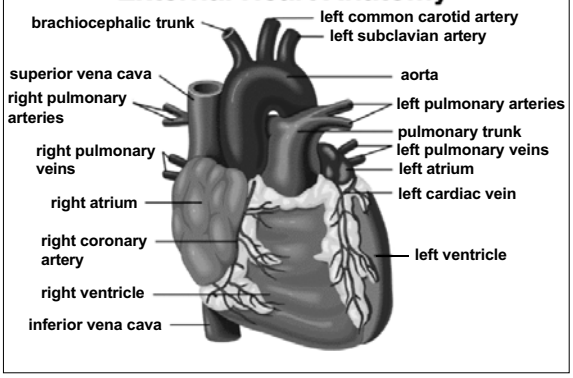
Structures of the Cardiovascular System

- Heart - muscular pump
- Blood vessels - network of tubes
- Blood - liquid transport vehicle

External Heart Anatomy

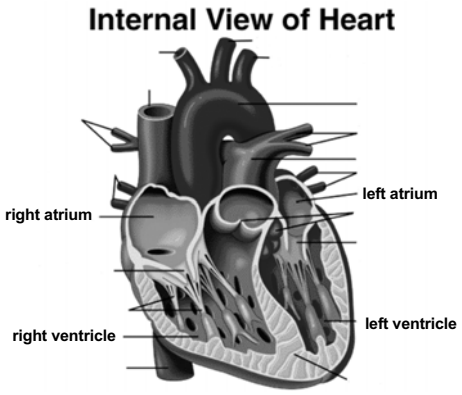


Major Function of the Cardiovascular System

Transportation

Anatomy of the Heart

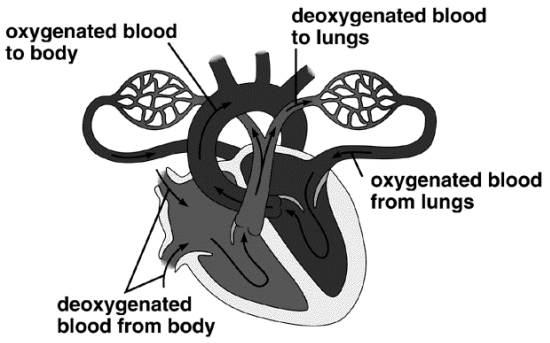
- Covering
  - Pericardium - double connective tissue sac
- Wall
  - Epicardium - external layer
  - Myocardium - thick bundles of cardiac muscle
  - Endocardium - thin lining of heart chambers



Chambers of the Heart

- Four chambers
  - 2 atria - right atrium & left atrium
    - - superior receiving chambers
  - 2 ventricles - right ventricle & left ventricle
    - - inferior discharging chambers

Path of Blood Through Heart



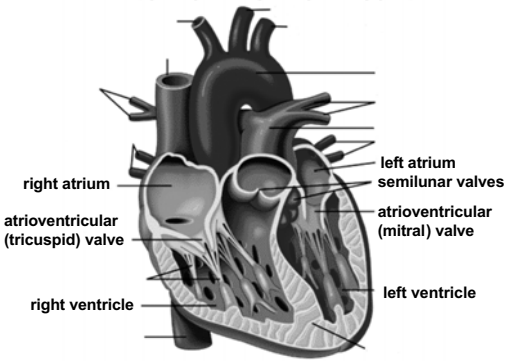
Heart is a Double Pump

- Pulmonary circulation
  - Right side of heart pumps blood to lungs
- Systemic circulation
  - Left side of heart pumps blood to all body organs

Heart Valves

- Function
  - Allow blood to flow in only one direction through heart chambers
- Atrioventricular valves
  - Between atria and ventricles on each side
- Semilunar valves
  - Base of arteries leaving ventricles

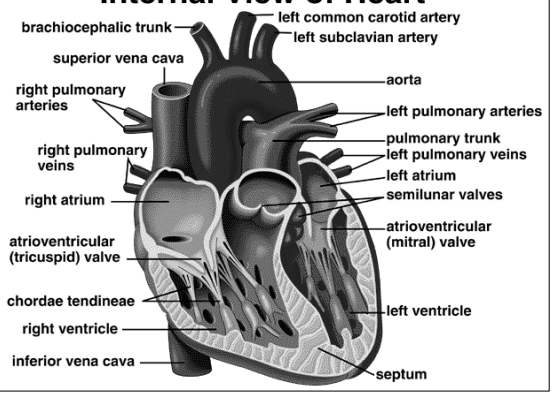
Internal View of Heart

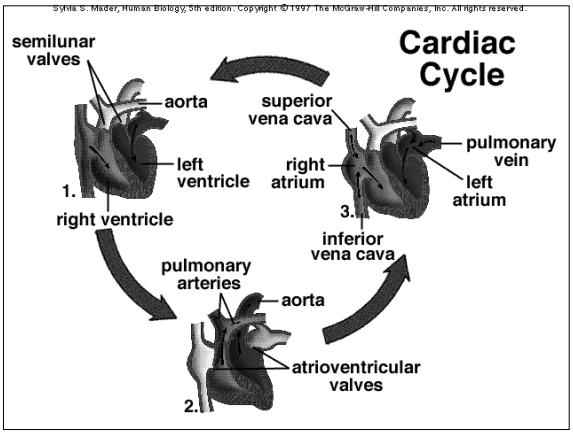


Conduction System of the Heart

- Sinoatrial <SA> node
  - Located in right atrium
- Atrioventricular <AV> node
  - Located at junction of atria & ventricles
- Atrioventricular <AV> bundle
  - Located in interventricular septum
- Purkinje fibers
  - Within muscles of ventricle walls

Internal View of Heart





Cardiac Cycle

One complete heartbeat

- Length of cardiac cycle = 0.8 second
  - Average heart beats 75 times per minute
- Both atria contract simultaneously
- Both ventricles contract simultaneously
  - Systole - ventricles contract, blood pressure increases
  - Diastole - ventricles relax, blood pressure decreases

Heart Sounds

Made during each cardiac cycle

- "lub-dup" sound
- "lub"
  - Sound caused by closing of AV valves
- "dup"
  - Sound caused by closing of semilunar valves

Cardiac Output

Amount of blood pumped out by each side of the heart in 1 minute.

- Stroke volume - volume of blood pumped out by a ventricle with each heartbeat.
- Cardiac output <CO> = heart rate <HR> X stroke volume <SV>
- CO = HR <75 beat/min> X SV <70 ml/beat> = 5250 ml/min

Regulation of Stroke Volume

Anything that increases the volume or speed of venous return increases stroke volume and force of contraction.

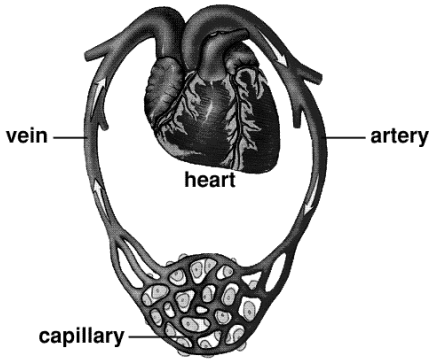
- For example

Exercise!

Regulation of Heart Rate

- Pacemaker <SA node> controls heart rate
- Other factors that can modify heart rate
  - During stress - sympathetic nervous system
  - Hormones
    - epinephrine & thyroxine - increases heart rate
  - Age, gender, exercise, and body temperature

Path of Blood from Heart



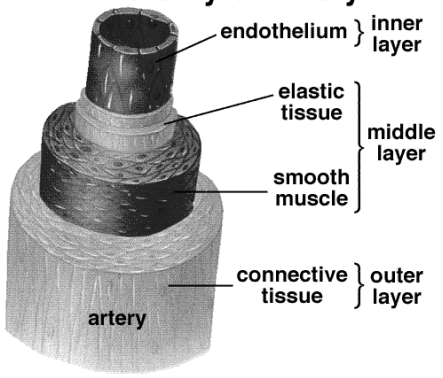
Blood Vessels

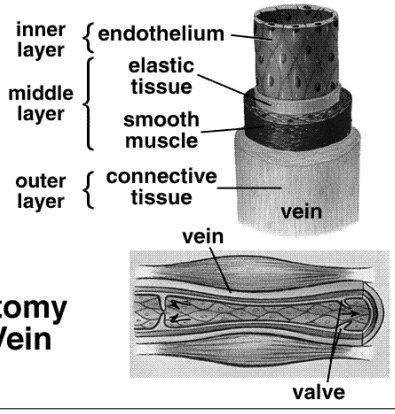
- Arteries - take away blood from the heart
  - Arterioles - small arteries
- Veins - return blood to the heart
  - Venules - small veins
- Capillaries - connect arteries and veins

Anatomy of Blood Vessels

- Tunica interna
  - Innermost layer - single layer of endothelium <squamous epithelial cells>
- Tunica media
  - Middle layer - mostly smooth muscle and elastic tissue
- Tunica externa
  - Outermost layer - mostly fibrous connective tissue

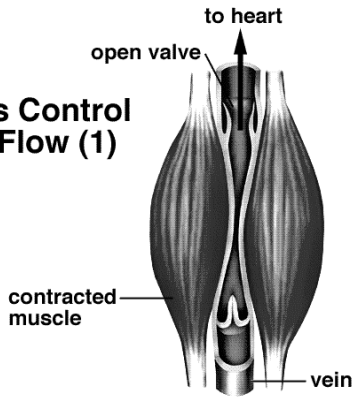
Anatomy of Artery

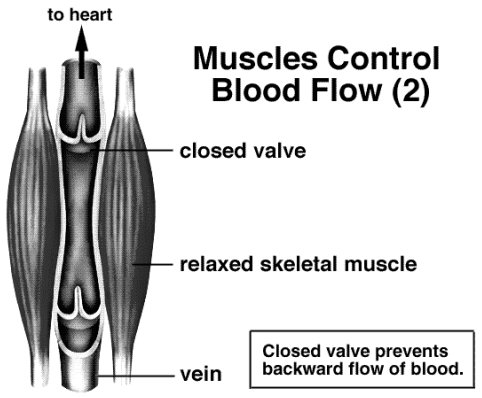




Anatomy of Vein

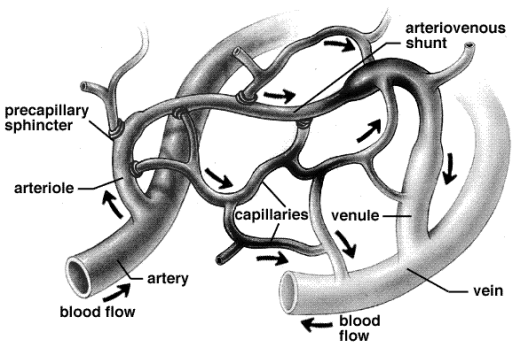
Muscles Control Blood Flow (1)



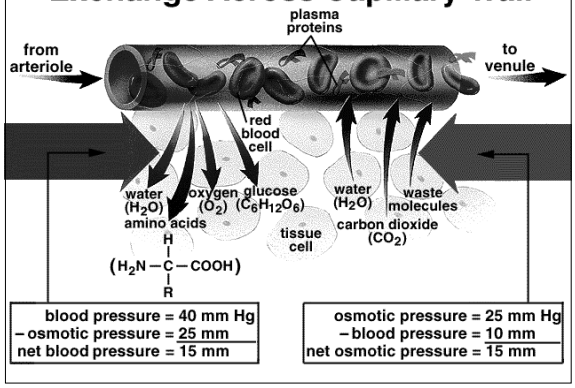


Muscles Control Blood Flow (2)

Anatomy of Capillary Bed

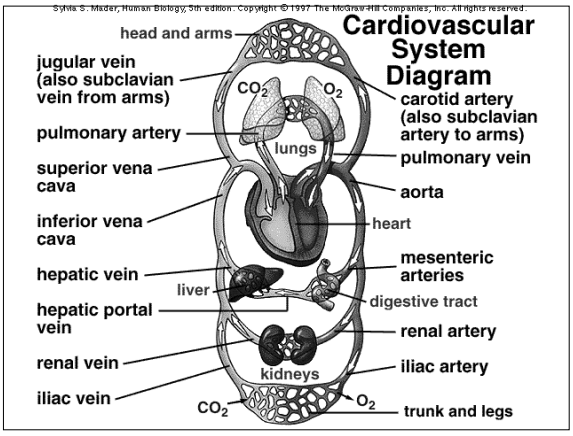


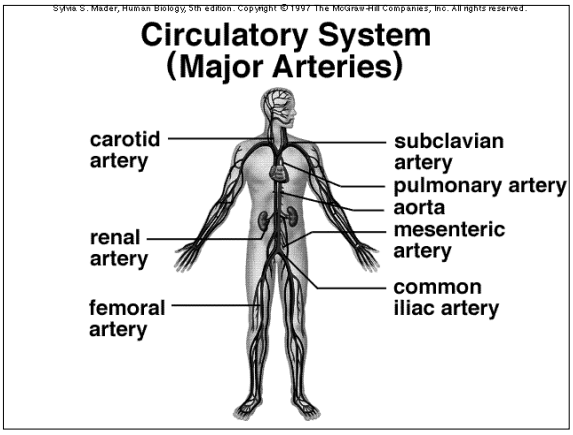
Exchange Across Capillary Wall



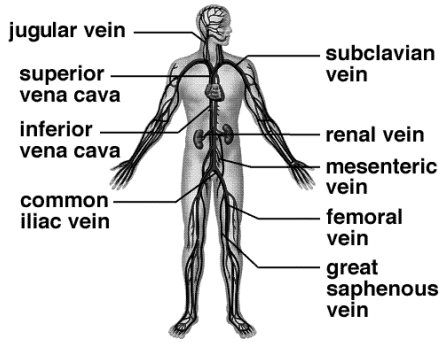
Capillary Exchange

- Direct diffusion
- Vesicles - endocytosis & exocytosis
- Diffusion through intercellular clefts
- Diffusion through pores

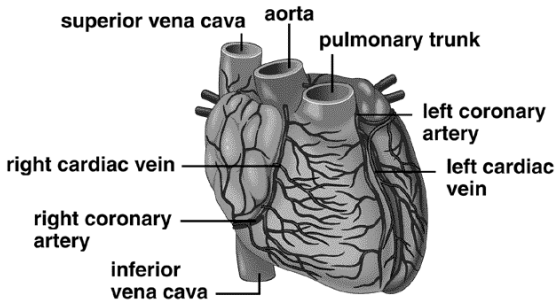




Circulatory System (Major Veins)



View of Coronary Arteries and Cardiac Veins



Physiology of Circulation

Vital Signs

- Arterial pulse
- Blood pressure
- Respiratory rate
- Body temperature

Arterial Pulse

The rhythmic expansion and recoil of arteries resulting from heart contraction.

Pulse rate (surges per minute) = heart rate (beats per minute)

Blood Pressure

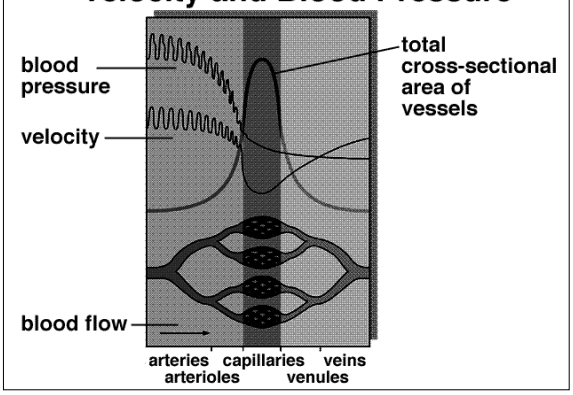
The pressure the blood exerts against the inner walls of the blood vessels.

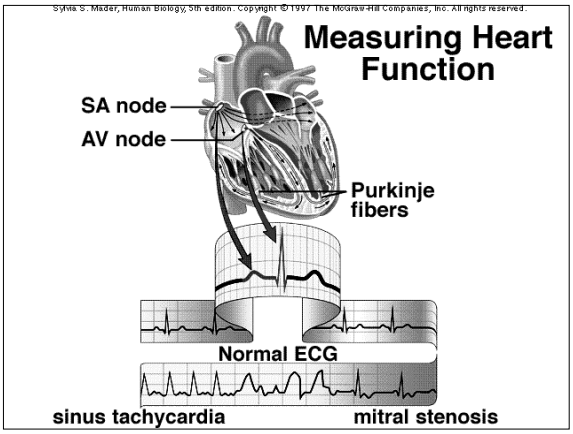
Effects of Various Factors on Blood Pressure

- Cardiac output
- Peripheral resistance
  - Neural factors - sympathetic nerves
  - Renal factors - kidneys
  - Temperature
  - Chemicals
  - Diet

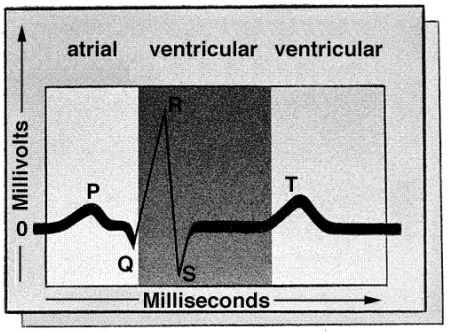
Variations in Blood Pressure

- Hypotension
  - Systolic blood pressure below 100 mm Hg
- Hypertension
  - Sustained elevated arterial pressure of 140/90 mm Hg

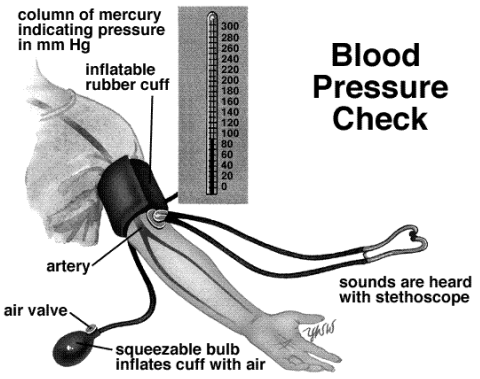




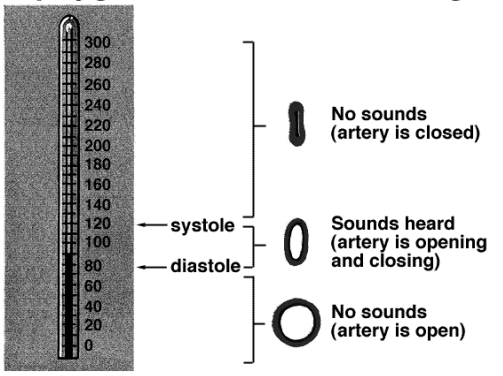
A Single Heartbeat



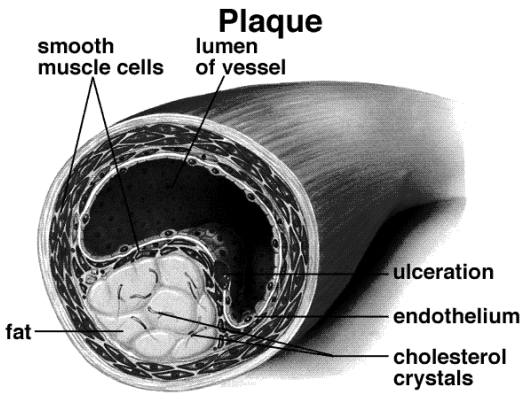
Blood Pressure Check



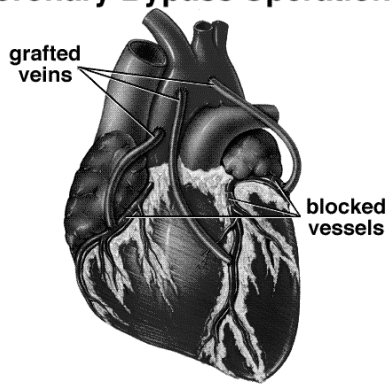
Sphygmomanometer Readings



Plaque



Coronary Bypass Operation



The End