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ABO Simulated Blood Typing Kit

Student Laboratory Kit

Introduction

A blood transfusion with blood of a mismatched blood type usually has serious consequences for the recipient of the blood. Today, complete blood analysis is done with sophisticated, costly equipment before transfusions are done. The basic principles of blood typing will be illustrated in this activity using simulated ABO and Rh blood typing sera and simulated bloods.

Concepts

- Antigens
- Antibodies
- Multiple Alleles
- Codominance

Background

General

Early attempts to transfer blood from one person to another produced varied results. Sometimes it seemed to help the recipient and other times it produced very serious consequences. Eventually, it was discovered that each individual has a unique combination of substances in his or her blood. Some of these substances may be compatible with another person's blood and some may not be compatible. These findings led to the discovery and development of procedures to type an individuals' blood. It is now known that safe transfusions of blood depend upon properly matching the blood types of the donors and the recipients.

Genetics of Blood Types

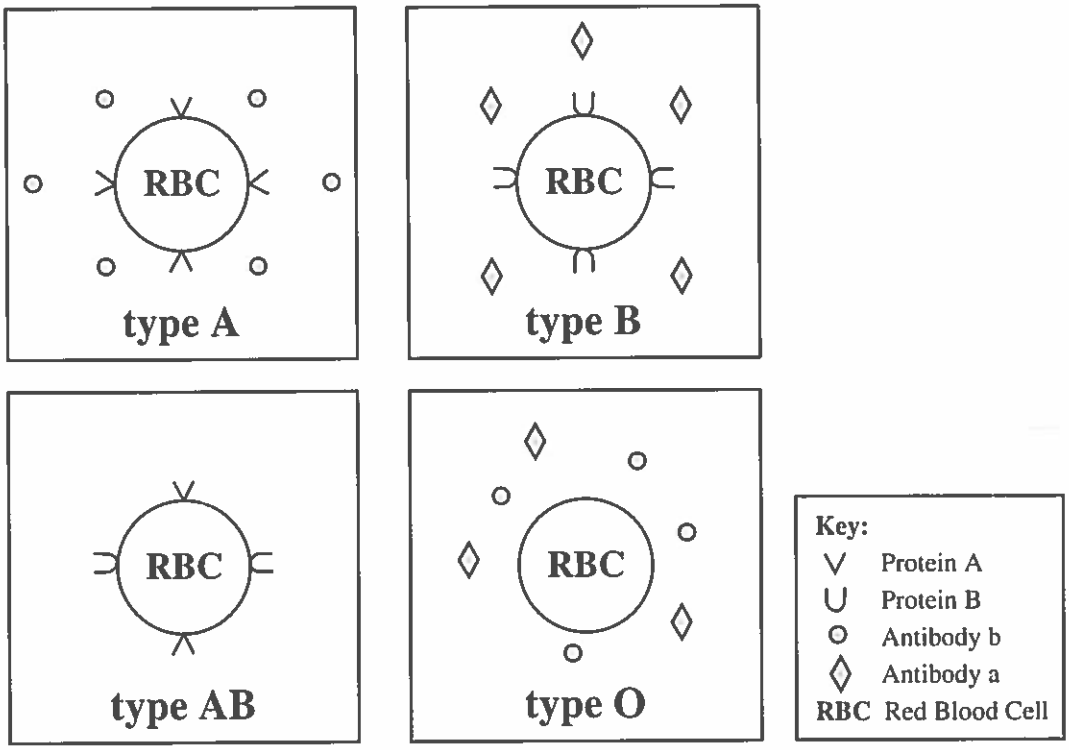
ABO blood type is determined by the presence or absence of specific proteins on an individual's red blood cells. A basic genetic principle is that an individual's inherited genes determines which proteins are produced in the individual's body. In the ABO blood typing system (just one of many blood factors) the blood proteins (antigens) are called the A and B proteins. The presence or absence of the A and B proteins on the red blood cells determines the individual's blood type in the ABO typing system. Individuals whose red blood cells contain protein A and lack protein B have type A blood. Those with protein B and lack protein A are called type B. Individuals with both protein A and protein B are called type AB and individuals with neither of the proteins is called type O.

ABO blood type is a genetic example of multiple alleles. There are three alleles in the gene pool for ABO blood type, i.e., I^A, I^B, and i. I^A codes for protein A, I^B codes for protein B and i codes for neither protein A nor protein B. Within this multiple allele pool the gene interactions illustrate both simple dominance as well as codominance. (Remember each individual has only two alleles for each trait even if there are multiple alleles in the gene pool.) When the I^Ai allele combination occurs, the individual is blood type A. When the I^AI^B combination occurs, the I^A and I^B alleles are codominant and the individual is blood type AB. The chart below illustrates the allele combinations, resulting blood type, proteins on the red blood cells, and antibodies in the blood for the four blood types in the ABO system.

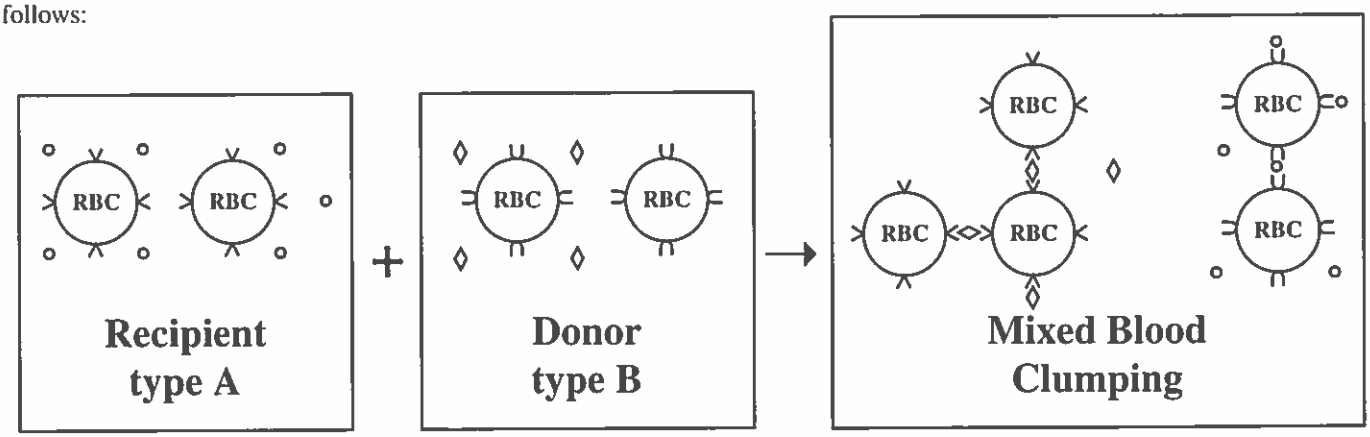
Phenotype	Genotype	Protein on RBC (antigen)	Antibodies in blood plasma
type A	IAIA or IAi	A	b
type B	IBIB or IBi	B	a
type AB	IAIB	A and B	—
type O	ii	—	a and b

Blood Transfusions

Blood groups are critically important with respect to transfusions. If someone with type A is given a transfusion of type B blood the two bloods will interact, clump and clog arteries which will have serious consequences to the individual. The clumping reaction is caused by the interaction of the proteins on the red blood cells and the antibodies present in the blood plasma. Antibodies are produced by the body in reaction to foreign proteins and are important in protecting the body against disease. Antibodies cannot distinguish a disease protein from protein on red blood cells. Individuals do not produce antibodies for proteins of their own red blood cells, but do produce antibodies for foreign proteins. Thus, a person with type A blood (A protein on surface of red blood cells) does not produce a antibodies. This person does produce b antibodies. If given the transfusion of type B blood, the antigens and antibodies of the mismatched blood will react and clump (a natural defense mechanism for foreign proteins). The illustrations below, in a very oversimplified way, illustrate the makeup of each of the four blood types.



Using the same illustration scheme, a transfusion of type B blood into an individual with type A blood might be illustrated as follows:



Similarly, a person with type B blood must not be given a transfusion with type A blood.

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Because type AB blood lacks both a and b antibodies, it would appear that an AB person could receive a transfusion of blood from any other type. For this reason, type AB persons are sometimes call *universal recipients.* It should be noted, however, that type A (b), type B (a) and type O (a and b) blood still contain antibodies (either a or b) that could cause clumping of type AB cells. Consequently, even for AB individuals, it is always best to use donor blood of exactly the same type as the recipient blood. If the matching type is not available and type A, B or O is used, it should be transfused very slowly so that the donor blood is well diluted by the recipient's larger blood volume.

Similarly, because type O blood lacks antigens A and B, it would seem that this blood type could be transfused into persons with blood of any other type. For this reason, persons with type O blood are often referred to as *universal donors*. Type O blood, however, does contain both anti-a and anti-b antibodies, and thus, if it is transfused into a person of a different blood type it should be done slowly to minimize large clumping reactions.

The bottom line for transfusion is that blood types should be matched for transfusions.

Blood Typing

ABO blood typing is based upon the clumping phenomena of bloods of mixed types. Blood sera antibodies can be isolated from other components of the blood and then used as blood typing sera. Antibodies-b (called Anti-a sera), for example, would clump red blood cells containing A-antigens (type A). Anti-b sera would clump type B blood. Clumping will occur in both sera with type AB blood and in neither sera with type O blood.

In the ABO blood typing procedure, drops of blood are first secured following sterile procedures. A drop of blood is placed in a drop of anti-a sera and another drop is placed in a drop of anti-b sera. The drops are then observed for clumping. The pattern of clumping or non-clumping is interpreted and the blood type determined. The following patterns occur for the various blood types:

Blood Type	Anti-a Sera	Anti-b Sera
A	clumping	no clumping
B	no clumping	clumping
AB	clumping	clumping
O	no clumping	no clumping

Materials (for each lab group)

Marking pen
Microscope slides, 3
Toothpicks, 3
Simulated Anti-A Sera, 6–9 drops
Simulated Anti-B Sera, 6–9 drops

Unknown Blood Samples:
Person W, 4–6 drops
Person X, 4–6 drops
Person Y, 4–6 drops

Safety Precautions

Wear chemical splash goggles, chemical-resistant gloves, and a chemical-resistant apron. Wash hands thoroughly with soap and water before leaving the laboratory.

Procedure

1. Label three microscope slides—"W," "X," and "Y."
2. Place 2 drops of Person W blood on each end of the slide marked "W." Similarly place 2 drops of "X" blood on slide "X," and "Y" blood on slide "Y."
3. Add 2 drops of Anti-A Sera to the blood on the left side of each slide. Similarly, add Anti-B Sera to the right side of each slide.
4. Stir the mixture in all six locations. Use a different clean toothpick for each location. Use only one toothpick per spot to avoid cross contamination. Mix each thoroughly and let the slides set for at least two minutes.
5. Observe each spot against a white background (paper) and record the results on the ABO Blood Typing Worksheet.
6. Study the results and answer the questions on the ABO Blood Typing Worksheet.
7. Dispose of all materials as directed by your instructor.

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Name: _____

ABO Simulated Blood Typing Worksheet

	Anti-A Sera	Anti-B Sera	Blood Type
Person W			
Person X			
Person Y			

Answer the following questions

1. What is Person X's blood type? What antigens are present on the surface of the red blood cells in Person X?

2. What is Person Y's blood type? What antibodies are present in Person Y's plasma?

3. Could a man with type AB blood be the father of a child with type O blood? Explain.

4. Could a child with type B blood with a mother of type A blood have a father with type A blood? Explain.

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