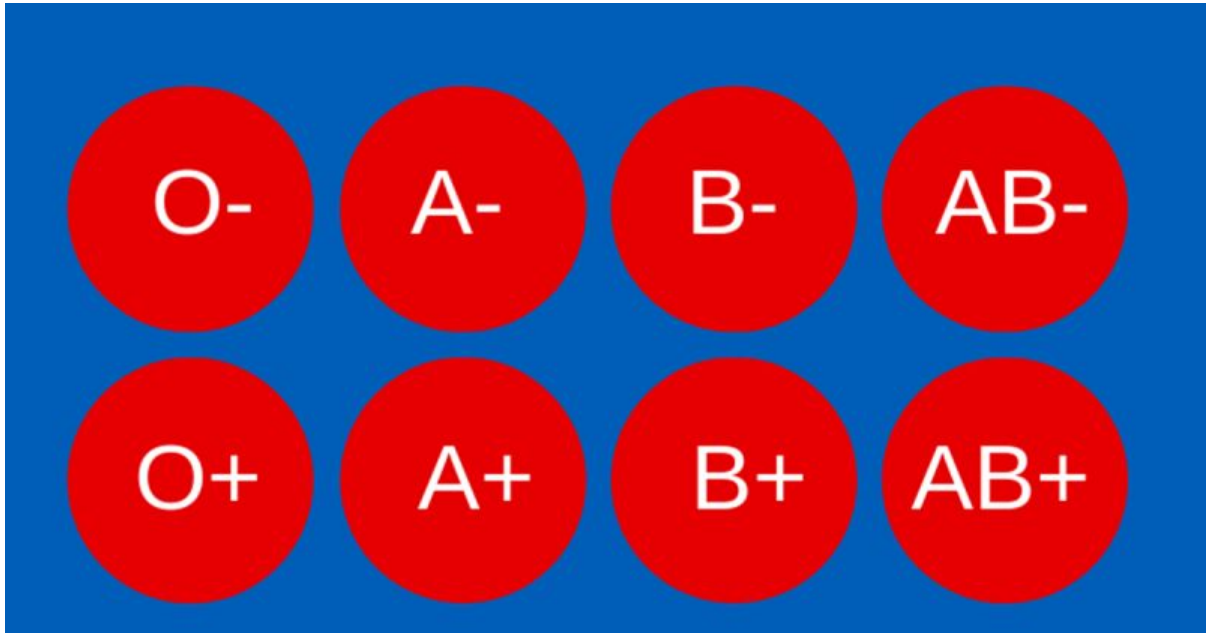
Blood Group Genetics

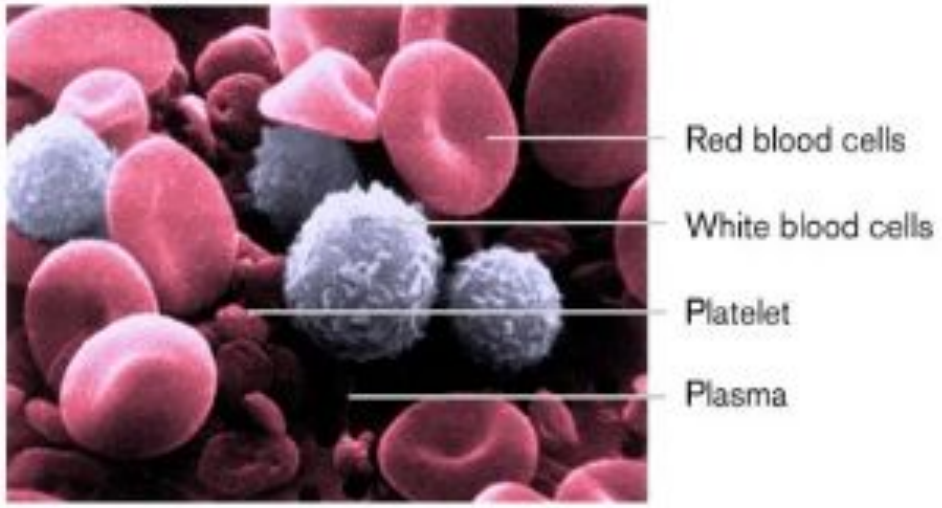


KARL LANDSTEINER
(1886-1943)

- Discovered ABO Blood group system in 1901
- Discovered Rh factor in 1930 along with Alexander S. Wiener
- Noble prize in Physiology or Medicine in 1930

Blood and its components

- Liquid fluid consisting of following components:



a. Cells (45%)

b. Plasma (55%)

c. Serum=plasma-fibrinogen

Antigen-Antibody

- **Antigen:**

  The foreign substance that triggers the production of antibodies.

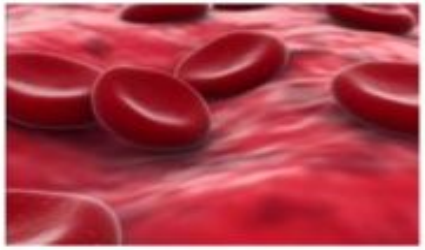
- **Antibodies:**

  The substances produced in response to antigens.

What are the different blood groups?

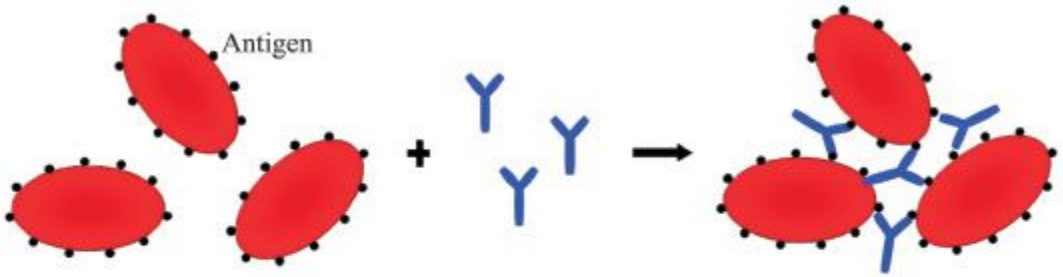
- The differences in human blood are due to the presence or absence of certain protein molecules called antigens and antibodies.

- The antigens are located on the surface of the RBCs and the antibodies are in the blood plasma.



- Individuals have different types and combinations of these molecules.

- The blood group you belong to depends on what you have inherited from your parents.



Blood Group systems

MAJOR

- ABO
- Rh (Rhesus)

MINOR

- MN
- Ii
- P
- Lewis
- Duffy
- Kidd
- Kell
- Lutheran

- There are more than 20 genetically determined blood group systems known today

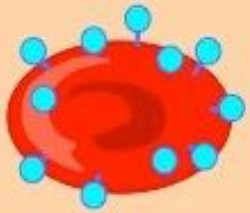
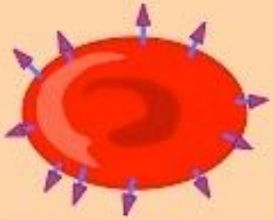
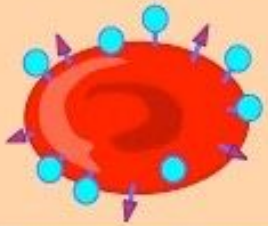
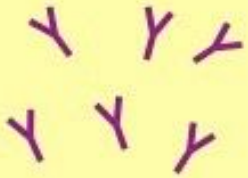
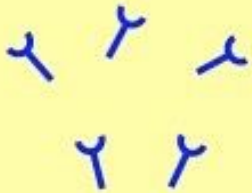
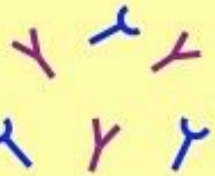
- The **AB0** and **Rhesus (Rh)** systems are the most important ones used for blood transfusions.

Classical ABO Blood Grouping System

- The most important in assuring a safe blood transfusion.
- Is based on presence or absence of A & B antigens on red cell membrane.
- There are 4 bloog groups according to this system
- A, B, AB & O

ABO Blood Group Types

- If A antigen is present, blood group will be A
- If B antigen is present, blood group will be B
- If both A and B antigens are present, blood group will be AB
- If neither A nor B antigen is present, blood group will be O

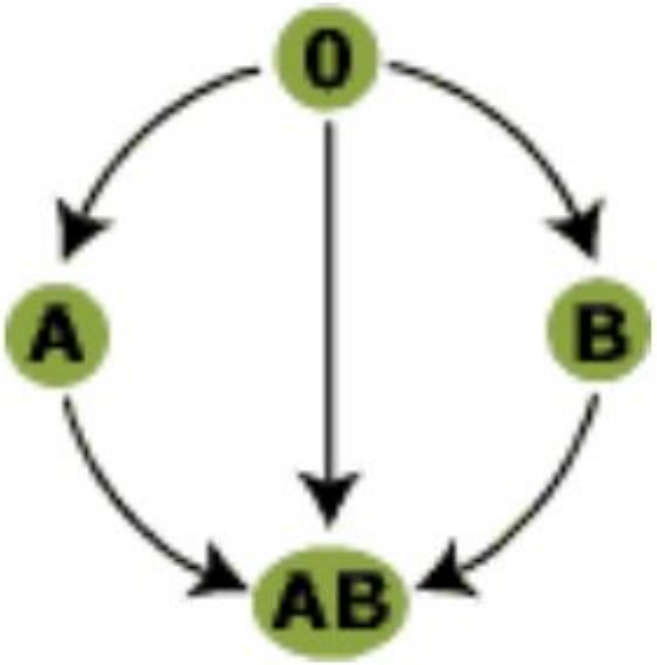
	Type A	Type B	Type AB	Type O
Antigen (on RBC)	Antigen A 	Antigen B 	Antigens A + B 	Neither A or B 
Antibody (in plasma)	Anti-B Antibody 	Anti-A Antibody 	Neither Antibody	Both Antibodies 
Blood Donors	Cannot have B or AB blood Can have A or O blood	Cannot have A or AB blood Can have B or O blood	Can have any type of blood Is the universal recipient	Can only have O blood Is the universal donor

• The table shows the four ABO phenotypes ("blood groups") present in the human population and the genotypes that give rise to them.

Blood Group	Antigens on RBCs	Antibodies in Serum	Genotypes
A	**A**	Anti-B	*AA* or *AO*
B	**B**	Anti-A	*BB* or *BO*
AB	**A** and **B**	Neither	*AB*
O	Neither	Anti-A and anti-B	*OO*

Blood transfusions – who can receive blood from whom?

People with blood group O are called **"universal donors"** and people with blood group AB are called "**universal receivers**."



WHICH BLOOD TYPES AM I COMPATIBLE WITH?

BLOOD TYPE	CAN GIVE TO	CAN RECEIVE FROM
A+	A+, AB+	A+, A-, O+, O-
O+	O+, A+, B+, AB+	O+, O-
B+	B+, AB+	B+, B-, O+, O-
AB+	AB+	EVERYONE
A-	A+, A-, AB+, AB-	A-, O-
O-	EVERYONE	O-
B-	B+, B-, AB+, AB-	B-, O-
AB-	AB+, AB-	AB-, A-, B-, O-


Rh Blood Group System

Rh Blood Group System

- This system also discovered by Karl Land Steiner(1940)
- Second important blood group system
- The main cause of hemolytic disease of new born(HDN)

Types of Rh Blood Group System

- **Rh Positive:**

  Posses Rh antigen on surface of RBCs

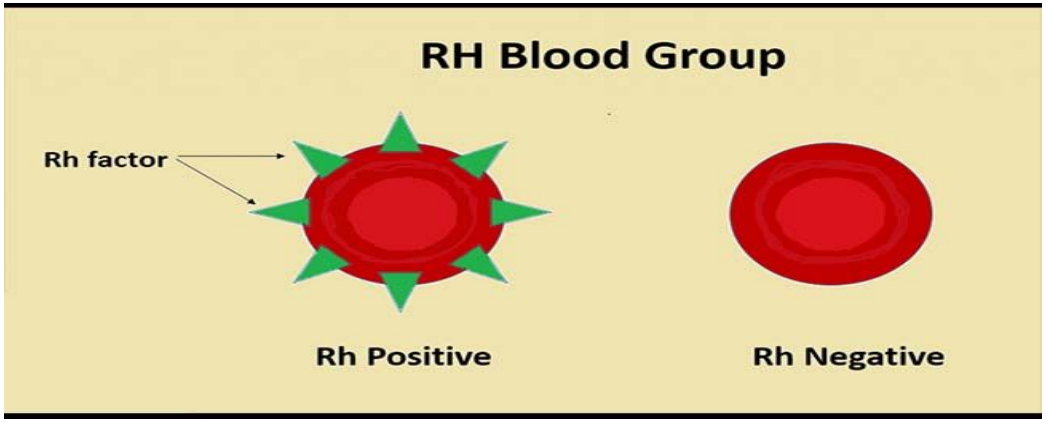
- **Rh Negative:**

  Lack Rh antigen on surface of RBCs

Rh FACTOR

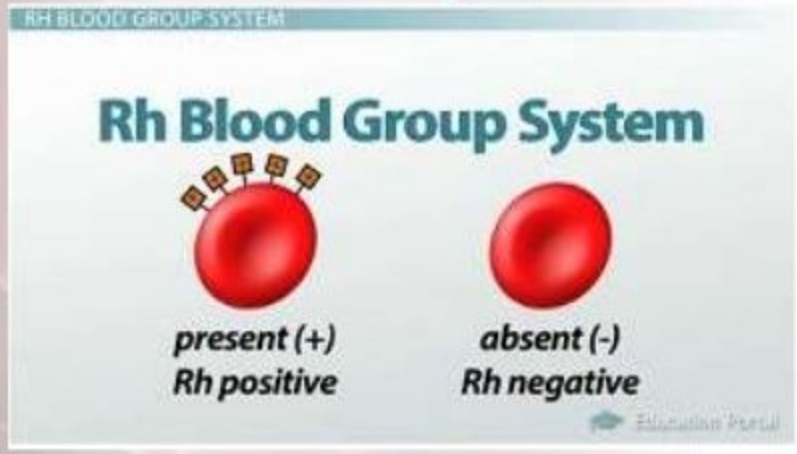
What does Rh refers to?

- Rh is the most important blood group system after ABO in transfusion medicine.
- One of the most complex of all RBC blood group systems with more than 50 different Rh antigens.
- The genetics, nomenclature and antigenic interactions are unsettled.
- There are two genes, RHD and RHCE



❖ RHD: What does the term D-positive and D-negative refers to?

- If Protein (D antigen) is present on the surface of Red blood cell, the blood will be termed as D-positive.
- If Protein (D antigen) is absent on the surface of Red blood cell, the blood will be termed as D-negative.



❖RHCE: Four additional antigens: C, c, E, e:

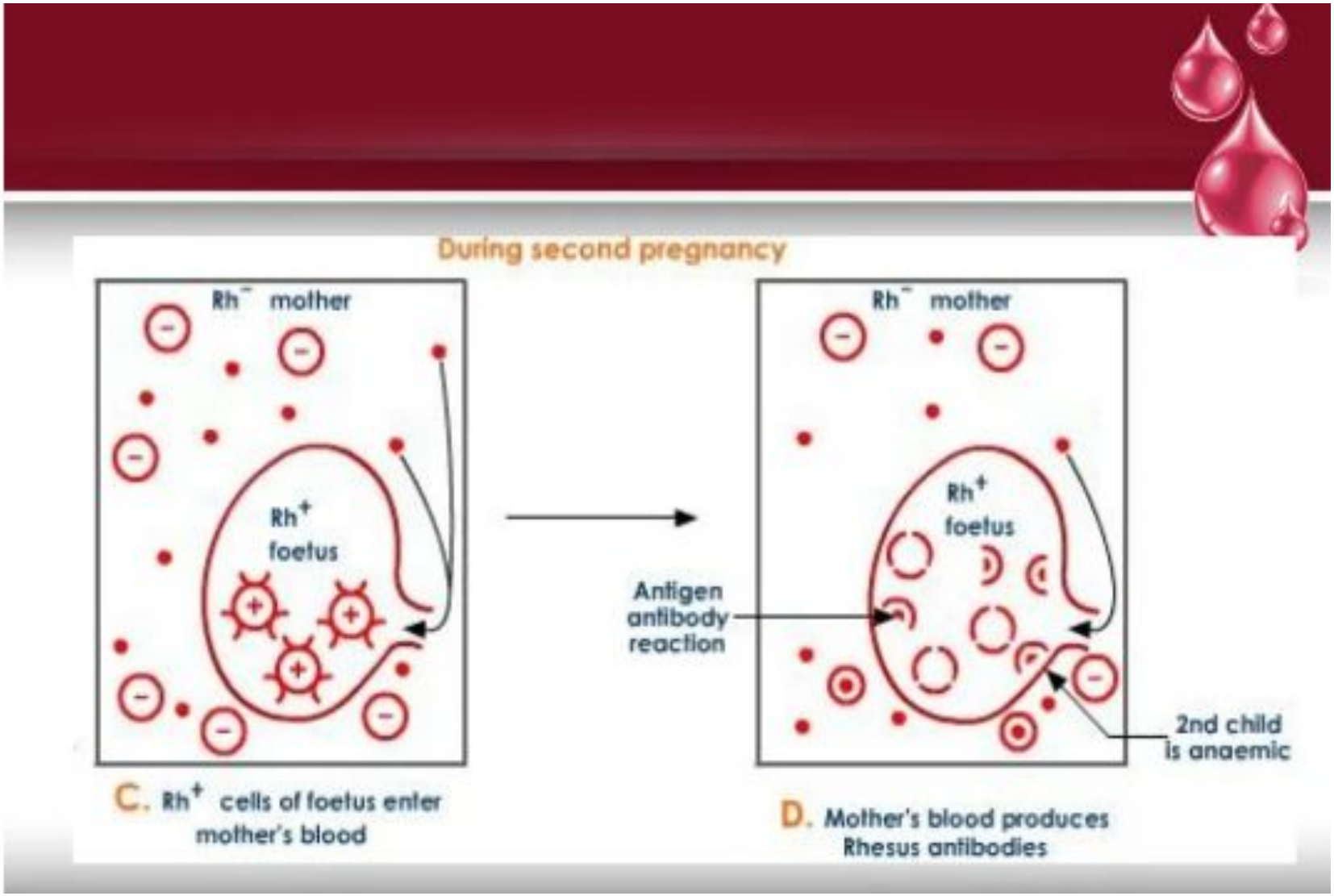
- The RhCE protein encodes the C/c antigen (in the 2nd extracellular loop) and the E/e antigen (in the 4th extracellular loop)

Erythroblastosis Fetalis

- Hemolytic disease of new born

Occurrence:

- If a mother with Rh^- have a fetus with Rh^+
- Mother develop Rh^- antibodies against fetus Rh^+
- These antibodies will react with subsequent Rh^+ fetus
- Lead to bursting of RBC's


During second pregnancy
Rh⁻ mother
Rh⁺ foetus
Rh⁻ mother
Rh⁺ foetus
Antigen antibody reaction
2nd child is anaemic
C. Rh⁺ cells of foetus enter mother's blood
D. Mother's blood produces Rhesus antibodies

Treatment For Erythroblastosis Fetalis

- Steps are taken to prevent antibodies production against fetus antigens
- Usually a shot of Rh antibodies are given to mother within 72 hours of delivery
- Blood Transfusion

Bombay Blood Group

It is the rarest type of blood group, only 4 per million of the world population have this blood group.

Bombay Blood Group

- It is also know as (HH) group.
- First discovered in Bombay in 1952.
- Very rare.
- Present in 0.004% population.
- Named by Dr. Bhande and others.
- Can receive blood only from Bombay blood group people.

Blood Type	Donate Blood To	Receive Blood From
A+	A+ AB+	A+ A- O+ O-
O+	O+ A+ B+ AB+	O+ O-
B+	B+ AB+	B+ B- O+ O-
AB+	AB+	Everyone
A-	A+ A- AB+ AB-	A- O-
O-	Everyone	O-
B-	B+ B- AB+ AB-	B- O-
AB-	AB+ AB-	AB- A- B- O-

- **Type O-negative** blood does not have any antigens. It is called the "**universal donor**" type because it is compatible with any blood type.
- **Type AB-positive** blood is called the "**universal recipient**" type because a person who has it can receive blood of any type.


Thank You!