

Human Biology 175
Lecture Notes: Cardiovascular System

Section 1 Blood

A) Connective Tissue:

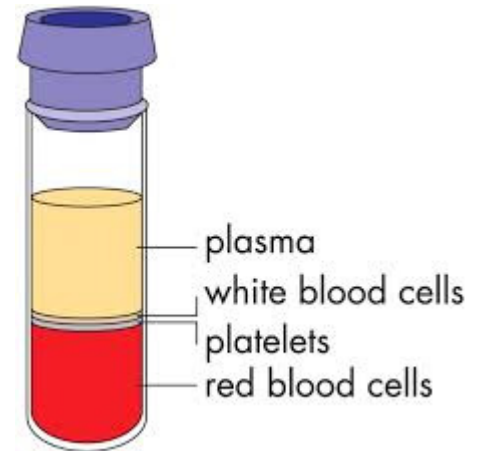
- 1) _____ extracellular matrix
- 2) _____ cells
 - a) Erythrocytes
 - b) Leukocytes
 - c) Thrombocytes

B) General Functions of Blood

- 1) _____
 - a) Respiratory gases _____
 - b) Nutrients (monomers of digestion) _____
 - c) Salts/ions/electrolytes _____
 - d) Cellular wastes _____
 - e) Hormones _____
- 2) _____
 - a) Antibodies
 - b) Clotting proteins
 - c) Phagocytes
- 3) _____
 - a) pH balance of body fluids
 - b) Body temperature

C) Plasma (fluid matrix/solution)

- 1) _____
 - a) universal solvent
 - b) Includes >100 different solutes
 - c) Composition varies continuously
 - d) Absorbs heat (_____)
- 2) _____ substances dissolved in a solvent
 - a) Ions/salts/electrolytes
 - (1) _____
 - (2) _____
 - (3) Examples: _____



3) Proteins

- a) _____ osmotic balance/buffering (liver)
- b) _____ blood clotting proteins (liver)
- c) _____ (B-cells)

4) Other Transported substances

- a) Nutrients (monomers and vitamins)
- b) Metabolic wastes
- c) Gases
- d) Hormones

D) Cells: _____

1) (RBC) _____

- a) Anatomy
 - (1) Biconcave disc
 - (2) Nonnucleated
 - (3) Filled with _____
 - (4) Lacks other cytoplasmic organelles (mitochondria)



- b) Functions: _____
- c) _____ condition characterized by decreased oxygen carrying ability
 - (1) Decreased number erythrocytes/amount amount of hemoglobin
 - (2) Abnormal hemoglobin/Genetic condition—sickle-cell

2) (WBCs) _____

- a) _____ capable of moving out of blood vessels to enter body tissues to carry out functions
 - (1) _____ chemicals attract leukocytes
- b) _____ contain granules (stain) of chemicals used in functions
 - (a) _____
 - (b) _____
 - (c) _____
- c) _____ Lack stainable granules
 - (1) _____
 - (2) _____

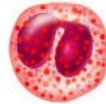
- 3) _____
 a) Granulocyte
 b) 3-7 lobed nucleus
 c) Most numerous (40-70%) of WBCs
 d) Function: _____
 (kill with oxidizing substances—bleach, hydrogen peroxide)

- Neutrophils



- 4) _____
 a) Granulocyte
 b) Function: _____
 (enzymes digest surface of worm)

- Eosinophils



- 5) _____
 a) (rare) Granulocyte
 b) Function: _____
 makes blood vessel walls leaky and chemical attractant for other WBCs to inflammation site.

- Basophils



- 6) _____
 a) Agranulocyte
 b) Function: _____ migrate to body tissues as needed

- Lymphocytes



- 7) _____
 a) Agranulocyte
 b) Spherical shaped nucleus
 c) Numerous (20-45%)
 d) Function: _____
 (1) Reside in lymphatic tissues
 (2) B-cells produce _____
 (3) T-cells fight _____

- Monocytes



- E) _____
 1) Cell fragment: anucleate, cell membrane and cytoplasm
 2) Function: _____

Section 2 Hematopoiesis

- A) _____
- 1) Location: _____
 - a) adult: Flat bones/ends of humerus and femur
 - b) Each formed element produced in response to needs/stimulus
 - c) _____ (hematocytoblast) mitotic cell that can give rise to different cell types
- B) Thrombocyte Formation
- 1) _____ Large cell that pinches off pieces of cell membrane/cytoplasm
 - 2) Hormonally controlled _____ (little known)
- C) Erythrocyte Formation
- 1) Live approximately 100 days
 - 2) Produced continually
 - 3) Eliminated by phagocytosis
 - 4) Hormonally controlled _____
 - a) Controlled by ability to transport _____
- D) Leukocyte Formation
- 1) Hormonally controlled _____
 - 2) Production in response to specific chemical signals
 - a) Inflammation
 - b) Bacteria/toxins

Section 3 Blood Typing

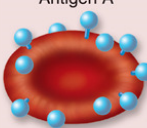

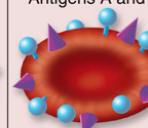




- A) Definitions:
- 1) _____ surface molecule that identifies a cell (recognition markers) and can stimulate an immune response
 - 2) _____ Protein produced by B-cells that bind (bond) to a specific antigen
 - 3) _____ 'clumping reaction' between a specific antibody and an antigen on the surface of a red blood cell that can result in clogging of blood vessels

B) ABO Blood Groups

- 1) Based on the presence of _____ /antigens on the surface of erythrocytes
 - a) _____ 'A' carbohydrate group on its surface
 - b) _____ 'B' carbohydrate group on its surface
 - c) _____ has both the 'A' and 'B' carbohydrate groups on its surface
 - d) _____ lacks either the 'A' or 'B' carbohydrate groups on its surface

- 2) Require match donors blood to recipients blood because agglutination can occur because of antibodies that are present in the recipients/donees blood
 - a) Type A blood Individual
 - (1) Erythrocyte has the _____ antigen
 - (2) _____ antibodies in their plasma (that ONLY agglutinate/bind with the _____ antigen)
 - b) Type B blood Individual
 - (1) Erythrocyte has the _____ antigen
 - (2) _____ antibodies in their plasma (that ONLY agglutinate/bind with the _____ antigen)
 - c) Type AB blood Individual
 - (1) Erythrocyte has the _____ antigen
 - (2) _____ antibodies in their plasma
 - d) Type O blood Individual
 - (1) Erythrocyte has _____ antigen.
 - (2) _____ antibodies in their plasma

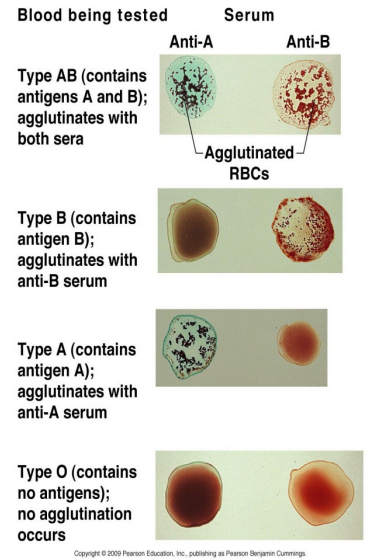
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| ABO Blood Types | | | | |
|-----------------|--|--|---|--|
| | Antigen A | Antigen B | Antigens A and B | Neither antigen A nor B |
| Erythrocytes |  |  |  |  |
| Plasma |  |  | Neither anti-A nor anti-B antibodies |  |
| Blood type | Type A Erythrocytes with type A surface antigens and plasma with anti-B antibodies | Type B Erythrocytes with type B surface antigens and plasma with anti-A antibodies | Type AB Erythrocytes with both type A and type B surface antigens, and plasma with neither anti-A nor anti-B antibodies | Type O Erythrocytes with neither type A nor type B surface antigens, but plasma with both anti-A and anti-B antibodies |

(a)

C) How to type blood:

- 1) Blood sample
- 2) Add Antibodies
- 3) Mix gently
- 4) Watch for agglutination reaction
 - a) Anti-A antibody binds A antigen--positive for A antigen
 - b) Anti-B antibody binds B antigen—positive for the B antigen



D) Universal Blood DONOR

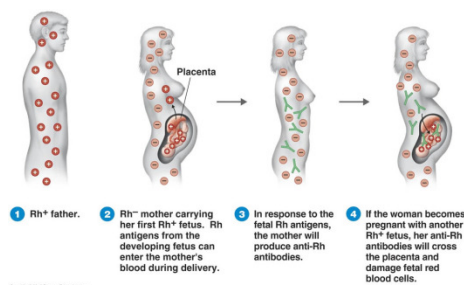
- 1) _____
- 2) Blood type that can be given to ANYONE without _____
- 3) Reason: Type O lacks the _____ that could bind/interact with the recipients/donees _____

E) Universal Blood RECIPIENT

- 1) _____
- 2) Blood type that can be transfused from anyone without causing an _____
- 3) Reason: Type AB lacks the _____ that could bind/interact with the DONORS _____

F) Rh (factor) Antigen

- 1) Found on surface of RBCs
 - a) _____ have the Rh antigen
 - b) _____ lack the Rh antigen
- 2) Anti-Rh antibodies are ONLY made upon exposure to the antigen
- 3) Problem if mom is _____ and the fetus is _____
 - a) Fetal blood mixes with moms in last stages of pregnancy
 - b) 1st Rh + child normal → stimulate mom to produce anti-Rh antibodies
 - c) 2nd child, mom's anti-Rh antibodies cross placenta and cause agglutination/hemolytic disease of newborn
 - d) Treat: RHOGAM injection (prevent mom from producing antibodies)



Section 4 Blood Vessels

A) General: Transport blood throughout the body

- 1) _____ transport blood away from the heart
- 2) _____ exchange between body tissues and blood
- 3) _____ return blood back to the heart

B) Blood Vessel Wall

1) Artery walls (tend to be round)

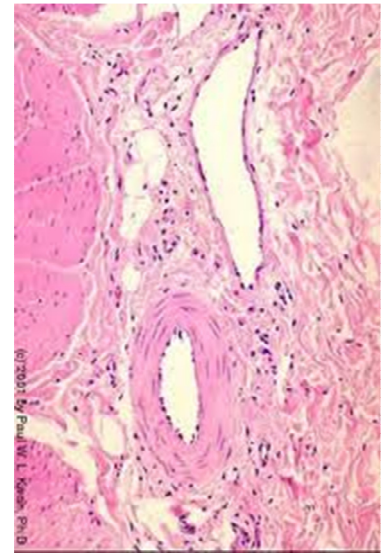
- a) Tunica intima: _____
 - (1) simple squamous epithelium
 - (2) Lines lumen
 - (3) Smooth surface
- b) Tunica media: _____
 - (1) Thick layer
 - (2) Contractions can change diameter/lumen size
- c) Tunica externa: _____
 - (1) supports/protects
 - (2) protein: _____ important role in blood clotting/hemostasis

2) Capillaries

- a) Tunica intima: _____
 - (1) simple squamous epithelium
 - (2) Lines lumen
 - (3) Smooth surface
- b) Only small number are 'open' and filled
- c) Function: _____ between blood and the interstitial fluid (fluid between cells of tissues)

3) Vein walls (flat)

- a) Tunica intima: _____
 - (1) simple squamous epithelium
 - (2) Lines lumen
 - (3) Smooth surface
 - (4) _____ prevent backflow
- b) Tunica media: _____
 - (1) Thin layer
- c) Tunica externa: _____
 - (1) supports/protects
 - (2) protein: collagen important role in blood clotting/hemostasis

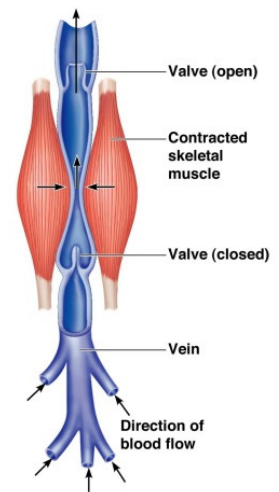


C) Blood flow through Arteries

- 1) Function: transport blood _____
- 2) Maintained by _____
- 3) Thick tunica media supports pressure changes

D) Blood flow through Veins

- 1) Function: _____ to the heart
- 2) _____ prevent backflow
- 3) _____ squeeze blood vessels
- 4) _____ respiratory movements/ changes in volume of the thoracic cavity
- 5) _____ inefficient venous return/overworked valves fail so vein twists/dilate (visible on body surface)



Section 5 Hemostasis

A) Blood Clotting/ _____ Components:

- 1) (Inactive) Plasma Proteins produced by the liver:
 - a) _____
 - b) _____
- 2) Damaged blood vessel wall exposes plasma proteins to _____
- 3) _____ (platelets)

B) Fast/Localized response to blood vessel damage

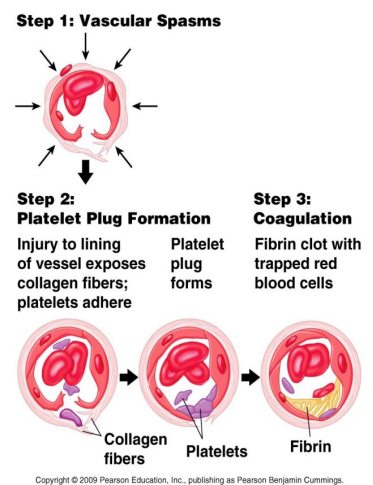
- 1) _____ smooth muscle contractions constrict blood vessel wall
 - a) Decrease blood flow to damaged area
- 2) _____
 - a) Exposed _____ activates passing _____
 - b) Thrombocytes stick/adhere/aggregate to wall off damage
- 3) _____
 - a) Inactive plasma proteins activated by injured tissues

Prothrombin –damaged tissues→ _____

b) Thrombin builds fibrin mesh

Fibrinogen –Thrombin→ Fibrin

c) Fibrin mesh traps RBCs until blood vessel repaired



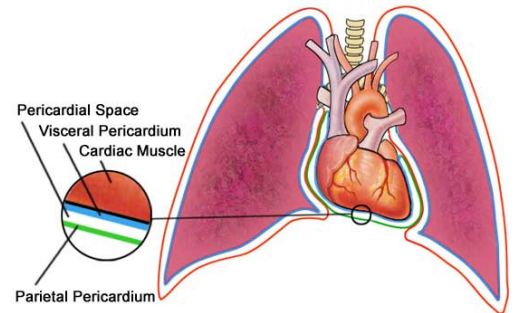
C) Anticoagulants

- 1) _____ blocks plate plug formation
- 2) _____ blocks thrombin—so fibrinogen is NOT converted to fibrin (no mesh)
- 3) _____ interferes with (liver) enzyme production of clotting proteins

Section 6 Heart

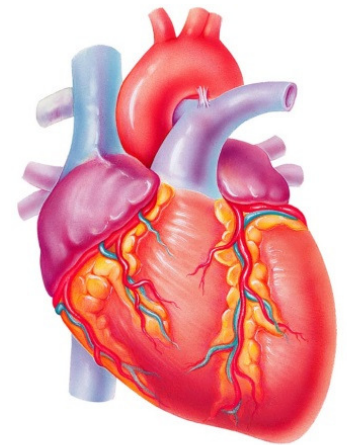
A) General:

- 1) Size of fist
- 2) _____ to the sternum
- 3) Tilts to the _____
- 4) _____ (Space within the thoracic cavity)



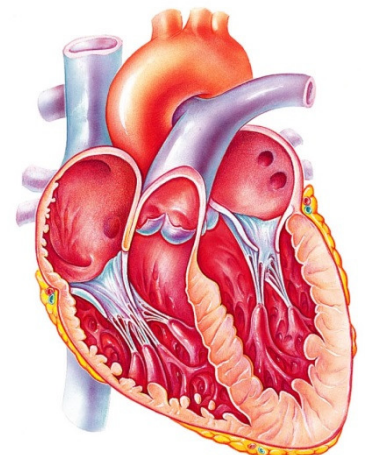
B) Pericardial Sac

- 1) _____ outermost sac layer
- 2) _____ lining sac/serous membrane
- 3) Attached to the _____ of the heart
- 4) Serous fluid fills the sac-- _____



C) External Surface

- 1) _____ Chambers
 - a) R/L atria
 - b) R/L ventricles
- 2) _____ Superior
 - a) Great vessels attached
 - b) Aorta
 - c) Pulmonary trunk
 - d) Superior/inferior vena cava
 - e) Pulmonary veins
 - f) Pericardial sac
- 3) _____ serous membrane covers surface
- 4) _____ inferior



D) Heart Wall

- 1) _____ serous membrane cover
- 2) _____ cardiac muscle tissue
- 3) _____ lines interior chamber and covers structures inside, continuous with endothelium (Simple Squamous)

E) Valves

1) Atrioventricular Valves: between atria and ventricles

- a) (R) _____
- b) (L) _____
- c) _____
- d) _____

2) Semilunar Valves

- a) _____
- b) _____

F) Ventricles

- 1) Trabeculae carneae
- 2) Interventricular septum (wall)
- 3) 'double' pump—each ventricle pumps to different body site(s)

G) Blood flow through the heart

1) Blood returns to the heart from the body

- a) Vena cava
- b) Right atria
- c) Right AV valve
- d) R ventricle
- e) Pulmonary semilunar valve
- f) Pulmonary trunk

2) Blood returns to the heart from the lungs

- a) Pulmonary veins
- b) Left atria
- c) Left AV valve
- d) Left ventricle
- e) Aortic semilunar valve
- f) Aorta

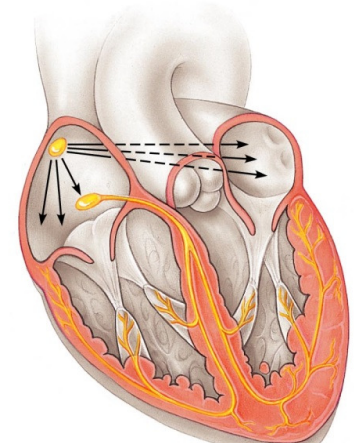
Section 7 Cardiac Cycle and Blood Pressure

A) Cardiac Cycle: _____

- 1) Atria contract
- 2) Ventricles contract
- 3) Ensures Blood flow _____
- 4) (average 70 beats per minute)

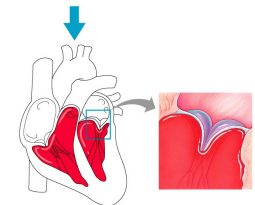
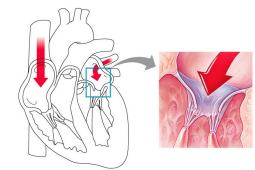
B) Regulation

- 1) _____
 - a) _____ (nervous tissue)
 - (1) 'Pacemaker' Starts the contraction
 - (2) Atrioventricular node--spreads across atria
 - (3) Atrioventricular bundle—continues to ventricles
 - (4) Purkinje fibers--ventricular contraction
 - b) Ensures coordinated/synchronous beating
- 2) _____ modify basic heart rate
 - a) _____ 'Fight or flight'
 - b) Hormones: _____
 - c) Physical factors: exercise/temperature

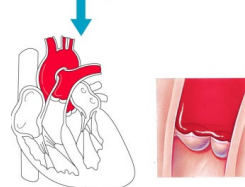
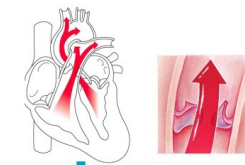


C) Heart Sounds: _____

- 1) heart valves snapping shut
- 2) Atrioventricular valves '**Lub**'
 - a) Between atria and ventricle
 - b) Attached to chordae tendineae
 - c) Anchored to papillary muscle
 - d) Right AV Valve: prevents backflow into the _____
 - e) Left AV valve: prevents backflow into the _____
- 3) Semilunar valves '**dub**'
 - a) Flaps within arterial walls
 - b) Pulmonary Semilunar prevents backflow into the _____
 - c) Aortic Semilunar: prevents backflow into the _____



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- D) _____: expansion/recoil of arterial wall with each beat of left ventricle
- 'Pressure Points': arteries close to body surface
- E) _____: Pressure that the blood exerts against the BV wall
- _____ ventricular contraction (blood pressure highest in arteries)
 - Systolic pressure: Pressure in arteries at peak ventricular contraction
 - _____ ventricular relaxation
 - Diastolic pressure: pressure in arteries at peak ventricular relaxation
 - Blood pressure decreases with distance from left ventricle

Section 8 Vascular Pathways

A) Cardiac Circulation

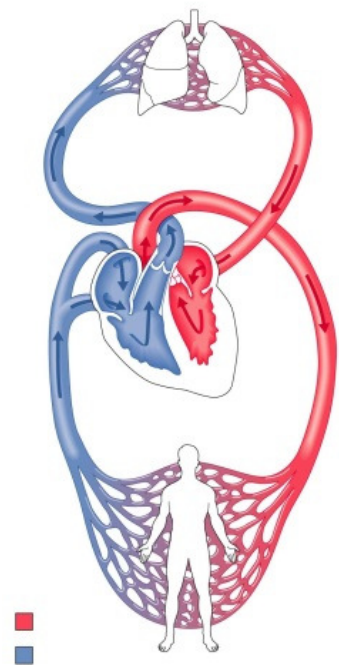
- Myocardium requires nutrients/oxygen/waste transport
- Coronary arteries exit _____
- Coronary veins return blood to the _____
- _____ chest pain due to brief lack of oxygen to heart muscle (warning)
- _____ cardiac tissue death
- _____ decreased pump efficiency/inadequate to meet body needs

B) _____ pathway from the heart to the lungs and back to the heart

- Purpose _____
- Route:
 - Right ventricle
 - Pulmonary trunk
 - Pulmonary arteries
 - Lungs
 - Pulmonary veins
 - Left atria

C) _____ pathway from the heart to the body and back to the heart

- Purpose _____
- Route:
 - Left ventricle
 - Aorta
 - Arteries
 - Arterioles
 - Capillaries
 - Venules
 - Veins
 - Superior/inferior vena cava
 - Right Atria



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