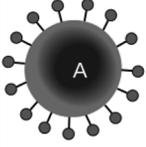
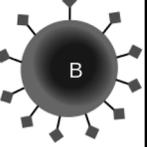
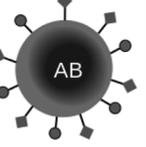
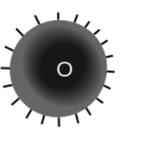
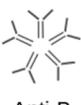
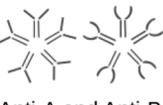


# Lab 20. Inheritance of Blood Type: Are All of Mr. Johnson's Children His Biological Offspring?

## Introduction

Karl Landsteiner identified the ABO blood group in 1901. The ABO blood group includes four types of blood (A, B, AB, and O). The differences in blood types are due to the presence or absence of certain types of antigens and antibodies. Antigens are molecules that are located on the surface of the red blood cells (RBCs), and antibodies are molecules that are located in the blood plasma. Individuals have different types and combinations of these molecules. The figure below shows which antigens and antibodies are associated with each blood type in the ABO blood group.

### Blood types and red blood cell surface antigens

	Type A	Type B	Type AB	Type O
Red blood cell type				
Antibodies in Plasma	 Anti-B	 Anti-A	None	 Anti-A and Anti-B
Antigens in Red Blood Cell	 A antigen	 B antigen	 A and B antigens	None

A single gene that consists of three different versions (or alleles) determines the four blood types in the ABO group. Allele A codes for the synthesis of RBCs that have the type A antigens on their surface. Allele B codes for the synthesis of RBCs that have the type B antigens on their surface, and allele O codes for RBCs that lack surface antigens. The A and B alleles are codominant to each other, and both the A and B alleles are dominant over the O allele. Although there are three different alleles associated with the ABO blood group gene, each individual only inherits two copies of it. One copy of the gene comes from the mother and one copy of the gene comes from the father. The ABO blood type therefore follows the multiple allele model of inheritance.

Although blood type is an inherited trait, the U.S. judicial system does not recognize ABO blood typing as an acceptable way to determine paternity because many individuals can have the same blood type. In the United States, for example, approximately 44% of the population has type O blood, 42% has type A blood, 10% has type B blood, and 4% has type AB blood. ABO blood-typing, however, can be used to exclude a man from being a child's father. Therefore, it is sometimes useful to conduct a quick and inexpensive test for ABO blood type to determine if further testing using a DNA analysis is warranted.

## Your Task

Mr. and Mrs. Johnson have been married for eight years. During this time, Mrs. Johnson has had three children. Recently Mr. Johnson found out that Mrs. Johnson has been secretly dating another man, Mr. Wilson, throughout their marriage. Mr. Johnson now questions if he is truly the biological father of the three children. Your goal is to use what you know about the inheritance of ABO blood types to determine if Mr. Johnson can be excluded as the father of any of Mrs. Johnson's children.

The guiding question of this investigation is, **Are all of Mr. Johnson's children his biological offspring?**

## Materials

You may use any of the following materials during your investigation:

- Type A blood sample
- Type B blood sample
- Type AB blood sample
- Type O blood sample
- Blood sample from Mr. Wilson
- Blood sample from Mr. Johnson
- Blood sample from Mrs. Johnson
- Blood sample from child 1
- Blood sample from child 2
- Blood sample from child 3
- Anti-A serum
- Anti-B serum
- 6 blood-typing slides
- Toothpicks

## Safety Precautions

1. Safety goggles, gloves, and aprons are required for this lab.
2. Under no circumstances is human or animal blood to be used or tested. Only use commercially prepared simulated blood products.
3. Wash hands with soap and water after completing the lab.
4. Follow all normal lab safety rules.

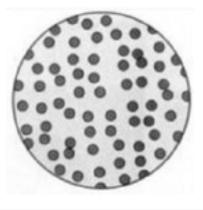
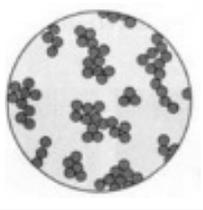
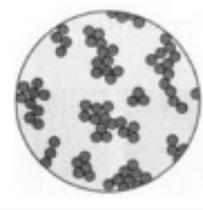
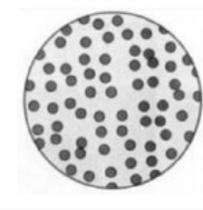
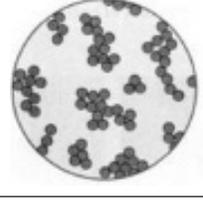
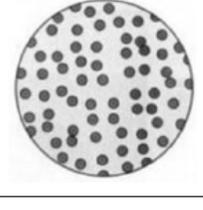
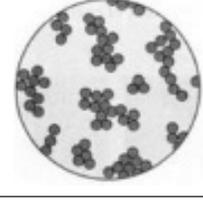
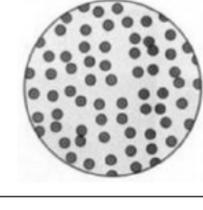
## Getting Started

To test a person's blood type, you can mix a sample of blood with an antiserum that has high levels of anti-A or anti-B antibodies. The simple test is performed as follows:

1. Add two drops of a blood sample to well A and to well B of a blood-typing slide.
2. Add two drops of the appropriate antiserum to each of the samples.
3. Stir each sample for 20 seconds with a toothpick.

If the blood cells have the appropriate antigens on their surface, agglutination (clumping of the blood) will occur. For example, if anti-A serum is added to a sample of blood and agglutination occurs, that means the blood contains cells that have the type A antigens on their surface. The figure below illustrates the reaction of each antiserum with each blood type. Be sure to test known samples first before the unknown samples to see what the agglutination reactions look like.

Reaction of different blood types with antiserum

Antiserum	Reaction when blood is mixed with antiserum			
	Type A	Type B	Type AB	Type O
Anti-B				
Anti-A				

Investigation Proposal Required?  Yes  No

## Connections to Crosscutting Concepts and to the Nature of Science and Scientific Inquiry

As you work through your investigation, be sure to think about

- how scientists develop and use explanatory models to make sense of their observations,

- the relationship between structure and function,
- the relationship between observations and inferences in science, and
- the difference between data and evidence.

## Argumentation Session

Once your group has finished collecting and analyzing your data, prepare a whiteboard that you can use to share your initial argument. Your whiteboard should include all the information shown in the figure to the right.

To share your argument with others, we will be using a round-robin format. This means that one member of your group will stay at your lab station to share your group's argument while the other members of your group go to the other lab stations one at a time to listen to and critique the arguments developed by your classmates.

The goal of the argumentation session is not to convince others that your argument is the best one; rather, the goal is to identify errors or instances of faulty reasoning in the arguments so these mistakes can be fixed. You will therefore need to evaluate the content of the claim, the quality of the evidence used to support the claim, and the strength of the justification of the evidence included in each argument that you see. In order to critique an argument, you will need more information than what is included on the whiteboard. You might, therefore, need to ask the presenter one or more follow-up questions, such as:

- How did you collect your data? Why did you use that method? Why did you collect those data?
- What did you do to make sure the data you collected are reliable? What did you do to decrease measurement error?
- What did you do to analyze your data? Why did you decide to do it that way?
- Is that the only way to interpret the results of your analysis? How do you know that your interpretation of your analysis is appropriate?
- Why did your group decide to present your evidence in that manner?
- What other claims did your group discuss before you decided on that one? Why did your group abandon those alternative ideas?
- How confident are you that your claim is valid? What could you do to increase your confidence?

Once the argumentation session is complete, you will have a chance to meet with your group and revise your original argument. Your group might need to gather more data or design a way to test one or more alternative claims as part of this process. Remember, your goal at this stage of the investigation is to develop the most valid or acceptable answer to the research question!

## Report

Once you have completed your research, you will need to prepare an investigation report that consists of three sections that provide answers to the following questions:

1. What question were you trying to answer and why?
2. What did you do during your investigation and why did you conduct your investigation in this way?
3. What is your argument?

Your report should answer these questions in two pages or less. This report must be typed, and any diagrams, figures, or tables should be embedded into the document. Be sure to write in a persuasive style; you are trying to convince others that your claim is acceptable or valid!

### Argument presentation on a whiteboard

The Guiding Question:	
Our Claim:	
Our Evidence:	Our Justification of the Evidence: