Why Opposites Attract: Blood Agglutination
Teacher Page (3B)

Activity Overview

CAST YOUR NET: ADVENTURES WITH BLOOD

Activity Objectives:

Using antigen models, students will be able to:

- Examine the ABO antigens found on red blood cells and the antibodies that are present in the bloodstream
- Identify the cause of agglutination as well as the reason why some blood types are able to be mixed
- Explain reasons for the process of agglutination

Activity Description:

In this activity, students will examine how antigens on the surface of red blood cells determine the ABO* blood types. Using templates provided in the activity, students will construct models of the antibodies present in A, B, AB, and O blood types. Using the ABO blood antigen models created in "Hey, What's Your Type?" and the antibody models from this activity, students will demonstrate the process of ***agglutination*** to enhance their understanding of antibody-antigen reactions.

Activity Background:

Have you ever heard the phrase "Opposites Attract"? Well, for certain blood antigens and antibodies it's true. This reaction was first discovered by Karl Landsteiner, shortly after he identified the ABO blood groups in 1901. Landsteiner found that humans possess ***immunity*** to blood antigens differing from their own type. This immunity is caused by the presence of antibodies in the bloodstream.

Antibodies are protein molecules that are triggered the presence of by ***antigens***. Antigens are molecules recognized by the immune system as foreign to the body causing an immune response. Antibodies to ABO antigens are produced when we are babies in response to environmental factors such as bacteria and fungi. It is important to note that we only make antibodies to the ABO antigens we **do not possess** on our red blood cells. Antibodies are found in the ***plasma*** of our blood rather than on red blood cells. Antibodies have very specific ***shapes*** and must be designed to fit antigens exactly. The best way to think of an antigen/antibody pair is to imagine two jigsaw puzzle pieces fitting together or a key fitting into its lock, see ***Figure 1 Antigens and Antibodies***.

* "ABO" describes one of many blood groups in our body

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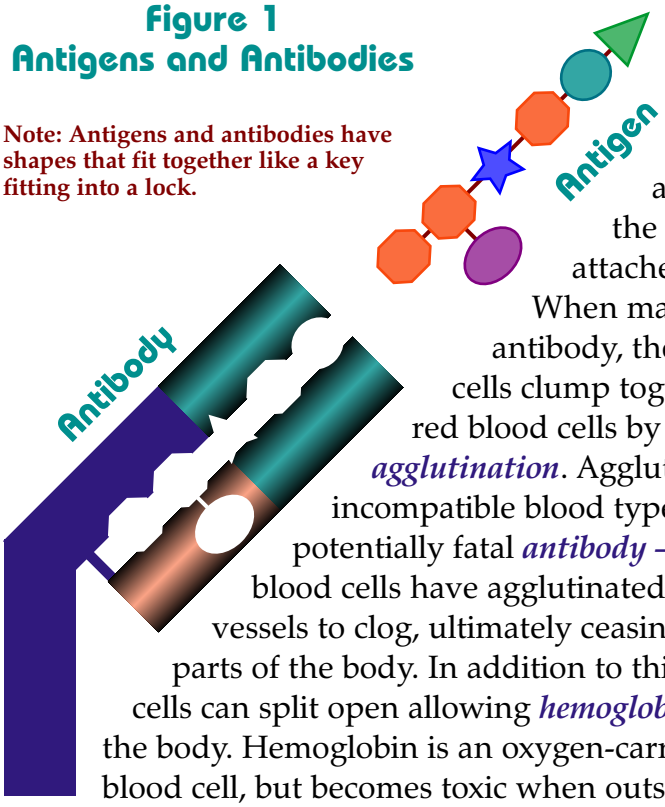
ACTIVITY 3B

Figure 1
Antigens and Antibodies

Note: Antigens and antibodies have shapes that fit together like a key fitting into a lock.



Once an antibody recognizes its ABO antigen, it will bind to the antigen, bringing any attached red blood cell with it. When many antigens bind to the antibody, the attached red blood cells clump together. This clumping of red blood cells by antibodies is known as *agglutination*. Agglutination occurs when incompatible blood types are mixed, allowing a potentially fatal *antibody – antigen reaction*. Once blood cells have agglutinated, they can cause blood vessels to clog, ultimately ceasing circulation to various parts of the body. In addition to this clotting, agglutinated cells can split open allowing *hemoglobin*, to be released into the body. Hemoglobin is an oxygen-carrying protein in the red blood cell, but becomes toxic when outside of the cell membrane. In order to prevent agglutination during blood transfusions, *blood typing* must be performed to ensure the compatibility between donor and recipient. The blood recipient must not possess antibodies for the donor blood's antigens to ensure a successful transfusion.

A person cannot have antibodies in their blood that will bind to the antigens on their red blood cells. We make antibodies only for antigens we *do not have* on our red blood cells. For example, a person with type **A** antigens cannot have **A** antibodies in the bloodstream (plasma), but can have **B** antibodies. A person with type **B** blood cannot have **B** antibodies, but can have **A** antibodies. A person with type **AB** blood cannot have either **A** or **B** antibodies. A person with type O blood can have **A** *and* **B** antibodies in their blood stream. Table 1 below details blood type compatibility:

Table 1 – Blood Type Compatibility

Blood Group	Antigens	Antibodies	Can give blood to	Can receive blood from
AB	A and B	NONE	AB	AB, A, B, O
A	A	B	A and AB	A and O
B	B	A	B and AB	B and O
O	NONE	A and B	AB, A, B, O	O

Note: You may want to put this chart on the board as students conduct the activity.

Activity Materials:

- 1 copy *Antibody Center Template**
- 5 copies *Antibody End Template**
- 1 copy *Antigens Template **
- 2 copies *Red Blood Cells Template**
- Construction paper
- Scissors
- Glue
- 3 Craft sticks per student (optional)

** Copy numbers noted on pages*

Activity Management Suggestions:

MODIFICATIONS:

For students needing more assistance: Group these students with peers who can assist them during the activity. Check often for understanding.

For highly able students: Students may also be grouped with other students to provide peer assistance. Students may also work on the extension activities.

Extension:

Allow these students to do research on the carbohydrate structures that make up blood sub-types in addition to the ABO and Rh antigens. Students may also do research on how the Rh factor complicates blood type compatibility.

Activity References Used:

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Quinley, E. (1998). Immunohematology: Principles and practice. New York: Lippencott.

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Roitt, I.; Brostoff, J.; & Male, D. (1998). Immunology: Fifth edition. Philadelphia: Mosby.

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