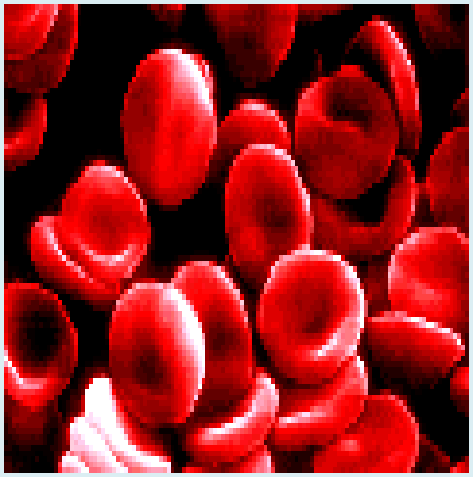

Forensic Serology

Forensic Science

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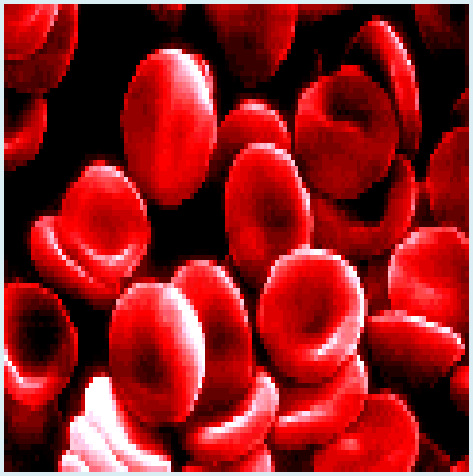
The Composition of Blood

- A complex mixture of cells, enzymes, proteins, and inorganic substances
- It mainly consists of
  - Erythrocytes = red blood cells (rbc)
  - Leukocytes = white blood cells (wbc)
  - Platelets = clotting factors
  - Plasma = the liquid part



The Composition of Blood (continued)

- Antigens, usually proteins, are located on surface of rbc's and are responsible for blood types
- Antibodies recognize and bind to specific antigens
- There is a specific antibody for every antigen that will react to form clumps; this is known as agglutination

A-B-O Blood System

Blood Type	Antigens on Red Blood Cells	Antibodies in Serum
A	A	anti-B
B	B	anti-A
AB	A and B	Neither anti-A nor B
O	Neither A nor B	Both anti-A and B

Type A agglutinates with anti-A, B agglutinates with anti-B, AB agglutinates with both anti-A and anti-B, and O will not agglutinate with either serum

Blood Donors and Recipients

BLOOD TYPE	DONATES TO	RECEIVES FROM
A	A, AB	A, O
B	B, AB	B, O
AB	AB	A, B, BA, O
O	A, B, AB, O	O

Type AB blood is known as the universal recipient and Type O, which is the most common among humans, is known as the universal donor

RH Factor

- Rh (Rhesus) factor is another important blood antigen
- It is a protein that some people carry, sometimes referred to as the D antigen
- People with the D antigen are said to be Rh positive (+) and those without are Rh negative (-)
- Important to the compatibility of donors and recipients
- An Rh+ person can receive Rh+ or Rh- blood, but an Rh- person can only receive Rh-
- The blood is Rh+ if it agglutinates with anti-D or Rh- if it does not

Genetics of Blood

- Blood types are determined by looking at 2 inherited genes (one from each parent)
- There are 3 alleles for blood types: A, B, and O, with 6 possible combinations

BLOOD TYPE	***ALLELE COMBINATIONS***
A	AA, AO
B	BB, BO
AB	AB
O	OO

Punnet Square for Blood

- A Punnet square can be used to determine the blood types of offspring from specific parent genotypes

- Example: what are the possible blood types for the offspring belonging to a Type AB female and a Type O male?

  Answer: Type A and Type B

The Forensics of Blood

- Investigators must answer 3 questions:
  - Is it blood?
  - Is it human or animal blood?
  - Whose blood is it?

Is It Blood?

- **Presumptive** (color) **tests**
  - **Kastle-Meyer** – turns bright pink; used for visible stains
  - **Luminol** – glows a luminescent blue; used for invisible stains

Is It Human or Animal Blood?

- **Precipitin test**
  - Human blood is injected into an animal (usually a rabbit)
  - Antibodies neutralize the invading human blood to form human antiserum
  - The questioned bloodstain is layered on top of the antiserum in a capillary tube
  - A band is formed at the interface of the two liquids

*Other commonly encountered animal blood can be tested this way as well to have a supply of antisera from different organisms

Whose Blood Is It?

- A DNA analysis must be performed to determine exactly who the blood belongs to

Characterization of Blood Evidence

CLASS CHARACTERISTICS

- What species does it belong to?
- What blood type is it?
- What is the Rh factor?
- Does the evidence have diseases present?

INDIVIDUAL CHARACTERISTICS

- DNA analysis

Bloodstain Pattern Analysis

- Important factors of blood spatter
  - Appearance
  - Distribution
  - Location

Bloodstain Pattern Analysis

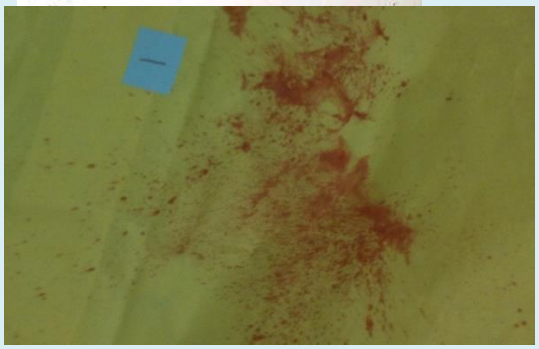
(continued)

Sources of bloodstains include

Passive (dripping)

Transfer

Projected

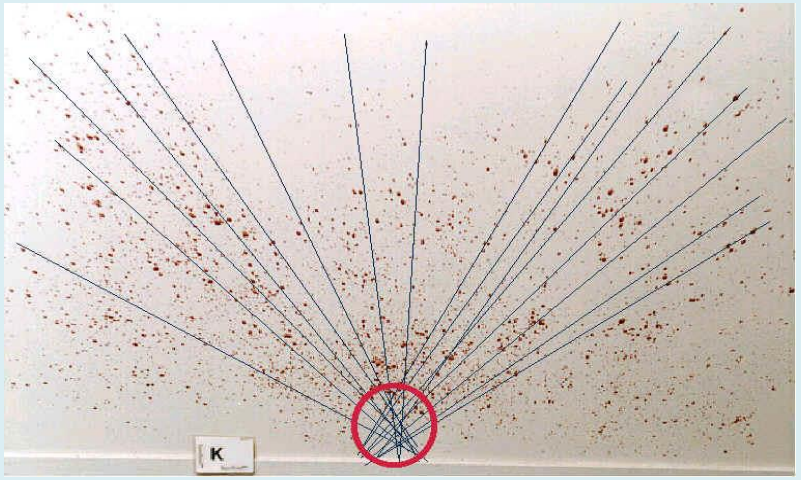


Bloodstain Pattern Analysis
(continued)

- Surface texture can change the appearance of a blood drop
- The direction of travel can be determined when blood strikes a surface because the pointed end of each drop faces its direction of travel
- The angle of impact is determined by measuring the width and the length of the drop, dividing the width by the length, then finding the inverse sin
  - The drop will be circular at right angles to the surface
  - As the angle decreases, the drop elongates

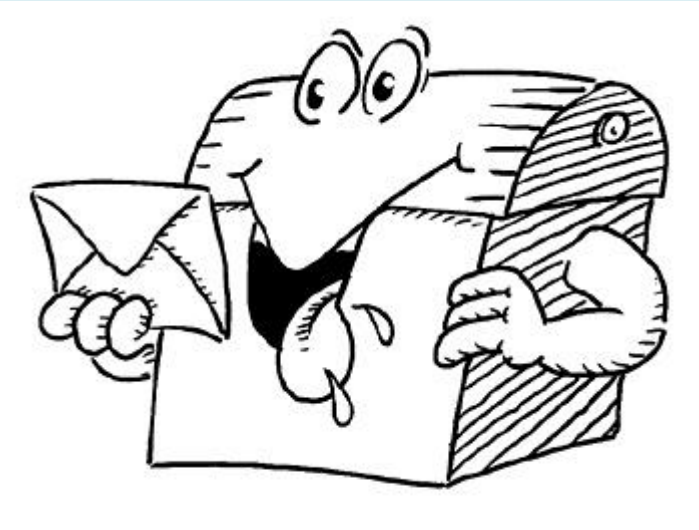
Bloodstain Pattern Analysis
(continued)

- The origin of spatter
  - Draw straight lines through the long axis of several bloodstains
  - The intersection is called the **area of convergence**



Other Body Fluids: Saliva

- Consists of
  - Water
  - Mucin, for swallowing
  - Amylase, for digestion
  - Buccal cells; cheek cells
    - A good source of DNA



Other Body Fluids: Saliva (continued)

- It is particularly associated with sexual assaults and bite marks
- Test for Saliva
  - Mix starch, iodine, and the sample of presumed saliva
  - Starch turns dark blue or purple in the presence of iodine
  - However, amylase breaks down starch
  - If the sample is saliva, the color will fade

Other Body Fluids: Semen

- Consists of
  - Water
  - Spermatozoa
  - Enzymes
  - Inorganic salts

Other Body Fluids: Semen (continued)

PRESUMPTIVE TEST

- Semen fluoresces under UV light
- Acid phosphatase, an enzyme secreted by the prostate gland, turns purple to indicate semen is present

CONFIRMATORY TEST

- Microscopic examination may reveal spermatozoa
- DNA typing must be done to individualize the sample

Other Body Fluids: Urine

- Most often, urine is used in the identification of the presence of specific drugs in the body
- EMIT (Enzyme-Multiplied Immunoassay Technique) reveals how antibodies bind to specific drugs that may be present in urine

Resources

- 0135158494, Saferstein, Richard. *Forensic Science: An Introduction.* New Jersey: Pearson Prentice Hall, 2011.
- 0536522820, Saferstein, Richard. *Criminalistics: An Introduction to Forensic Science.* 8th ed. Upper Saddle River, NJ; Pearson Prentice Hall, 2004.
- Do an Internet search for the following: The Case of Dr. Samuel Sheppard by Fred McGunagle