Blood Typing – Teacher’s Notes

Background:

What are the four components of blood and their functions?

Red Blood Cells – Transport oxygen, carbon dioxide, and other nutrients.
White Blood Cells – Fight off infection, disease, bacteria, etc.
Platelets – Help clot blood to stop bleeding. (scabs)
Plasma – The liquid, or serum, part of the blood.

Today’s lab deals with the four basic blood types, which corresponds with the red blood cells. First, let’s look at how the blood types were discovered.

Blood transfusions are a common medical practice today, and have actually been around for over one hundred years. Up until the early 1900's the blood was chosen randomly, which, of course, caused many deaths. The large number of deaths led some researchers to study why this was occurring. Finally, around 1927, a man named Karl Landsteiner and his research team discovered that there are actually antigens, or proteins, attached to the red blood cell that make a person’s blood not compatible with all other blood types. This mixing was causing the blood to clump, or clot, inside the body, which causes death due to the loss of blood flow to the heart. Landsteiner and his team then named the four basic types and researched which types could mix with others. These types are called: A, B, AB, and O. Now let’s talk about the red blood cells.

Red blood cells have antigens, or proteins, that are attached and act as binding sites. There are four different antigens, which is where the blood types get their names. The A antigen is found on type “A” cells, the B antigen is found on type “B” cells, both the A and B antigens are found on type “AB” cells, and type “O” has no antigens, thus calling it ‘zero’. Red blood cells also have antibodies which are along side of the blood cell to attack foreign substances (i.e. infection, disease, bacteria, etc.). These will attack the foreign substance, bind to it, and carry it to the white blood cells to digest. Because these antibodies attack substances that they can bind to, they are named opposite to the antigens. This means that type “A” has Anti-B antibody, type “B” has Anti-A antibody, type “AB” has no antibodies, and type “O” has both Anti-A and Anti-B antibodies. (This sounds backwards, but keep in mind that the antibodies are to attack substances that they can bind to, so they are opposite to avoid killing themselves off.)

How do we get our blood types? Just like our hair color, eye color, skin color, dimples, curling our tongue….from our parents, their parents, and their parents before them. (Genetic) Blood types can be either the same as one parent or a mixture of both parents depending on the parental blood types. The details are for another lesson.

Cut Outs:
Here is a visual of the four basic blood types. Notice that type “A” has scalloped antigens, so the antibody needs to look different so as not to bind to itself. Type “B” has ‘chunkier’ antigens, and the scalloped Anti-A antibody to prevent binding to itself. Now let’s look at type “AB”, notice how it has both the scalloped look of type “A” and the ‘chunkier’ look of type “B”. For this reason, neither Anti – A nor Anti – B antibodies accompanies this type. Type “O”, on the other hand, is smooth with no antigens, which means both antibodies are found here.

What does this mean for blood typing? One thing to keep in mind is that only the antibodies of the person receiving the blood affect the transfusion. Remember, these are the antibodies that want to attack the foreign substance. The ones being transferred are the foreign substance, thus can not attack.

Type “A”, therefore, can only receive itself and type “O” because type “B” would be attacked by the Anti – B antibodies, as well as type “AB”.
Type “B” can only receive itself and type “O” because both type “A” and type “AB” would be attacked by the Anti – A antibody.
Type “O” can only receive itself because the Anti – A antibody would attack type “A” and type “AB” and Anti – B antibody would attack type “B” and type “AB”.
Type “AB” can receive all types due to its lack of antibodies to attack the other types.

Therefore type “O” is called the universal donor, and type “AB” is the universal receiver.

★ About 45% of the US population is type “O”
★ About 41% are type “A”
★ About 10% are type “B”
★ About 4% are type “AB”
Sample results:

<table>
<thead>
<tr>
<th>SAMPLE</th>
<th>RESULTS (+ or -)</th>
<th>BLOOD TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jane</td>
<td>+</td>
<td>A</td>
</tr>
<tr>
<td>John</td>
<td>-</td>
<td>O</td>
</tr>
<tr>
<td>David</td>
<td>+</td>
<td>AB</td>
</tr>
<tr>
<td>Wiley</td>
<td>-</td>
<td>B</td>
</tr>
</tbody>
</table>

Answers to questions:

1. What type of blood does the accident victim have?  ____ Wiley has blood type B

2. Who can donate blood to help save the victim?  ____ Only John can donate to Wiley

3. If David were injured who could donate blood to him?  ____ All siblings can donate to David

4. What blood type can receive any of the four blood types?  ____ Blood type AB

5. What blood type can donate to any of the four blood types?  ____ Blood type O

6. Why is it important to know a person’s blood type?  ____ for transfusion – incompatible blood can cause agglutination, which can lead to death (students may come up with other answers)

FYI:

Approximately 41% of US Population has type A blood, 10% has type B blood, 4% has type AB blood, and 45% has type O blood.

The Rh factor – the Rh system is also based on a protein (the D antigen) that lies on the surface of red blood cells. People with the protein are Rh+ while people without are Rh-. Testing for Rh follows the same procedure as for ABO but uses the anti-D serum. Approximately 85% of Americans are Rh+ and 15% are Rh-. 