Function of Blood

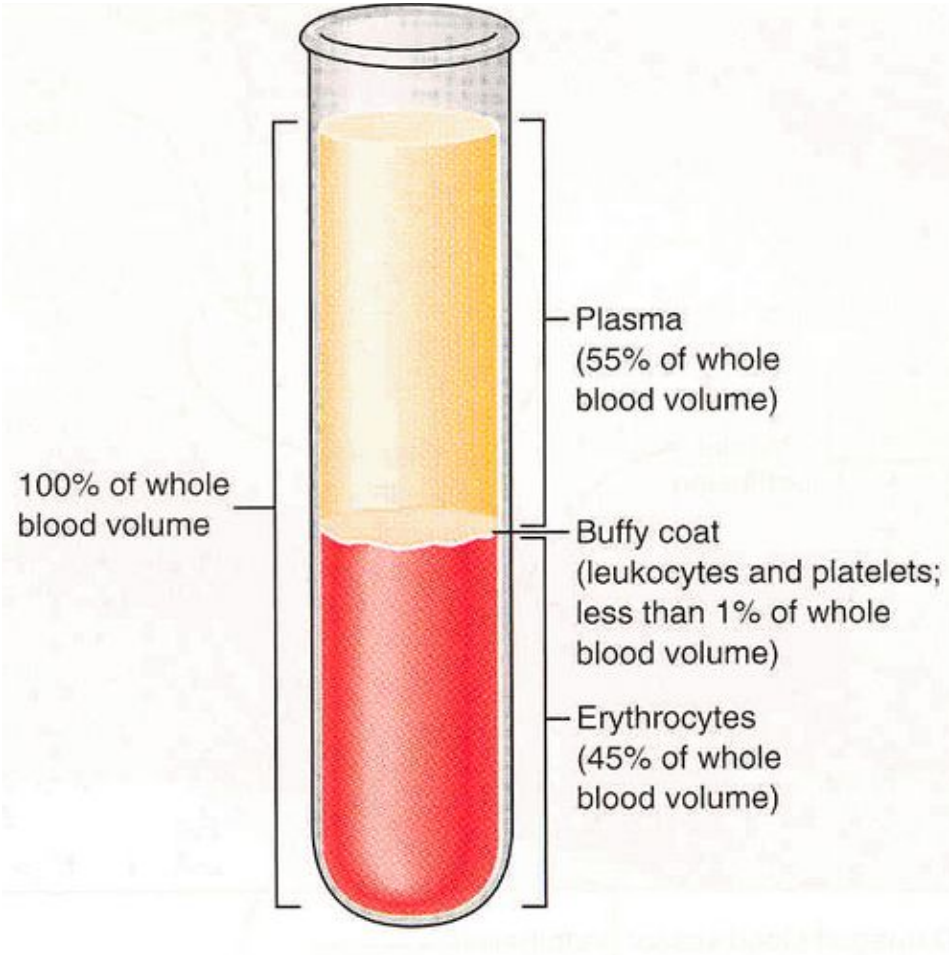
- Blood **transports** everything that must be carried from one place to another, such as:
  - **Nutrients**
  - **Wastes**
  - **Hormones**
  - **Body heat**

Physical Characteristics of Blood

- Sticky, opaque fluid
- **Heavier and thicker** than water
- Color range
  - **Oxygen-rich** blood is **scarlet red**
  - **Oxygen-poor** blood is **dull red or purple**
- Metallic, salty taste
- Blood temperature is slightly **higher than body temperature,** at 38ºC or 100.4ºF

Components of Blood

- Blood is the only **fluid tissue**, a type of **connective tissue**, in the human body
- Components of blood
  - **55% Plasma**
    - **Nonliving fluid matrix**
  - **45% Formed elements**
    - **Living cells**

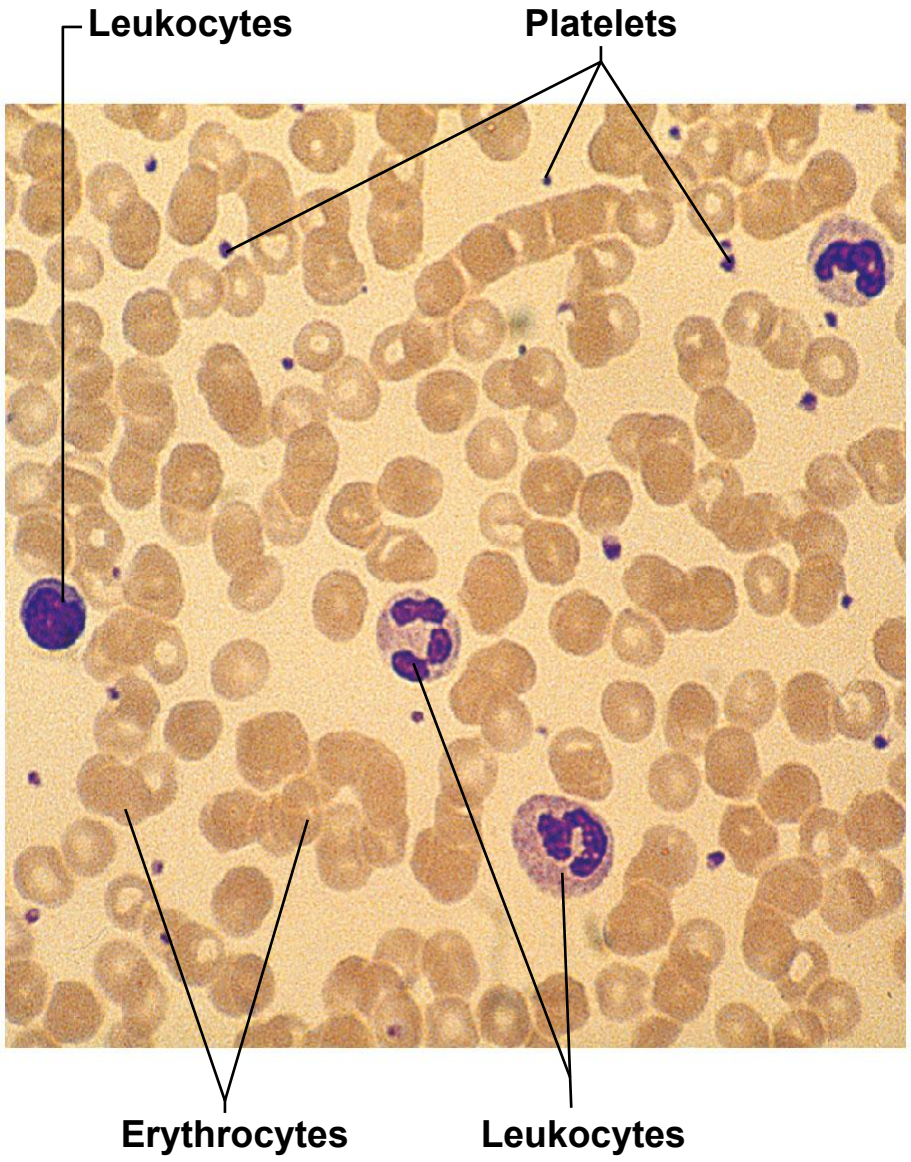


Plasma

- **90% water**
- Straw-colored fluid
- Includes many dissolved substances:
  - **Nutrients**
  - **Electrolytes (salt)**
  - **Respiratory gases**
  - **Hormones**
  - **Plasma proteins (aid in clotting, contain antibodies)**
  - **Waste products**

Formed Elements

- **Erythrocytes**
  - Red blood cells (RBCs)
  - **Transport oxygen**
- **Leukocytes**
  - White blood cells (WBCs)
  - **Defense and immunity**
- **Platelets**
  - Cell fragments
  - **Blood clotting**



Antigens

- Blood types are based on the **presence or absence of two antigens**

- Antigen (**Agglutinogen**)
  - **Plasma membrane protein** found on the surface of red blood cells
  - Substance that the body **recognizes as foreign and activates the immune system**

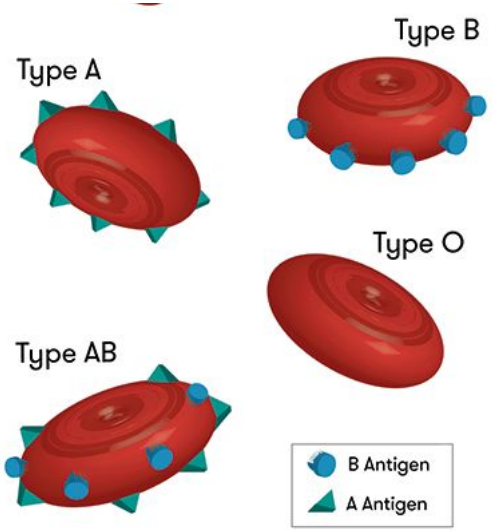
Antibodies

- The “recognizers” of antigens are **antibodies**

- Antibodies (**Agglutinins**)
  - Present in **blood plasma**
  - **Attach to RBCs with surface antigens different from those on their own RBCs**

- Binding of antibodies to antigens causes the RBCs to **clump (agglutination)**, which leads to the **clogging of small blood vessels throughout the body**
  - This would occur if a blood transfusion occured with the incorrect blood type
  - Can cause kidney failure or even death

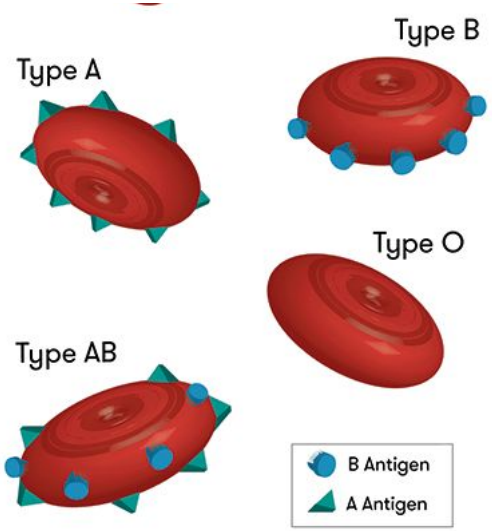
Human Blood Types



- Type AB
  - **Presence of both antigens A and B**
  - **Lack of antibodies**
  - Can receive blood from **A, B, AB, and O**
    - **Universal recipient**
  - Can give blood to **AB**

- Type A
  - **Presence of antigen A**
  - **Produces anti-B antibody**
  - Can receive blood from **A and O**
  - Can give blood to **A, AB**

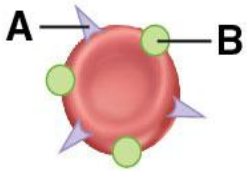
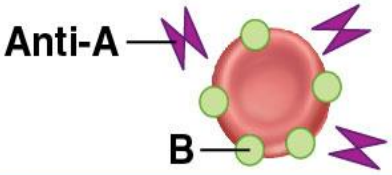
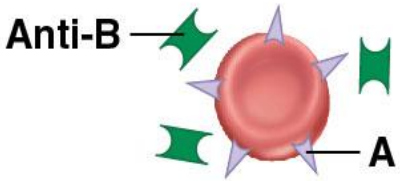
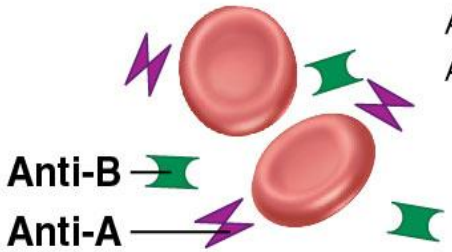
Human Blood Types



- Type B
  - **Presence of antigen B**
  - **Produces anti-A antibody**
  - Can receive blood from **B and O**
  - Can give blood to **B or AB**

- Type O
  - **Lack of both antigens A and B**
  - **Produces anti-A and anti-B antibodies**
  - Can receive blood from **O**
  - Can give blood to **O, A, B, and AB**
    - **Universal donor**

Table 10.3 ABO Blood Groups

Blood group	RBC antigens (agglutinogens)	Illustration	Plasma antibodies (agglutinins)	Blood that can be received	Frequency (% of U.S. population)			
					White	Black	Asian	Native American
AB	A, B		None	A, B, AB, O "Universal recipient"	4	4	5	<1
B	B		Anti-A (a)	B, O	11	20	27	4
A	A		Anti-B (b)	A, O	40	27	28	16
O	None		Anti-A (a) Anti-B (b)	O "Universal donor"	45	49	40	79

Human Blood Types

- Rh Blood Type
  - Rh is an another **antigen** that is also used to identify human blood types
  - The presence or absence of Rh is indicated in human blood type as **"positive or negative"**
  - Rh^+
    - **Presence of Rh antigen**
  - Rh^-
    - **Absence of Rh antigen**

Blood Typing

- Blood samples are mixed with **anti-A and anti-B serum**
- **Agglutination or the lack of agglutination** leads to identification of blood type
- Rh factors is done in the same manner

Genetics of Blood Types

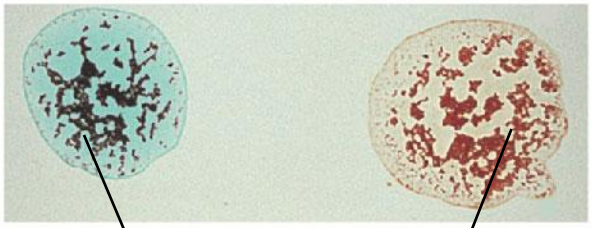
- The human ABO blood types are genetically inherited by the combination of **3 different alleles.**
  - **Allele I^A** codes for the production of **antigen A**
  - **Allele I^B** codes for the production of **antigen B**
  - **Allele i does not produce any antigens**
- **I^A and I^B are dominant over i**
  - i is recessive
- **I^A and I^B are codominant**
  - When I^A and I^B are both present, they are both expressed

Blood being tested

Serum

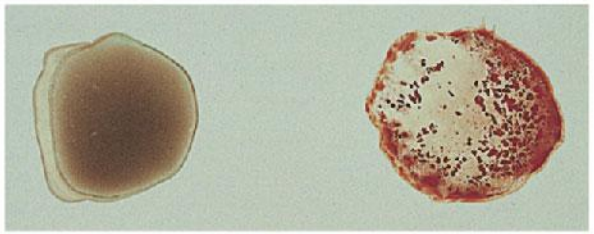
Anti-A **Anti-B**

Type AB
(contains antigens A and B; agglutinates with both sera)



Agglutinated RBCs

Type B
(contains antigen B; agglutinates with anti-B serum)



Type A
(contains antigen A; agglutinates with anti-A serum)

Type O
(contains no antigens; does not agglutinate with either serum)