قسم الكيمياء الحيوية
Biochemistry Department
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BCH 471

Experiment (1)

ABO Blood Grouping & Rh Groups

OBJECTIVES

- To determine the blood group according to the ABO system.
- To test for the availability of the Rh factor (D antigen) on the surface of erythrocytes.

BLOOD GROUP SUBSTANCES

- 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 red blood cells
- Antigens are also found in a wide variety of tissues and biological fluids such as saliva, milk , seminal fluid, urine , and gastric juice.
- The antibodies are in the blood plasma to attack foreign antigens, resulting in clumping (agglutination)

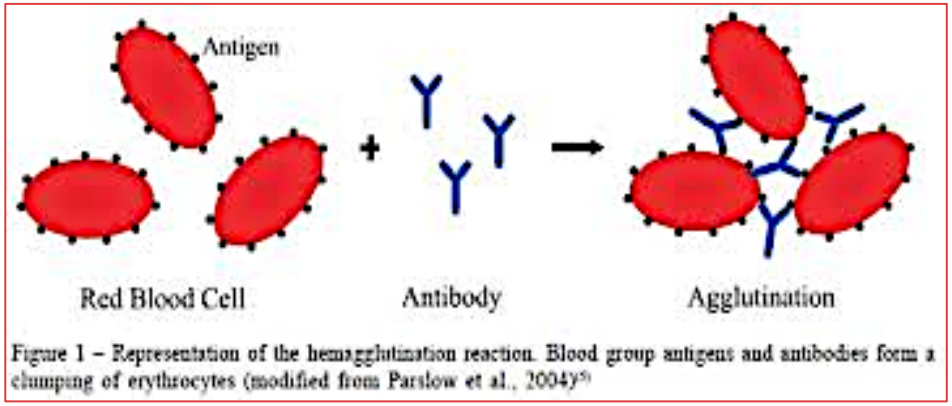
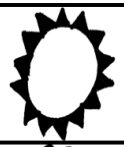
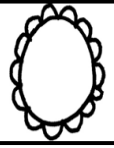
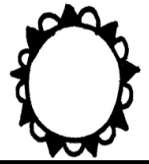


Figure 1 – Representation of the hemagglutination reaction. Blood group antigens and antibodies form a clumping of erythrocytes (modified from Parslow et al., 2004)[5]

ABO BLOOD TYPE SYSTEM

- The ABO blood type system is the major blood type classification system.
- The four blood types in the ABO system (A, B, AB, and O) refer to different versions of oligosaccharides which are present on the surface of RBCs.

People with:	Have:
Type A blood	Type A carbohydrate molecules on their red blood cells 
Type B blood	Type B carbohydrate molecules on their red blood cells 
Type AB blood	Both type A and type B carbohydrate molecules on their red blood cells 
Type O blood	Neither type A nor type B carbohydrate molecules on their red blood cells 

IMPORTANCE OF THE ABO SYSTEM

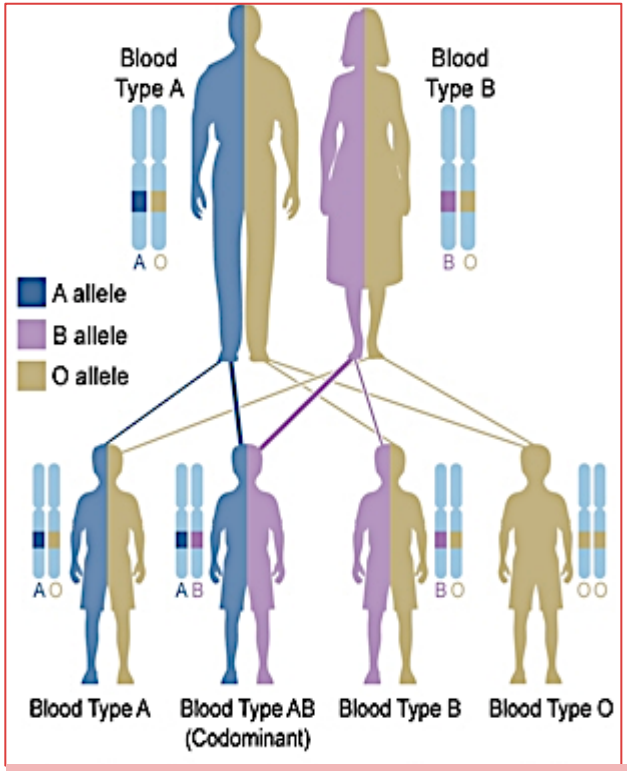
- Blood group antigens must be determined to secure a safe practice of blood transfusion.
- They are also useful in determining familial relationships in forensic medicine.

GENETICS OF BLOOD TYPES

- Your blood type is established before you are born, by specific GENES inherited from your parents.
  - You have two copies of this gene, one inherited from your MOTHER and the other inherited from your FATHER.

father \ mother	A	B	O
A	AA	AB	AO
B	BA	BB	BO
O	OA	OB	OO

alleles	blood type
A+A	= A
A+O	= A
A+B	= AB
B+B	= B
B+O	= B
O+O	= O



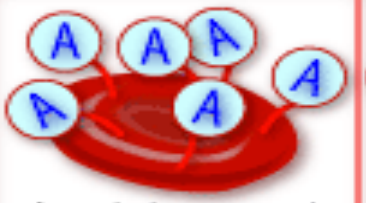
Codominance

is a condition in which the alleles of a gene pair in a heterozygote are fully expressed thereby resulting in offspring with a phenotype that is neither dominant nor recessive

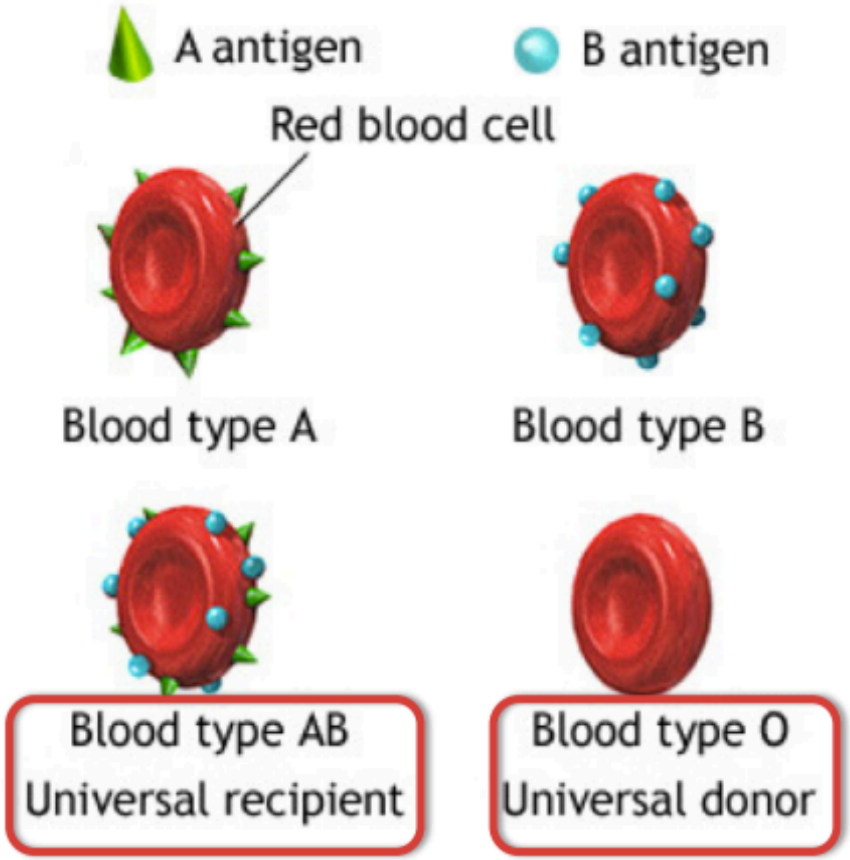
BLOOD TYPES

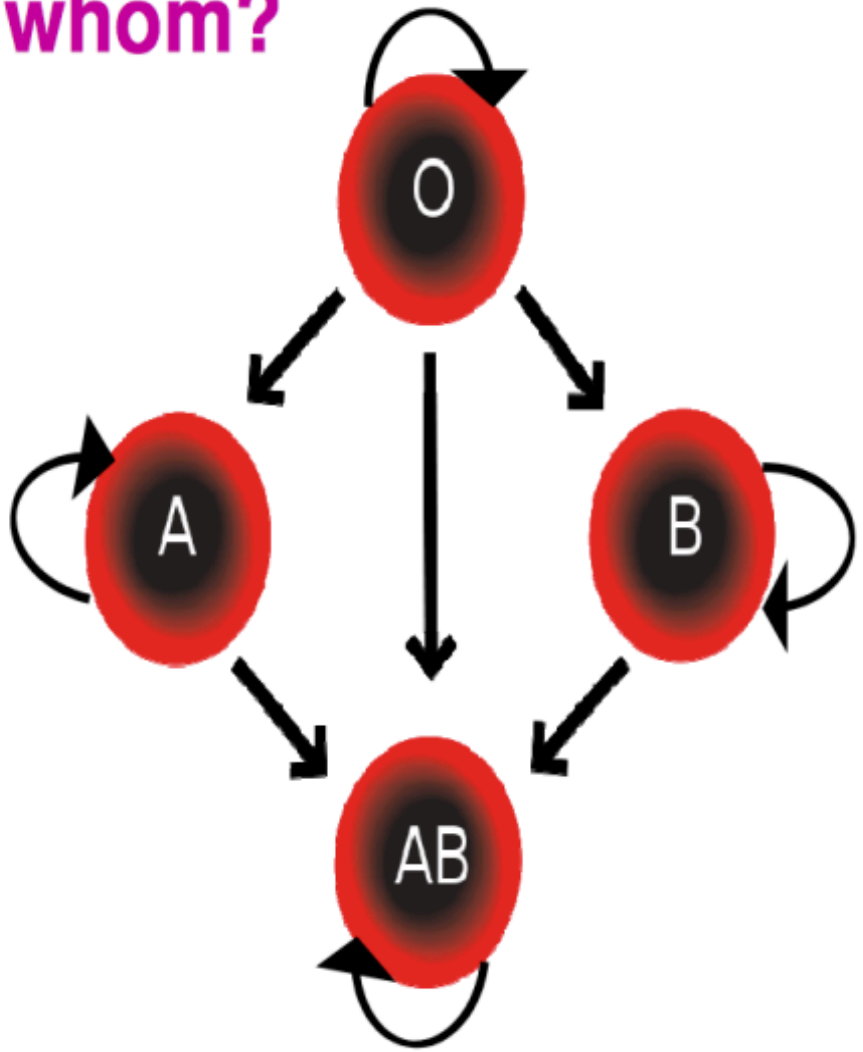
- There are 3 alleles or genes for blood type: A, B, & O.
- Since we have 2 genes, there are 6 possible combinations.

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)	 A agglutinogens only	 B agglutinogens only	 A and B agglutinogens	 No agglutinogens
Plasma Antibodies (phenotype)	 b agglutinin only	 a agglutinin only	NONE. No agglutinin	 a and b agglutinin

Blood transfusions – who can receive blood from whom?



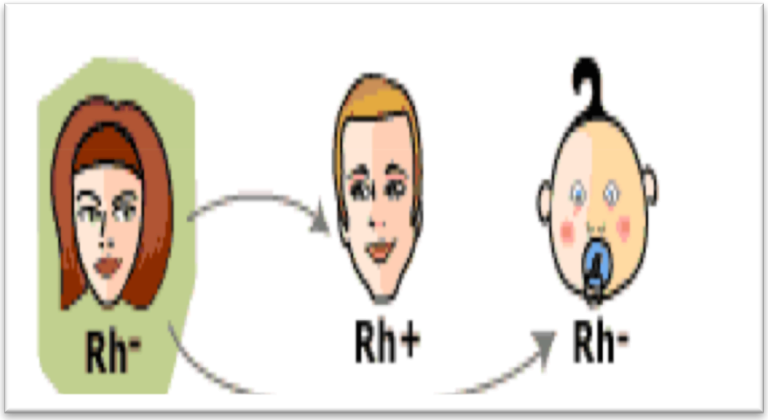


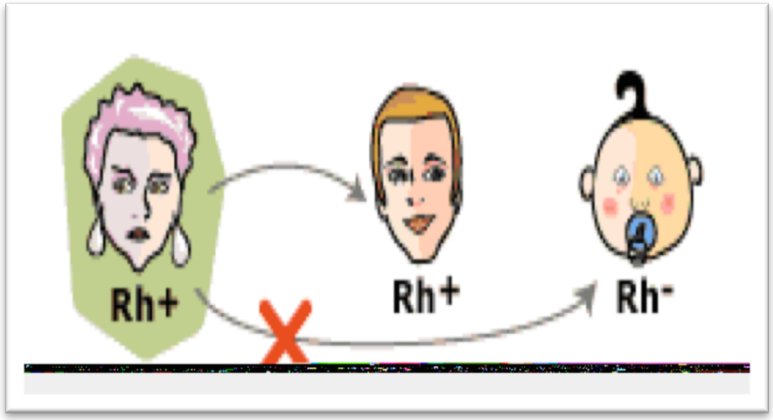
RHESUS BLOOD GROUP

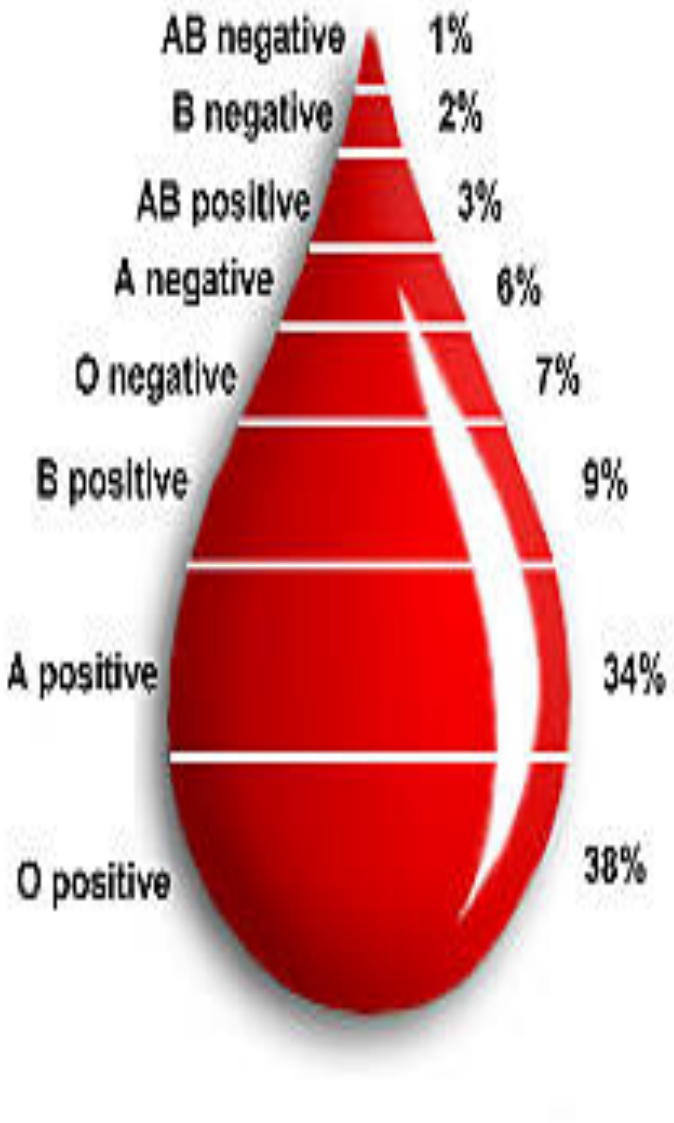
- First studied in rhesus monkeys.
- Is the second most significant blood group system in human transfusion.
- The D antigen (RhD) is the most important.
- If it is present on RBCs' surface, the blood is RhD positive (~80% of the population), if not it's RhD negative.
- So, for example, some people in group A will have it, and will therefore be classed as A+ (or A positive), while the ones that don't, are A- (or A negative) and so it goes for groups B, AB and O.

RH BLOOD GROUP

- A person with Rh+ blood can receive blood from a person with Rh- blood without any problems
- A person with Rh- blood can develop Rh antibodies in the blood plasma if he or she receives blood from a person with Rh+ blood, whose Rh antigens can trigger the production of Rh antibodies





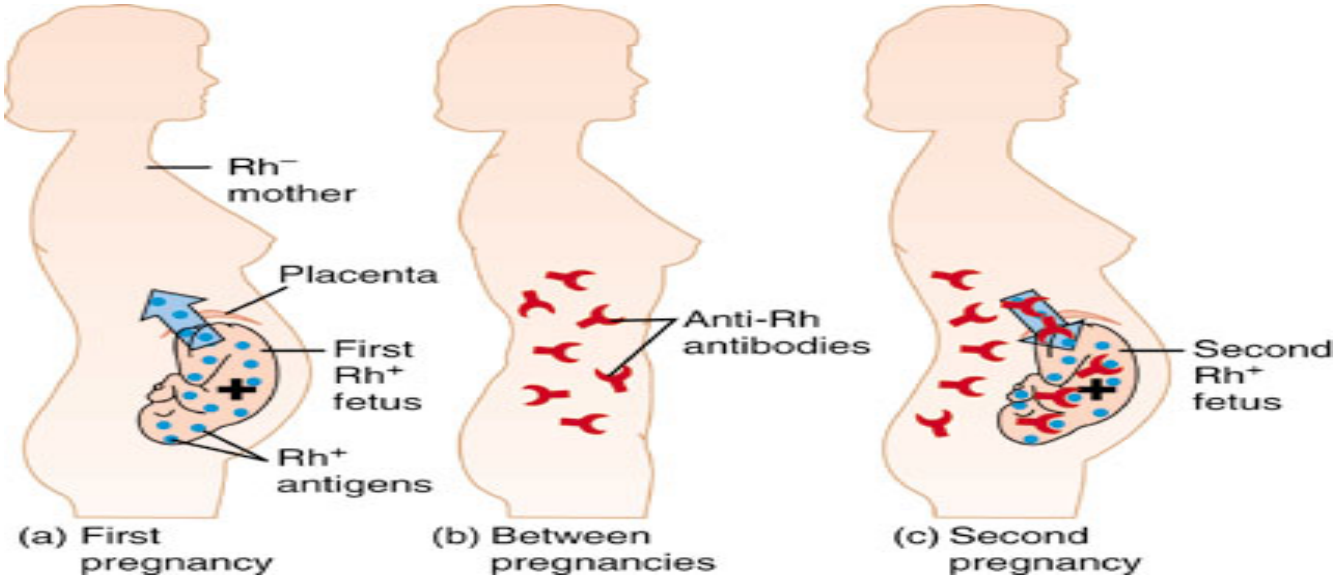


RED BLOOD CELL COMPATIBILITY TABLE

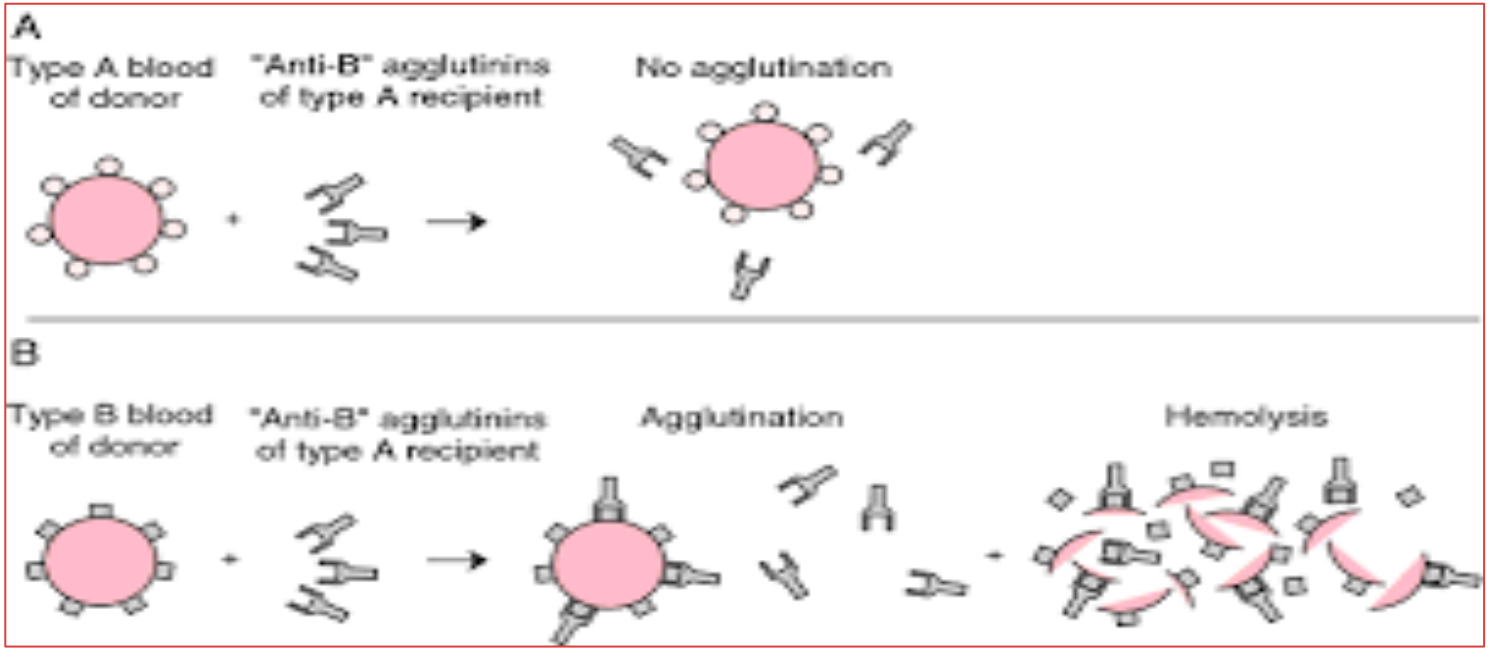
Recipient	Donor							
	O-	O+	A-	A+	B-	B+	AB-	AB+
O-	✓	✗	✗	✗	✗	✗	✗	✗
O+	✓	✓	✗	✗	✗	✗	✗	✗
A-	✓	✗	✓	✗	✗	✗	✗	✗
A+	✓	✓	✓	✓	✗	✗	✗	✗
B-	✓	✗	✗	✗	✓	✗	✗	✗
B+	✓	✓	✗	✗	✓	✓	✗	✗
AB-	✓	✗	✓	✗	✓	✗	✓	✗
AB+	✓	✓	✓	✓	✓	✓	✓	✓

HEMOLYTIC DISEASE OF THE NEWBORN (HDN)

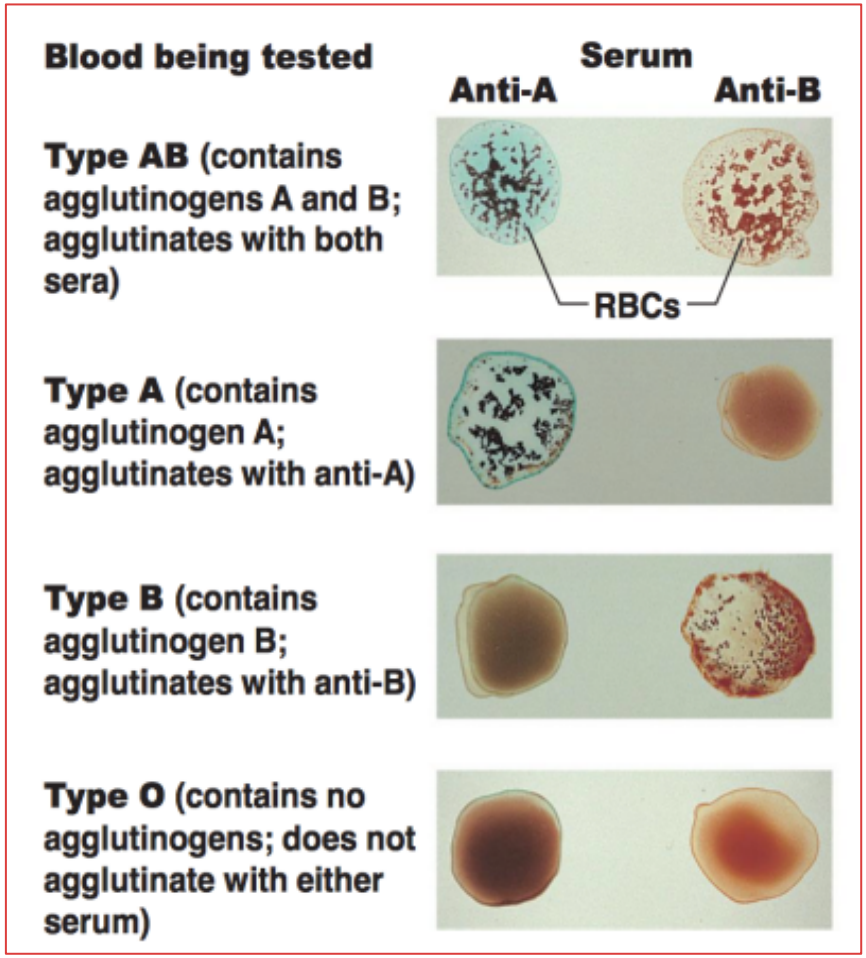
- Also called, Erythroblastosis Fetalis
- Mother is Blood type Rh-, Father and fetus are Rh+
- First pregnancy = sensitization at delivery due to hemorrhage
- Second pregnancy = Mother produce anti-Rh IgG antibodies that cross placenta to attack fetal RBCs leading to hemolysis

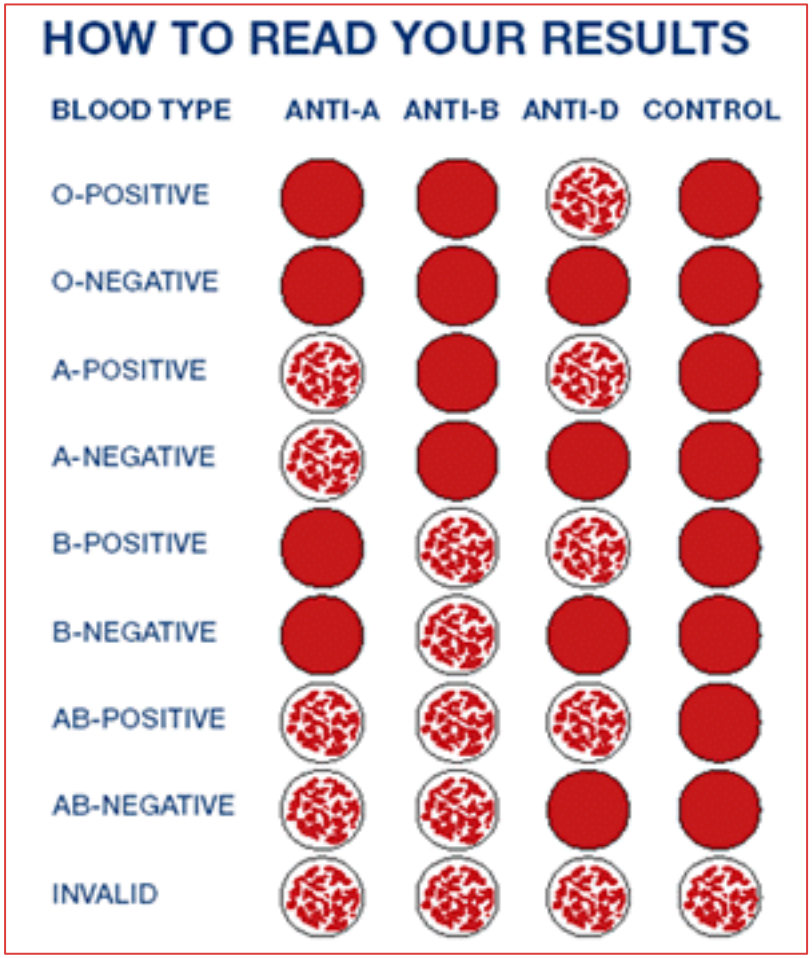


PRINCIPLE OF TEST



RESULTS


Blood being tested
Serum
Anti-A
Anti-B
Type AB (contains agglutinogens A and B; agglutinates with both sera)
RBCs
Type A (contains agglutinogen A; agglutinates with anti-A)
Type B (contains agglutinogen B; agglutinates with anti-B)
Type O (contains no agglutinogens; does not agglutinate with either serum)


HOW TO READ YOUR RESULTS
BLOOD TYPE
ANTI-A
ANTI-B
ANTI-D
CONTROL
O-POSITIVE
O-NEGATIVE
A-POSITIVE
A-NEGATIVE
B-POSITIVE
B-NEGATIVE
AB-POSITIVE
AB-NEGATIVE
INVALID