of interventricular septum 	<ul style="list-style-type: none"> • Majority of right bundle branch • Anterior-superior fascicle of left bundle branch • Portion of the posterior-inferior fascicle of the left bundle branch
Circumflex	<ul style="list-style-type: none"> • Left atrium • Anterolateral and posterolateral walls of left ventricle • Posterior wall of left ventricle 	<ul style="list-style-type: none"> • SA node (40% to 50% of population) • AV node (10% to 15%)

Coronary Veins

- Run parallel to coronary arteries
- Drain myocardial blood into right atrium
 - Thebesian veins
 - Anterior cardiac veins
 - Coronary sinus
- Thebesian and anterior cardiac veins are tributaries of coronary sinus