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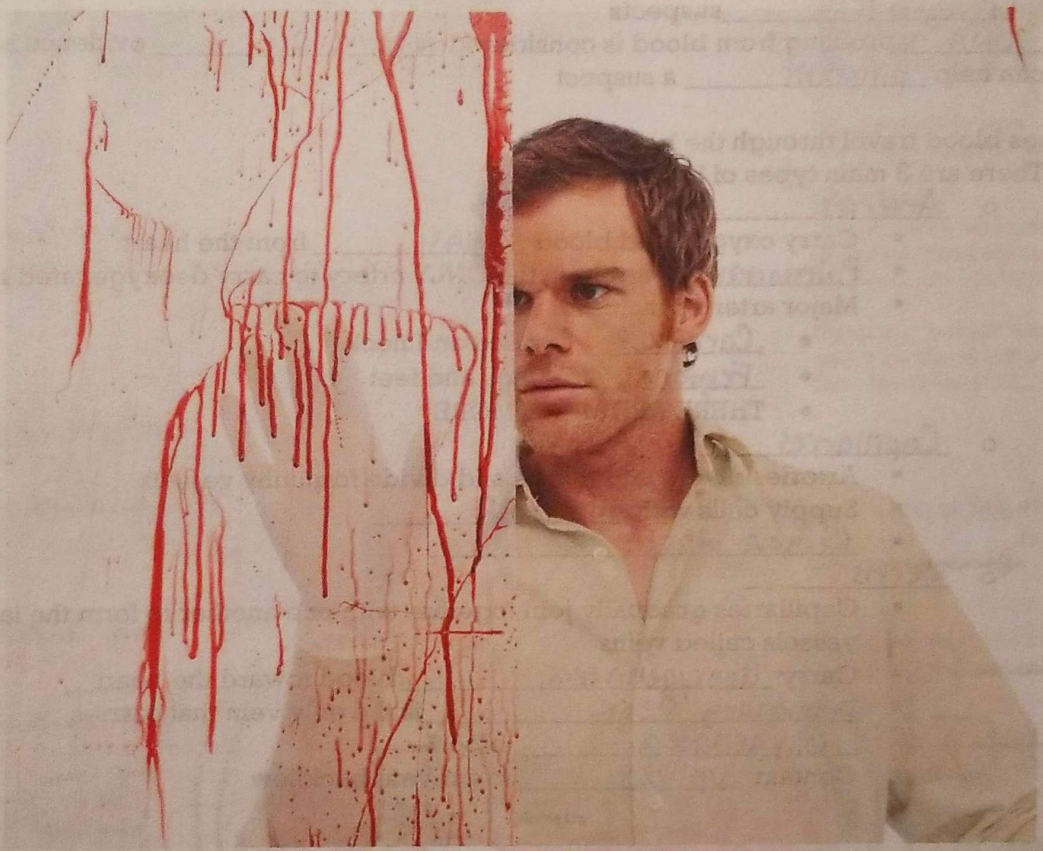
Unit 9b: Blood: (Spatter Analysis)



By the end of the unit, you will be able to:

- Describe how blood flows through the body
- Conduct a blood spatter analysis
- Discuss the science behind various types of blood spatter patterns
- Describe steps and tests used to find and process blood evidence at crime scenes

Unit Vocabulary:

- 3 main blood vessels: _____
- Blood spatter: _____
- Satellite drops: _____
- Lines of convergence: _____
- Point of Origin: _____
- Passive Drops: _____
- Arterial gushes: _____
- Splashes: _____
- Smear: _____
- Wipe: _____
- Swipe: _____
- Cast off: _____
- Luminol: _____
- Kastle-Meyer Test: _____
- ELISA Test: _____

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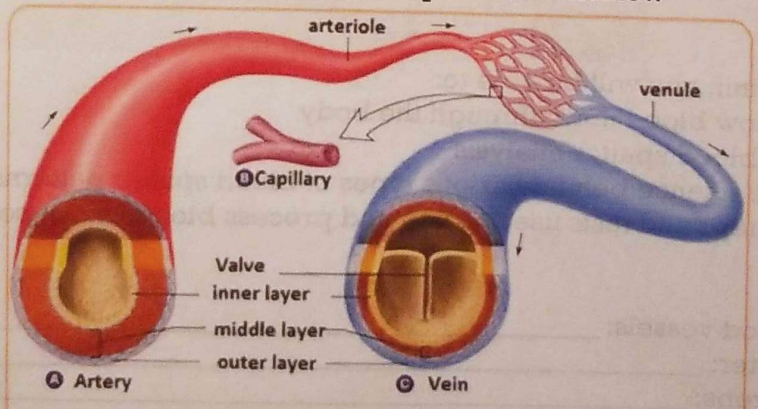
Class Evidence or Individual Evidence?

- Blood typing is considered class evidence and is good to rule out suspects
- DNA profiling from blood is considered individual evidence and can help pinpoint a suspect

How does blood travel through the body?

- There are 3 main types of blood vessels…
  - Arteries
    - Carry oxygenated blood AWAY from the heart
    - Pulmonary artery is the ONLY artery to carry deoxygenated blood
    - Major arteries include:
      - Carotid – head and neck
      - Femoral – legs and feet
      - THERE ARE MANY MORE!
  - Capillaries
    - Arteries divide and divide and divide form tiny vessels
    - Supply cells with nutrients
    - Remove waste
  - Veins
    - Capillaries gradually join together with one another to form the larger vessels called veins
    - Carry deoxygenated blood toward the heart
    - Pulmonary vein is the only vein that carries oxygenated blood
    - Contain valves to prevent backflow



At any given moment, about 30% of the blood in your systemic circulation will be found in the arteries, 5% in the capillaries and 65% in the vein.

What is blood spatter?

- A grouping of blood stains constitutes a blood spatter pattern
- Patterns help to reconstruct the events surrounding shootings, stabbings, beating, etc.
- In 1939, Dr. Victor Balthazard first researched and analyzed spatter patterns

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The Children's Heart Institute
HASAN ABDALLAH, M.D., FAAP, FAAC
www.childrenheartinstitute.org

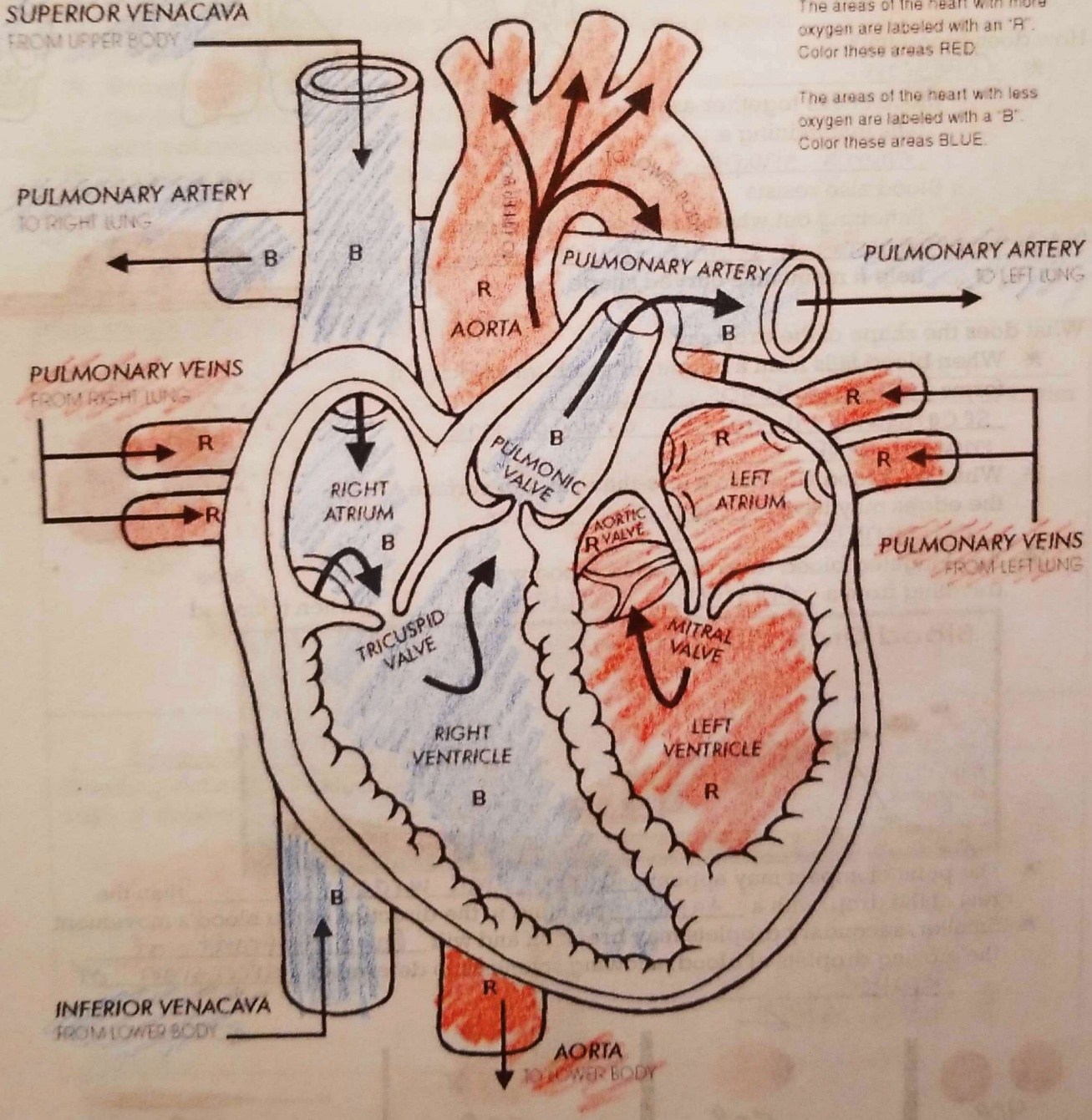
The Heart

This drawing shows how blood flows through the heart.

Color Me:

The areas of the heart with more oxygen are labeled with an "R". Color these areas RED.

The areas of the heart with less oxygen are labeled with a "B". Color these areas BLUE.



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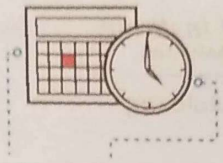
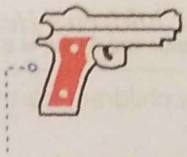
What can the blood spatter tell us?

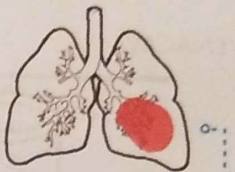
- The direction blood traveled
- Angle of impact
- Point of origin of the blood
- Velocity of the blood
- Manner of death

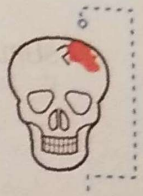

Date and time of crime


Type and velocity of weapon


Movements/position of those involved


If the assailant was left or right handed


Types of injuries dealt

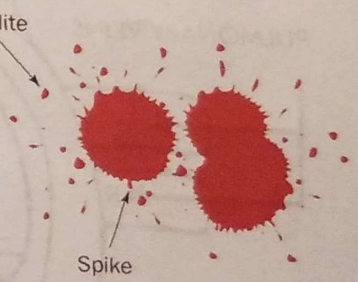

Whether death was immediate

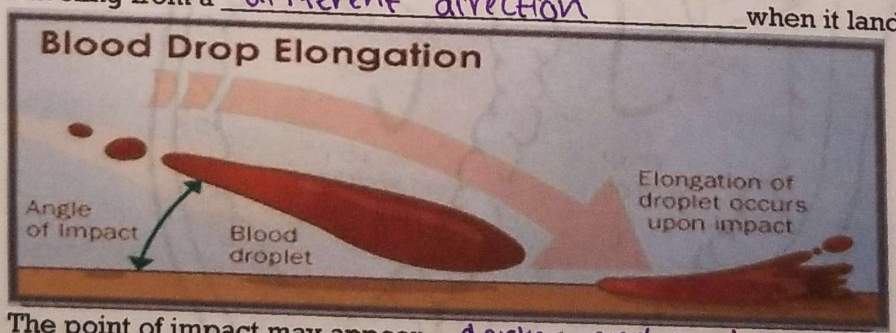
How does blood fall?

- Cohesion
  - Blood sticks together as it falls maintaining a round shape
  - Blood also resists flattening out when it falls on a flat surface
  - Cohesion & surface tension help it maintain a curved shape

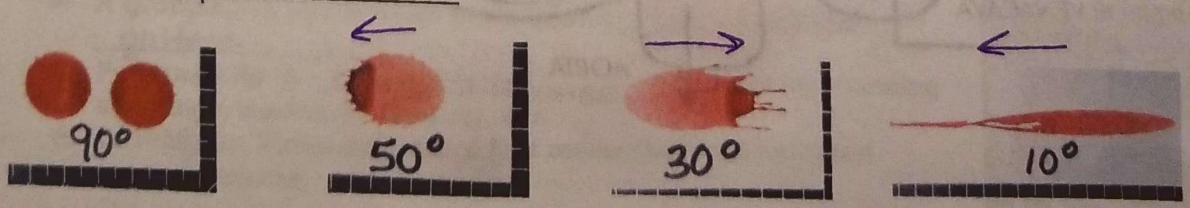
What does the shape of the drop say?

- When blood falls from a height, or at a high velocity, it forms satellite drops, small secondary droplets around the main drop
- When the blood falls onto a less-than-smooth surface, the edges may have spikes, or extensions
- An elongated blood drop indicated blood was traveling from a different direction when it landed





- The point of impact may appear darker and wider than the rest of the drop, with a tail pointing in the direction of the blood's movement
- Smaller, secondary droplets may break off and will land in front of the moving droplets of blood, allowing scientists to determine direction of spatter



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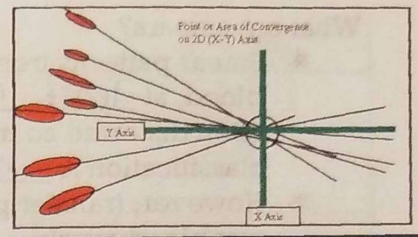
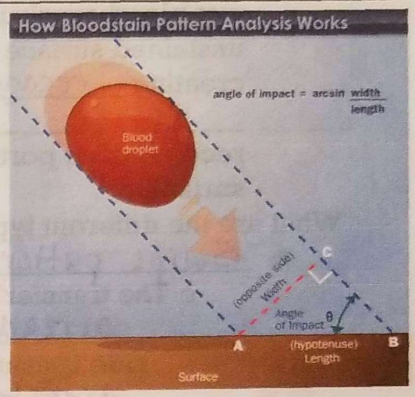
- When there are two or more blood spatters, a scientist can draw lines of convergence that can pinpoint the location of the blood source



Where did the blood come from? Point of Origin

- Measuring the length and width of blood drops and using trigonometry allows us to determine an approximate point of origin.
- Only experienced analysts trained in this technique should perform these measurements.
- Strings can be placed over blood drops along the axes of the stains at the calculated impact angles, and a resulting point of origin can be visualized in three dimensions.
- Angle of impact = the width of the bloodstain in mm / the length of the bloodstain in mm
  - Use the answer to figure of the arc sin of that number (opposite side/hypotenuse)



What are the different kinds of blood spatter?

Passive drops

Passive fall (90° angle to floor) – circular drops w/ secondary satellites

Arterial Gushes

Results from damage to an artery

Splashes

Help show position of victim

Smears

Bleeding victim touching walls or furniture

Blood Trails ~~Treads~~

Victim moving from one place to another

Blood Pools

Victim bleeds heavily

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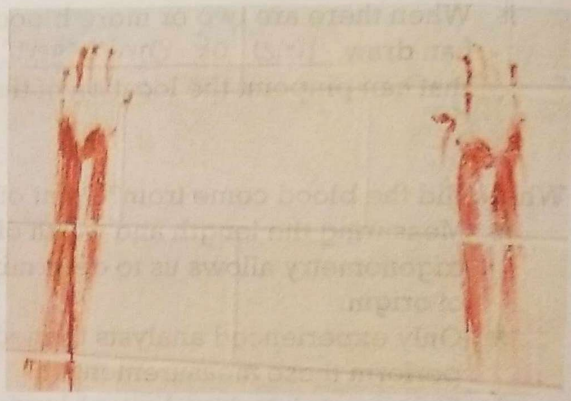
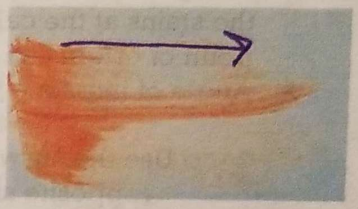
What are smears?

- Smear patterns from a large volume of blood, at least 0.5 mL, are often distorted so much that further classification is not possible
- However, transfer patterns occur when a wet bloody surface contacts a second unstained surface unstained surface creating recognizable mirror image or at least a recognizable portion of the original surface



What are the different types of smears?

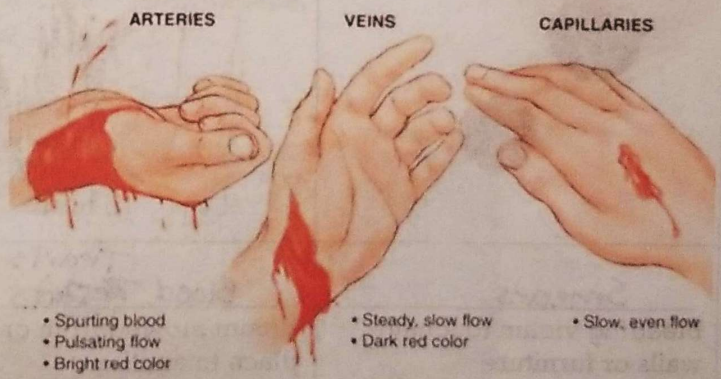
- Swipe pattern
  - The transfer of blood onto a surface not already contaminated with blood. One side is usually feathered which indicates the direction of travel.
  - One common pattern at scenes is a hair swipe - a long thin fine line transfer.

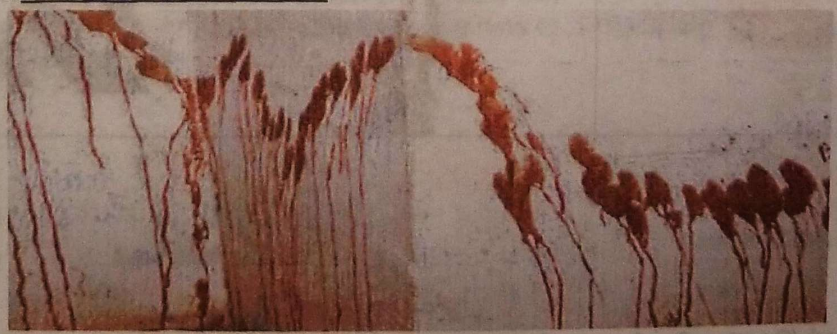


- Wipe pattern
  - Created when an object moves through blood that has not completely dried and moves, removes, or otherwise alters it

What are gushes?

- Arterial spurting usually occurs when an artery is damaged and the blood spurts or gushes from the wound in large volume pulses
- It continues spurting as long as the heart continues beating
- Large drops striking a vertical surface decelerate from air resistance and produce a pattern without spines.
- The drops strike the surface and then characteristically drip or run downward due to their large volume.





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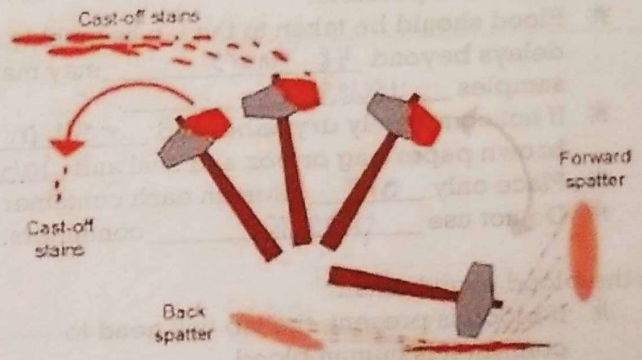
How does speed and velocity impact blood spatter?

	High Velocity	Medium Velocity	Low Velocity
Example	gunshot wound	beating / stabbing	blunt object impact
Size of blood droplets	less than 1mm	1-2mm	4-6mm

What is cast-off?



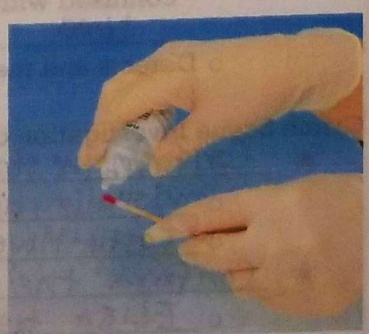
- The movement and the number of swings can often be documented by examining the cast-off pattern.
- During a beating with an instrument which produces the bleeding, blood will not normally collect on the surface of the instrument from the first strike.
- On subsequent strikes at the same location, blood will adhere to the instrument since it now strikes a blood source.
- When the instrument is raised or swung backward, its movement allows small drops of blood to be released from its surface.
- Some of these small drops will strike a surface, often a ceiling, at a 90-degree impact angle

How do you know if there is any blood?

- Even with the most thorough cleaning, blood leaves residue that is difficult to remove

What is Luminol?

- Luminol powder mixed with hydrogen peroxide is able to detect hemoglobin left behind by blood.
- Spray the area and if blood is present it will luminesce for about 20 seconds.
- Reacts with old or new blood, however it destroys the blood so it cannot be tested later



Is it actually blood?

- If blood stains or drops are found, confirm they are in fact blood
- There are many chemical to test for the presence of blood
- Kastle-Meyer Test - swab turns pink if blood is detected

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How is blood evidence collected?

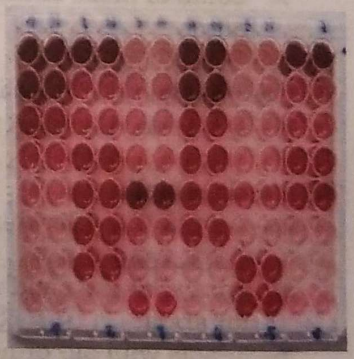
- To be presented accurately and usefully in court, bloodstain evidence must be recognized, documented, preserved, and correctly evaluated.
  - When possible, deliver blood or stained object to lab immediately.
  - If unable to deliver to the Laboratory, or if the object must be mailed, allow the stain to air dry completely before packaging.

- Blood that is in pools should be absorbed by a gauze pad and allowed to air dry. After it dries it should be refrigerated or frozen as soon as possible.
- Blood should be taken to the lab as quickly as possible; delays beyond 48 hours may make the samples useless.
- If not completely dry, label and roll in paper or place in a brown paper bag or box and seal and label container.
- Place only one item in each container.
- Do not use plastic containers.

Is the blood even human?

- If blood is present, the lab will need to confirm it is human blood
- All mammals, except camels and llamas and circular, un-nucleated RBC
- Animals that are not mammals (birds, fish, etc.) have oval blood cells with a nucleus

So how do we know if it is human blood?



- Enzyme-Linked Immunosorbent Assay Test a.k.a. ELISA test
  - Uses antibodies that react to human blood to tell if mammal blood is from human. However, in rare cases, it can be confused with chimpanzee & gorilla blood
  - Detects and measures antibodies in your blood

Crime Scene Investigation of Blood Summary

- Confirm the stain is blood
  - visualization w/ luminol
  - Kastle-Meyer test
- Confirm the stain is human
  - ELISA test
- Determine blood type
  - Antibody test
- Try to determine whose blood it is. If individual information is needed, then do DNA analysis