

# Blood Groups

**B.Sc Second year Honours (Zoology) Paper - 4**

**Dr. Mirza Imteyaz Baig**

**Assistant Professor**

**Department of Zoology**

**Raja Singh College, Siwan.**

**Mobile no: 09538245814**

**E- mail: bmirza7@gmail.com**

## *Blood Typing and Transfusions*

- A blood transfusion is the transfer of blood from one individual to another.
- For transfusions to be done safely, blood must be typed so that agglutination (clumping of red blood cells) does not occur when blood from different people is mixed.

Blood typing usually involves determining the ABO blood group and whether the individual is Rh<sup>-</sup> or Rh<sup>+</sup>.

## Terminology to help understand ABO blood typing?

**Antigen** - a foreign substance, often a polysaccharide or a protein, that stimulates an immune response

**Antibody** – is protein made in response to an antigen in the body and bind to that antigen

**Blood transfusion** – transfer of blood from one individual into another individual

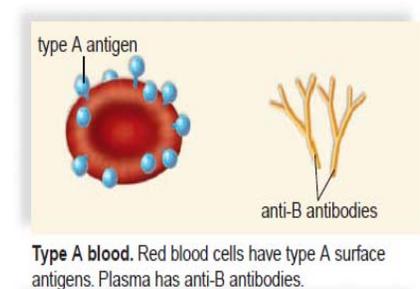
## ABO Blood Groups

### *What determines the A, B, AB or O blood type?*

➤ The plasma membrane of RBC has glycoproteins . That can be antigens to other individuals.

➤ ABO blood typing is based on the Presence and/or absence of 2 blood antigens, Type A and Type B

➤ Each blood type has antibodies; A and B Type of antibodies .



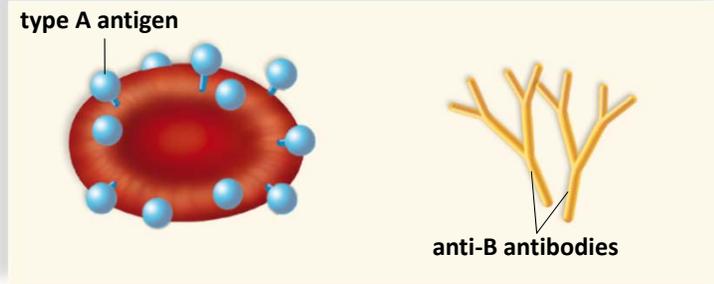
- Antibodies are only present for those antigens lacking on the red blood cells because these proteins recognize and bind the protein they are named after.
- Each blood type **has antibodies that correspond to the opposite blood type.**
- Thus, an individual with type A blood has anti-B antibodies in the plasma, and a person with type B blood has anti-A antibodies in the plasma.
- A person with type O blood has both antibodies in the plasma and someone with type AB blood lacks both antibodies.
- Anti-A and/or anti-B antibodies are not present at birth, but they appear over the course of several months.
- Each antibody has a **binding site** *that will* combine with its corresponding antigen in a tight **lock-and-key fit.**

## *How can you remember what each blood type means?*

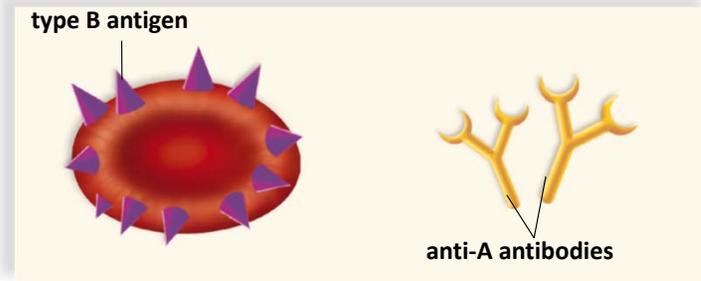
- Blood types are named after the protein antigens that are present on the surface of their RBC, except type O that entirely lacks A and B proteins.
- Blood types only have antibodies to antigens they do not have on the surface of their cells
- For example: Type A blood
  - Have A proteins on its surface
  - Have B antibodies
- What can you say about someone with type AB blood?

# Looking at each blood type in the ABO blood system

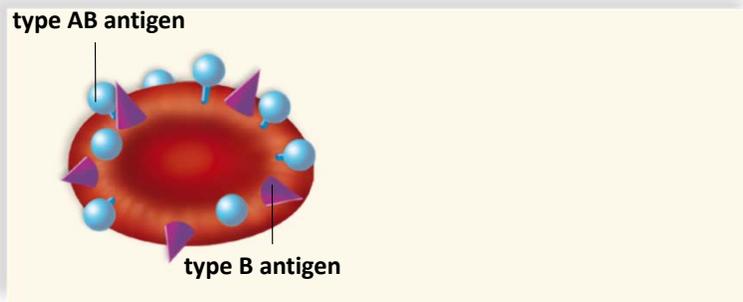
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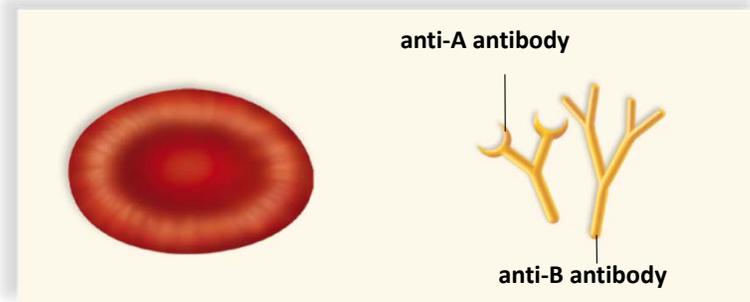
**Type A blood.** Red blood cells have type A surface antigens. Plasma has anti-B antibodies.



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



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

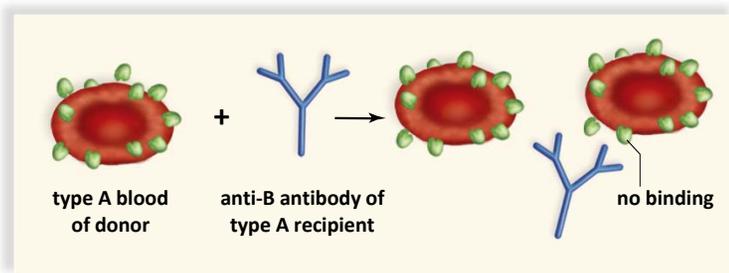


**Type O blood.** Red blood cells have neither type A nor type B surface antigens. Plasma has both anti-A and anti-B antibodies.

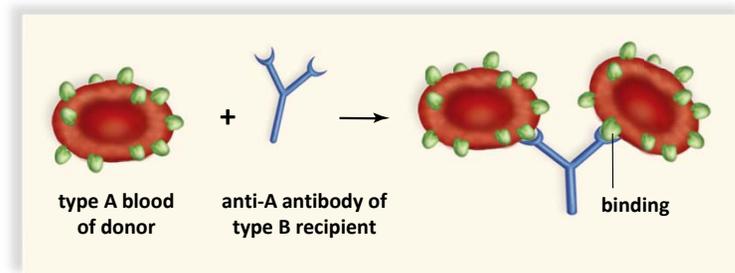
## Blood Compatibility

- First, consider the antigens found on the blood transfusion recipient.
- Second, consider the antibodies found in the donor blood.
- If the antibodies in the donor blood can recognize the antigen on the recipient's blood then the blood will agglutinate (clump) and cause rejection.

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a. No agglutination



b. Agglutination

# ABO System

## The ABO Blood System

| Blood Type (genotype)                       | Type A (AA, AO)   | Type B (BB, BO)   | Type AB (AB)   | Type O (OO)   |
|---|---|---|--|---|
| Red Blood Cell Surface Proteins (phenotype) | <br>A agglutinogens only | <br>B agglutinogens only | <br>A and B agglutinogens | <br>No agglutinogens    |
| Plasma Antibodies (phenotype)               | <br>b agglutinin only   | <br>a agglutinin only   | NONE.<br>No agglutinin   | <br>a and b agglutinin |

You can receive ...

|     | O- | O+ | B- | B+ | A- | A+ | AB- | AB+ |
|-----|----|----|----|----|----|----|-----|-----|
| AB+ |    |    |    |    |    |    |     |     |
| AB- |    |    |    |    |    |    |     |     |
| A+  |    |    |    |    |    |    |     |     |
| A-  |    |    |    |    |    |    |     |     |
| B+  |    |    |    |    |    |    |     |     |
| B-  |    |    |    |    |    |    |     |     |
| O+  |    |    |    |    |    |    |     |     |
| O-  |    |    |    |    |    |    |     |     |

If your blood type is ...

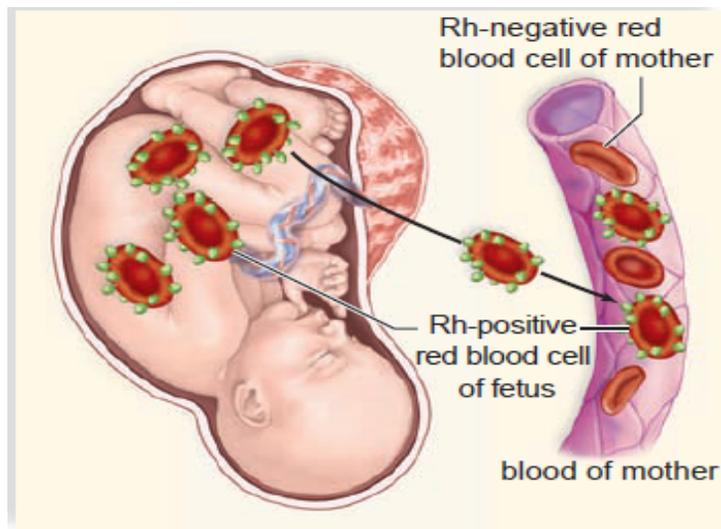
## Rh Blood Groups

- The Rh factor is often included (used) when expressing a blood type by naming it positive or negative.
- People with the Rh factor are positive and those without Rh are negative.
- Rh antibodies only develop in a person when they are exposed to the Rh factor from another's blood (usually a fetus).

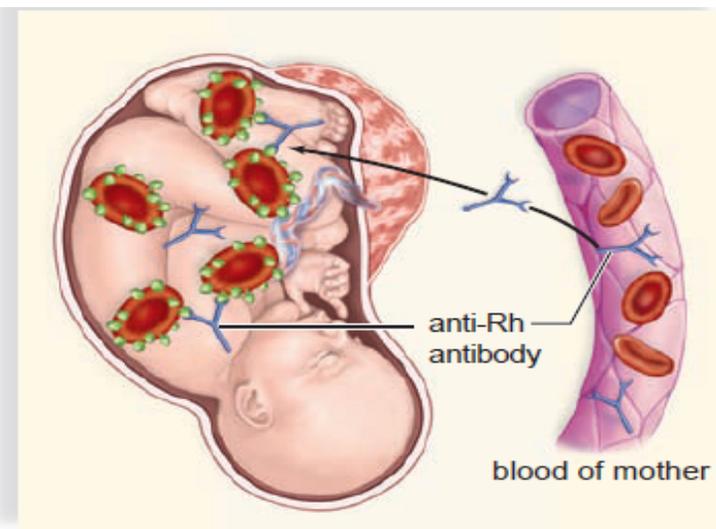
### When is the Rh factor important?

- During pregnancy under these conditions:
  - Mom: Rh<sup>-</sup>
  - Dad: Rh<sup>+</sup>
  - Fetus: Rh<sup>+</sup> (possible with the parents above)
- In this case above some Rh<sup>+</sup> blood can leak from the fetus to the mother during birth causing the mother to make Rh antibodies
- This can be a problem if the mother has a second fetus that is Rh<sup>+</sup> because she now has antibodies that can leak across the placenta and attack the fetus

- This condition is known as hemolytic disease of the newborn that can lead to retardation and even death. It starts in the womb and continues after the baby is born. Due to red blood cell destruction, the baby will be severely anemic. Excess hemoglobin breakdown products in the blood can lead to brain damage and mental retardation, or even death.



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.

## How can hemolytic disease of the newborn be prevented?

- Rh<sup>-</sup> women are given an injection of anti-Rh antibodies no later than 72 hours after birth to an Rh<sup>+</sup> baby.
- These anti-Rh antibodies that attack any of the baby's red blood cells in the mother's blood before these cells can stimulate her immune system to produce her own antibodies. This treatment is termed RhoGAM , and does not harm the newborn's red blood cells.
- Thus , these antibodies attack fetal red blood cells in the mother before the mother's immune system can make antibody.
- This will have to be repeated if an Rh<sup>-</sup> mother has another Rh<sup>+</sup> baby in case she has later pregnancies.