



Selected blood test lab

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Blood typing

- **blood type = blood group**
- is a classification of blood based on the presence or absence of inherited antigenic substances on the surface of red blood cells (RBCs).
- These **antigens** may be :
 - proteins,
 - carbohydrates,
 - glycoproteins,
 - or glycolipids,
- depending on the blood group system, and some of these antigens are also present on the surface of other types of cells of various tissues.

- Several of these red blood cell surface antigens, that stem from one allele (or very closely linked genes), collectively form a **blood group system**.
- Blood types are inherited and represent contributions from both parents. A total of 30 human blood group systems are now recognized by the International Society of Blood Transfusion (ISBT).
- Many pregnant women carry a fetus with a different blood type from their own, and the mother can form antibodies against fetal RBCs.
- Sometimes these maternal antibodies are IgG, a small immunoglobulin, which can cross the placenta and cause hemolysis of fetal RBCs, which in turn can lead to hemolytic disease of the newborn, an illness of low fetal blood counts which ranges from mild to severe

ABO BLOOD GROUPS

Blood Group	Antigens on RBCs	Antibodies in Serum	Genotypes
A	A	Anti-B	<i>AA or AO</i>
B	B	Anti-A	<i>BB or BO</i>
AB	A and B	Neither	<i>AB</i>
O	Neither	Anti-A and Anti-B	<i>OO</i>

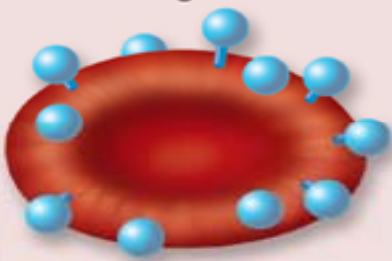
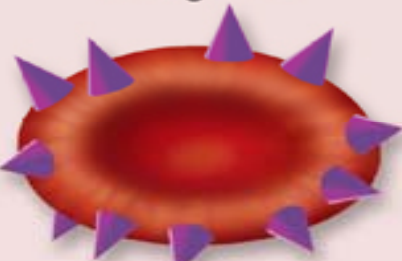
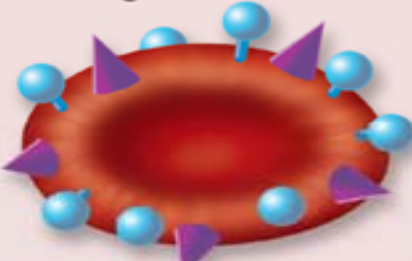




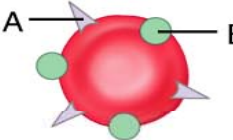
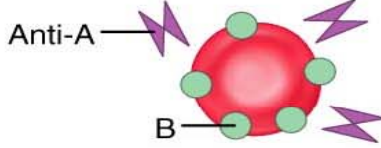
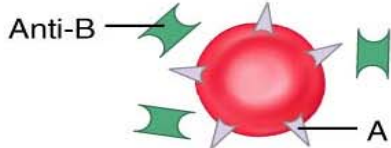
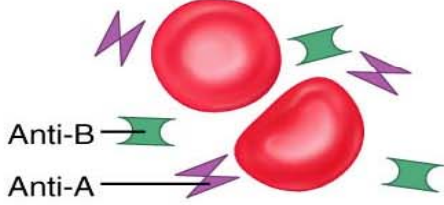
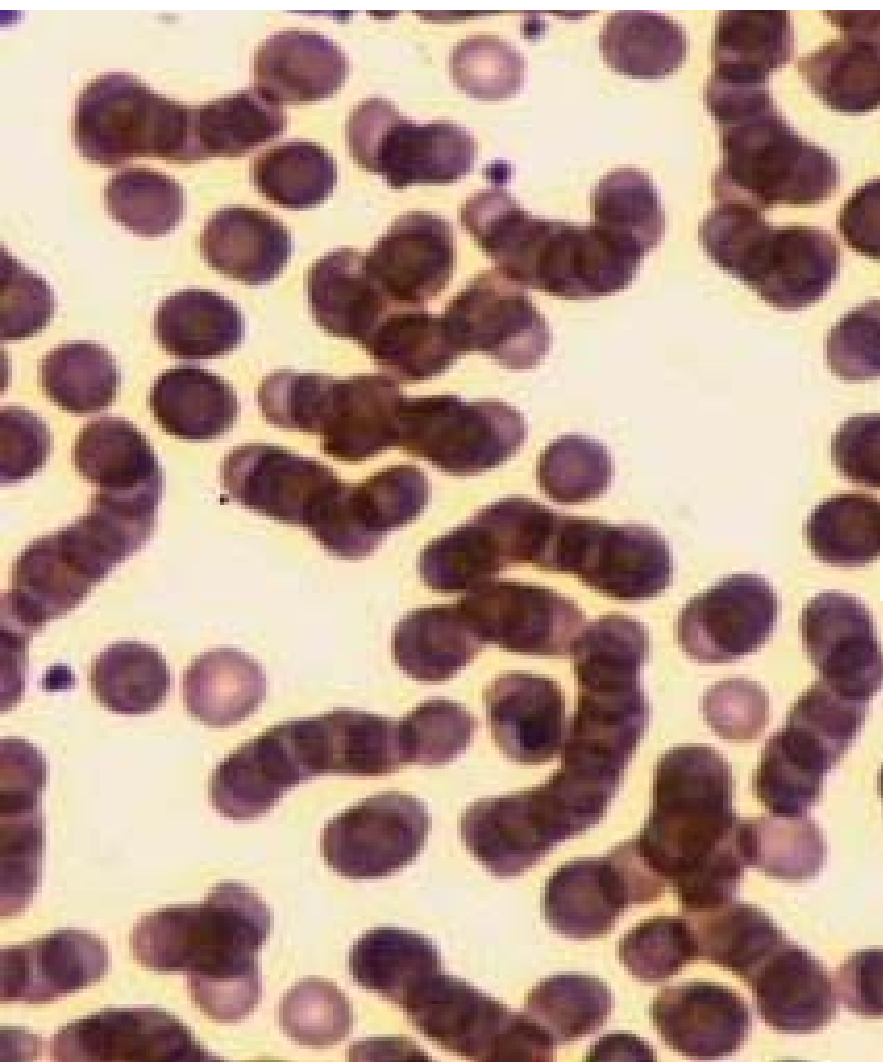
Erythrocytes	Antigen A 	Antigen B 	Antigens A and B 	Neither antigen A nor B 
Plasma	Anti-B antibodies 	Anti-A antibodies 	Neither anti-A nor anti-B antibodies	Both anti-A and anti-B antibodies 
Blood type	Type A Erythrocytes with type A surface antigens and plasma with anti-B antibodies	Type B Erythrocytes with type B surface antigens and plasma with anti-A antibodies	Type AB Erythrocytes with both type A and type B surface antigens, and plasma with neither anti-A nor anti-B antibodies	Type O Erythrocytes with neither type A nor type B surface antigens, but plasma with both anti-A and anti-B antibodies

TABLE 17.4 ABO Blood Groups

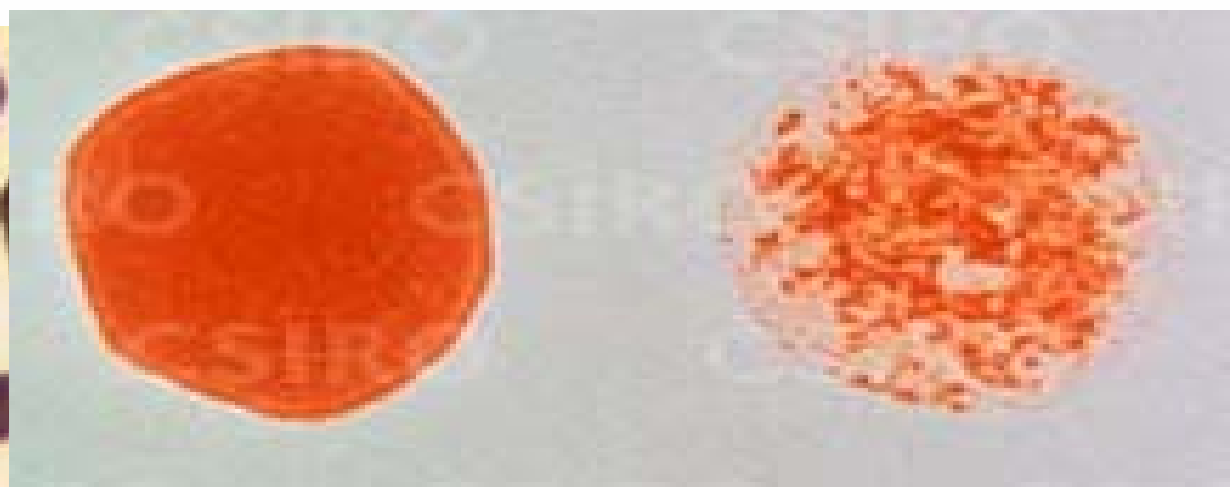
BLOOD GROUP	FREQUENCY (% U.S. POPULATION)				RBC ANTIGENS (AGGLUTINOGENS)	ILLUSTRATION	PLASMA ANTIBODIES (AGGLUTININS)	BLOOD THAT CAN BE RECEIVED
	WHITE	BLACK	ASIAN	NATIVE AMERICAN				
AB	4	4	5	<1	A B		None	A, B, AB, O (Universal recipient)
B	11	20	27	4	B		Anti-A (a)	B, O
A	40	27	28	16	A		Anti-B (b)	A, O
O	45	49	40	79	None		Anti-A (a) Anti-B (b)	O (Universal donor)



Actual blood sample taken during a demonstration showing red blood cells glued together lacking oxygen.

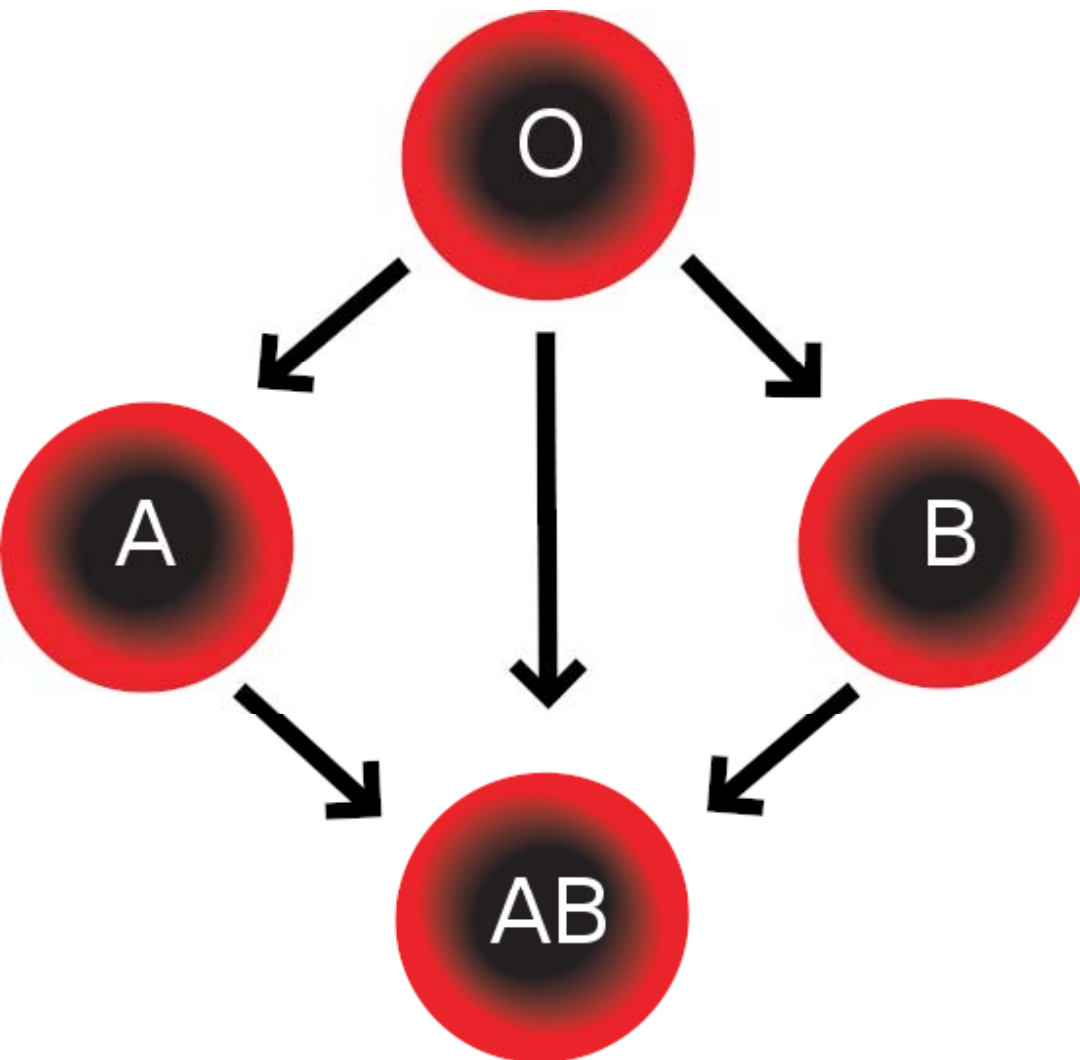


The same blood cells 30 minutes after the person drank x2o treated water showing blood cells floating free & full of oxygen



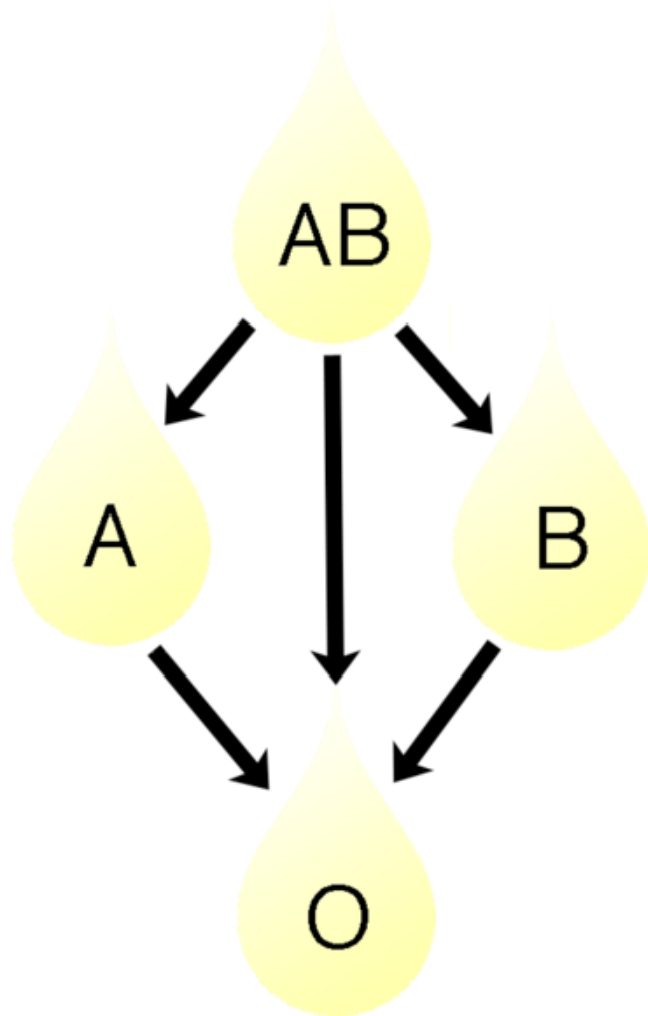
Blood groups

A	A antigen on RBC surface and B antibody in plasma.	Rh+ blood transfusions into an Rh- individual can result in massive IgG production.
B	B antigen on RBC surface and A antibody in plasma.	
AB	A and B antigens on RBC surface; no antibodies in plasma; “universal recipient.”	Incompatible blood transfusions can cause immunologic response, hemolysis, renal failure, shock, and death.
O	Neither A nor B antigen on RBC surface; both antibodies in plasma; “universal donor.”	



RBC Compatibility chart

In addition to donating to the same blood group; type O blood donors can give to A, B and AB; blood donors of types A and B can give to AB.



















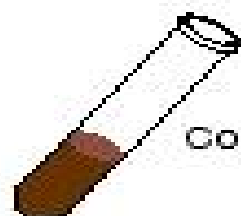
Plasma compatibility chart

In addition to donating to the same blood group; plasma from type AB can be given to A, B and O; plasma from types A and B can be given to O.

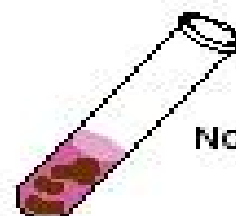


		Father's Blood Type				
		A	B	AB	O	
Mother's Blood Type	A	A or O	A, B, AB, or O	A, B, or AB	A or O	Child's Blood Type
	B	A, B, AB, or O	B or O	A, B, or AB	B or O	
	AB	A, B, or AB	A, B, or AB	A, B, or AB	A or B	
	O	A or O	B or O	A or B	O	

Recipient's blood			Reactions with donor's red blood cells			
ABO antigens	ABO antibodies	ABO blood type	Donor type O cells	Donor type A cells	Donor type B cells	Donor type AB cells
None	Anti-A Anti-B	O				
A	Anti-B	A				
B	Anti-A	B				
A & B	None	AB				



Compatible



Not compatible



Blood Types

	O	AB	B	A
Typing Serum A				
B				

•**BLOOD FACTS:**

A person with type O blood can donate to anyone (**universal donor**), but can receive blood from a person with type O blood only.

- A person with type AB blood can receive blood from anyone (**universal recipient**), but can donate blood only for others who have type AB blood.
- A person with type A blood can donate blood for people with type A or type AB blood. A person with type A blood can receive blood from a person with type A or type O.
- A person with type B blood can receive blood from a person with type B or type O. A person with type B blood can donate blood for persons with either type B or type AB blood.
- Actually, blood banking is more complicated than this simple description, with test run for other minor compatibility antigens (like the MN antigen system) before transfusions are given.

Human Blood Groups

- RBC membranes have glycoprotein antigens on their external surfaces
- These antigens are:
 - Unique to the individual
 - Recognized as foreign if transfused into another individual
 - Promoters of agglutination and are referred to as agglutinogens
- Presence or absence of these antigens is used to classify blood groups

Blood Groups

- Humans have 30 to 50 varieties of naturally occurring RBC antigens
- The antigens of the **ABO and Rh** blood groups cause vigorous transfusion reactions when they are improperly transfused
- Other blood groups (**M, N, Dufy, Kell, and Lewis**) are mainly used for legalities

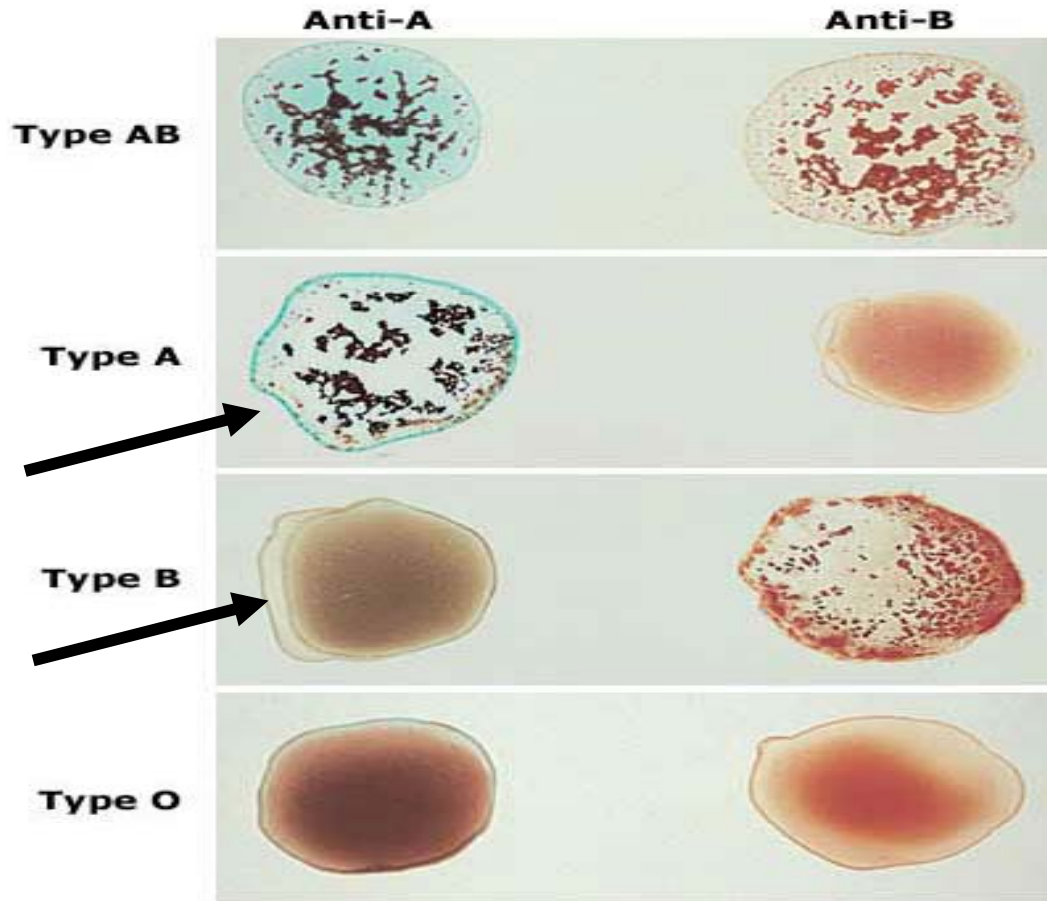
ABO Blood Groups

- The ABO blood groups consists of:
 - **Two antigens (A and B) on the surface of the RBCs**
 - **Two antibodies in the plasma (anti-A and anti-B)**
- ABO blood groups may have various types of antigens and preformed antibodies
- Agglutinogens and their corresponding antibodies cannot be mixed without serious hemolytic reactions

Multiple alleles

ABO blood groups

Type A blood
transfused into
Type B person
Type B blood
transfused into
Type B person -
OK



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A medical
problem -
some blood
transfusions
produce lethal
clumping of
cells.

Don't worry
about details
yet...

Rh TYPING: INTRODUCTION

- **It is the second most important typing of blood.**
- **These blood groups were originally discovered in Rhesus monkeys**
- **Rh is another type of agglutinin.**
- **It is also present on the outer surface of the erythrocytes.**

Rhesus [Rh] Blood Groups

- There are eight different Rh agglutinogens, three of which (C, D, and E) are common
- Presence of the Rh agglutinogens on RBCs is indicated as Rh⁺
- Anti-Rh antibodies are not spontaneously formed in Rh⁻ individuals
- However, if an Rh⁻ individual receives Rh⁺ blood, anti-Rh antibodies form
- A second exposure to Rh⁺ blood will result in a typical transfusion reaction



Rh or D Agglutinins

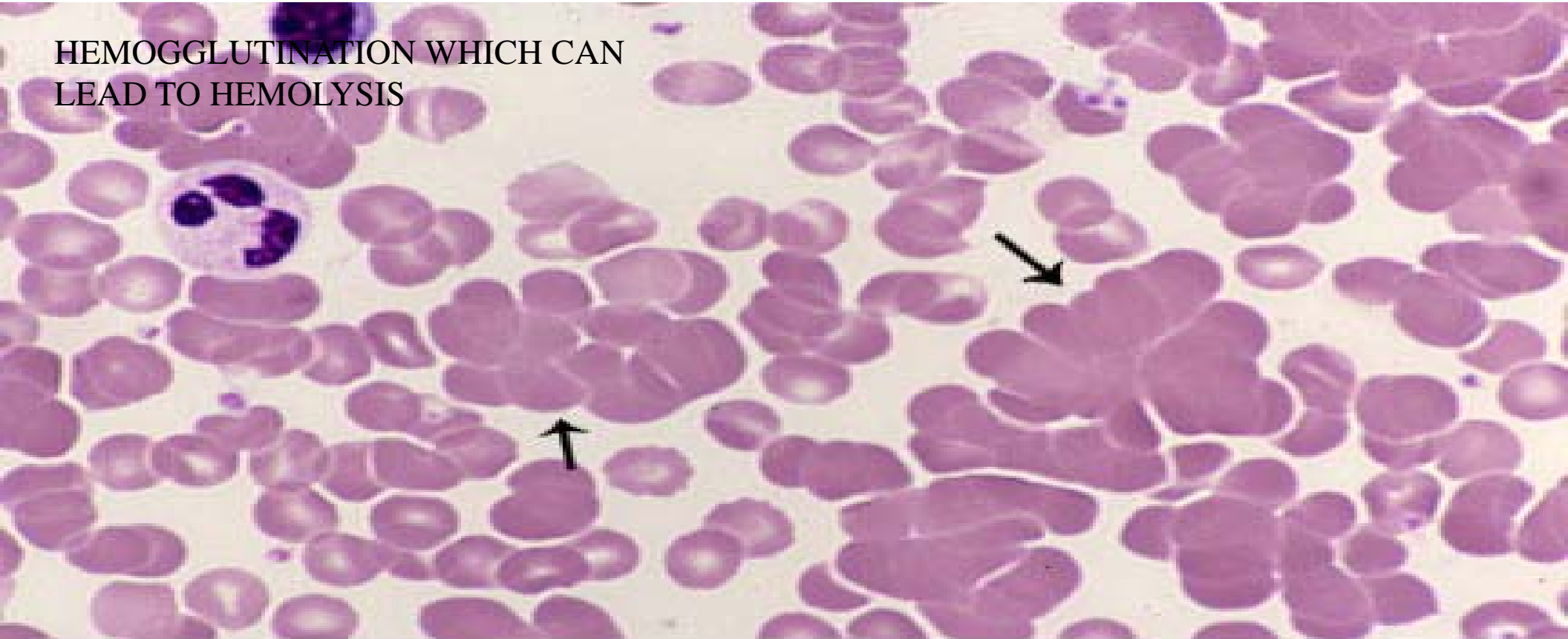
- Anti-D agglutinins or antibodies do not occur naturally.
- They are produced by the Immune systems as and when it is exposed to the D antigens.
- So these Anti D agglutinins are found only in some of the Rh Negative people.
- Those who have been exposed to the Rh or D antigen



AGGLUTININS

- The antibodies to the agglutinogens are called Agglutinins.
- These are present naturally in ABO groups.
- They are always present in the plasma of the individual.
- There are two types of agglutinins in the ABO blood system:
 - Anti A or α : Alpha
 - Anti B or β : Beta
- **The A group people have the Beta or anti B agglutinin in their plasma.**
- **Similarly the B group people have the Alpha or Anti-A agglutinin in their plasma.**
- **The AB group of people have no agglutinins in their plasma.**
- **The O group people have both Alpha and Beta types of agglutinins in their plasma**

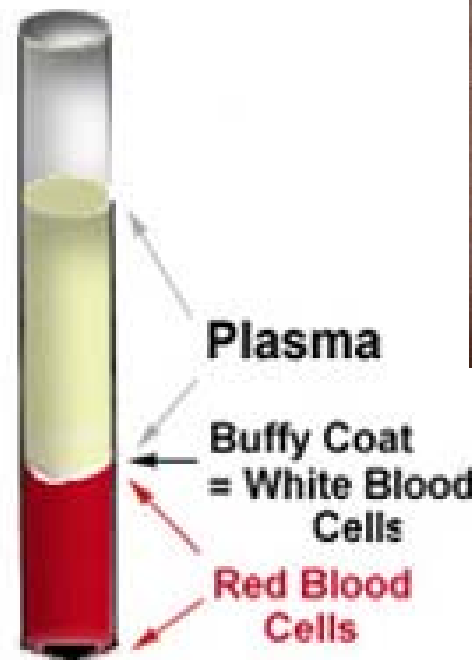
HEMOGGLUTINATION WHICH CAN
LEAD TO HEMOLYSIS



Source: Lichtman MA, Shafer MS, Felgar RE, Wang N:
Lichtman's Atlas of Hematology: <http://www.accessmedicine.com>
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$$\text{HEMATOCRIT} = \frac{\text{PACKED RBC HEIGHT}}{\text{TOTAL SAMPLE HEIGHT}} \times 100$$

- The hematocrit (Ht or HCT) or packed cell volume (PCV) or erythrocyte volume fraction (EVF) is the proportion of blood volume that is occupied by red blood cells.
- It is normally about 47% for men and 42% for women.
- It is considered an integral part of a person's complete blood count results, along with hemoglobin concentration, white blood cell count, and platelet count.

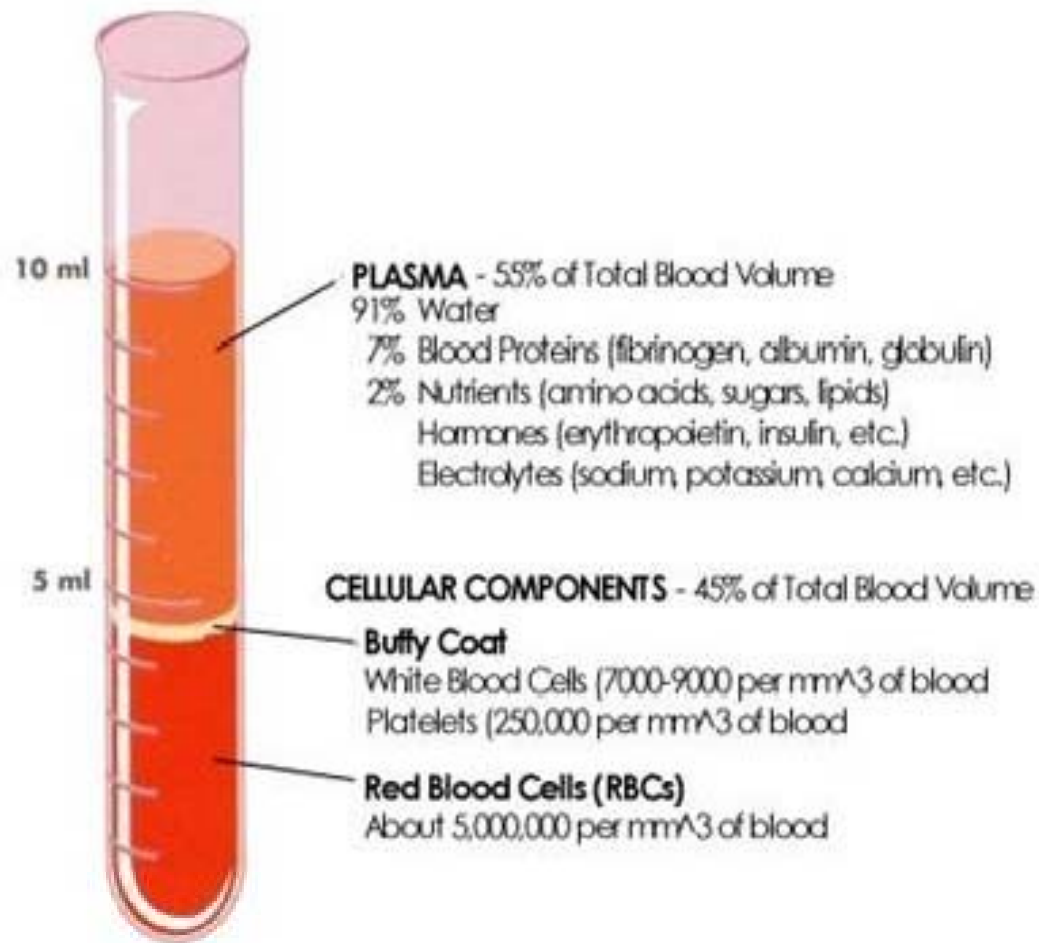


CRITOCAPS CARD

The diagram shows a CritoCaps Card with four wells at the top, each containing a colored disc: Anti-A (green), Anti-B (purple), Anti-D/anti-Rh (yellow), and Control (light blue). Below the wells are two main sections for data entry. The left section has fields for 'Name - Surname', 'Date - Positive or Negative', and 'ABO'. The right section has fields for 'Address - Direction', 'Date', and 'Signature - Print'.

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				



The **buffy coat** is the fraction of an anticoagulated blood sample after density gradient centrifugation that contains most of the **white blood cells and platelets**.





- Diagnostic Uses of the Buffy Coat
- **Quantitative Buffy Coat (QBC) is a laboratory test to detect infection with malaria or other blood parasites:** the blood is taken in a QBC capillary tube which is coated with acridine orange (a fluorescent dye) and centrifuged; the fluorescing parasites can then be observed under ultraviolet light at the interface between red blood cells and buffy coat. This test is more sensitive than the conventional thick smear and in >90% of cases, the species of parasite can also be identified.
- In cases of extremely low white blood cell count, it may be difficult to perform a manual differential of the various types of white cells, and it may be virtually impossible to obtain an automated differential. In such cases the medical technologist may obtain a buffy coat, from which a blood smear is made. This smear contains a much higher number of white blood cells than whole blood.