

# Blood Types

Everyone has a blood type which is determined by proteins on the surface of red blood cells called antigens. The first discovered and most commonly looked at blood types are the ABO and Rhesus blood types. Someone with A antigens is blood type A, with B antigens is blood type B, and someone with A and B antigens is blood type AB. Someone with neither antigens is blood type O. Rhesus blood type is determined by the presence (+ve) or lack of (-ve) Rhesus antigens. These three antigen types can give 8 different blood types.

**A<sup>+</sup>**
**A<sup>-</sup>**
**B<sup>+</sup>**
**B<sup>-</sup>**  
**AB<sup>+</sup>**
**AB<sup>-</sup>**
**O<sup>+</sup>**
**O<sup>-</sup>**

The immune system in the blood contains antibodies, which are proteins made by white blood cells to attack foreign cells in the body. Antibodies bind to antigens on the surface of these foreign cells and cause them to clump together or agglutinate.

Blood of type A will have antibodies in its plasma which bind to the B antigen, blood type B will have antibodies in its plasma which will attack the A antigen. Blood of type AB will have neither antibody as if they had either they would attack their own cells. Blood of type O however has none of these antigens present on its cells and so will create antibodies which will attack cells with either A or B antigens.

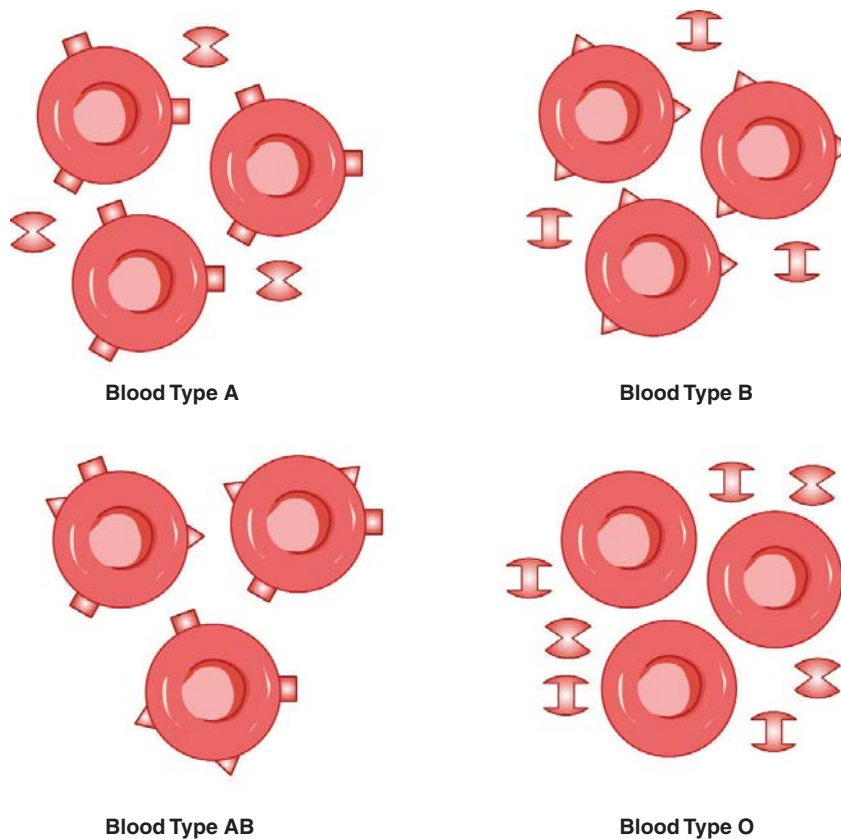


Figure 9 – ABO Blood Types

Similarly Rhesus positive will not have anti rhesus antibodies in its plasma but rhesus negative blood will. These agglutination reactions allow a method of testing blood to determine its type.

# Blood Type Testing

Blood antibodies can be extracted from the blood to create serums which can be used to test blood of an unknown ABO/Rh group. With serums for A, B and Rh antigens the blood type of a sample can be determined.

When blood type antibodies come into contact with cells with the associated antigen on its surface they bind causing the blood to agglutinate.

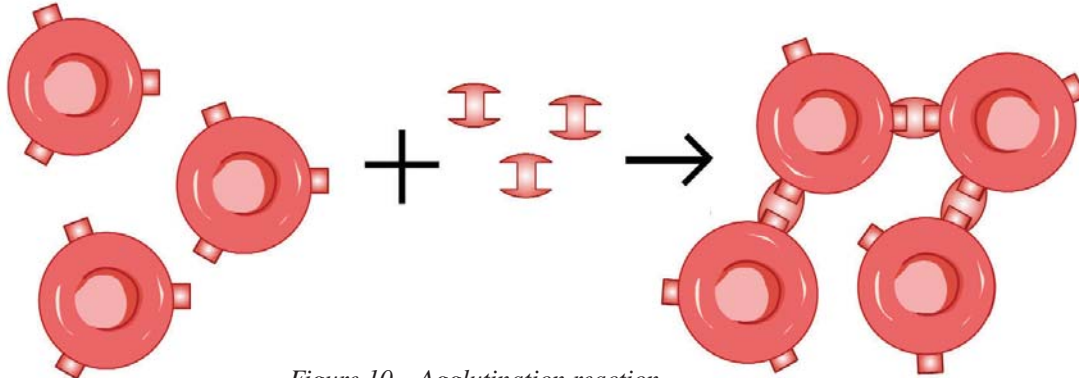


Figure 10 – Agglutination reaction

Table 2 shows the different reactions from to the antibody serums which the different blood types have.

ABO/Rh Agglutination Reactions			
Anti-A Serum Agglutination	Anti-B Serum Agglutination	Anti Rh-Serum Agglutination	Blood type
✓	X	✓	A <sup>+</sup>
✓	X	X	A <sup>-</sup>
X	✓	✓	B <sup>+</sup>
X	✓	X	B <sup>-</sup>
✓	✓	✓	AB <sup>+</sup>
✓	✓	X	AB <sup>-</sup>
X	X	✓	O <sup>+</sup>
X	X	X	O <sup>-</sup>

Table 2 - Blood type Reactions

## Blood Type Frequencies

The frequencies of the different blood types in the UK population are well known and can be used to rule out suspects in a criminal investigation. Blood which tests positive for type A cannot be left at the scene by someone with type B. However this type of evidence doesn't work the other way and if a suspect has the same blood type as blood left at the scene, they cannot be confirmed as the source using blood typing but neither can they be ruled out as the source of that blood

Blood type Frequencies					
A	B	AB	O	Rh <sup>+</sup>	Rh <sup>-</sup>
42%	10%	4%	44%	83%	17%

Table 3 - UK Blood type Frequencies

# Blood Transfusions

Blood types aren't used just in forensic science however as they are very important in emergency medicine, if we lose blood in an accident it can be dangerous or even fatal. When someone has lost a lot of blood they may require a blood transfusion. Blood types are very important at this stage because if the wrong blood type is given to someone it will agglutinate in the host. This happens because the antibodies in the recipient will attack the red blood cells in the donor blood as they are foreign cells. For this reason it is important to know which blood types can be received by an individual.

People with type AB blood can receive blood from any of the other ABO blood types; this is known as being a Universal Recipient.

Donor blood of type O can be given to patients of all the ABO blood types, as its cells contain no antigens that the antibodies will attack, this is known as the Universal Donor.

		Donor Blood Group						Donor Blood Group	
		A	B	AB	O			Rh <sup>+</sup>	Rh <sup>-</sup>
Recipient's Blood Group	A	✓	X	X	✓	Recipient's Blood Group	Rh <sup>+</sup>	✓	✓
	B	X	✓	X	✓		Rh <sup>-</sup>	X	✓
	AB	✓	✓	✓	✓				
	O	X	X	X	✓				

Table 3 - Blood Compatibility

The above table deals with packed cells which can be donated and where most of the Anti-A, Anti-B and Anti-Rh antibodies have been filtered out of the blood or are too dilute as to be important. However blood plasma which is separated can also be used in transfusions as well, in the case of blood plasma with the cells filtered out the antibodies may still be present and so the compatibility is different. Rhesus blood types do not initially influence plasma donation as the body will not produce anti-Rh antibodies unless it has already been exposed to rhesus antigens before. If at an emergency this is unknown, then rhesus positive plasma will not contain any antigens which will attack cells as long as there is an ABO match.

		Donor Blood Group			
		A	B	AB	O
Recipient's Blood Group	A	✓	X	✓	X
	B	X	✓	✓	X
	AB	✓	✓	✓	X
	O	✓	✓	✓	✓

Table 4 - Plasma Compatibility