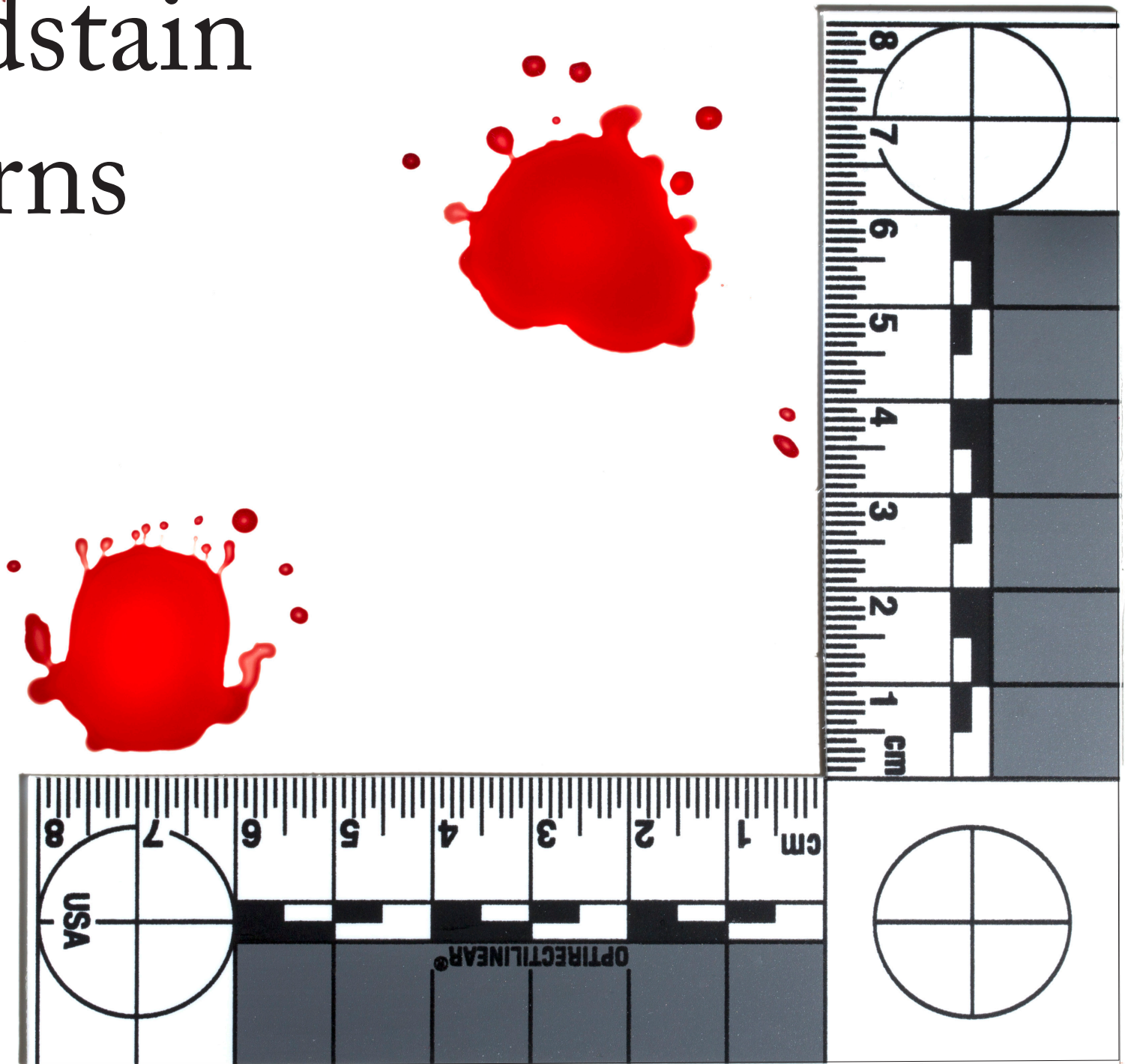


# Bloodstain Patterns

Katherine Snyder

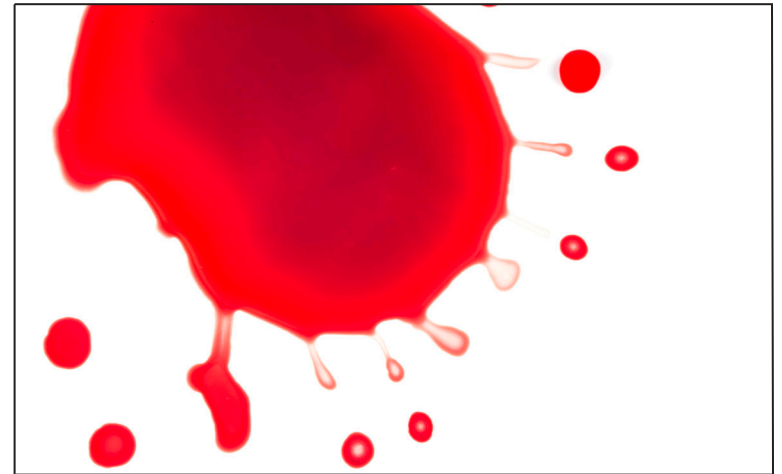


# Anatomy of a Passive Blood Drop

Blood drops can take many different shapes, but initially the surface tension of blood causes it to take on a spherical shape upon separating from the source. The blood will only change shape from impact. Therefore, most blood spatter begins with a perfect circle. After impact, the blood drop can gain tails (elongation), crowns, spines, and satellites.

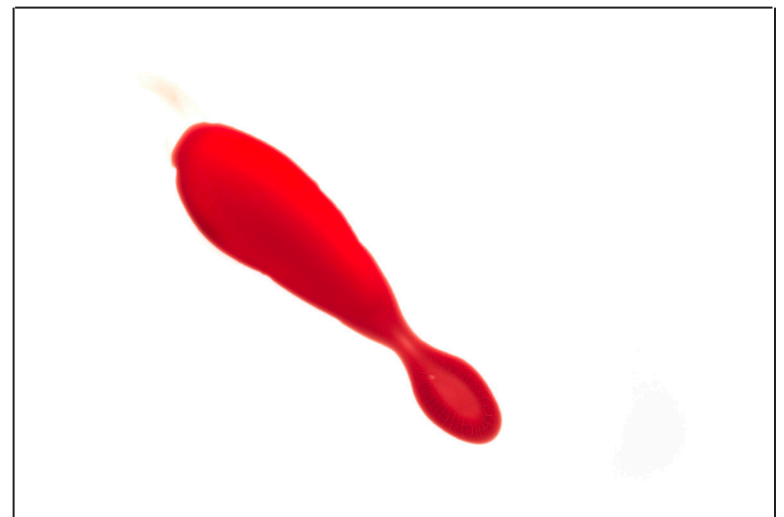


A singular drop that was expelled from a low height so that no other shapes were formed.



This drop formed a crown, spines, and satellites. The satellites can be seen as the individual drops that are not connected to the crown. A crown is the collection of spines seen on the right side of the blood drop.

The drop shown below has developed a tail, most likely from the angle the drop fell at before impact.



# Impact

When the blood falls from the source, the circular droplet essentially splashes out of itself to create the different patterns that are visible to the human eye. There are four phases of impact: contact and collapse, displacement, dispersion, and retraction.



**1 Contact and collapse:** When the droplet comes in contact with a surface, it begins to collapse within itself. The top part of the droplet remains intact, and most of the blood is pushed outward, forming a ring.



**2 Displacement:** Once the droplet has finished collapsing, the remaining blood that did not form the rim is pushed out, which forms an irregular edge on the droplet. However, the surface tension is not yet broken on the droplet so it remains as one entity.



**3 Dispersion:** The blood that is pushed outward breaches the rim and forms the patterns that are easily recognizable. These include crowns and other slight abnormalities. With more acute angles of impact, the patterns that form are forced out on one side of the droplet, causing the patterns to only appear on the opposite side of impact.



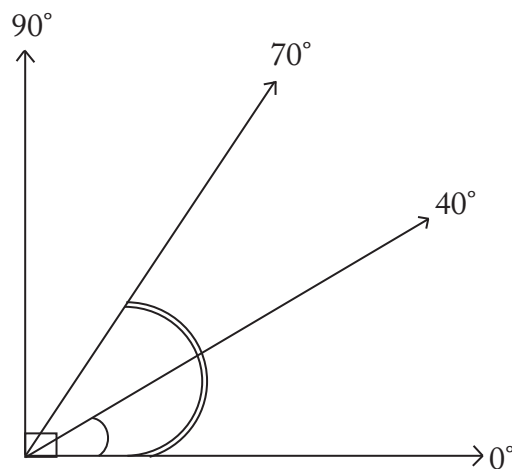
**4 Retraction:** The surface tension of the droplet is finally broken and tails, spines, and satellites are formed.

# Angle of Impact

The angle of impact can be seen from the presence of elongations or tails. The longer the tail, the more acute the angle of impact.

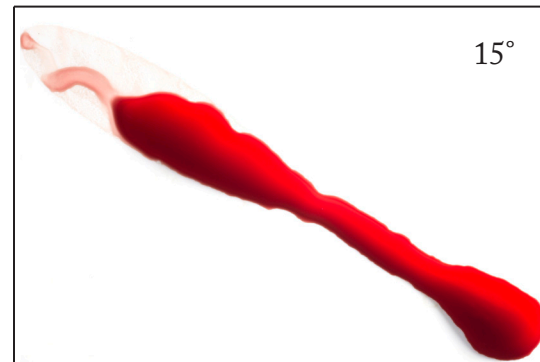
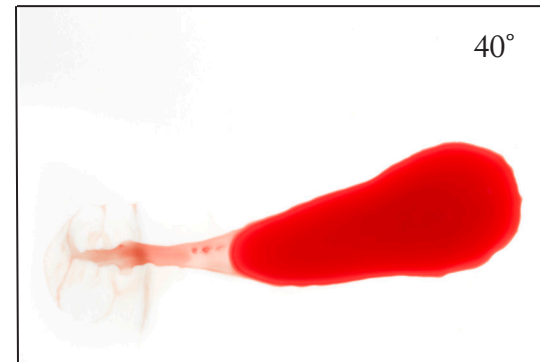
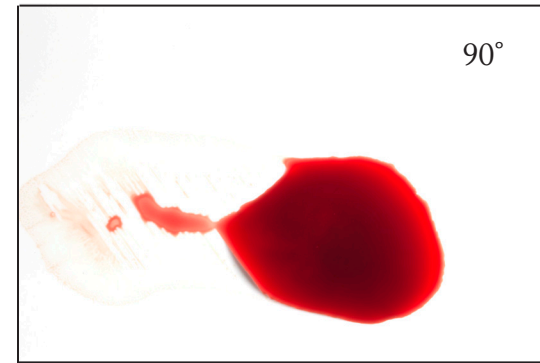
Under forty degrees generally creates a second impact, making a recognizable exclamation point pattern. Drops that fall between forty and seventy degrees have spines and tails, however still have a very circular shape to them. The distinctive patterns that emerge are generally concentrated to the opposite side of the angle of impact. Drops that fall above seventy degrees are generally perfectly circular, but do have spines and satellites. Drops that fall between seventy-five and ninety degrees are virtually indistinguishable from each other.

The angle of impact can be calculated by measuring the length and the width, and dividing the width by the length. Find the arcsine of the found number and that is the angle of impact. It is important to not include the tail when measuring, but only the initial droplet.



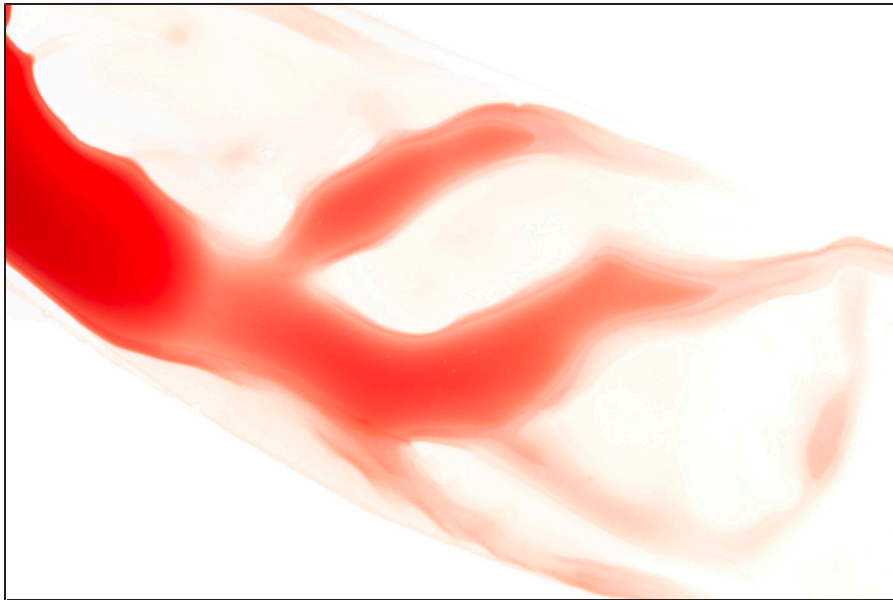
$$\text{width} \div \text{length} = A$$

$$\arcsin(A) = \text{angle of impact}$$

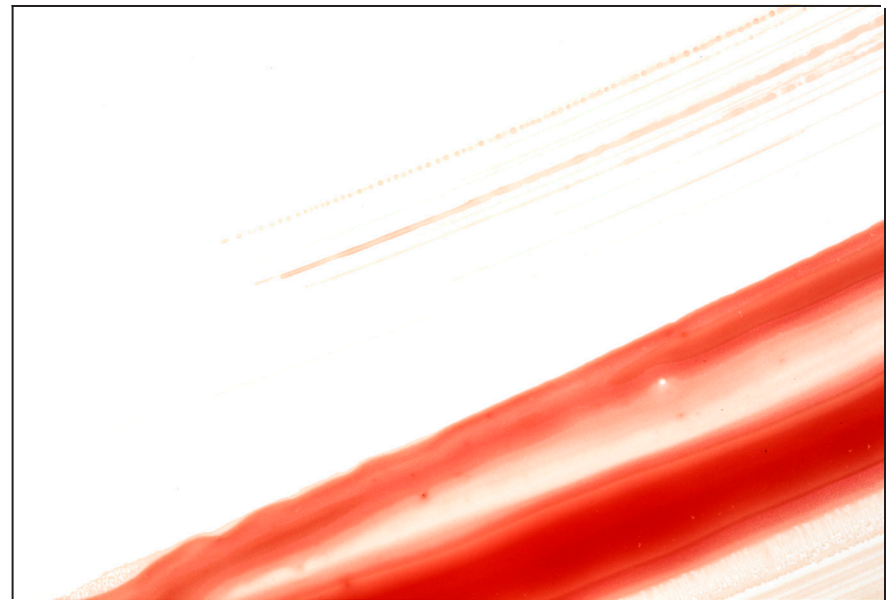


# Blood Transfer

Transfer patterns occur when an item comes in contact with a blood droplet, and transfers some of the blood away from the initial impact place. This can include wipes, pattern transfers, and drags.



This image shows a pattern transfer from a crumpled rubber glove. Pattern transfers can occur when an item becomes saturated in blood, then touches another surface, which results in the item's appearance showing up in blood. Common pattern transfers include shoe prints and hand prints.



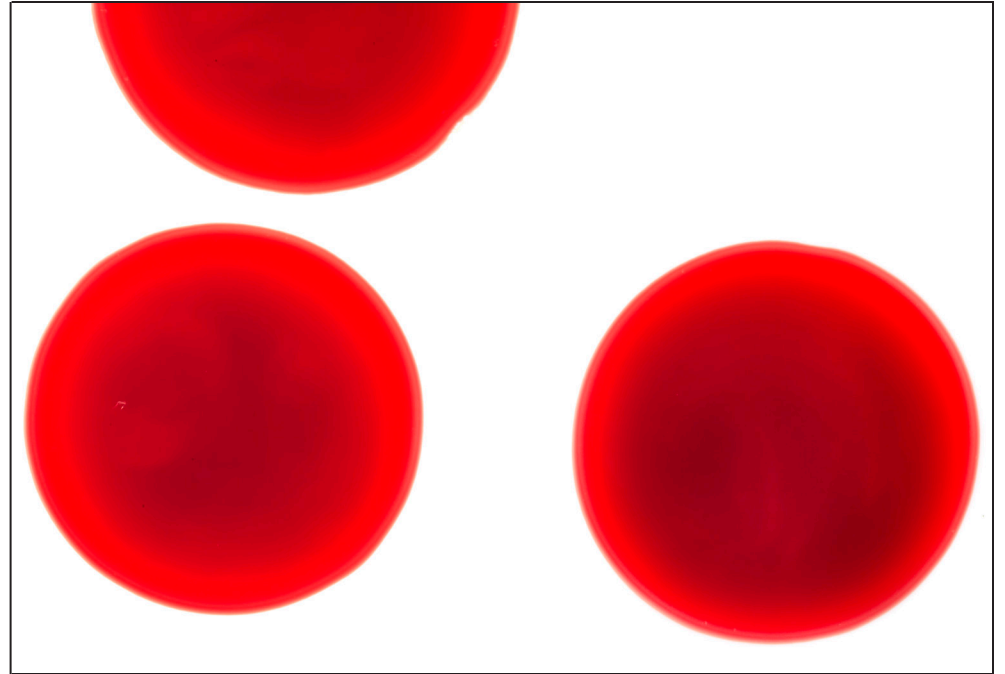
A drag is shown in this image. Drag marks most often occur when an item, person, or appendage becomes saturated in blood, and is dragged across a surface. Common drag marks seen include hand prints across walls, and bodies across the ground.



# Passive Blood Stains

Passive blood drops occur when blood drips off of a weapon or a person. This is the most common type of spatter and generally indicates gravity acting on an injured person. These are typically characterized by pooling, similar drops, and flowing. Double drips occur when a drop of blood drips into the same location twice, creating a series of satellite drops.

Top: Similar Drops  
Bottom Left: Double Drip  
Bottom Right: Pooling



# Cast Off

Cast off occurs when a weapon has come in contact with a body and is swung again. Blood is flung off the weapon and comes in contact with a surface. This is a dynamic blood stain, which is when blood is forcefully ejected from a source.

This pattern is extremely easy to identify, as all of the cast off drops have the same shape. Since all of the drops had the same angle of impact, they all formed similar elongations. The elongations point in the direction of the motion. Cast off generally is found in only one direction, however, if a weapon is swung multiple times the elongations may vary slightly.

The directionality of the pattern is extremely important to figuring out the scene of the crime because it indicates where in a scene the crime took place as well as how many blows occurred. Since cast off is a motion based pattern, simply counting the number of arcs will indicate roughly how many strikes the victim sustained.



Cast off from a serrated knife

# How to Photograph Blood Stains

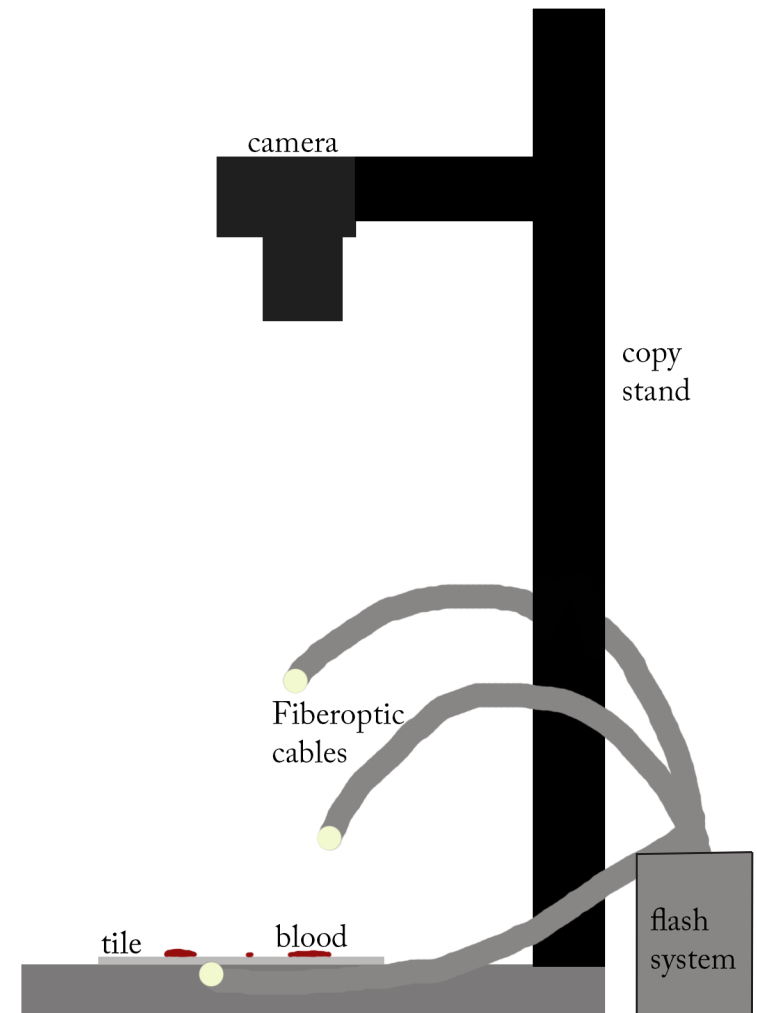
The images in this article were photographed using a Canon 6D and either a 65 millimeter macro lens or, in the case of the cover, a 100 millimeter macro lens.

All images were shot at ISO 100, 1/125th of a second, and f/16.

The images were all lit with the Microptics ML-1000 Fiberoptic Illumination System on half power.

The background was a tile to allow for easy cleaning between shots, and a plastic drop cloth was placed under the entire setup to protect all of the surrounding surfaces from blood.

To create a more authentic setup, defibrinated sheep blood was used. The defibrination process is important for use in an academic setting, as the blood has been sterilized to prevent the spread of pathogens. Since the fibrin is removed, the defibrinated blood does not clot, which enables the blood to be used for longer periods of time.





# About



Katherine Snyder is currently studying biomedical photographic communications and criminal justice at Rochester Institute of Technology. After she graduates in the spring of 2017, she is hoping to work in the forensic photography field.

## Contact

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www.katherinesnyderphoto.com

# Bibliography

Information on blood stains and the calculations required for calculating their angles of impact can be found at these sources:

<http://www.forensicssciencesimplified.org/blood/principles.html>

[http://www.crimescene-forensics.com/Crime\\_Scene\\_Forensics/Bloodstains.html](http://www.crimescene-forensics.com/Crime_Scene_Forensics/Bloodstains.html)

[http://www.bmi.gv.at/cms/bmi\\_siak/4/2/1/ie2012/files/brodbeck\\_ie\\_2012.pdf](http://www.bmi.gv.at/cms/bmi_siak/4/2/1/ie2012/files/brodbeck_ie_2012.pdf)