

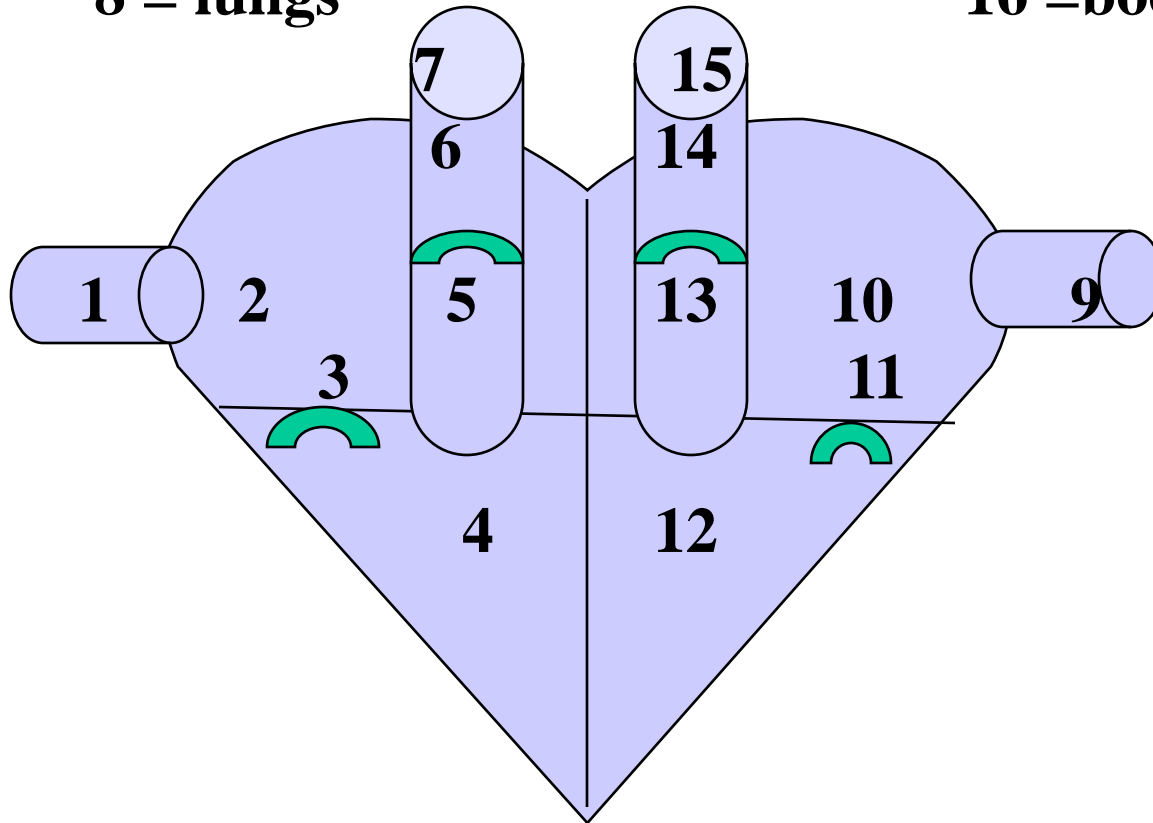
# CV Topics

- 1) heart**
- 2) blood vessels**
- 
- 4) heart tests**
- 5) blood**
- 6) blood tests**
- 7) diseases**

# “Engineer’s Heart”

8 = lungs

16 = body



# Blood Flow thru Heart

Oxygen-poor

Mixed

Oxygen-rich

## 8. Pul. Circ.

1. vena cava (2)

2. RA

3. tricuspid valve

4. RV

5. pul. semi. valve

6. pulmonary trunk

7. pulmonary arteries (2)

9. pul. veins (4)

10. LA

11. bicuspid valve

12. LV

13. aortic semi. v.

14. aorta

15. aortic art. (4)

## 16. Sys. Circ.

# Cardiac Cycle

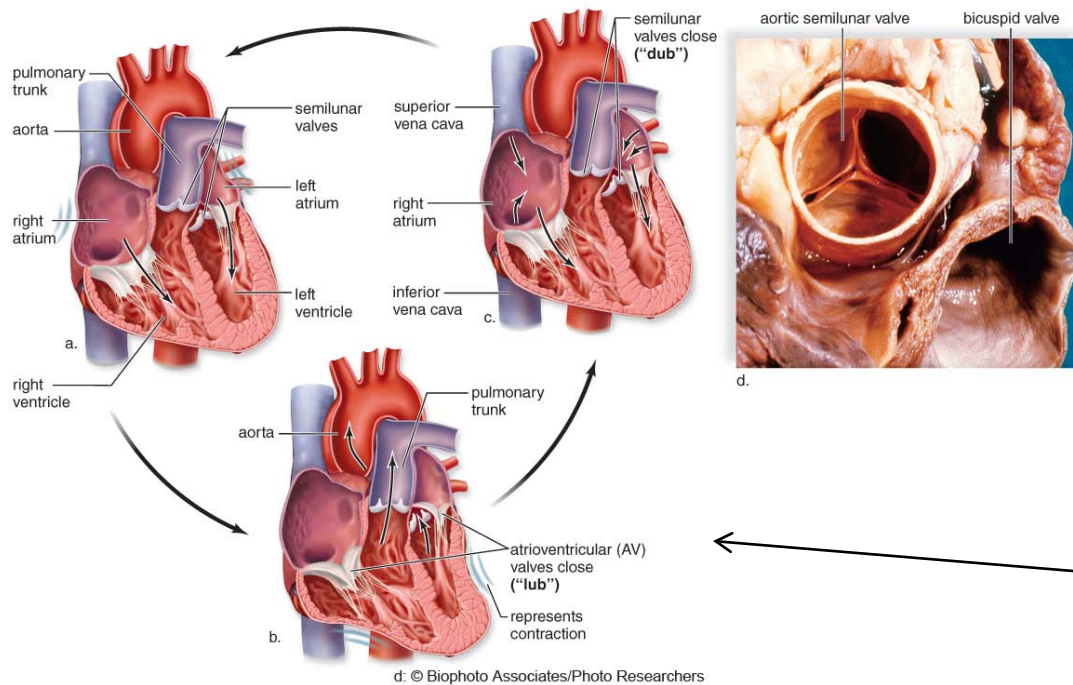
**3 phases; 2 valves**

**#1 Diastole**

**#2 Atrial Systole**

**semilunar valves:  
aortic  
bicuspid**

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**#3  
Ventricular  
Systole**

# Cardiac Phases

## 1) Diastole: (.4 / .8 sec)

- ventricle relax (vent. fill-up)
- atria relax (vent. fill-up)

## 2) Atrial Systole (.1/ .8 sec)

- ventricle relax (vent. fill-up)
- atria contract (eject to vent.)

## 3) Ventricular Systole: (.3 / .8 sec)

- ventricle contract (eject to circuits)
- atria relax (accept from circuits)

**\*1 cycle = 1 heart beat = .8 sec per beat**

- based on HR = 75 bpm

# Control of Heartbeat (2)

## Atrial Systole

**SA node: initiate elec. signal**

- atrial muscles contract
- atria eject blood to 2 ventricles

## Ventricular Systole

**AV node, AV bundle, Bundle Branches,**

**Purkinje fibers: conduct elec. signal**

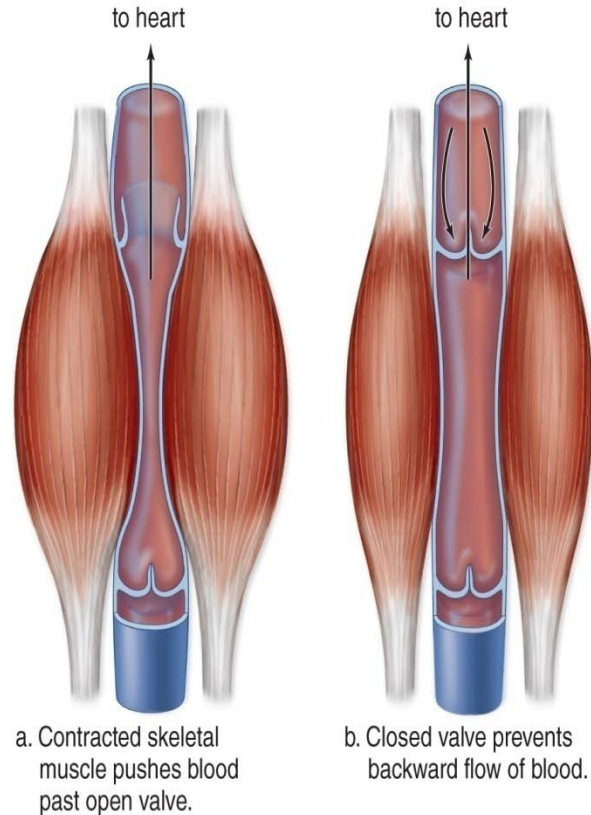
- ventricular muscles contract
- ventricles eject blood to 2 circuits

**Diastole: no elec. signal**

- atrial & ventricle muscles relax
- 4 chambers fill with blood

# How does blood return to heart?

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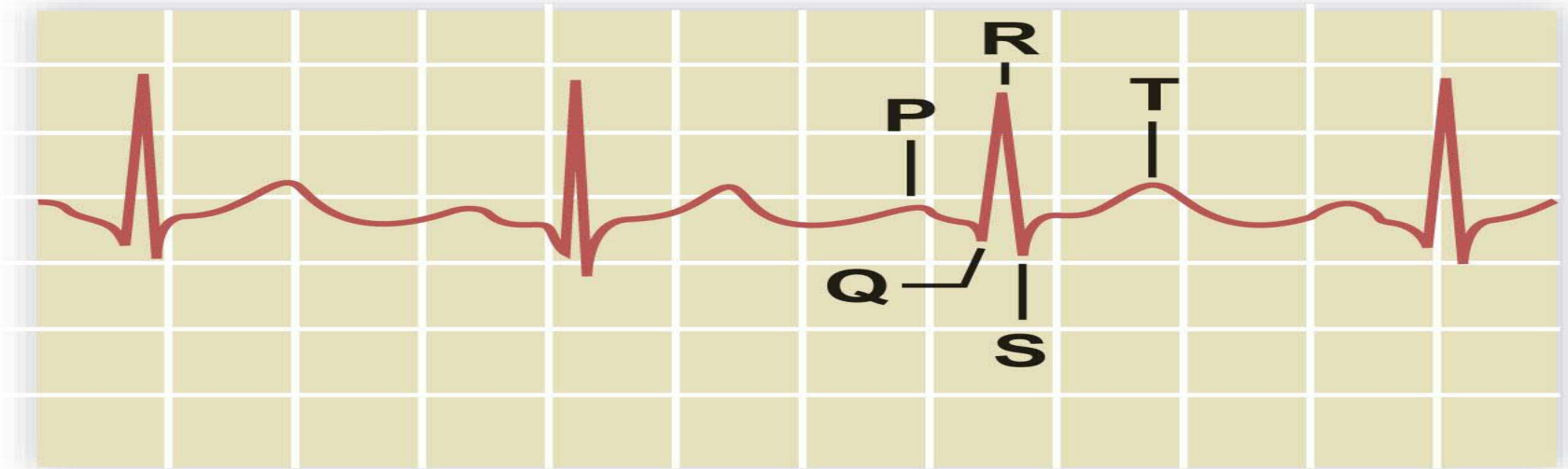
- 1) heart pumps blood**
- 2) lymph vessels return excess fluids**
- 3) veins return blood to heart**
  - a) skeletal muscle pump**
  - b) one-way valves in veins**
  - c) breathing**
    - chest pressure changes**

# EKG Waves

waves = electrical activities in the heart

3 types:

- 1) P wave: atrial activity
- 2) QRS wave: ventr. activity
- 3) T wave: ventricular end phase



**b) A normal ECG recording**

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# BP Values

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**Table 5.1** Normal Values for Adult Blood Pressure\*

|  | Top Number<br>(Systolic) | Bottom Number<br>(Diastolic) |
|--|--------------------------|------------------------------|
| Hypotension                                    | Less than 95             | Less than 50                 |
| Normal   | Below 120                | Below 80                     |
| Prehypertension                                | 120–139                  | 80–89                        |
| Stage 1 hypertension                           | 140–159                  | 90–99                        |
| Stage 2 hypertension                           | 160 or more              | 100 or more                  |
| Hypertensive crisis<br>(emergency care needed) | Higher than 180          | Higher than 110              |

**normal BP: 120/80**

**high BP (hypertension): 140/90**

- normal: exercise

- abnormal:

**irreg. heart beat, red face**

**low BP (hypotension): 100/60**

- normal: stand up suddenly

- abnormal: heavy blood loss,  
**dizzy, faint, sluggish**

# What is blood?

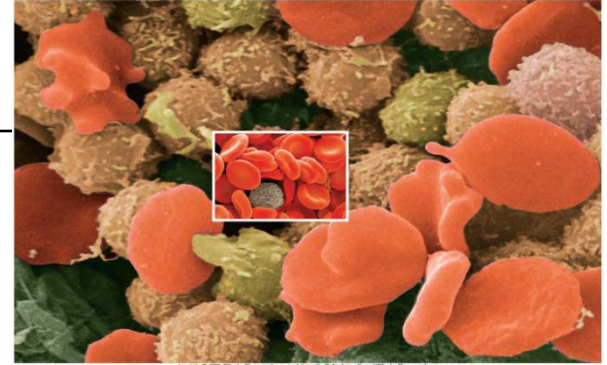
**Looks red; feels sticky.**

**5 liters of:**

- 1) cells (formed elements) - RBC, WBC, platelets**
- 2) plasma (liquid) - water, salts, plasma proteins**

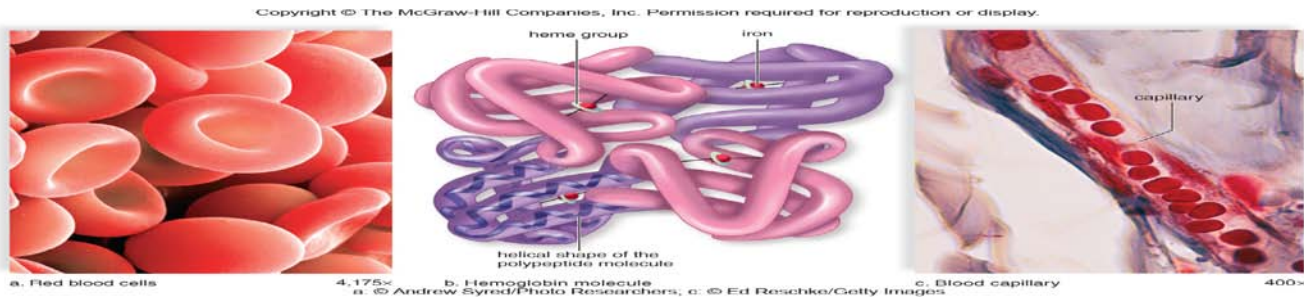
**functions:**

- 1) transport - oxygen & nutrients to cells;  
carbon dioxide & waste from cells**
- 2) defense - against microscopic organisms,  
and blood loss (hemorrhage)**
- 3) regulation - body temperature, water-salt  
balance, and acid-base balance (pH 7.4)**



# RBC

- 1) **hemoglobin (Hb):**
  - iron gives red color
  - carry oxygen & carbon dioxide
  - cannot release carbon monoxide->suffocate
- 2) **no nucleus or mitochondria: not use oxygen**
- 3) **disc shape: more surface for gas diffusion  
easier to slip thru capillary**



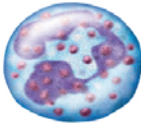
# WBC

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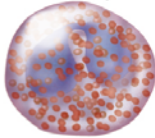
## White Blood Cells

### Granular leukocytes

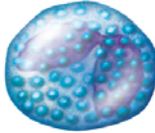
- Neutrophils



- Eosinophils

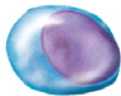


- Basophils



### Agranular leukocytes

- Lymphocytes



- Monocytes



## Function

Phagocytize pathogens and cellular debris.

Use granule contents to digest large pathogens, such as worms, and reduce inflammation.

Promote blood flow to injured tissues and the inflammatory response.

Responsible for specific immunity; B cells produce antibodies; T cells destroy cancer and virus-infected cells.

Become macrophages that phagocytize pathogens and cellular debris.

**function: fight infection**

**- phagocytosis**

**- immune response**

**compared to RBC:**

**larger, have nucleus,**

**no Hb, less numerous**

**assignment:**

**Draw and describe the**

**functions of each WBC**

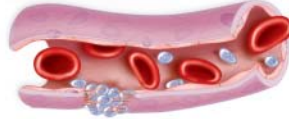
# Platelets

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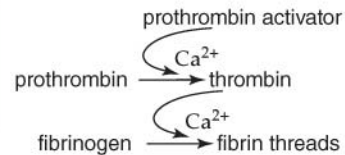
1. Blood vessel is punctured.



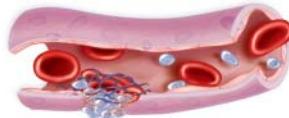
2. Platelets congestate and form a plug.



3. Platelets and damaged tissue cells release prothrombin activator, which initiates a cascade of enzymatic reactions.

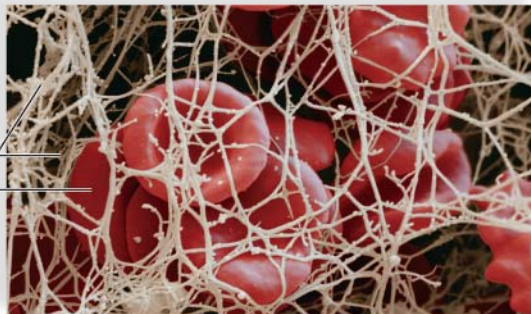


4. Fibrin threads form and trap red blood cells.



a. Blood-clotting process

fibrin threads  
red blood cell



b. Blood clot

b: © Eye of Science/Photo Researchers

4,400x

**blood clot function:  
prevent blood loss**

**steps:**

- 1) BV puncture**
- 2) platelets form plug**
- 3) calcium + plasma  
prothrombin ->  
thrombin**
- 4) fibrin threads ->  
trap prevent RBC loss**



# Aspirin

wounds → damaged tissues prod. thromboxane  
→ ↑ blood clots to reduce blood loss

unknown reasons, less healthy indiv., no wounds  
prod. thromboxane → ↑ blood clots heart & brain BV  
(atherosclerosis) → ↑ heart attack & strokes

aspirin inhibits thromboxane → ↓ blood clots  
+: "blood thinner" to prevent atherosclerosis  
-: dosage? ↓ → no effect; ↑ → abdominal bleeding

# Warfarin

**surgery → damaged tissues prod. thromboxane  
→ ↑blood clots to reduce blood loss**

**after surgery: warfarin prescribed for blood thinning**

**+ : "blood thinner" to prevent atherosclerosis  
effect canceled by Vitamin D**

**- : ↑dosage, long period (weeks, months)**

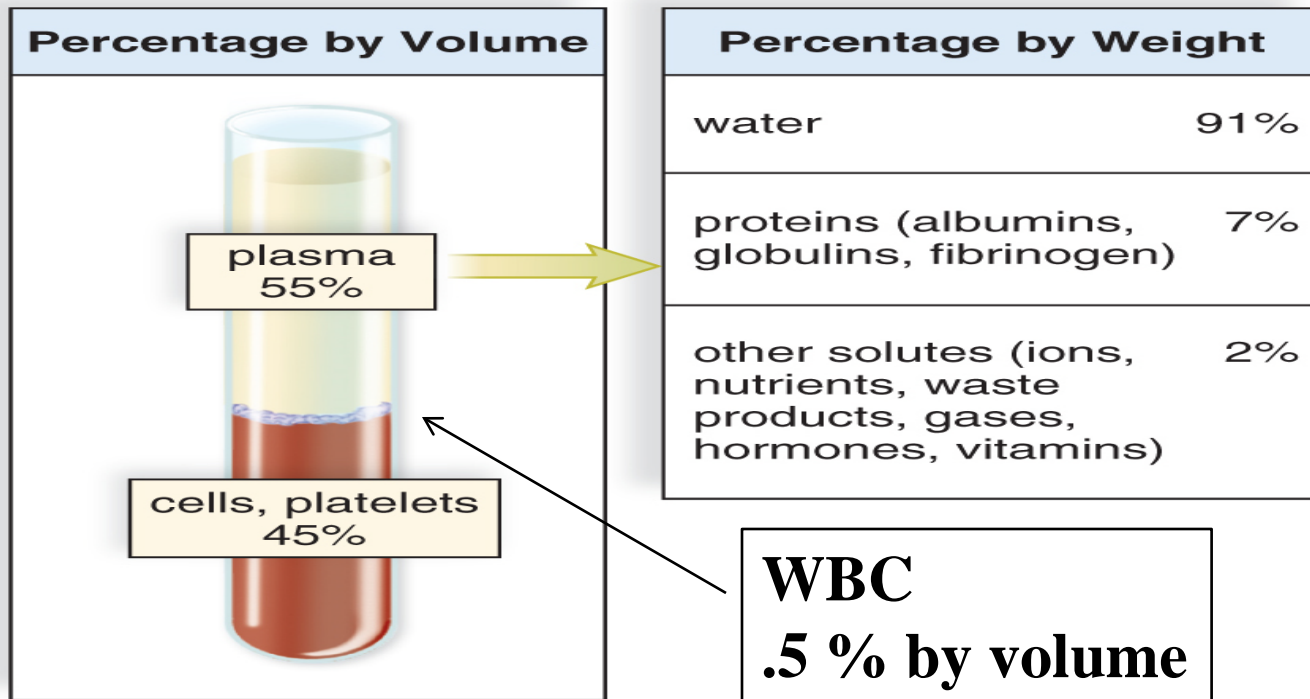
**problems:**

- 1) easier bleeding & bruises, longer recovery**
- 2) eventually ulcers & abdominal bleeding**
- 3) restricted foods high in Vit D, eg broccoli**
- 4) CV patients - lifelong on warfarin**

# Blood Test - Hematocrit

- 1) blood is drawn, placed in tube, spun
- 2) 3 volume % calculated
  - WBC not shown, usu. .5%

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# Hematocrit Usage

## **normal values:**

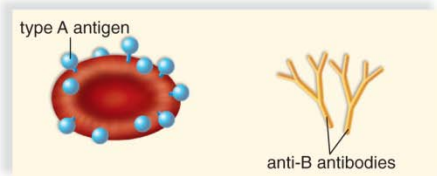
- 1) plasma (55%) - transports materials**
- 2) RBC (44%) - transports O<sub>2</sub> & CO<sub>2</sub>**
- 3) WBC (1%) - defence**

## **abnormal values:**

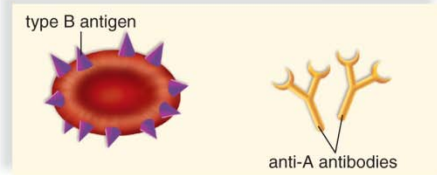
- 1) plasma > 55% & RBC < 44%**
  - "thin blood", anemia**
  - usu. tired, low energy, less alert**
- 2) WBC >1%**
  - fighting infection; leukemia**
  - usu. tired, low energy, less alert**

# ABO Blood Types

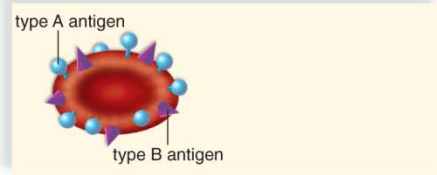
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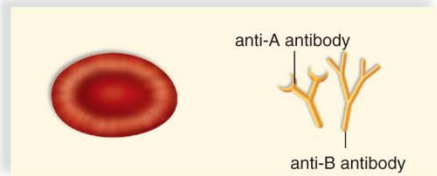
**Type A blood.** Red blood cells have type A surface antigens. Plasma has anti-B antibodies.



**Type B blood.** Red blood cells have type B surface antigens. Plasma has anti-A antibodies.



**Type AB blood.** Red blood cells have type A and type B surface antigens. Plasma has neither anti-A nor anti-B antibodies.



**Type O blood.** Red blood cells have neither type A nor type B surface antigens. Plasma has both anti-A and anti-B antibodies.

**4 blood types: A, B, AB, O**

**2 antigens: A, B**

**2 antibodies: anti-A, anti-B**

**transfusion:**

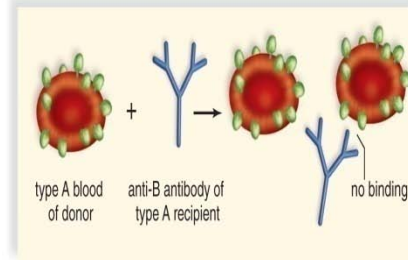
**compatible**

**no binding**

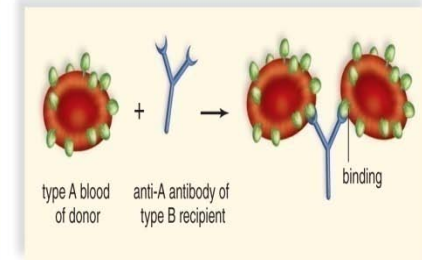
**not compatible**

**binding  
(agglutinates)**

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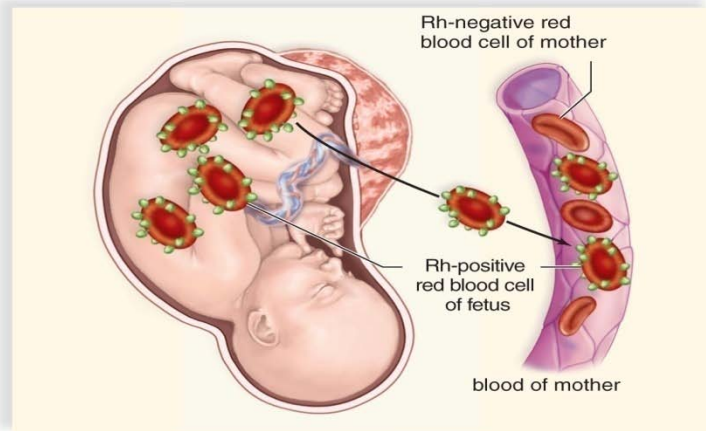
a. No agglutination



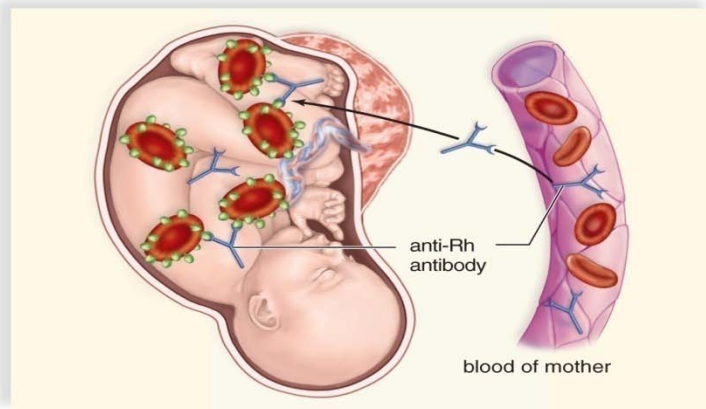
b. Agglutination

# Rh Blood Type

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a. Fetal Rh-positive red blood cells leak across placenta into mother's bloodstream.



b. Mother forms anti-Rh antibodies that cross the placenta and attack fetal Rh-positive red blood cells.

**antigen: Rh**  
**Rh+ father**  
**Rh- mother**  
**Rh+ child**

**anti-Rh**  
**antibody**  
**attacks Rh**  
**antigen in**  
**fetus ->**  
**fetal anemia**

# CV Diseases

**Describe the cause & effects of:  
Heart & BV**

- 1) angina pectoris (chest pain)**
- 2) heart attack**
- 3) atherosclerosis (plaque)**
- 4) embolism (thrombo-embolism)**
- 5) stroke**

**Blood**

- 1) anemia**
- 2) sickle cell anemia**
- 3) leukemia**
- 4) mononucleosis**
- 5) hemophilia**