Name _____ Period _____ **Unit 5: Blood and Blood Stain Analysis**

Blood Composition and Function

By the end of this chapter you will be able to:

- Explain the composition of blood
- Describe the function of blood cells
- Determine the blood type of a blood sample
- Conduct a blood spatter analysis
- Examine wounds and describe the nature of the weapon
- Find and process blood evidence

Crime Scene Investigation of Blood

1. Search for _____
2. Determine
    a. _____?
    b. Is the blood human?
    c. _____?
3. _____:
    a. Does the blood type match a suspect's blood?
    b. If not, exclude that suspect
    c. If yes, decide if DNA profiling is necessary

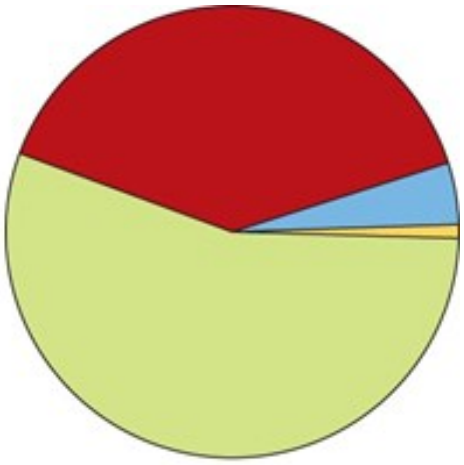
Introduction and History

- Blood typing provides _____
- DNA profiling provides _____
- A blood spatter pattern provides information
    - the truthfulness of an account by a witness or a suspect
    - the _____
    - the angle and velocity of impact
    - the _____

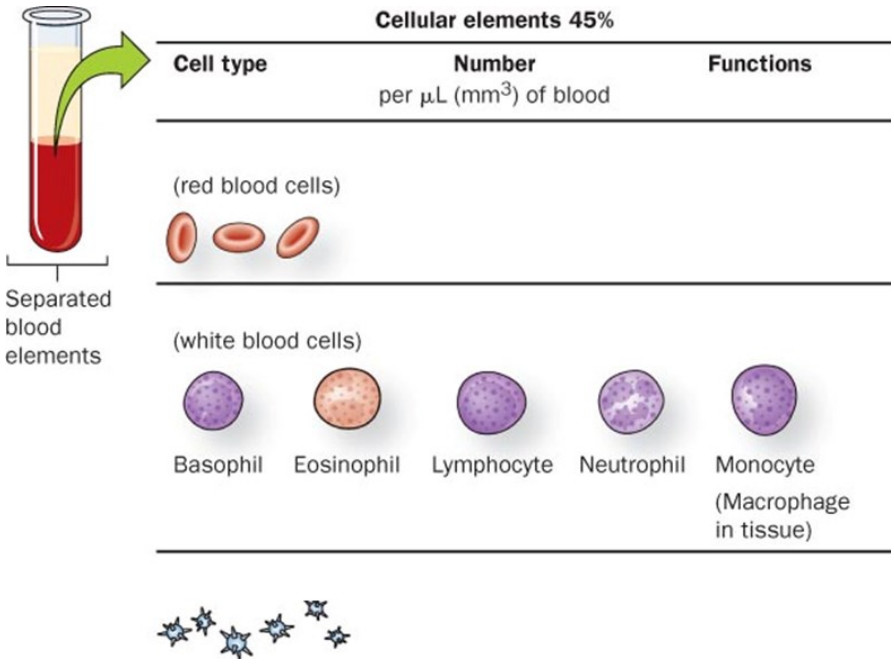
Composition of Blood

- **_____**—a liquid suspending other blood components
- **_____ (Erthrocytes)**—carries oxygen to the body's cells and carbon dioxide away
- **_____ (Leukocytes)**—fights disease and foreign invaders and, alone, contain cell nuclei
- **_____**—aids in blood clotting and the repair of damaged blood vessels

Composition of Blood (label):

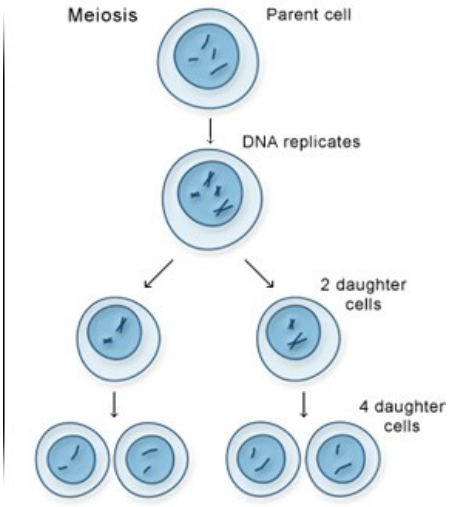


Cellular Components of Blood



Meiosis

- _____: DNA wrapped around protein. It is condensed so it can be transferred to new cells.
- Meiosis: forms unique _____ (sex cells→sperm/egg)
- _____(n): ½ set of chromosomes, gamete (sex) cells
- _____ (2n): full set of chromosomes, body (somatic) cells



Some Definitions….

- *Genetics:* The scientific study of _____
- _____*:* A specific characteristic of an individual.
- _____:
  - Sequence of DNA that codes for a protein (and, therefore, a *trait*)
  - Passed down from parent to offspring
- *Allele:*_____ (one from each parent)
  - _____*: 2* of the same allele for the same gene
  - _____*:* different alleles for the same gene

Principle of Dominance

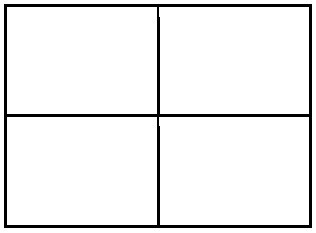
- *Definition:* Some alleles are _____and others are_____

Genotype vs. Phenotype

- *Genotype:* the _____ (i.e. combination of alleles for each particular gene)
- *Phenotype:* the_____ exhibited by an organism (observable)

Can we PREDICT which trait(s) will be inherited??

- *Probability:* (Define)
- Punnett Squares



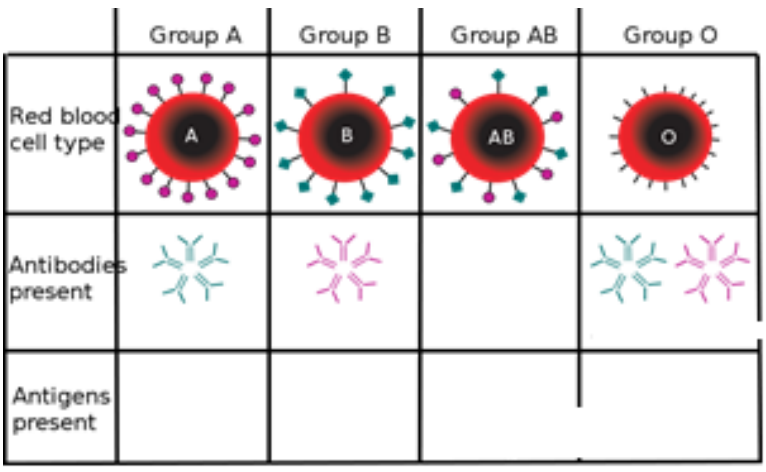
Punnett square Practice

- If a father is type I^aI^a and the mother is I^Bi^i
  - What is the probability of the offspring having the blood type I^aI^b?

Blood Typing—Proteins

- Discovered in 1900 by _____
- Identifies the presence or absence of particular proteins embedded in the cell
- _____ than DNA profiling
- Produces class evidence but can still link a suspect to a crime scene or exclude a suspect

Blood typing antigens & antibodies



Blood Typing—Proteins % in population (U.S.)

A	B	AB	O

Rh Factor

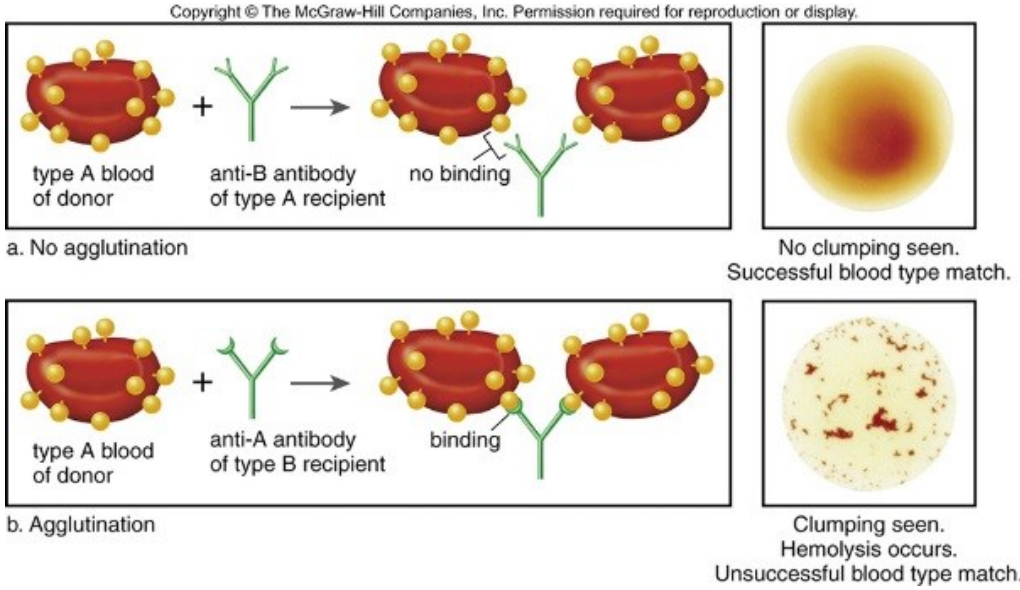
- _____ of the population has a protein called RH factor on their blood cells

Blood Typing—Antibodies

- _____ are Y-shaped proteins secreted by white blood cells that attach to antigens to destroy them (immune response)
- _____ **(**antibody generator) are carbohydrates attached to the surface of cells that react with antibodies

Antigen/antibody response

- In the presence of foreign antigens, antibodies bind to the antigen and, in the case of blood, cause_____, (clump together).



Blood Typing—Probability and Blood Types

- The probability of a blood type equals the product of probabilities for each protein group

  If **Type A =** _____ and **Rh Factor =** _____

  Then **A+ =** _____ **x** _____ **=** _____

- Knowing additional proteins and enzymes in the blood sample
  - _____
  - Increases the probability of identifying a suspect

Practice problem

What is the probability of having AB- blood knowing Ab is 3% of the population, and no Rh is 15%?

Blood Spatter Analysis Notes

http://youtu.be/mlx3-1E1c8U

Introduction

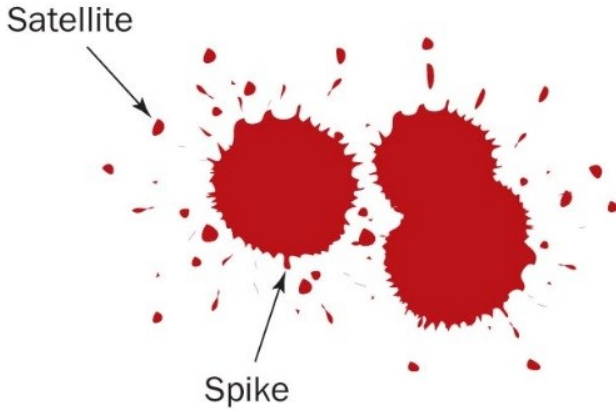
- A blood spatter pattern provides information
  - the truthfulness of an account by a witness or a suspect
  - the _____
  - the _____
  - the _____

Blood Spatter

- _____—spatter patterns first analyzed
- Blood may spatter when a _____
- Blood spatter pattern—a grouping of blood stains
- Patterns help to _____ surrounding a shooting, stabbing, or beating
- Blood Spatter Analysis

Analysis of a spatter pattern can aid in determining the:

- direction blood traveled
- _____
- point of origin of the blood
- _____
- manner of death

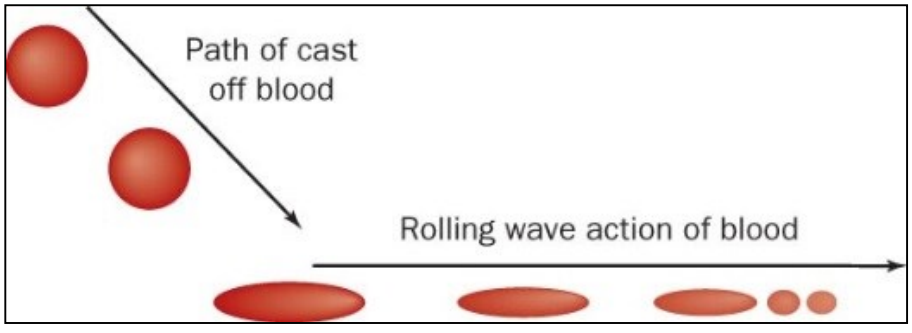


Blood Spatter Analysis

- _____—
  - When blood falls from a height, or at a high velocity,
  - It overcomes its natural cohesiveness, and separates from the main droplet
- _____—
  - Form around the droplet edges when blood falls onto a less-than-smooth surface

Blood Spatter Analysis—Directionality

- The shape of an individual drop of blood provides clues to the _____
- How will the _____ compare with the rest of a blood pattern?

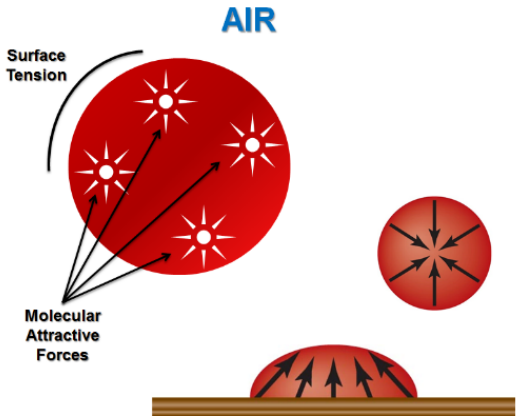


Blood droplets travel through the air in the _____

Should you be able to accurately determine the distance that a blood drop fell by measuring the diameter of a bloodstain at a crime scene? _____

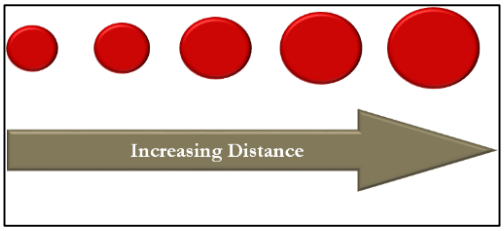
Blood droplets do not move through the air in a teardrop shape!

Surface Tension: greater attraction of molecules to itself (_____) than air molecules (_____)



Stain size as a function of distance fallen

- The farther the distance, the _____.
- This progressive increase in size is limited by two factors:
  1. _____
  2. Terminal velocity for blood is _____



Scalloped edges on a bloodstain are a function of the target surface and _____ to the distance fallen. (Draw a scalloped drop)

Should you be able to accurately determine the distance that a blood drop fell by measuring the diameter of a bloodstain at a crime scene? Why?

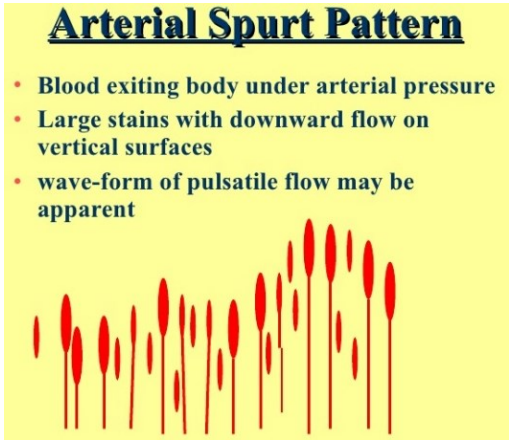
Blood Spatter Patterns

Use of force to describe the blood spatter

- In the past, forensic investigators used 'velocity' to describe a pattern of blood dispersion.
  _____ velocity (gravity/drop, 5ft/s)
  → _____ velocity (punch, 25ft/s)
  → _____ velocity (gunshot, 100ft/s)
- While velocity described the _____ and _____ of the blood spatter dispersion,
- **Force describes _____.**
- To find the force, F=ma, which is measured in Newtons
  - F=force
  - m=mass
  - a=acceleration
- The goal is to: _____ the stain first, then determine the _____

Other Blood Spatter Patterns

- Blood flow patterns
  - _____ elevation to _____ elevation
  - Shows if a body has been moved



Arterial Bleeding

- Typically found on walls or ceilings and are caused by _____ of the heart

Blood Trails

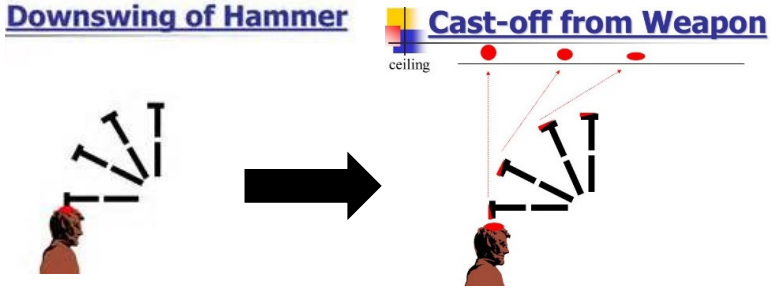
- Show _____
  - One end of the blood drop will be more scalloped than the other
- Shows _____ of the victim

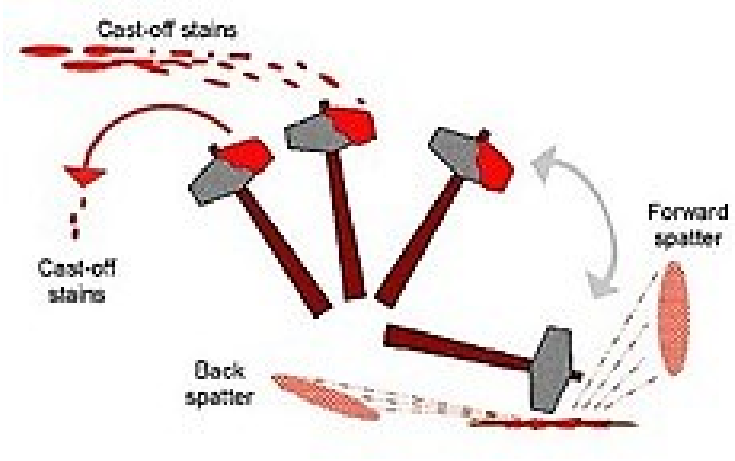
Blood Pools

- Pools of blood form around a victim who is _____ and remains in _____
- If victim is _____
  - May appear to be droplets or swipes/wipes connecting _____ location to _____

Cast off Patterns

- Show where a _____ (suspect/assailant)
- Does _____ indicate what _____ is used

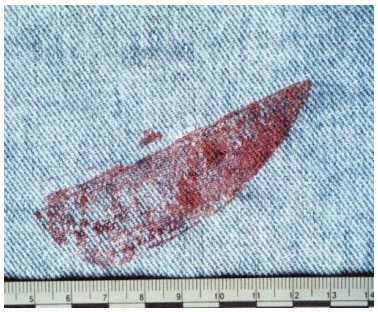




Transfer Pattern

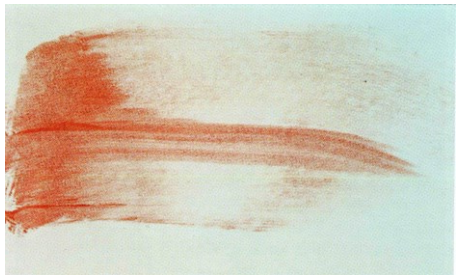
Any pattern that occurs when _____ comes in contact with another object or surface.

Sometimes the transfer pattern can assist in _____ the bloody _____.

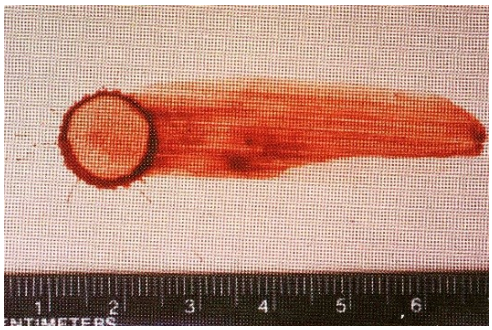


Swipes and Wipes

- A "swipe" occurs when a _____ moves _____ a clean surface and deposits blood on that surface.



- A "wipe" occurs when an object moves _____ and disturbs _____ that has already been deposited on a surface.

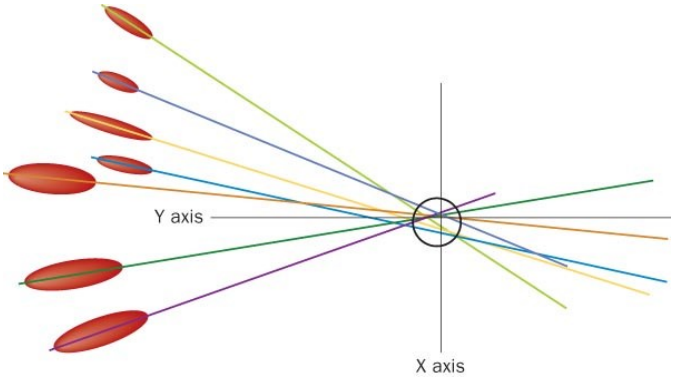


Dark ring around blood drop = _____

Starts drying at perimeter

Wiping through blood at different times gives different skeletonization

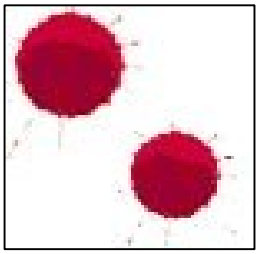
Lines of convergence—two or blood spatters can pinpoint the location of the blood source (forms area of convergence)



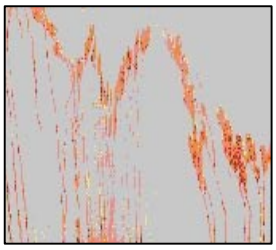
Blood Spatter Analysis —Six Patterns

Describe each of these:

a) Passive drops

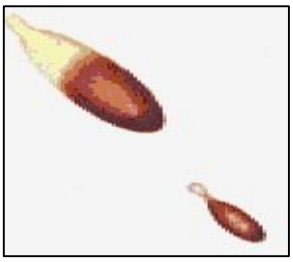


b) Arterial gushes



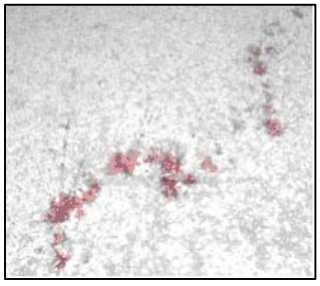
c) Splashes

d) Smears



e) Trails

f) Pools



Discuss roles for scenario:

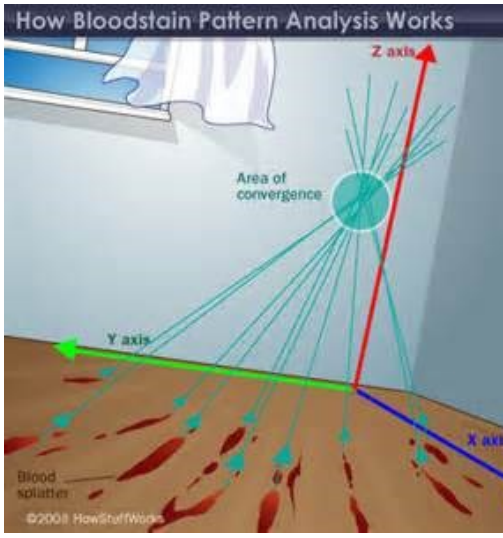
- Lead investigator
    - Make sure all steps are covered in correct order
    - Keep squad on task
    - Assist any squad member with their task
    - Take lead on assigning roles to complete the investigative report
- Photographer
    - 3 images for each scene
    - Detailed photos for 5-6 blood spatters for analysis later (if needed)
    - Responsible for uploading photos into report
- Crime scene Sketcher
    - Record scene measurements
    - Sketch (general) location of blood spatter
    - Record 5-6 width/length measurements for analysis
- Evidence technician
    - Presumptive blood test
    - Measure blood spatters (5-6) for width and length-make sure photographer takes pictures of these
- Evidence Technician 2
    - Assist with angle of impact calculations
    - Set up strings to determine area of convergence

Steps on Scene

1. Photograph scene
2. Presumptive blood test
3. Sketch and measure scene
4. Determine how many impacts are on scene
5. Pick 5-6 spatters/direction of impact to calculate angle of impact
6. Use stringing method to find area of convergence
7. Photograph after strings are set up and document height, distance of blood travel from convergence

Stringing Method

1. Find angle of impact:
    1. width/length of blood spatter
        1. Actual size doesn't matter, you can measure on a photo as the ratio will be the same
    2. Sin^{-1}(width/length)
2. Put a protractor along the long axis of the spatter
3. Tape string to the bottom of the stain
4. Move the string until it matches the angle of impact and tape down
5. Repeat for 5-6/direction of impact



Presumptive Blood Tests

Presumptive vs confirmatory blood tests

- Presumptive Tests **(a**lso known as preliminary tests, screening tests or field tests)
  - Indicates a _____ is present
  - _____
  - Provide _____ information to determine what test to perform next
  - Used in _____with confirmatory tests
- Confirmatory Tests
  - Confirm a substance is present
  - _____
  - May be more _____, require additional equipment, and _____

Test	Kastle-Meyer (Phenolphthalein)	Leucomalachite Green (LMG)	Hemastix ®	Luminol	Fluorescein
Changes from Color to Color					
Reacts with					
Steps to perform test					

Test	Limitations	Sensitivity	Other Notes
Kastle-Meyer (Phenolphthalein)			
Leucomalachite Green (LMG)			
Hemastix ®			
Luminol			
Fluorescein			