Serology

- **Antigens**: Proteins on the surface of red blood cells that are responsible for the different blood types.
- **Antibodies**: Proteins in the blood or secretory fluids that attack foreign antigens.

![Antigen-Agglutination](image)

<table>
<thead>
<tr>
<th>Blood Type</th>
<th>Antigen</th>
<th>Antibody</th>
<th>Donor</th>
<th>Recipient</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>A</td>
<td>B</td>
<td>A, AB</td>
<td>A, O</td>
</tr>
<tr>
<td>B</td>
<td>B</td>
<td>A</td>
<td>B, AB</td>
<td>B, O</td>
</tr>
<tr>
<td>AB</td>
<td>A, B</td>
<td>none</td>
<td>AB</td>
<td>all</td>
</tr>
<tr>
<td>O</td>
<td>none</td>
<td>A, B</td>
<td>all</td>
<td>O</td>
</tr>
</tbody>
</table>

- **Agglutination**: A type of allergic reaction where red blood cells clump together, usually in response to a particular antibody.
- **Precipitin Test**: A test that distinguishes between human and animal blood by using an animal serum that contains antibodies specific to human antigens. The animal serum reacts to agglutinate human blood.
- **Phenolphthalein**: The Kastle-Meyer color test is based on the catalytic breakdown of peroxides by hemoglobin. The contact of reduced phenolphthalein reagent and hydrogen peroxide with a bloodstain produces a deep pink color.

When confronted by a stain that looks like blood, what are the first three questions you must ask yourself?

1) **Is the stain a bloodstain?** – Presumptive chemical (Kastle-Meyer and luminol) or microcrystalline (Takayama and Teichmann) tests
2) **From what species did the blood originate?** – Precipitin test
3) **How closely can the blood be associated to a particular individual?** – Distribution of blood types

Which blood test is the most sensitive?
The luminol test is more sensitive than the Kastle-Meyer test.

What substances might give a false positive in a Kastle-Meyer test?
Potatoes and horseradish may give a false positive in a Kastle-Meyer test.

What three types of cells make up blood? Which type of cell contains DNA?

1) **Red Blood Cells (Erythrocytes)**: Red blood cells contain hemoglobin. They transport oxygen from the lungs to the cells, and then carry carbon dioxide back to the lungs, where it is exhaled.
2) **White Blood Cells (Leukocytes)**: White blood cells are the primary cells of the immune system. They produce antibodies and contain DNA.
3) **Platelets**: Platelets start the clotting process by initiating the formation of fibrin to form a clot. Removing the sold clotting material leaves a pale yellow, watery fluid called serum.

Why is it better to donate red blood cells than to donate whole blood?
It is dangerous to donate whole blood because antibodies in the donated blood might attack antigens in the host blood, resulting in agglutination.

How can the distribution of blood types help to narrow down a list of suspects?

<table>
<thead>
<tr>
<th>Blood Type</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>40</td>
</tr>
<tr>
<td>B</td>
<td>11</td>
</tr>
<tr>
<td>AB</td>
<td>4</td>
</tr>
<tr>
<td>O</td>
<td>45</td>
</tr>
<tr>
<td>RH +</td>
<td>85</td>
</tr>
<tr>
<td>RH -</td>
<td>15</td>
</tr>
</tbody>
</table>
Blood Spatter

• **Passive Drop:** Bloodstain drops created or formed by the force of gravity acting alone.

• **Contact/Transfer Pattern:** A bloodstain pattern created when a wet, bloody surface comes in contact with a second surface; a recognizable image of all or a portion of the original surface may be observed in the pattern.

• **Void:** An absence of stains in an otherwise continuous bloodstain pattern, like a reverse shadow.

• **Low-Velocity Impact Spatter:** A bloodstain pattern caused by a low-speed impact or force to a blood source; velocity may be up to about 5 ft/sec with drop size of 4 to 6 mm.

• **Medium-Velocity Impact Spatter:** A bloodstain pattern caused by a medium-speed impact or force to a blood source; a beating or stabbing typically causes this type of spatter, and velocity may be about 25 ft/sec with a stain generally of 1 to 4 mm.

• **High-Velocity Impact Spatter:** A bloodstain pattern caused by a high-speed impact or force to a blood source such as that produced by gunshot; velocity may be 100 ft/sec, generally forming drops ≤ 1 mm.

• **Terminal Velocity:** An object in free fall reaches a constant (terminal) velocity when the force of gravity acting upon the object equals the force of air resistance.

• **Impact Angle:** The acute angle formed between the direction of a blood drop and the plane of the surface it strikes.

What information can we deduce from blood spatter?

1) Type and velocity of weapon
2) Number of blows
3) Handedness of assailant
4) Position and movements of the victim and assailant during and after the attack
5) Which wounds were inflicted first
6) Type of injuries
7) How long ago the crime was committed
8) Whether death was immediate or delayed

What is the proper way to package and store blood evidence?

When packaging and storing blood evidence, do not block out air; a sealed container may trap any moisture present and cause mold and mildew to form. Paper bags or envelopes may be used.

Describe the stringing technique.

1) Stretch a string through the long axis of each drop to locate the area of convergence.
2) Place a ring stand on the area of convergence.
3) Determine the angle of impact for each drop using trigonometry.
4) Raise each string to the calculated angle and attach it to the ring stand. Convergence indicates the location of the point of origin of the blood.

The **HIGHER** the velocity of blood traveled, the **SMALLER** the blood drop.

The **STeeper** the angle of impact, the more **ELLiptical** the blood drop.