

The Cardiovascular System (Heart)

The Cardiovascular System

- A closed system of the heart and blood vessels
 - The heart pumps blood
 - Blood vessels allow blood to circulate to all parts of the body
- The function of the cardiovascular system is to deliver oxygen and nutrients and to remove carbon dioxide and other waste products

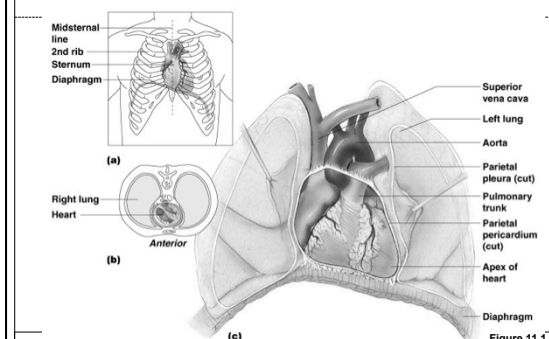
The Heart

- The heart is approximately the size of your fist, it's hollow and cone shaped. Surprisingly, it's weight is less than a pound.
- Located in the mediastinum, the middle cavity of the thorax and flanked by two lungs.
- The apex points towards the left hip and rests on the diaphragm. (The muscle that moves to change the volume of your lungs)

The Heart

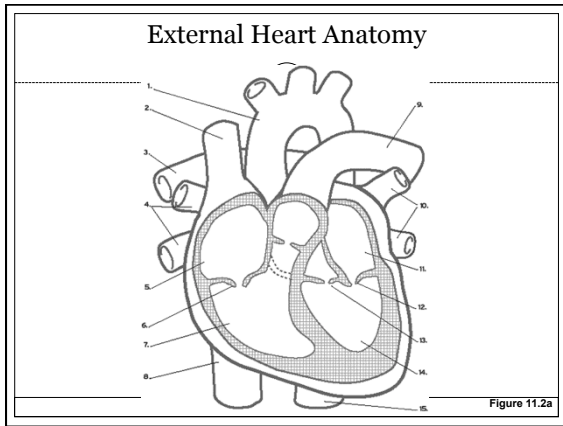
- The larger portion or the base points towards the right shoulder and lies beneath the second rib.
- The heart is enclosed in a double sac membrane called the pericardium.
- A slippery fluid called serous fluid allows the heart to beat in a near frictionless environment.

The Heart



The Heart: Heart Wall

- Three layers
 - Epicardium
 - ✦ Outside layer
 - ✦ Connective tissue layer
 - Myocardium
 - ✦ Middle layer
 - ✦ Mostly cardiac muscle
 - Endocardium
 - ✦ Inner layer



The Heart: Chambers

- Right and left side act as separate pumps
- Four chambers
 - Atria
 - Receiving chambers are supplied with blood from the veins.
 - Right atrium
 - Left atrium
 - Ventricles
 - Discharging chambers pump blood out to the body through arteries.
 - Right ventricle
 - Left ventricle

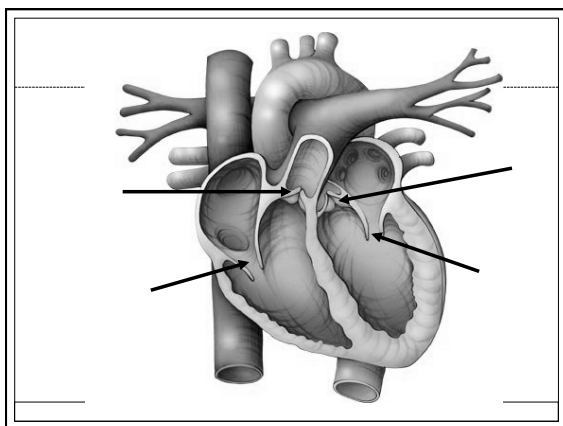
Figure 11.2c

Flow Within The Heart: Valves

- Allow blood to flow in only one direction
- Four valves
 - Atrioventricular valves (AV) – between atria and ventricles
 - Bicuspid valve (left)
 - Tricuspid valve (right)
 - Semilunar valves between ventricle and artery
 - Pulmonary valve
 - Aortic valve

The Heart: Valves

- Valves open as blood is pumped through
- Held in place by chordae tendineae (“heart strings”)
- Close to prevent backflow



Operation of Heart Valves

Operation of the AV valves

- 1 Blood returning to the atria, puts pressure against AV valves; the AV valves are forced open
- 2 As the ventricles fill, AV valve flaps hang loosely into ventricles
- 3 Atria contract, forcing additional blood into ventricles

AV valves open

- 1 Ventricles contract, forcing blood against AV valve flaps
- 2 AV valves close
- 3 Chordae tendineae tighten, preventing valve flaps from everting into atria

AV valves closed

Operation of the semilunar valves

As ventricles contract and intraventricular pressure rises, blood is pushed up against semilunar flaps, forcing them open

Semilunar valve open

As ventricles relax, and intraventricular pressure falls, blood flows back from aorta, filling the lattices of semilunar valves and forcing them to close

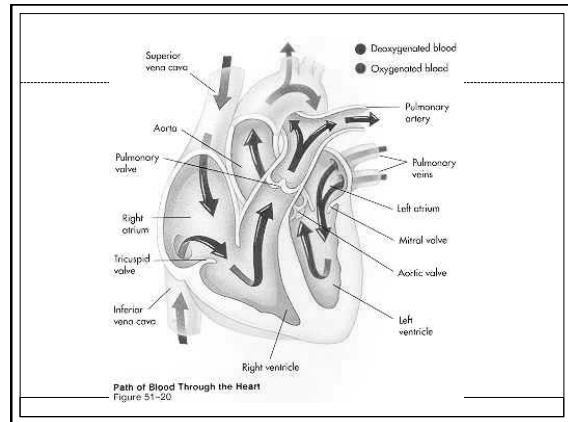
Semilunar valve closed

Figure 11.4

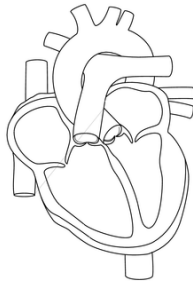
Pulmonary Circulation

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- Pulmonary Circulation-The flow of blood between the heart and the lungs.
- Deoxygenated blood leaves the right ventricle and goes to the lungs via the pulmonary artery. The blood picks up oxygen in the lungs and returns to left atrium of the heart via the pulmonary vein.



The Parts of the Heart



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Systemic Circulation

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- Systemic Circulation-The oxygenated blood leaves the heart via the aorta and flows throughout the body. The deoxygenated blood returns to the right atrium of the heart via the inferior or superior vena cava.

Blood Circulation

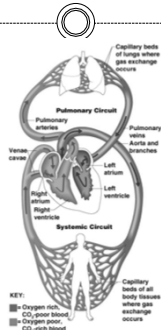


Figure 11.3

The Heart: Associated Great Vessels

- Aorta
 - Leaves left ventricle out to the body
- Pulmonary arteries
 - Leave right ventricle out to the lungs
- Vena cava (Superior or Inferior)
 - Enters right atrium from the body
- Pulmonary veins (four)
 - Enter left atrium from the lungs

General Rule-With Exceptions

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- Arteries carry oxygenated blood out of the heart to the body
 - EXCEPTION-Pulmonary artery carries deoxygenated blood out of the heart to the lungs.
- Veins carry deoxygenated blood back to the heart from the body.
 - EXCEPTION-Pulmonary vein carries oxygenated blood to the heart from the lungs.

Coronary Circulation

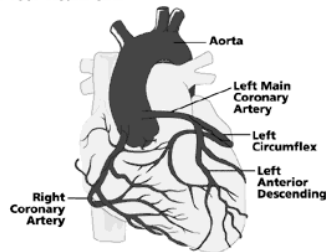
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- Blood in the heart chambers does not nourish the myocardium
- The heart has its own nourishing circulatory system
 - 4 major coronary arteries (clogging causes heart attack)
 - Cardiac veins

4 Major Coronary Arteries

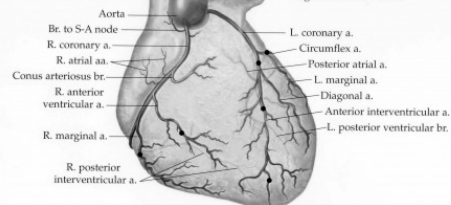
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Coronary Arteries (anterior view)

Coronary arteries supply blood to heart tissue. They originate from the aorta.



● Common areas of coronary artery blockage that result in damage to heart muscle.

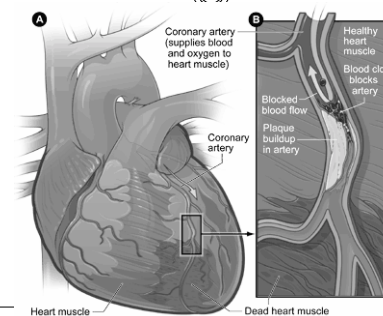
What is a Heart Attack?

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- A heart attack occurs when blood flow to a part of your heart is blocked for a long enough time that part of the heart muscle is damaged or dies. The medical term for this is myocardial infarction.

Blockage

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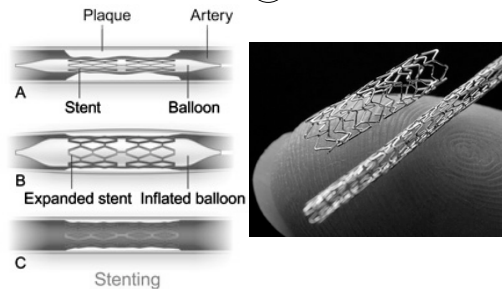
Avoiding Surgery

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- Patients may experience the effects of a heart attack at any time of day. Some people are lucky enough to get treatment and not need surgery. A stent may be used to open up the clogged artery.

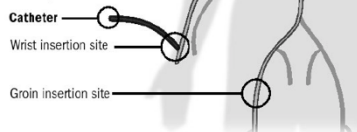
Inserting a Stent

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to the heart, through the wrist

Doctors at Ohio State University Medical Center are clearing clogged arteries by going through patients' wrists rather than the groin. Insertion through the wrist is said to be more comfortable for patients and requires shorter recovery time because of a lower bleeding risk.



Source: Ohio State University Medical Center

MARY NGUYEN | DISPATCH

The Heart: Conduction System

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- Intrinsic conduction system (nodal system)
 - Heart muscle cells contract, without nerve impulses, in a regular, continuous way
 - Can be restarted with electrical current

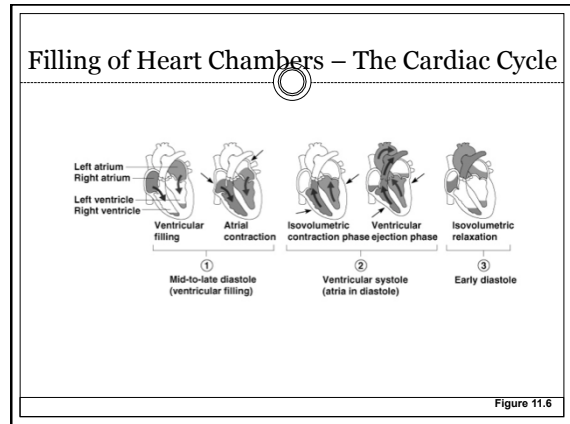
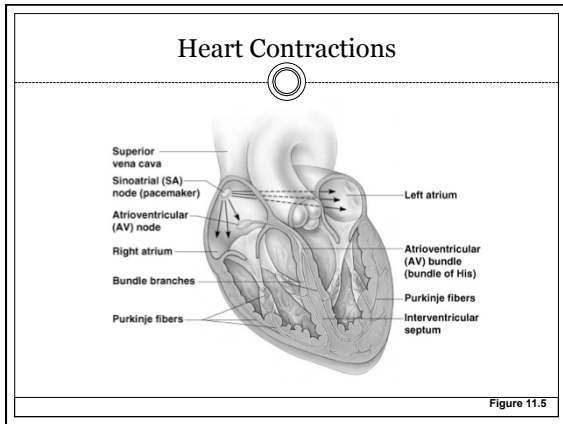
The Heart: Conduction System

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- Special tissue sets the pace
 - ✦ Sinoatrial Node-Located in the right atrium and initiate the contraction
 - Pacemaker
 - ✦ Atrioventricular Node-Located between the atria and the ventricles
 - ✦ Purkinje Fibers-Spread within the muscles of the ventricle walls.



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- ### The Cardiac Cycle
- The events in one complete cycle of heartbeats.
 - The average heart beats about 75 beats per minute.
 - Atria contract simultaneously
 - Atria relax, then ventricles contract
 - Systole = contraction
 - Diastole = relaxation

- ### The Heart: Cardiac Cycle
- Cardiac cycle – events of one complete heart beat
 - Mid-to-late diastole – blood flows into ventricles
 - Ventricular systole – blood pressure builds before ventricle contracts, pushing out blood
 - Early diastole – atria finish re-filling, ventricular pressure is low

- ### The Heart: Cardiac Output
- Cardiac output (CO)
 - Amount of blood pumped by each side of the heart in one minute
 - $CO = (\text{heart rate [HR]}] \times (\text{stroke volume [SV]})$
 - Stroke volume
 - Volume of blood pumped by each ventricle in one contraction

