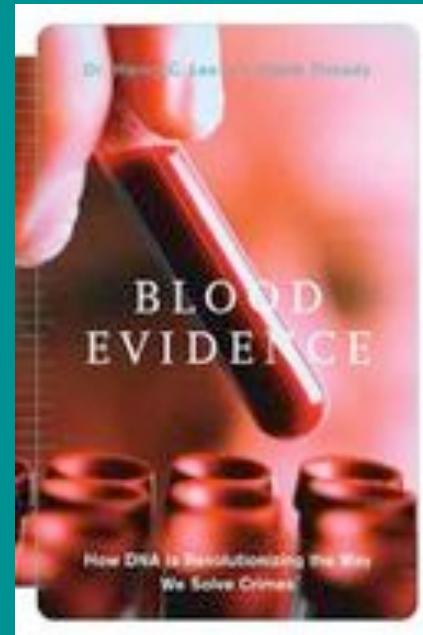


FORENSIC SCIENCE

Serology

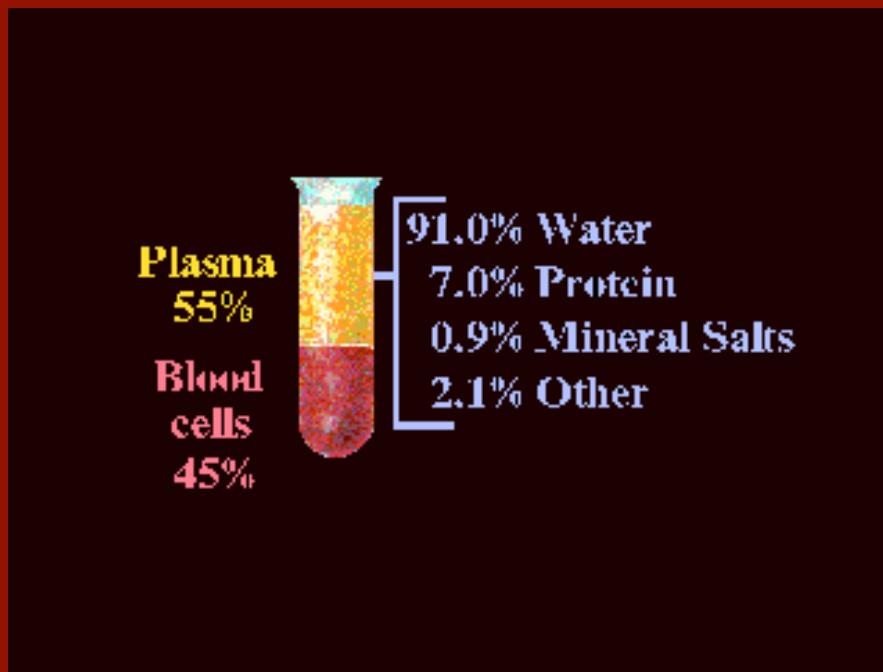
Serology

- The study of body fluids including blood, semen, and saliva



I. What is Blood?

A. slightly basic solution made of Red Blood Cells, White Blood Cells, Platelets & Plasma.

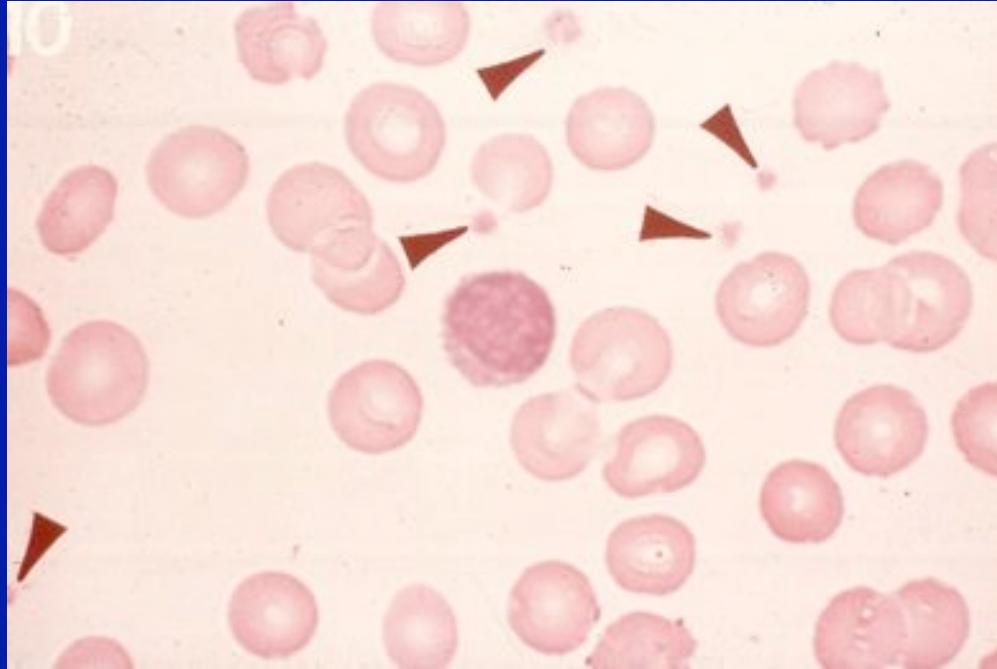


1.PLASMA (55% of blood)

- This is the fluid portion of blood

2. Cells (45% of blood)





a. Platelets (Thrombocytes)
—responsible for blood clotting

b. White Blood Cells (Leukocytes)

responsible for
“cleaning” the
system of foreign
invaders and
protecting the
body from
disease and
infection.



c. Red Blood Cells (Erythrocytes)



Non nucleus cells

Transport oxygen to cells and carbon dioxide away from cells

Contain hemoglobin which gives blood its red color

Contain antigens on their surface

Antigen- carbohydrate that helps determine blood type

B. Physical Properties of Blood

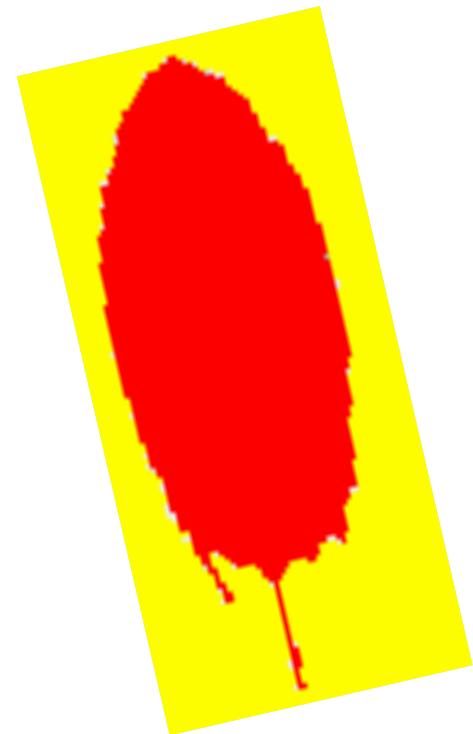
- A healthy adult has 4.5-6 liters of blood in their body



Unknown Stain at a Scene

Questions to be answered:

- Is it blood?
- Is it human blood?
- Whose is it?
 - Determine blood type
 - Determine the method(s) in which blood may have been deposited



II. Determination of Blood

A. Is it Blood?

1. Kastle-Meyer,
Leucomalachite Green,
and Hydrogen Peroxide— used to determine if a visible stain is blood
2. Luminol Test – use to detect invisible blood stains



B. What species is it?

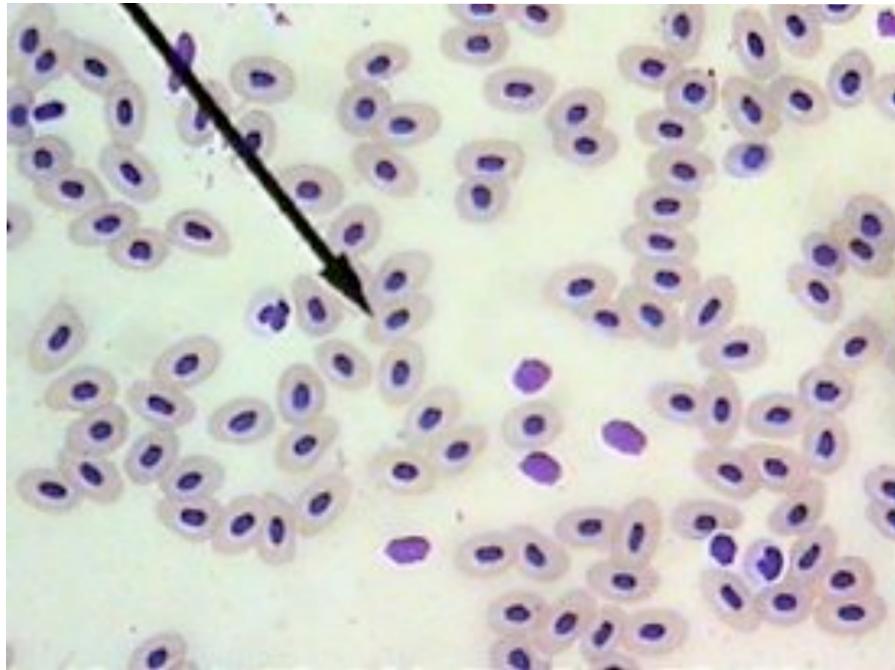
Animal vs Human

- Microscopic survey
- Precipitin test—inject human blood into a rabbit and its body will form antibodies. Remove these antibodies and place on drop of blood. If the blood clots, then it is human.



Eastern cottontail rabbit
(*Sylvilagus floridanus*)

Animal Blood

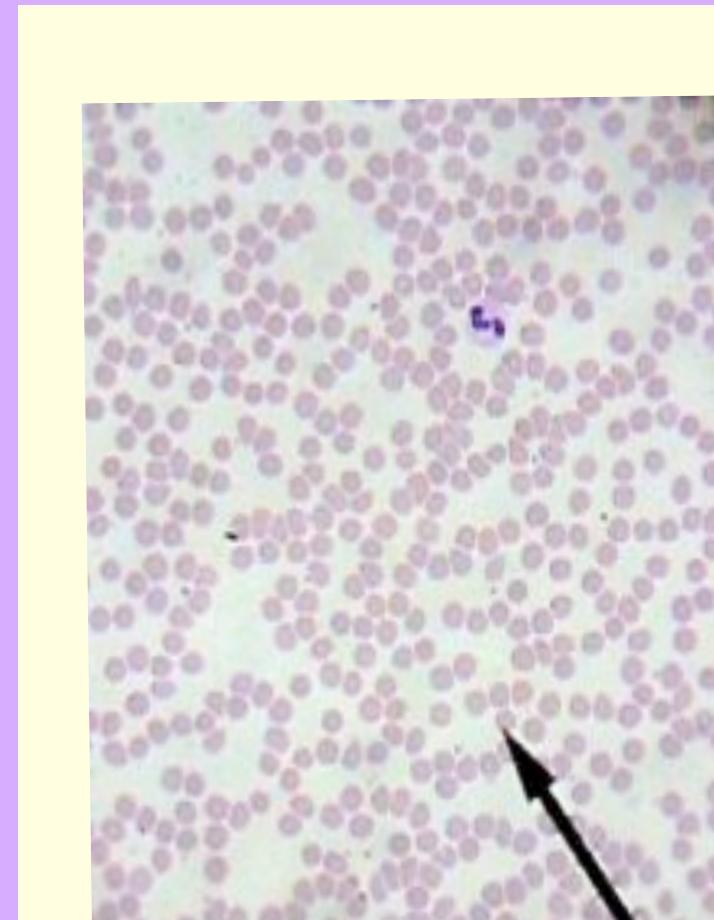


Frog Blood

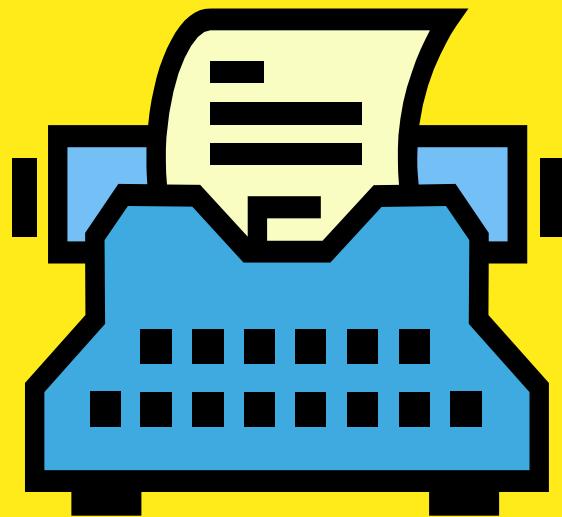
- Larger nucleic red blood cells

Human Blood

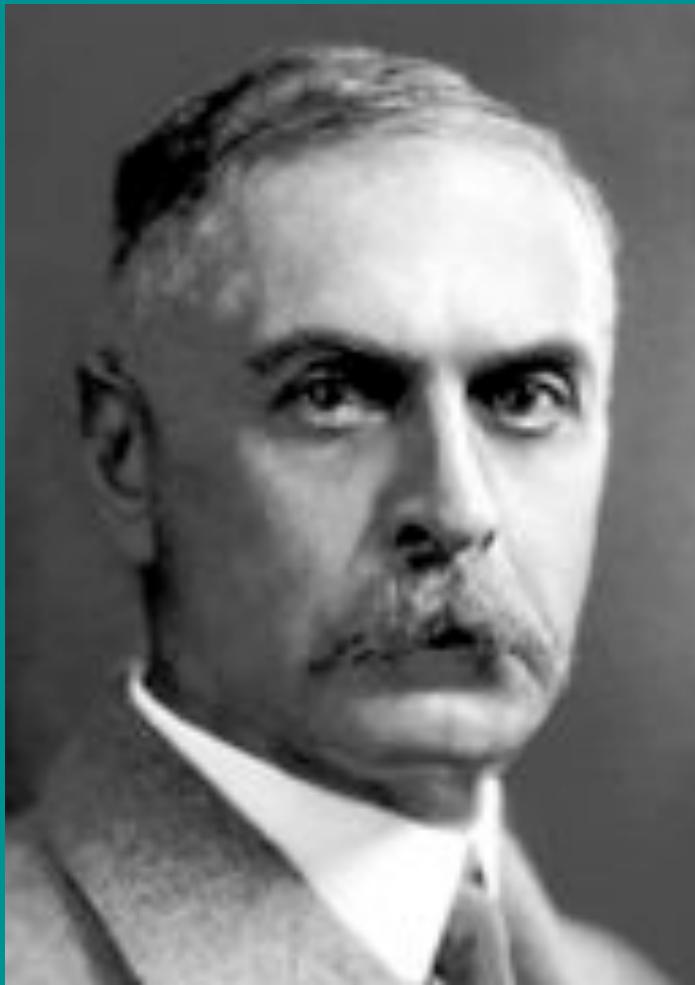
- Smaller numerous non-nucleic red blood cells
- Larger but less numerous white blood cells
- Contain Platelets



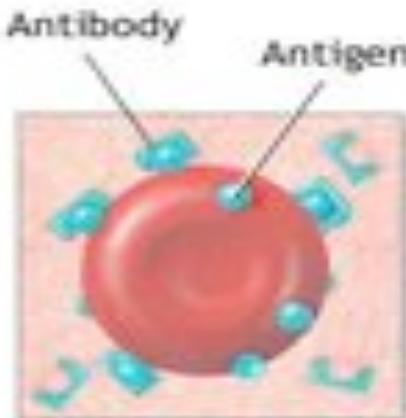
III. Blood Typing



A. Understanding Blood Types



1. Discovered
by Karl
Landsteiner in
1901.



Red blood cell

An antigen is a substance that induces the formation of antibodies because it is recognized by the immune system as a threat

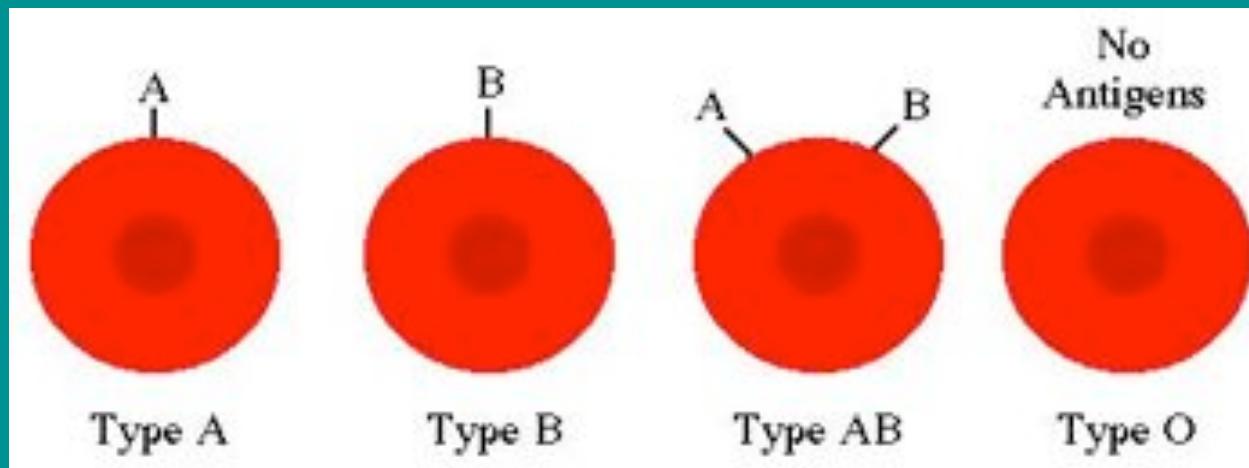
He determined:

©ADAM

- a. All blood groups are defined by the antigens on their Red Blood Cells and antibodies in their serum
- b. For every antigen there exists a specific antibody
- c. Over 600 different blood antigens exist but only a few are common.

2. Common antigens are A and B

a. Red Blood Cells can contain either (A or B,) both (AB), or neither (O) antigen.

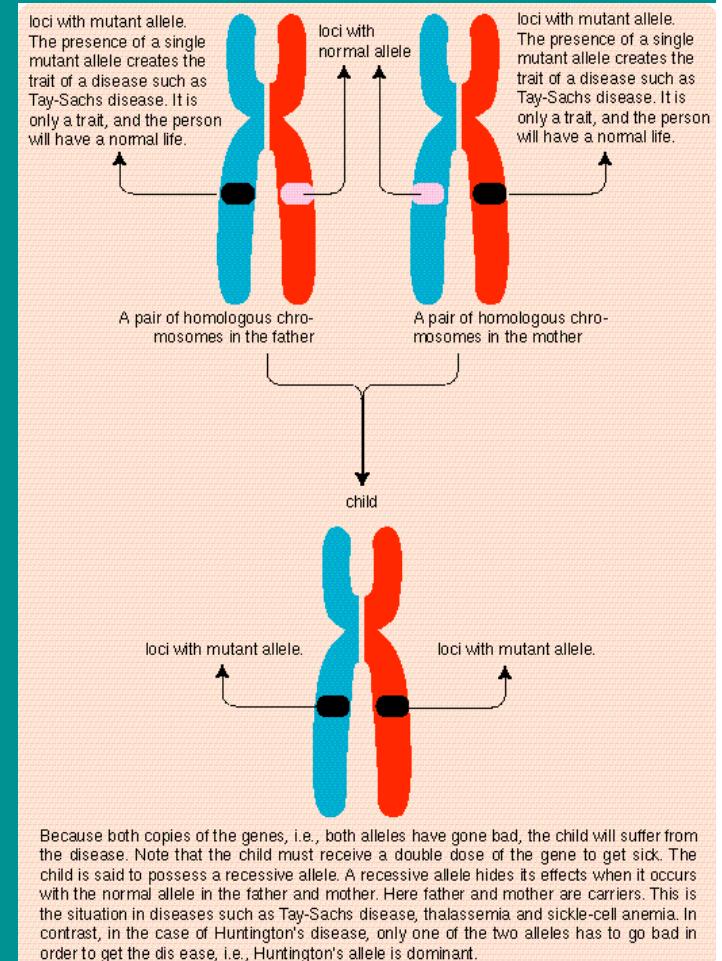


b. 4 Blood types exist based on 3 alleles

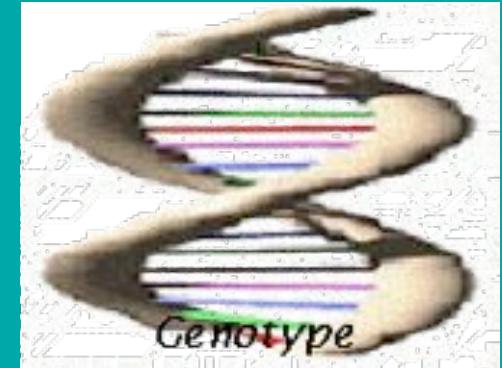
Allele- alternate forms of a gene

Homozygous Allele- 2 same genes

Heterozygous Allele – 2 different genes



Alleles make-up your
GENOTYPE, or genes.



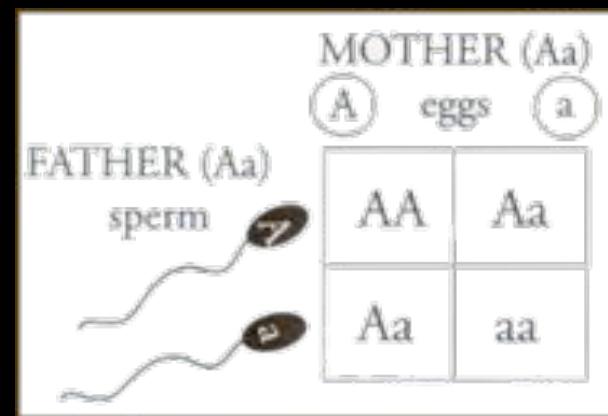
Your genotype
determines your
PHENOTYPE, or your
outward appearance.



PHENOTYPE (outward expression)	GENOTYPE (genes)
Type A blood	AA or AO
Type B blood	BB or BO
Type O blood	OO
Type AB blood	AB

c. Everyone receives their genes in pairs. One blood type letter comes from each parent.

- determination of blood type can be predicted by Punnet squares.



Population Distribution of Blood Types in the U. S.

Type	Percent
O	45
A	39
B	12
AB	4

3. Rh factor (Rhesus factor)

In 1940 Landsteiner and Weiner reported the discovery of the Rh factor by studying the blood of the Rhesus monkey. 85% of Caucasians, 94% of Black Americans and 99% of all Asians are Rh positive.

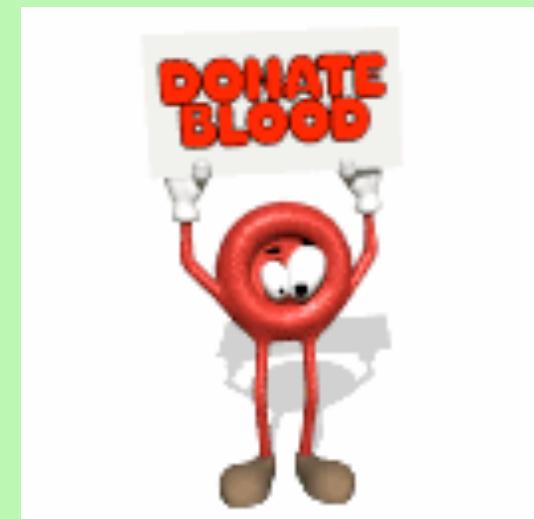


- a. Rh is a type of antigen found on Red Blood cells.
- b. Aka: “D” antigen
- c. People who have D antigen = Rh+
- d. People who do not have D antigen = Rh –

** Rh- moms will produce antibodies against and Rh+ baby causing problems.

OTHER BLOOD ANTIGENS

Other less known antigens found on the red blood cell are: M, N, and S



BLOOD ENZYMES

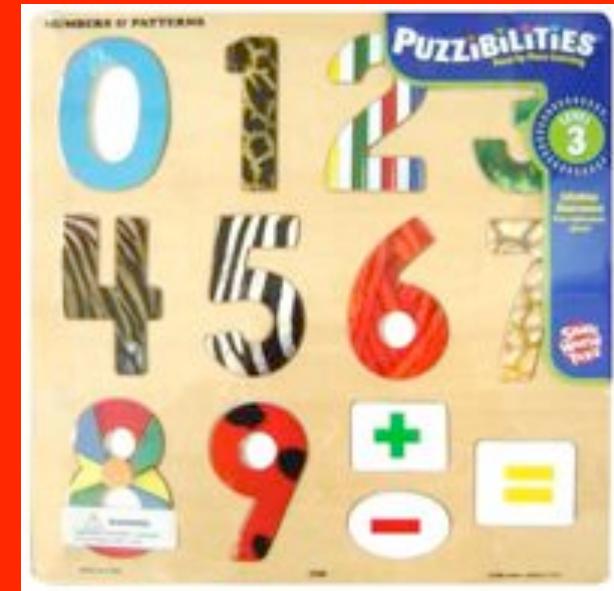
Besides antigens, enzymes are also found in the blood.

Two types of blood enzymes are PGM and EAP

These enzymes can help individualize blood stains even more.

PROBABILITY

- Blood typing can show the probability that two samples of blood came from the same source.
- To determine the probability of a person with a particular combination of blood types, change the percentages to fractions and multiply them.
(see handout)

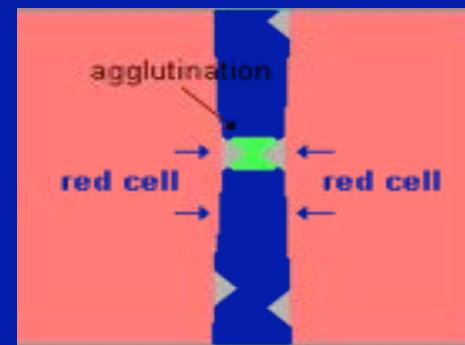
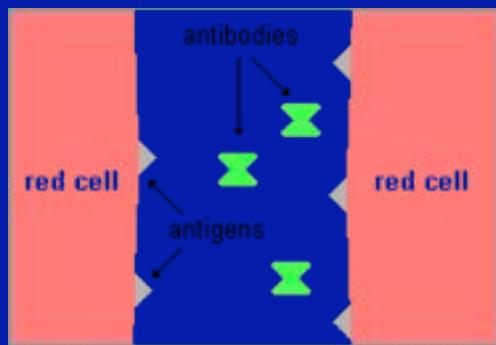


B. Determining Blood Types

1. Agglutination

- Clumping of Red Blood Cells
- Occurs when blood is added that has different antigens than the original blood

ie) person with blood type A produces anti-B antibodies which will destroy type B blood (causing agglutination)



Blood Typing

- A blood type has antigen A and will agglutinate with B.
- B blood type has antigen B and will agglutinate with A.
- AB blood type has antigen A and B and will not agglutinate with either A or B.
- O blood type has neither antigen A or B and will agglutinate with either.

Blood Groups

Type	Antigen	Antibody	Can Give Blood To:	Can Get Blood From
A	A	B	A, AB	O, A
B	B	A	B, AB	O , B
AB	A and B	Neither A nor B	AB	A, B, O, AB
O	Neither A nor B	A and B	A, B, O, AB	O

2. Procedure:

Only need 2 antiserums to determine blood type anti-A and anti-B

→Anti-A serum

- looks normal in B and O blood
- Clots in A and AB blood

→Anti-B serum

- looks normal in A and O blood
- clots in B and AB blood

Blood Reactions to Antiserum

REACTION		BLOOD TYPE
Anti-A Serum	Anti-B Serum	
Agglutination	No agglutination	Type A
No agglutination	Agglutination	Type B
Agglutination	Agglutination	Type AB
No agglutination	No agglutination	Type O

C. Secretors

- 80% of people are considered secretors. Their blood-type antigens are found in high concentration in their body fluids such as saliva, semen, vaginal secretions and gastric juice. If you are a secretor, you will have a higher concentration of A and B antigens than does your blood!!

IV. Blood Spatter

A field of forensic study which deals with the physical properties of blood and the patterns produced under different conditions as a result of various forces being applied to the blood.

A. BLOOD DROPLET Characteristics

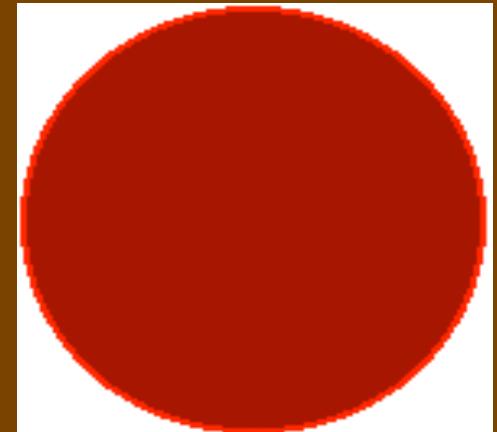
- A blood droplet will remain spherical in space until it drops onto a surface
- Once a blood droplet impacts a surface, a bloodstain is formed.
- A droplet falling from the same height, hitting the same surface at the same angle, will produce a stain with the same basic shape.



B. CONDITIONS EFFECTING BLOODSTAIN SHAPE

1. Texture of the target surface

- a. The harder and less porous the surface, the less the blood drop will break apart.
 - On clean glass or plastic droplet will have smooth outside edges



b.The softer and more porous the surface, the more a blood drop will break apart.

–On a rough surface

will produce

scalloping

on the edges



2. Method of Blood Distribution

a. Bloodstain transfer--When a bloody object comes into contact with a surface and leaves a patterned blood image on the surface.



b. Swipe--wet blood is transferred to a surface which did not first have blood on it



c. Wipe--a non-blood bearing object moves through a wet bloodstain, altering the appearance of the original stain



d. **Cast-off**--blood that is thrown from an object in motion



e. **Backspatter**--blood that is directed back toward its source of energy.

**3. Directionality--relates to
the direction a drop of blood
traveled in space from its
point of origin**





Direction of Travel

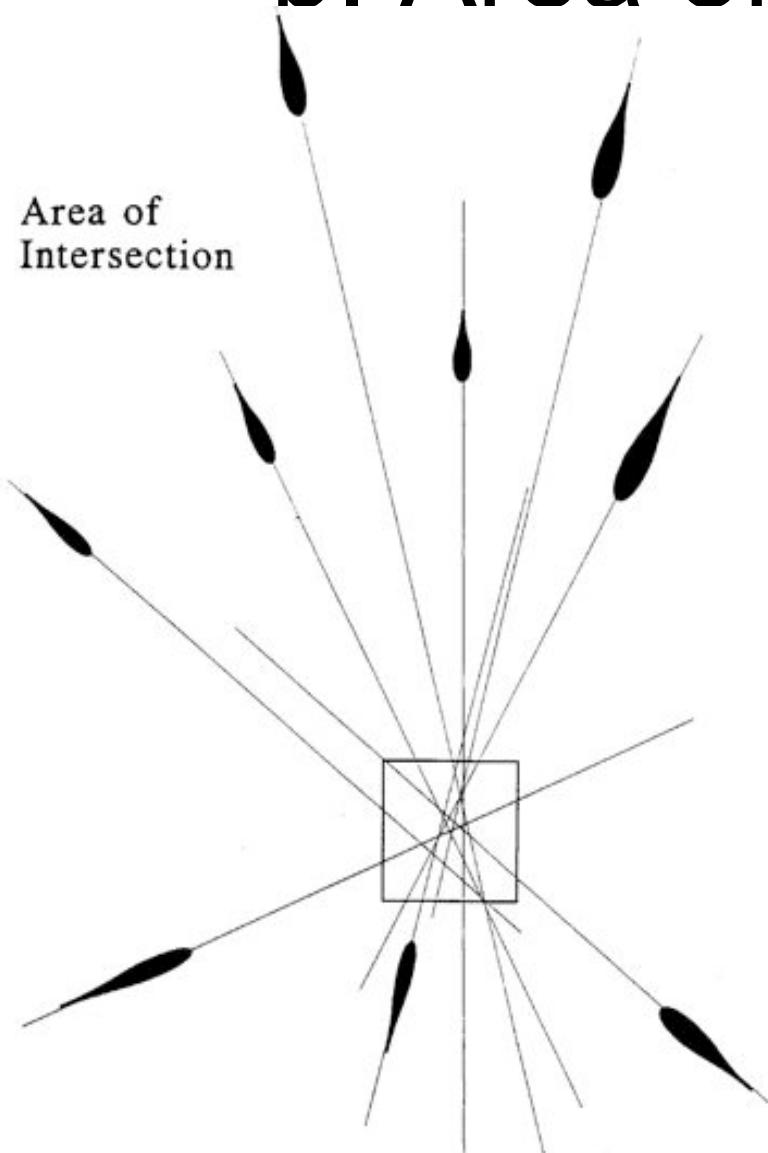


a. Blood Stains

The pointed end of the blood stain faces the direction the stain is traveling.



b. Area of Convergence

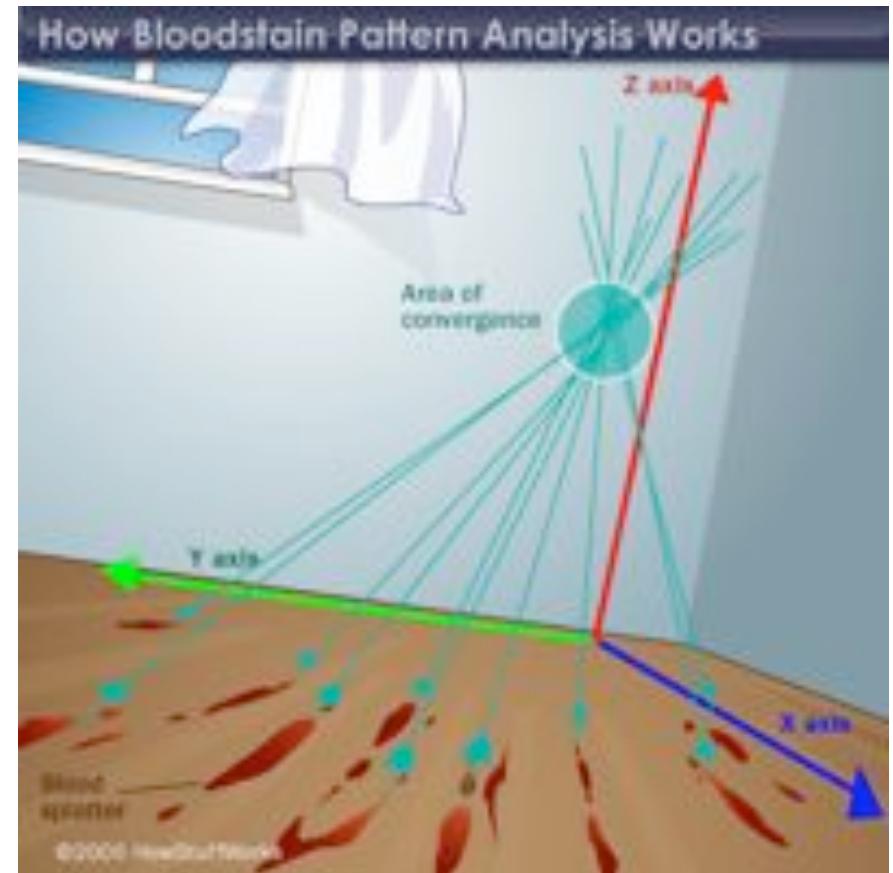


The location of the blood source can be determined by drawing lines the various blood droplets to the point where they intersect. This is the blood's origin.

c. Point of Origin

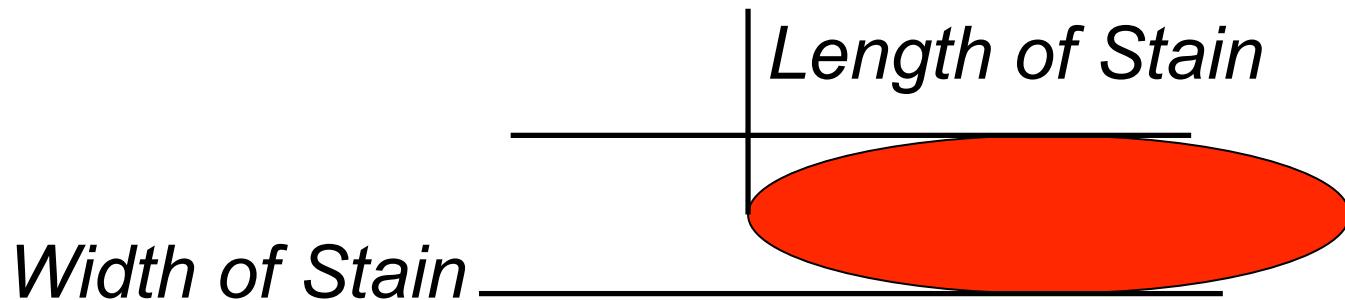
The point of origin is the height at which the “blow” occurred.

It is determined by drawing a line from the area of intersection straight up to where the angle of impact would intersect



d. Angle of impact--angle at which blood strikes a target surface.

Impact Angle Calculation



$\sin^{-1} \frac{\text{width}}{\text{length}} = \text{Impact Angle}$

Impact

- The more acute the angle of impact, the more elongated the stain.
- 90 degree angles are perfectly round with 80 degree angles taking on a more elliptical shape.
- At about 30 degrees the stain will begin to produce a tail.



- The more acute the angle, the easier it is to determine the direction of travel.

4. Velocity at which the blood droplet left the original surface

- Terminal velocity--the greatest speed to which a free falling drop of blood can accelerate in air. It is dependent upon the acceleration of gravity and the friction of the air against the blood--approximately 25 feet/second.



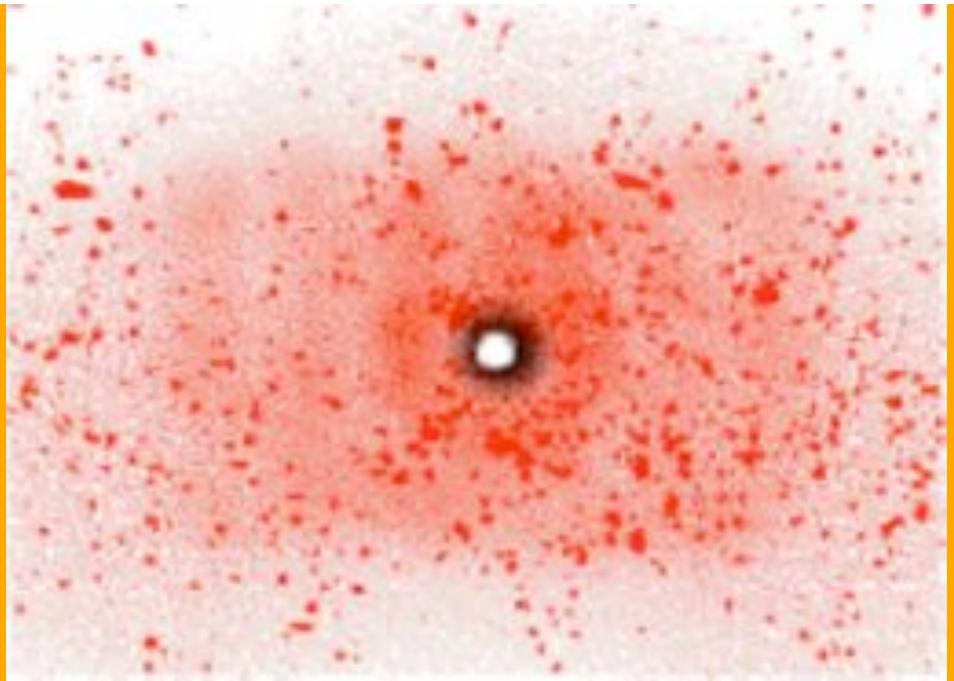
Low velocity

a bloodstain pattern resulting from an blunt object impact.



Medium Velocity

The majority of stains in this pattern are between 1 mm and 3 mm in diameter. This type of pattern is most often associated with blunt force trauma or cutting/stabbing actions.



High velocity

The majority of the resulting bloodstains are smaller than 1 mm in diameter. This type of pattern is most often associated with gun shot wounds and industrial machinery.

C. Questions Answered by Blood Spatter Interpretation

1. The distance between the target surface and the origin of blood at the time of blood shed
2. The point(s) of origin of the blood
3. Type and direction of impact that produced the bloodshed

4. The position of the victim and/or object during bloodshed
5. Movement of the victim and/or object after bloodshed
6. The number of blows, shots, etc. causing the bloodshed and/or the dispersal of blood.

VI. Blood Evidence

- Class evidence for blood would include blood type. If you can determine the DNA you would have individual evidence.
- Blood stain patterns are considered circumstantial evidence in a court room. Experts could argue many points including direction of stains, height of the perpetrator, position of the victim, left/right hand, whether the body was moved, etc.