Serology

Serology is the examination and analysis of body fluids. A forensic serologist may analyze a variety of body fluids including saliva, semen, urine, and blood. From 1950 to the late 1980's, forensic serology was an important part of forensic lab procedures. With the development of DNA techniques, more time, money, and significance was placed in developing DNA labs. However, with limited funds and the time required for DNA testing, most labs still use many of the basic serology testing procedures.

Presumptive Tests for Blood Determination

- **Kastle-Meyer color test**—a mixture of phenolphthalein and hydrogen peroxide; the hemoglobin will cause the formation of a deep pink color if blood is present
- **Hematest® tablet**—reacts with the heme group in blood causing a blue-green color
- **Luminol test**—reaction with blood to produce light

Human vs Animal Blood

- **Microscopic observation**
- **Precipitin test**—blood is injected into a rabbit; antibodies are formed; the rabbit's blood is extracted as an antiserum; the antiserum is placed on sample blood. The sample will react with human proteins if human blood is present. This test is very sensitive and requires only a small amount of blood.

Blood Characteristics

- Plasma is the fluid portion of the blood (55%)
- Cells (45%)
- Erythrocytes are red blood cells. They are responsible for oxygen distribution.
- Leukocytes are the white blood cells; they are responsible for "cleaning" the system of foreign invaders.
- Thrombocytes or platelets are responsible for blood clotting
- **Serum** is the liquid that separates from the blood when a clot is formed. This contains the particular blood type antigens for the person. If added to an unknown sample, serum will clump with blood containing the antibodies for its type (for ex. Serum A would clump with type B blood)
- **Antiserum** is liquid containing *antibodies* for a particular blood type. If antiserum is added to blood and agglutination occurs (clumping) then that means the antibodies found antigens of the same type (for ex. Antiserum A would clump when type A blood was found)

Blood Terminology

- **ABO blood groups**—based on having an A, B, both or no antigens on red blood cells
- **Rh factor**—may be present on red blood cells; positive if present and negative if not
- **Antigen**—a substance that can stimulate the body to make antibodies. Certain antigens (proteins) found in the plasma of the red blood cell's membrane account for blood type.
- **Antibody**—a substance that reacts with an antigen
- **Agglutination**—clumping of red blood cells; will result if blood serum with different antigens are mixed or if antibodies (antiserum) for a particular antigen is added

Blood Type	Antigens Present	Antibodies present	Can receive	Can donate to
A (AA or AO)	A	B	O, A	A, AB
B (BB or BO)	B	A	O, B	B, AB
AB (AB)	A & B	None	O, A, B, AB	AB
O (OO)	None	A & B	O	O, A, B, AB

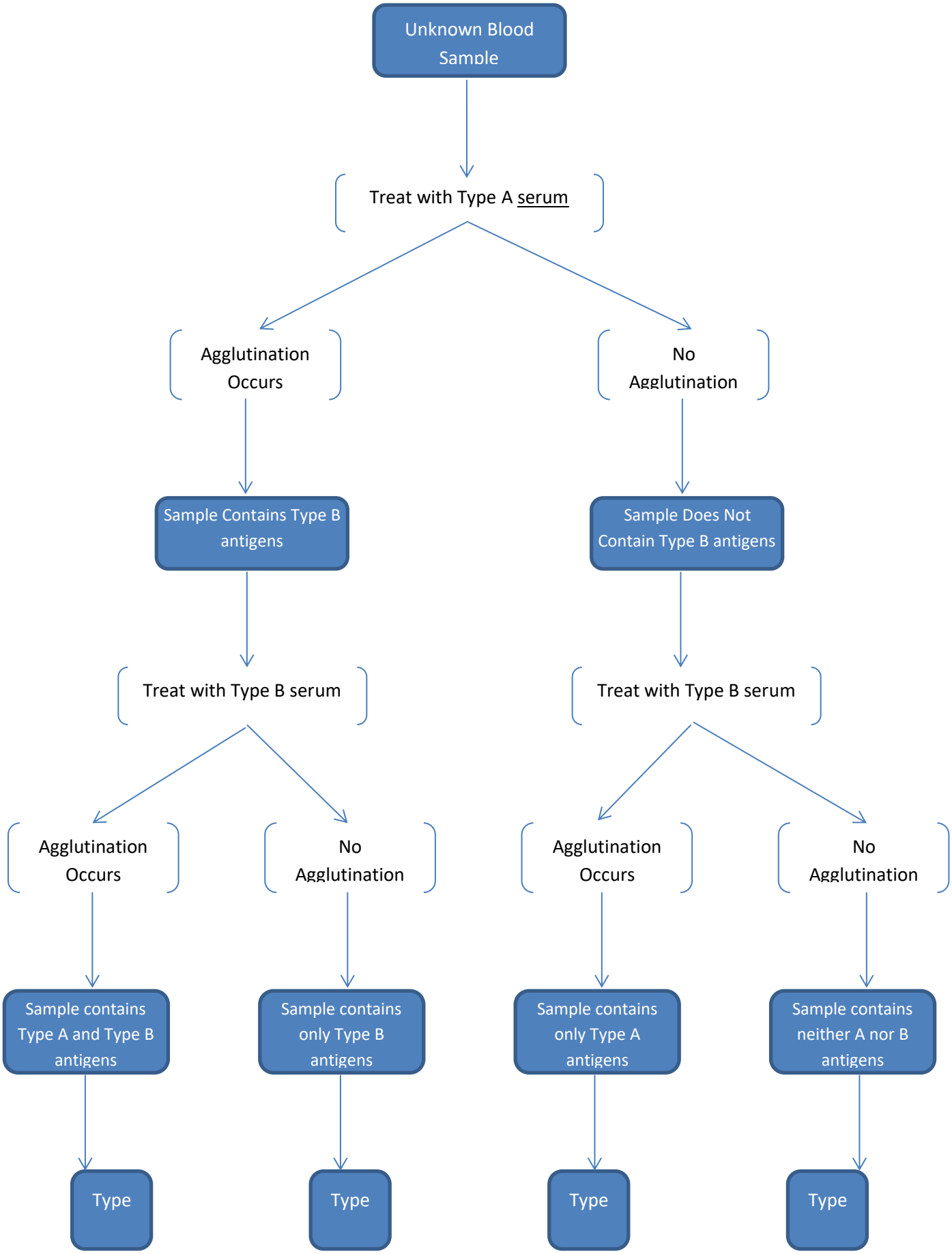
A and B are codominant, O is recessive. Possible genotypes are in parentheses above. The "type" is the phenotype.

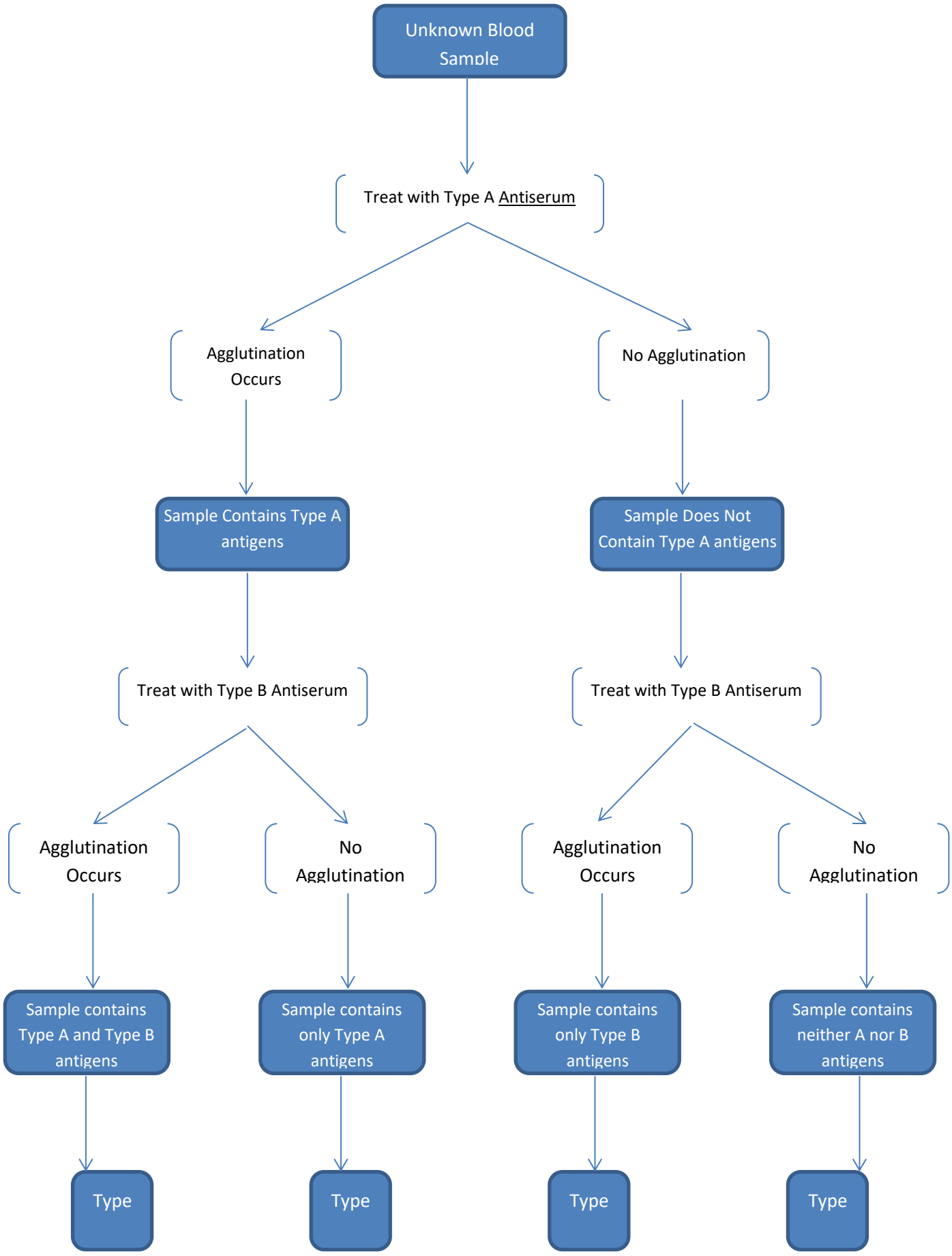
+ is dominant, - is recessive. Being + or – is the phenotype, possible genotypes are in parentheses below.

Blood Type	Antigens Present	Antibodies present	Can receive	Can donate to
+ (++ or +-)	+	None	+ or -	+
- (--)	none	+	-	+ or -

Possible Rh offspring type	+	-
+	+ or -	+ or -
-	+ or -	-

Possible ABO offspring type	A	B	AB	O
A	A or O	A, B, AB or O	A, B, or AB	A or O
B	A, B, AB or O	B or O	A, B, or AB	B or O
AB	A, B, or AB	A, b, or AB	A, B, or AB	A or B
O	A or O	B or O	A or B	O


Unknown Blood Sample
Treat with Type A serum
Agglutination Occurs
No Agglutination
Sample Contains Type B antigens
Sample Does Not Contain Type B antigens
Treat with Type B serum
Treat with Type B serum
Agglutination Occurs
No Agglutination
Agglutination Occurs
No Agglutination
Sample contains Type A and Type B antigens
Sample contains only Type B antigens
Sample contains only Type A antigens
Sample contains neither A nor B antigens
Type
Type
Type
Type


Unknown Blood Sample
Treat with Type A Antiserum
Agglutination Occurs
No Agglutination
Sample Contains Type A antigens
Sample Does Not Contain Type A antigens
Treat with Type B Antiserum
Treat with Type B Antiserum
Agglutination Occurs
No Agglutination
Agglutination Occurs
No Agglutination
Sample contains Type A and Type B antigens
Sample contains only Type A antigens
Sample contains only Type B antigens
Sample contains neither A nor B antigens
Type
Type
Type
Type

What is each person's blood type below?

	Antiserum A	**Antiserum B**	**Rh Antiserum**	**Blood Type**
Mr. Thomas	Agglutination	No Rxn	Agglutination	
Ms. Chen	No Rxn	Agglutination	No Rxn	
Mr. Juarez	Agglutination	Agglutination	Agglutination	
Ms. Brown	No Rxn	No Rxn	No Rxn	

What are the four main ABO blood types?

A student carrying out blood typing finds that the blood sample forms clumps when type-A ***serum*** is added. What is the type of the blood sample?

If Ms. Brown in the example above were serving as a blood donor, what ABO blood type(s) could receive her blood safely?

Which person among the four represented can receive blood from Ms. Chen? Explain.