



## How Are Antibodies Used for Blood Typing?

### Kit Contents

QTY	ITEM DESCRIPTION
4	Synthetic blood samples (these are not real blood and are safe for student use)
4	Blood typing slides
1	Antisera type A (blue)
1	Antisera type B (yellow)
1	Anti-Rh factor
12	Mixing sticks
1	Chemical splash goggles
1	Gloves, pair
1	Lab notebook

### Summary

Prerequisites	None
Safety	No issues

### Frequently Asked Questions



[http://www.sciencebuddies.org/science-fair-projects/project\\_ideas/BioChem\\_p008.shtml#help](http://www.sciencebuddies.org/science-fair-projects/project_ideas/BioChem_p008.shtml#help)

### Abstract

Have you ever heard about different blood types? Do you know what your blood type is? Antibodies help scientists determine different human blood types. This project is a practical introduction to the human immune system in which you will learn about what antibodies are, how they are formed, and how they can be used to identify different types of cells.

### Objective

Identify the unknown "blood types" of the synthetic samples and determine if any of the samples are compatible as donor-recipient pairs for a blood transfusion.

### Introduction

The human immune system has various ways of responding to an infection caused by pathogens like bacteria, viruses, or fungi. Our bodies produce proteins (**antibodies**) that are highly specific for the infectious agent as a part of our **humoral immune response**. The antibodies help stop the infection from spreading further and help to eliminate the pathogen from the body.

Antibodies are also used to help our bodies find and destroy "foreign" cells such as tumors. Because antibodies bind tightly to only one type of structure on the surface of cells (**antigens**), they can also be useful for identifying different types of blood cells. It is important to correctly identify blood cells in our bodies if we ever need to receive blood from someone else (**transfusion**) because we are sick.

Our **blood type** is determined based on the presence or absence of two proteins, antigen A and antigen B, on the surface of our red blood cells. There are four possible combinations of blood types namely: Type A (only antigen A), Type B (only antigen B), Type AB (both antigens A and B), and Type O (neither antigens A nor B). This is referred to as the ABO blood typing system. In addition, red blood cells have a **Rhesus factor** or **Rh**, which is either present or absent. If the Rh factor is present, the cells are referred to as Rh positive. Including both the ABO and Rh systems for blood typing, there are a total of 8 possible blood types, which are shown in Table 1, below, along with a summary of how to determine blood type based on whether the antigens and Rh factor are present.

Blood Type	Antigen A Present	Antigen B Present	Rh Factor Present
O positive	No	No	Yes
A positive	Yes	No	Yes
B positive	No	Yes	Yes
O negative	No	No	No
A negative	Yes	No	No
AB positive	Yes	Yes	Yes
B negative	No	Yes	No
AB negative	Yes	Yes	No

**Table 1.** Blood Types & Presence of Antigens and Rh Factors for Each

Table 2, below, shows these blood types along with approximately what percentage of the U.S. population is each blood type.

Blood Type	% of U.S. Population
O positive	38
A positive	34
B positive	9
O negative	7
A negative	6
AB positive	3
B negative	2
AB negative	1

**Table 2.** Blood Types & Proportion of U.S. Population for Each Type

Blood types are determined by using antibody reagents that specifically react with the A, B, and Rh proteins on the surface of red blood cells. First, three drops of blood are placed on a microscope slide. Next, a drop of anti-A reagent is added to one drop of blood, a drop of anti-B reagent is added to the second drop of blood and a drop of anti-Rh reagent is added to the third drop of blood. The slide is gently rotated and examined for clumping (**agglutination**). If clumps are seen in the anti-B and anti-Rh reagents but not the anti-A reagent, then the person's blood is considered "B positive."

When you donate blood, your blood type is determined (usually by the American Red Cross) and is used to match your blood with someone who needs it. If someone got the wrong blood type during a transfusion, they could have a very severe reaction. Type O negative blood is considered the "universal donor" because anyone can receive that blood type without having a reaction. Type AB positive is considered the "universal recipient" because someone with that blood type can receive blood from anyone else without having a reaction.

In this project you will use synthetic blood samples, provided in the kit, to determine the blood type from four different people. Based on their blood types would any of the four people make good donor-recipient pairs for a blood transfusion?

## Terms and Concepts

In order to do this project, you should conduct background research that enables you to understand the following terms and concepts:

- Antibody
- Humoral immune system
- Antigen
- Transfusion
- Blood type
- Rhesus factor
- Agglutination
- Red blood cells
- Plasma

## Questions

- The blood types in the Introduction are for red blood cells. There are other cell types in your blood though. What are the other cell types and do they have the same blood typing systems?
- What blood type is needed for a transfusion for a Type O positive patient?

- What would happen if someone was transfused with an incompatible blood type?

## Bibliography

- American Red Cross (n.d.). *Blood Types*. Retrieved September 17, 2012 from <http://www.redcrossblood.org/learn-about-blood/blood-types> (<http://www.redcrossblood.org/learn-about-blood/blood-types>)
- Edelson, Maureen F. (2011, February). Blood Types. *Kids Health*. Retrieved September 17, 2012 from [http://kidshealth.org/teen/cancer\\_center/treatment/blood\\_types.html](http://kidshealth.org/teen/cancer_center/treatment/blood_types.html) ([http://kidshealth.org/teen/cancer\\_center/treatment/blood\\_types.html](http://kidshealth.org/teen/cancer_center/treatment/blood_types.html))
- Dowshen, Steven (2009, November). Immune System. *Teens Health*. Retrieved September 17, 2012 from [http://teenshealth.org/teen/your\\_body/body\\_basics/immune.html](http://teenshealth.org/teen/your_body/body_basics/immune.html) ([http://teenshealth.org/teen/your\\_body/body\\_basics/immune.html](http://teenshealth.org/teen/your_body/body_basics/immune.html))

## Experimental Procedure

1. In your lab notebook make a data table, like Table 3 below, to record all your data and observations.

Trial Number	Sample Number	Reaction with Anti-A (Y/N)	Reaction with Anti-B (Y/N)	Reaction with Anti-Rh (Y/N)	Determined Blood Type (from Table 1, in the <b>Background</b> ( <a href="http://www.sciencebuddies.org/science-fair-projects/project_ideas/BioChem_p008.shtml#background">http://www.sciencebuddies.org/science-fair-projects/project_ideas/BioChem_p008.shtml#background</a> ) tab)
1	1				
	2				
	3				
	4				
2	1				
	2				
	3				
	4				
3	1				
	2				
	3				
	4				

**Table 3.** You will need a data table like this to record your data.

2. Using the dropper vial, place a drop synthetic blood sample #1 in each well of the blood typing slide. Replace the cap on the dropper vial. Always replace the cap on one vial before opening the next vial to prevent cross contamination.
3. Add a drop of synthetic anti-A to the well labeled A. Replace the cap.
4. Add a drop of synthetic anti-B serum to the well labeled B. Replace the cap.

5. Add a drop of synthetic anti-Rh serum to the well labeled Rh. Replace the cap.
6. Using a different color mixing stick for each well, gently stir the synthetic blood and antiserum drops for 30 seconds. Remember to discard each mixing stick after a single use to avoid contamination to your samples.
7. After 30 seconds of stirring *carefully* examine the liquid in the wells.
  - a. If the liquid is clear or light pink with no particles or cloudiness formed, then no reaction has occurred and you should mark "No" in the appropriate box in the data table.
  - b. If there are solid particles that have formed in mixing the sample or antiserum (they may be darker or lighter than the original liquid), then a reaction has occurred and you should mark "Yes" in the appropriate box. Also, if the liquid has very small particles formed, giving a cloudy appearance to the liquid, then a reaction has occurred and you should mark "Yes" in the appropriate box.
  - c. It is important to look very closely at the wells and only do one well at a time. Be sure to stir at least 30 seconds with the plastic stick. The final product may be clear, white or dark pink depending on the combination of blood sample and antiserum, so look carefully to see if small or large particles have formed in the well.
  - d. Reference the photos in Figure 1 below for help determining if a reaction has occurred or not. If you continue to have trouble read the [FAQ](#) (#help) for this project.



**Figure 1.** If the antiserum does *not* cause agglutination the sample will be free of floating particles like the picture on the left. If the antiserum *does* cause a reaction the sample will turn cloudy and you will see particles form as shown in the picture on the right.

8. Record the results for the first blood sample in the data table.
9. Thoroughly rinse the blood typing slide, then repeat steps 2 through 8 for synthetic blood samples 2, 3, and 4.
10. Repeat steps 2 through 9 two more times so that you have done a total of three trials.
11. Once you have determined the blood type for each sample (by referring to Table 1, in the [Background](#) ([http://www.sciencebuddies.org/science-fair-projects/project\\_ideas/BioChem\\_p008.shtml#background](http://www.sciencebuddies.org/science-fair-projects/project_ideas/BioChem_p008.shtml#background)) tab), you are ready to look at the data like a doctor. Would any of the samples make good donor-recipient pairs for a blood transfusion? Why or why not?

## Variations

- What happens if you mix two different synthetic blood samples together?
- What happens if you mix two different antibody reagents together?
- What happens if you don't mix the slide well after adding all the reagents?
- Is the agglutination reaction affected by temperature?
- If you mix the slide for longer times does the agglutination disappear?

## Related Links

- [Science Fair Project Guide](http://www.sciencebuddies.org/science-fair-projects/project_guide_index.shtml) ([http://www.sciencebuddies.org/science-fair-projects/project\\_guide\\_index.shtml](http://www.sciencebuddies.org/science-fair-projects/project_guide_index.shtml))
- [Other Ideas Like This](http://www.sciencebuddies.org/science-fair-projects/search.shtml?v=solt&pi=BioChem_p008) ([http://www.sciencebuddies.org/science-fair-projects/search.shtml?v=solt&pi=BioChem\\_p008](http://www.sciencebuddies.org/science-fair-projects/search.shtml?v=solt&pi=BioChem_p008))

- [Medical Biotechnology Project Ideas](http://www.sciencebuddies.org/science-fair-projects/recommender_interest_area.php?ia=BioMed) ([http://www.sciencebuddies.org/science-fair-projects/recommender\\_interest\\_area.php?ia=BioMed](http://www.sciencebuddies.org/science-fair-projects/recommender_interest_area.php?ia=BioMed))
- [Diabetes, Nutrition & Haematopoiesis Project Ideas](http://www.sciencebuddies.org/science-fair-projects/recommender_interest_area.php?ia=Novo) ([http://www.sciencebuddies.org/science-fair-projects/recommender\\_interest\\_area.php?ia=Novo](http://www.sciencebuddies.org/science-fair-projects/recommender_interest_area.php?ia=Novo))
- [My Favorites](http://www.sciencebuddies.org/science-fair-projects/recommender_show_favorites.php) ([http://www.sciencebuddies.org/science-fair-projects/recommender\\_show\\_favorites.php](http://www.sciencebuddies.org/science-fair-projects/recommender_show_favorites.php))

If you like this project, you might enjoy exploring these related careers:



### Medical & Clinical Laboratory Technician

Doctors need information to decide if a person is healthy or sick, if a baby's earache is bacterial or viral, or if the man next door needs medication to lower his cholesterol and prevent a heart attack. The information often comes in the form of results from lab tests. Medical and clinical laboratory technicians are the people who perform these routine medical laboratory tests, giving the doctors the information needed to diagnose, treat,

and prevent disease. [Read more](http://www.sciencebuddies.org/science-fair-projects/science-engineering-careers/HumBio_medicalandclinicallaboratorytechnician_c001.shtml) ([http://www.sciencebuddies.org/science-fair-projects/science-engineering-careers/HumBio\\_medicalandclinicallaboratorytechnician\\_c001.shtml](http://www.sciencebuddies.org/science-fair-projects/science-engineering-careers/HumBio_medicalandclinicallaboratorytechnician_c001.shtml))



### Cytotechnologist

When a patient gets sick, his or her doctor will take sample cells from the affected part of his or her body and send them to a lab for testing to figure out what is wrong. This is where the cytotechnologist steps in. The cytotechnologist will take the sample cells, make slides from them, and examine the slides under a microscope. Cytotechnologists are trained to detect abnormalities in cells that come from all body sites in order to

make a diagnosis of cancer or other diseases. These professionals help pathologists and doctors diagnose diseases early, thus saving lives. [Read more](http://www.sciencebuddies.org/science-fair-projects/science-engineering-careers/HumBio_cytotechnologist_c001.shtml) ([http://www.sciencebuddies.org/science-fair-projects/science-engineering-careers/HumBio\\_cytotechnologist\\_c001.shtml](http://www.sciencebuddies.org/science-fair-projects/science-engineering-careers/HumBio_cytotechnologist_c001.shtml))

## Credits

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subject=How%20Are%20Antibodies%20Used%20for%20Blood%20Typing?) after you have checked the Frequently Asked Questions for this PI at [http://www.sciencebuddies.org/science-fair-projects/project\\_ideas/BioChem\\_p008.shtml#help](http://www.sciencebuddies.org/science-fair-projects/project_ideas/BioChem_p008.shtml#help)

In your email, please follow these instructions:

1. What is your Science Buddies kit order number?
2. Please describe how you need help as thoroughly as possible:

Examples

**Good Question** *I'm trying to do Experimental Procedure step #5, "Scrape the insulation from the wire. . ." How do I know when I've scraped enough?*

**Good Question** *I'm at Experimental Procedure step #7, "Move the magnet back and forth . . ." and the LED is not lighting up.*

**Bad Question** *I don't understand the instructions. Help!*