Blood

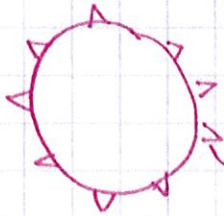
Consists of:

1. plasma - fluid portion of unclotted blood, mainly H_2O, makes up 55% of blood
2. erythrocytes - red blood cells
3. leukocytes - white blood cells
4. platelets - tiny cells that help your body form clots to stop bleeding

(45% blood)

5. serum - liquid that separates from blood when a clot forms (pale-yellowish liquid)

Blood Types



red blood cell

antigens - proteins that stimulate the body to produce antibodies against it
- A or B & Rh

antibodies - proteins in blood serum that destroy or inactivate a specific antigen

There are actually 15 blood antigen systems (only responsible for 2)

(1) ABO system

A
B
AB
O

(2) Rh system (D factor) → Rhesus

Rh+ (have Rhesus factor)
Rh− (do not have the Rhesus factor)

Blood type	antigen in red blood cell	antibodies in serum
A	A	anti-B
B	B	anti-A
AB	A & B	neither anti-A or anti-B
O	neither A or B	both anti-A & anti-B

Agglutination - clumping together of red blood cells by an antibody.

Blood Testing

+ clumped
− no clumping

Antigen on blood cell	Anti-A + blood	Anti-B + blood	Blood Type	Rh + blood
A	+	−	A	
B	−	+	B	
AB	+	+	AB	
O	−	−	O	
			+	+
			−	−

Blood Donation

Type	Can give blood to	Can get blood from
A	A or AB	A or O
B	B or AB	B or O
AB	AB	A or B or AB or O
O	A or B or AB or O	O

universal receivers

universal donors

Bloodstain Pattern Analysis Notes

General Features of Bloodstain Formation - Info that can be obtained from interpreting blood patterns

- the direction the blood originated
- the angle at which the blood hit a surface
- the location/position of victim when hit
- the movement of a bleeding individual
- the minimum # blows
- the approximate location of individual hitting.

pic. #1

Other Relevant Info:

- useful in reconstructing the order of events in a crime
- controlled experiments using exact surface bloodstain occurred

Surface Texture - extremely important

- harder, nonporous surface - results in less spatter Ex) glass or smooth tile
- rough surface - result in irregularly shaped spatter w/ serrated edges
- satellites

tiny blood drop around a main drop

Direction of Blood

Travelling blood shows the direction it was travelling when it hit the surface. It's more elliptical w/ the pointy tail pointing in the direction blood was moving.

pic #2

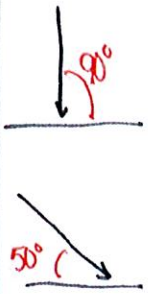
→ travelling left to right

Angle of Impact

- done by measuring circular distortion of the stain
  - 90° (vertical drop to surface)
    - stain is circular
  - as angle decreases, the stain elongates

$$\measuredangle = \sin^{-1}\left(\frac{\text{width of stain}}{\text{length of stain}}\right)$$

pic #3



Impact Bloodstain Spatter Patterns - many droplets of blood

Impact Spatter: most common, produced when an object makes forceful impact w/ a source of blood, project blood away from a source.

pic #4

Forward Spatter: blood travelling in same direction as the force away from the source

Back Spatter: (blow-back spatter) - blood directed back toward the " source

Classifying Impact Spatter

Low Velocity Spatter: a lot of large separate or compounded drops
- diameter is 4 mm or more
- applied force is 5ft/s or less

Ex) slapping

See pic. #13

Medium Velocity Spatter: small droplets
- diameter is 1mm - 4mm
- applied force is 5-25 ft/s

Ex) hitting w/ golf club

High Velocity Spatter: very small droplets
- diameter 1mm or less
- applied force 100ft/s or more

Ex) gunshot or explosion

Origin of Impact

Area of Convergence: area on a 2-dimensional plane from which the blood originates
- Draw straight lines thru the long axis of several blood droplets, following the line of their tails. Where they all meet (converge) is the area of convergence.

Pic #6

Area of Origin: the area in 3-D space from which the blood was produced.
- String Method
1) Find the area of convergence & angle of impact
2) Place a pole/stand as an axis on area of convergence
3) attach one end of string by the droplet, place a protractor next to it & lift the string until it matches the angle of impact. Attach string to pole.

Other Bloodstain Spatter Patterns

Gunshot Spatter:
forward spatter from exit wound
back spatter from entry wound

Cast-Off Spatter: created when a blood covered object fling in an arc onto a nearby surface

Pics #5 & 7

Arterial Spray Spatter: occurs when a victim suffers an injury to a main artery or the heart. Beating heart pumps pressurized blood to spurt out of wound
- bright red blood

see pic #14

Expirated Blood Spatter: expelled blood from the mouth or nose from an internal injury
- may have bubbles of air in it
- may be lighter in color if mixed w/saliva

Void Patterns: when an object blocks the deposition of blood spatter on a surface
- give clues to size & shape of missing object/person

Pools: blood collected on a flat surface in undisturbed place
- can be absorbed by bed, sofa, or rug.
- stain can skeletonize - edges dry faster than rest of blood & stain of outline remains when blood is cleaned.

Drip Trail Patterns: drops of blood coming from a moving object or person
- often seen in stabbings
- can show direction & speed person was moving

pic #12

Documenting Bloodstain Evidence
- Note & photograph each pattern, & sketch
  - overall scene
  - medium shots
  - close ups w/ a ruler

Contact/Transfer Pattern - when a bloody object touches another object w/o blood
- Ex fingerprints, footprints, tool prints, fabric prints
- swipe patterns - a bloody moving object crossing a surface

pics #8 & 9

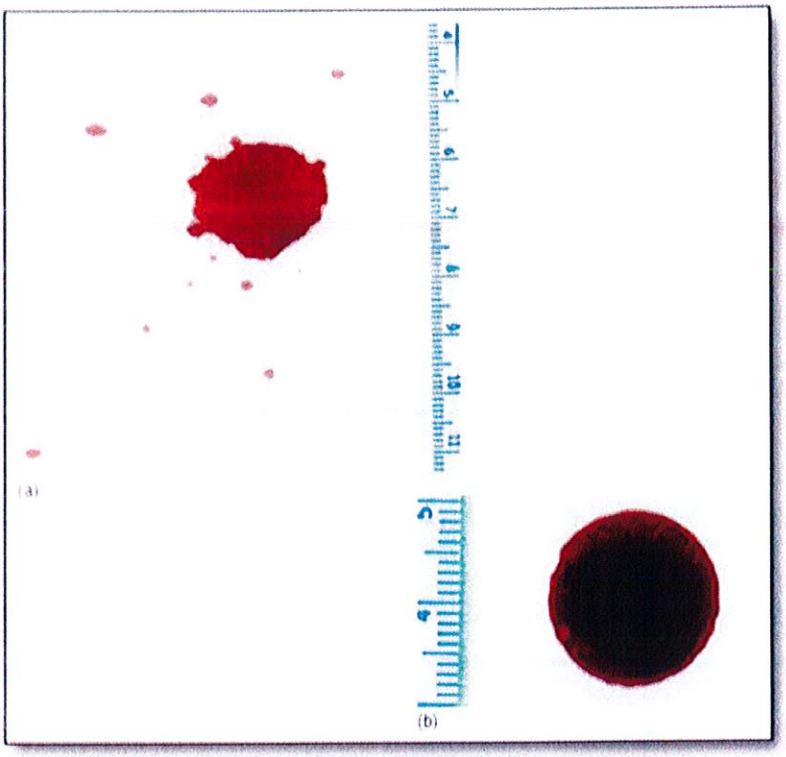
Flows - patterns made by drops of blood flowing due to gravity
- change in direction of flow means the body was moved

pic #10

FIGURE 11–3 (a) A bloodstain from a single drop of blood that struck a glass surface after falling 24 inches. (b) A bloodstain from a single drop of blood that struck a cotton muslin sheet after falling 24 inches. *Courtesy A.Y. Wonder*

#1

satellite spatter
Small drops of blood that are distributed around the perimeter of a drop or pool of blood and were produced as a result of the blood impacting the target surface.



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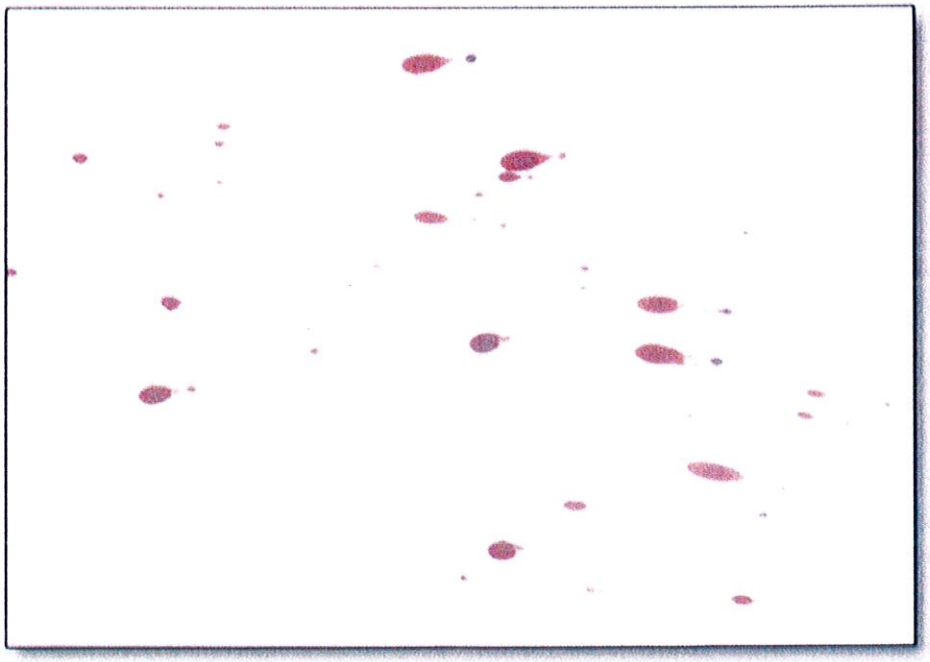


FIGURE 11–4 A bloodstain pattern produced by droplets of blood that were traveling from left to right. *Courtesy A.Y. Wonder*

#3

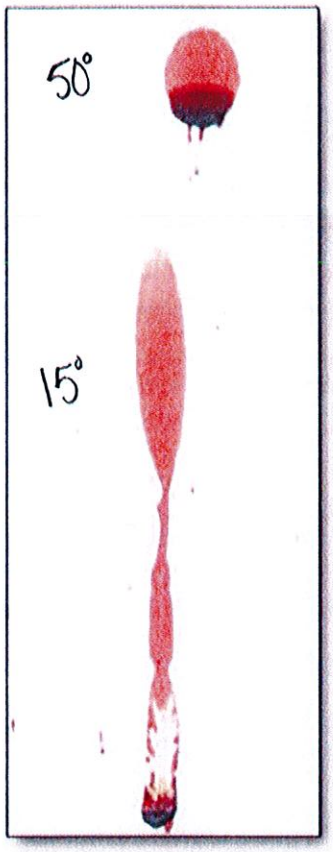


FIGURE 11–5 The higher pattern is of a single drop of human blood that fell 24 inches and struck hard, smooth cardboard at 50 degrees. On this drop the collection of blood shows the direction. The lower pattern is of a single drop of human blood that fell 24 inches and struck hard, smooth cardboard at 15 degrees. On this drop the tail shows the direction. *Courtesy A. Y. Wonder*

#4

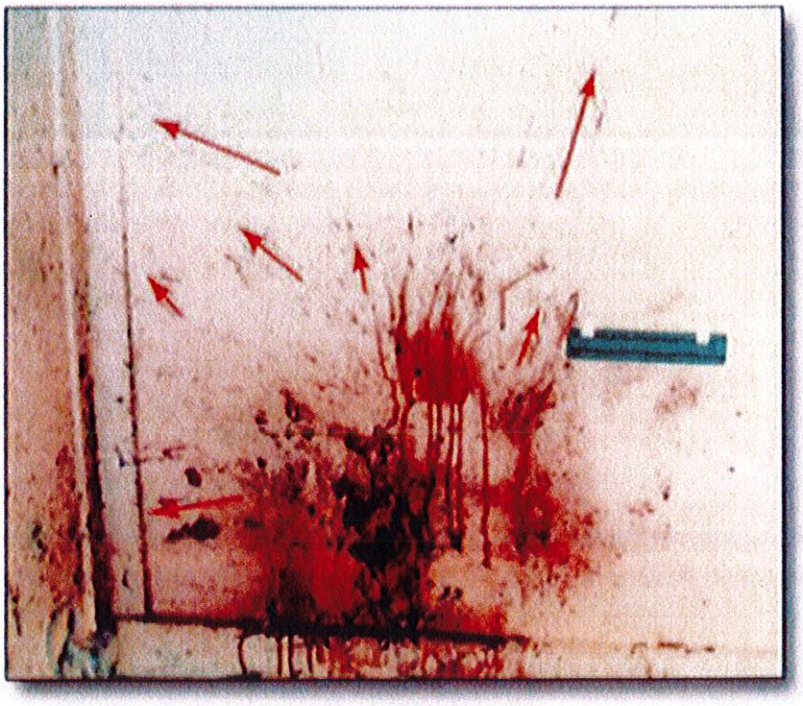


FIGURE 11–6 Impact spatter produced by an automatic weapon. The arrows show multiple directions of travel for skull fragments emanating from the gunshot. *Courtesy A. Y. Wonder*

#5

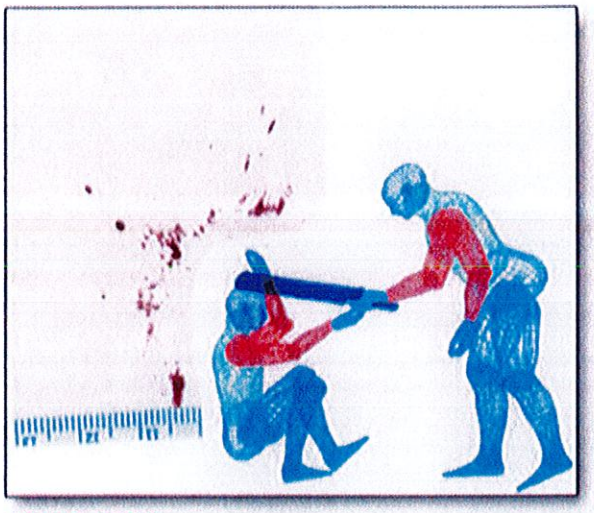


FIGURE 11–7 A

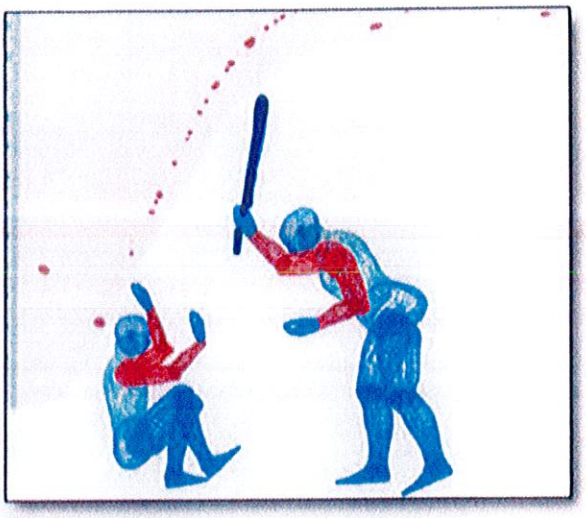


FIGURE 11–7 B

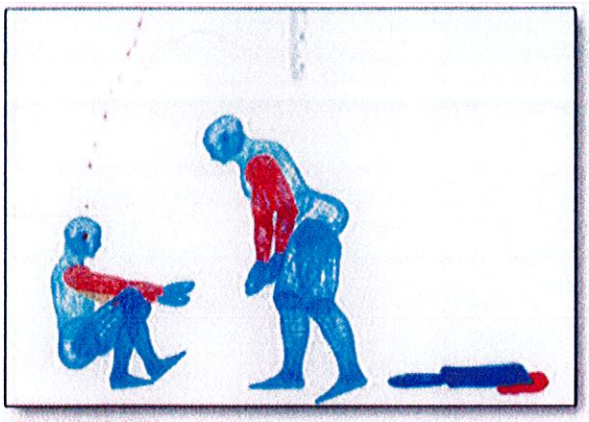


FIGURE 11–7 C

FIGURE 11–7
(a) The action associated with producing impact spatter.
(b) The action associated with producing cast-off spatter.
(c) The action associated with producing arterial spray spatter.
Courtesy A.Y. Wonder

#6

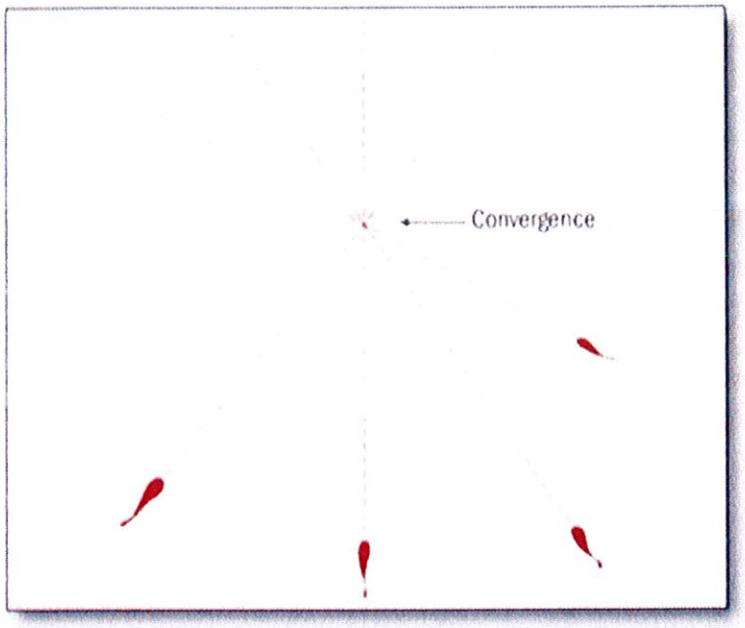


FIGURE 11–8 An illustration of stain convergence on a two-dimensional plane. Convergence represents the area from which the stains emanated. *Courtesy The Institute of Applied Forensic Technology, Ocoee, Florida*

#7

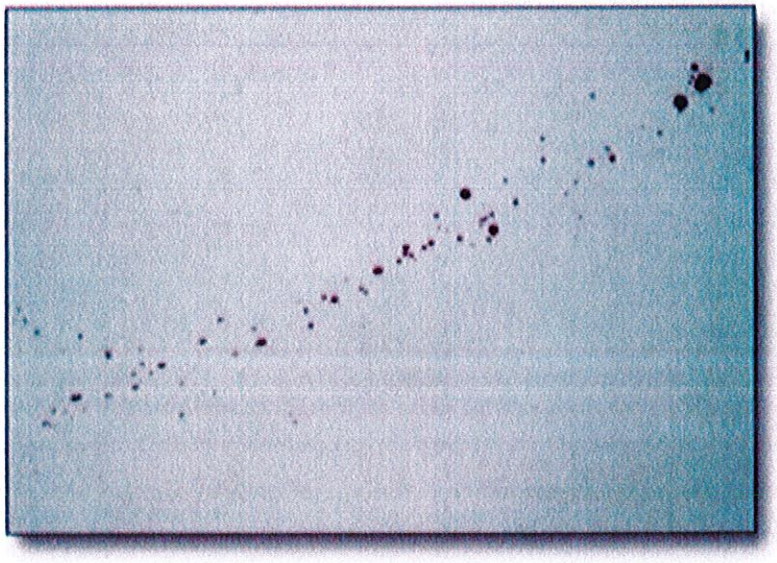


FIGURE 11–11 The cast-off pattern created from one backward and one forward motion of an overhand swing. The larger drops are away from the victim because they're made when the weapon holds the greatest amount of blood. The smaller spatters are directed toward the victim. *Courtesy Bloodstain Pattern Evidence by A.Y. Wonder, p. 295. Copyright Elsevier, 2007*

#8

FIGURE 11–15 A transfer pattern consisting of bloody fingerprints with apparent ridge detail. *Courtesy Lawrence A. Presley, Arcadia University.*

#9

FIGURE 11–16 A series of swipe patterns moving from right to left. *Courtesy A. Y. Wonder.*

#10

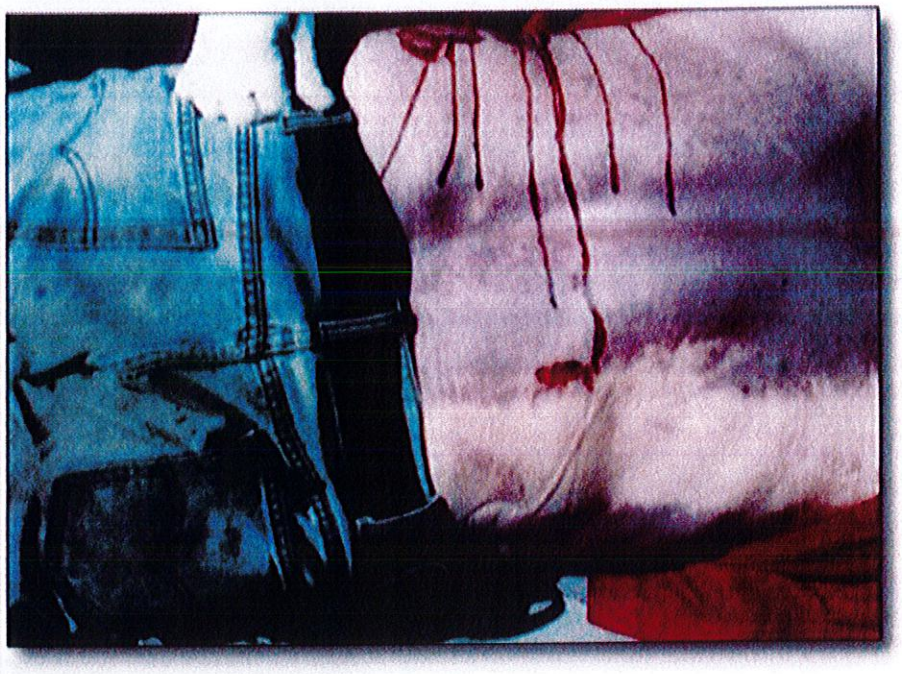


FIGURE 11–17
The flow pattern suggests that the victim was upright and then fell while blood flowed. The assailant claimed the victim was stabbed while sleeping. *Courtesy Bloodstain Pattern Evidence by A.Y. Wonder, p. 98. Copyright Elsevier, 2007.*

#11

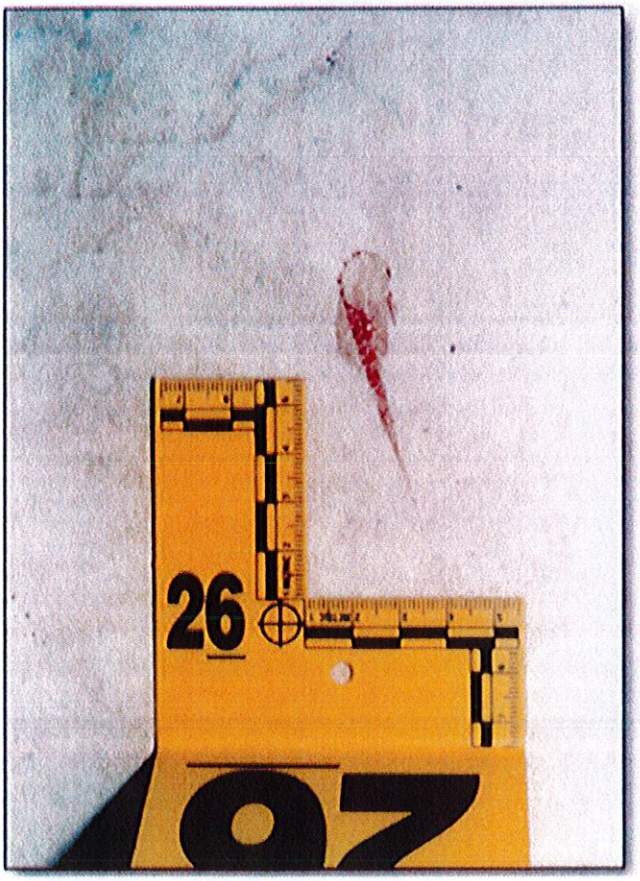


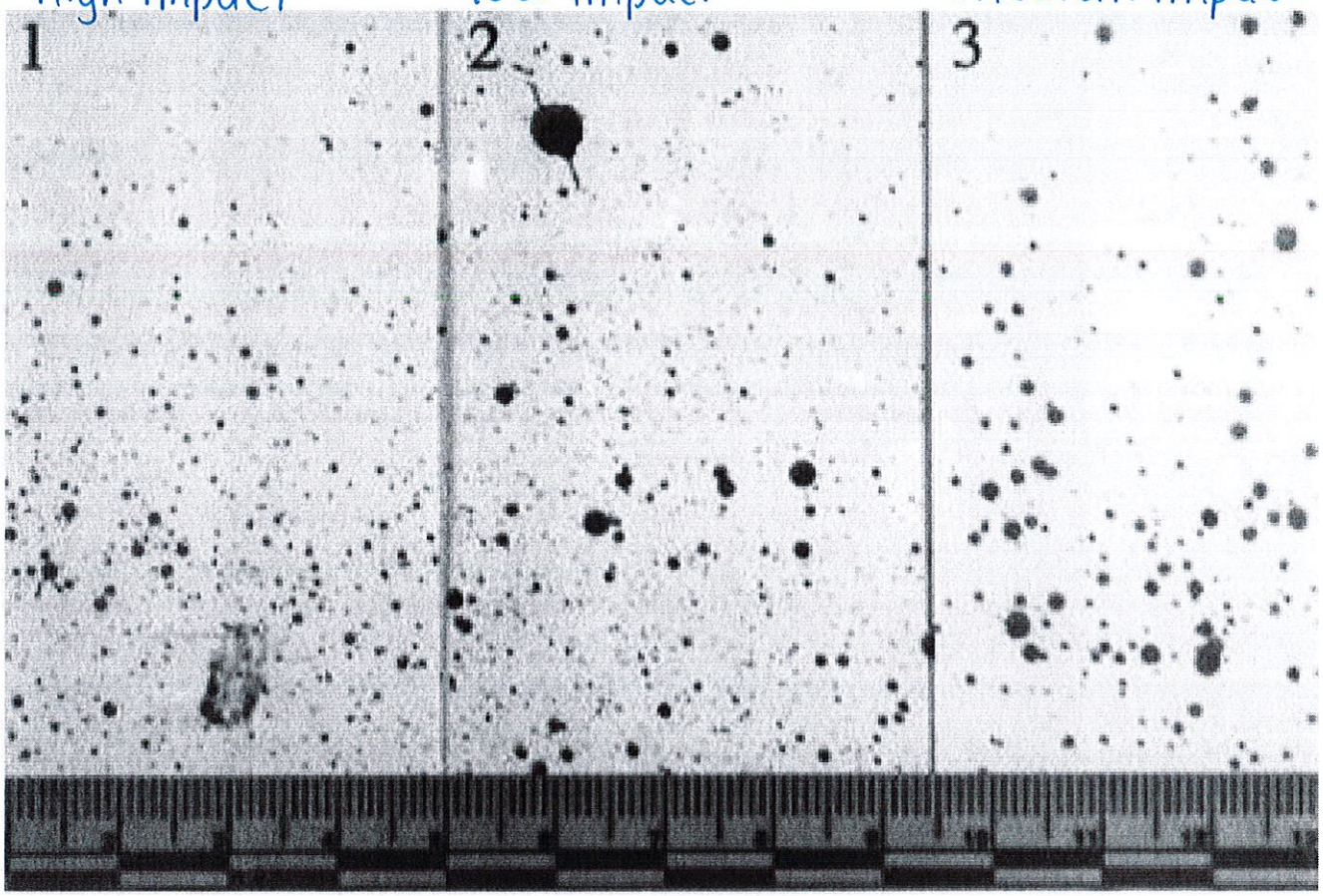
FIGURE 11–18
Skeletonization is shown in a bloodstain that was disturbed after the edges had time to skeletonize. *Courtesy A.Y. Wonder.*

FIGURE 11–19
A drip trail pattern leads away from the center of the mixed bloodstain pattern
Courtesy Norman H. Reeves, Bloodstain Pattern Analysis, Tucson, AZ, www.bloody1.com

#12

#13

high impact | low impact | medium impact



#14

Arterial gush or spurt

- Bloodstain pattern (s) resulting from blood exiting the body under pressure from a breached artery.