Stringing Bloodstains: Real World Applications of Mathematics and Physics

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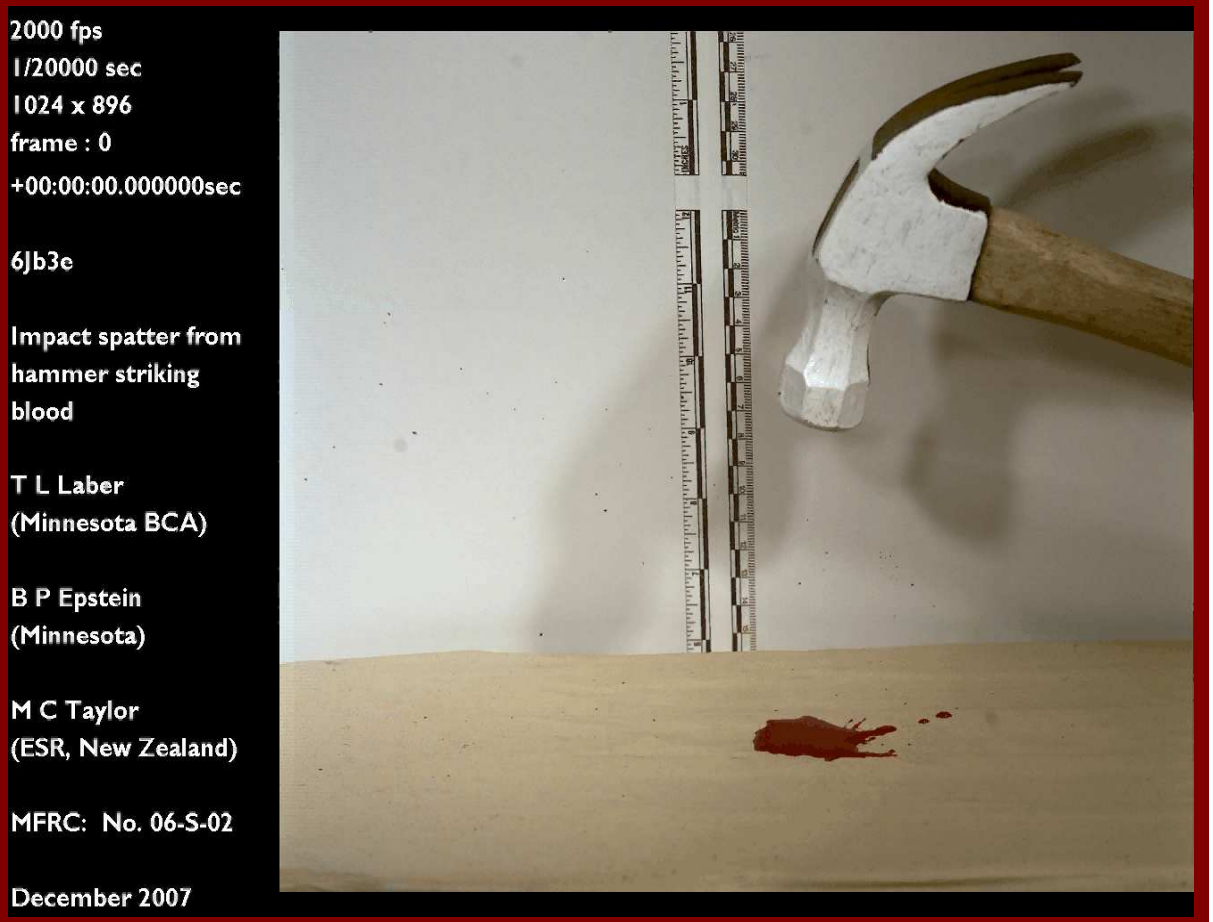
Projectile Motion Activity
Find the Position of the Blood Source

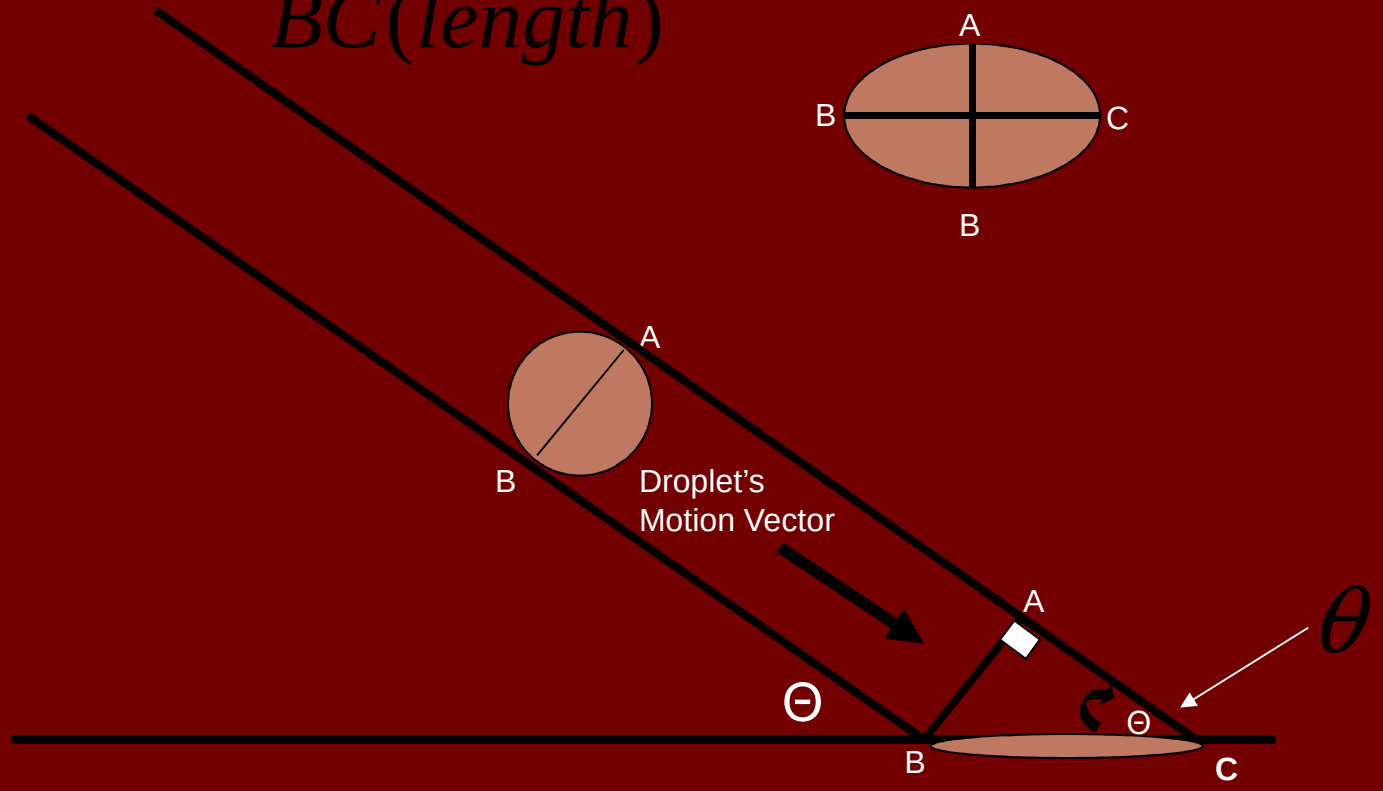
- Blood in flight obeys laws of gravity—a projectile
- Use impact spatter due to blunt force trauma
- Use trigonometry to locate position of source

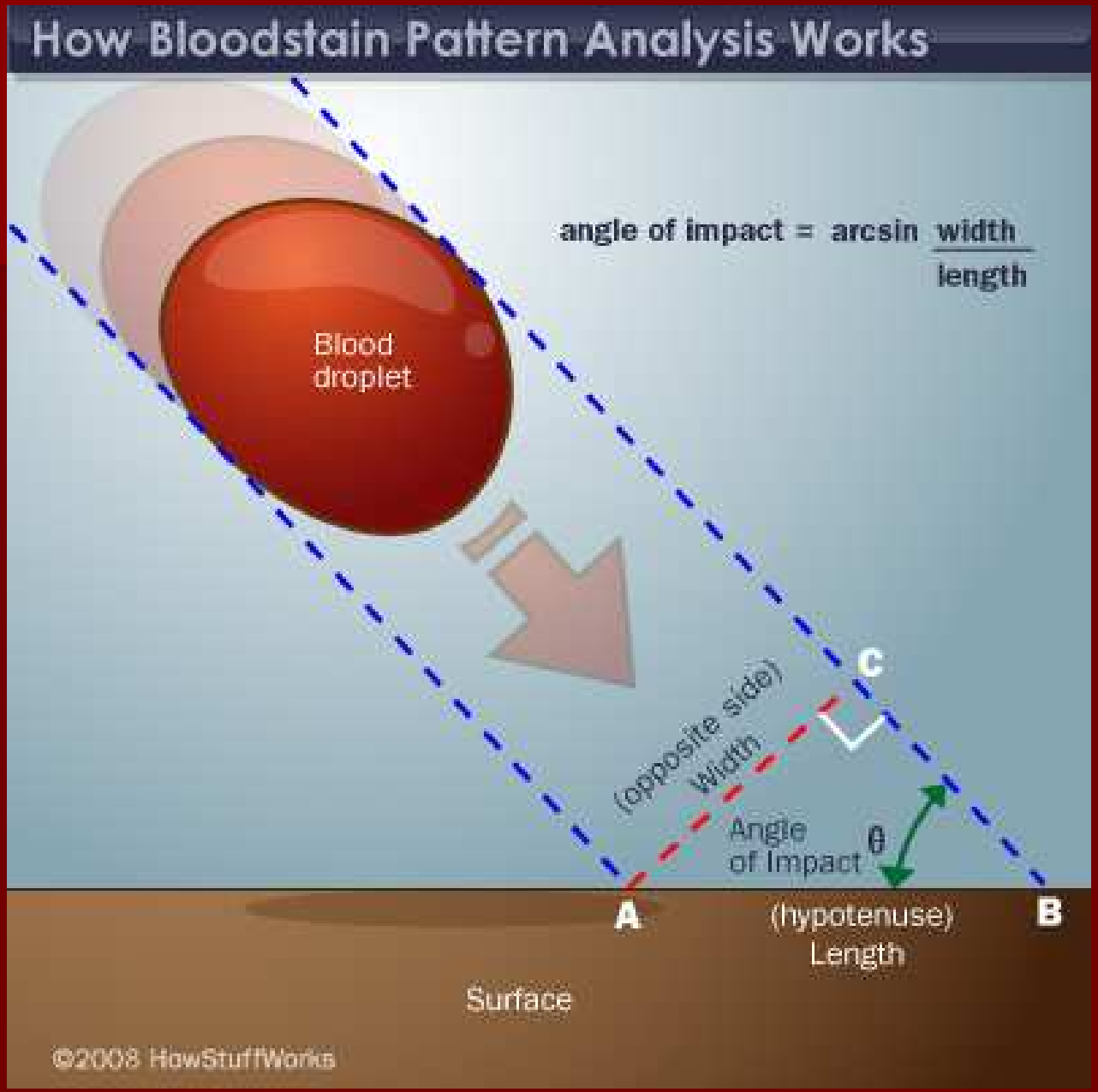


Blood cast onto a surface at an angle has an elliptical shape

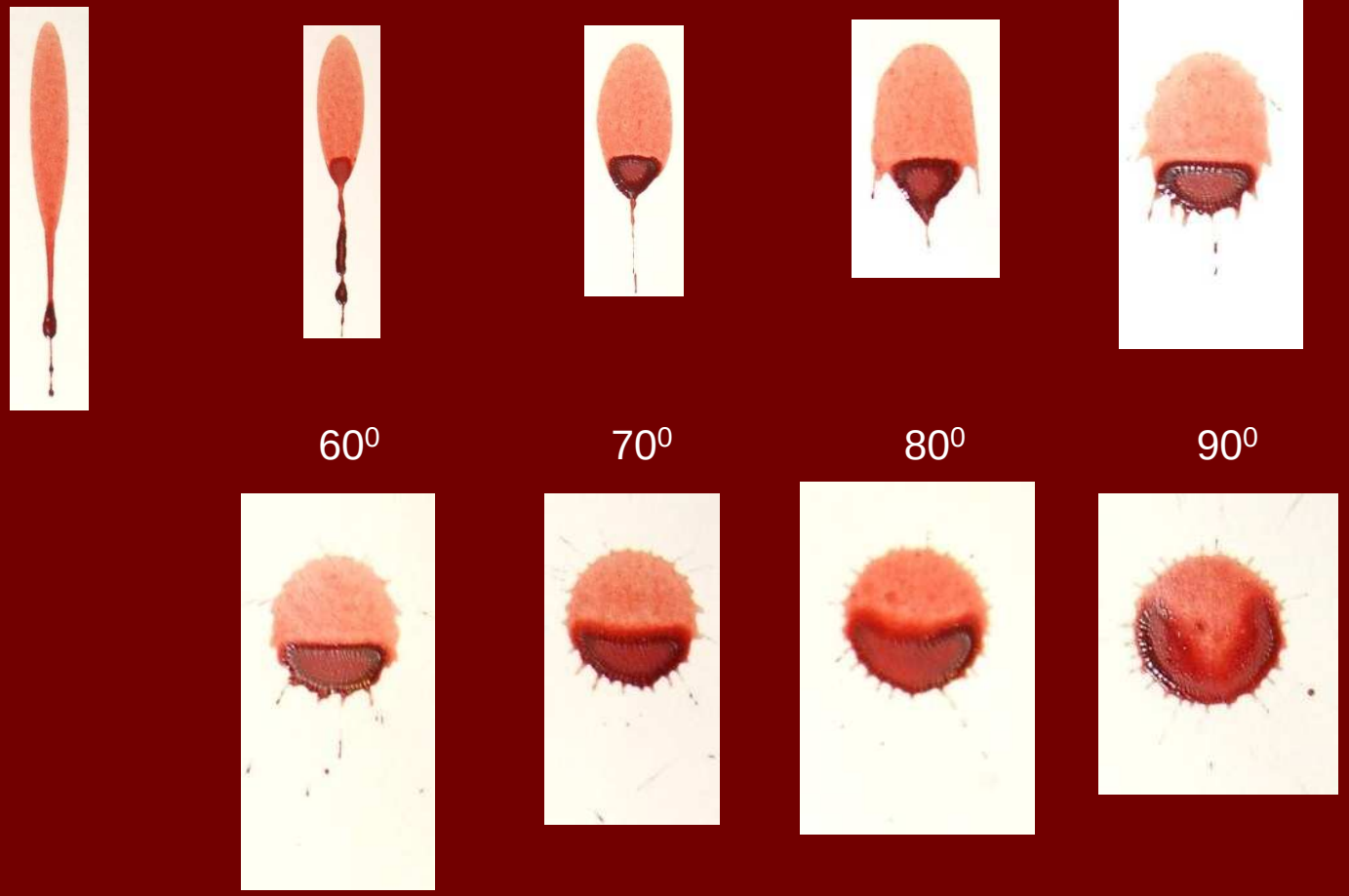
Analyzing the Motion of a Blood Droplet

$$\theta = \sin^{-1} \frac{AB(width)}{BC(length)}$$



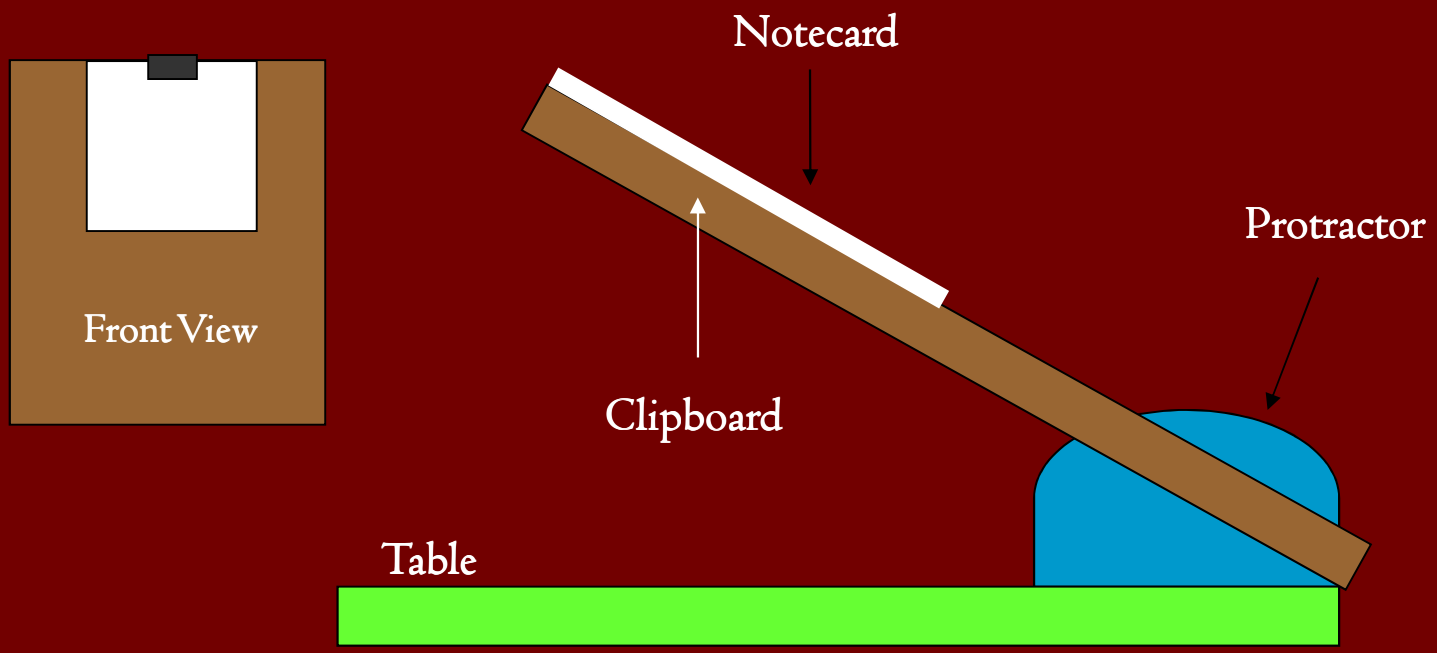


Typical Blood Shapes At Various Impact Angles



Simulating Angled Blood Drops

- Impact Angle Apparatus

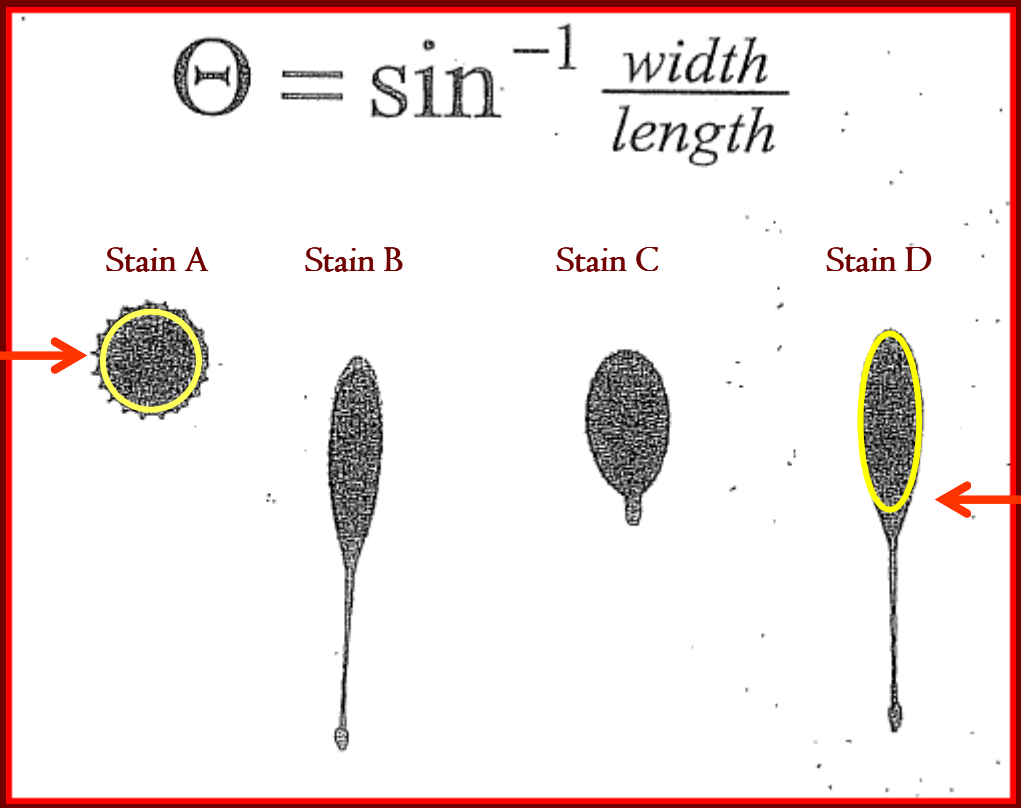


Mathematics of Bloodstains

Measure width & length of bloodstain to determine impact angle.

$$\Theta = \sin^{-1} \frac{width}{length}$$

Measure only the *round* part of the stain-not the spines



Measure only the *ellipse* of the stain-not the tail

Calculating Impact Angle—Practice Sheet

- Check your answers (lengths in mm):

  Stain A: W/L=12/12 90^0

  Stain B: W/L=6/20 18^0

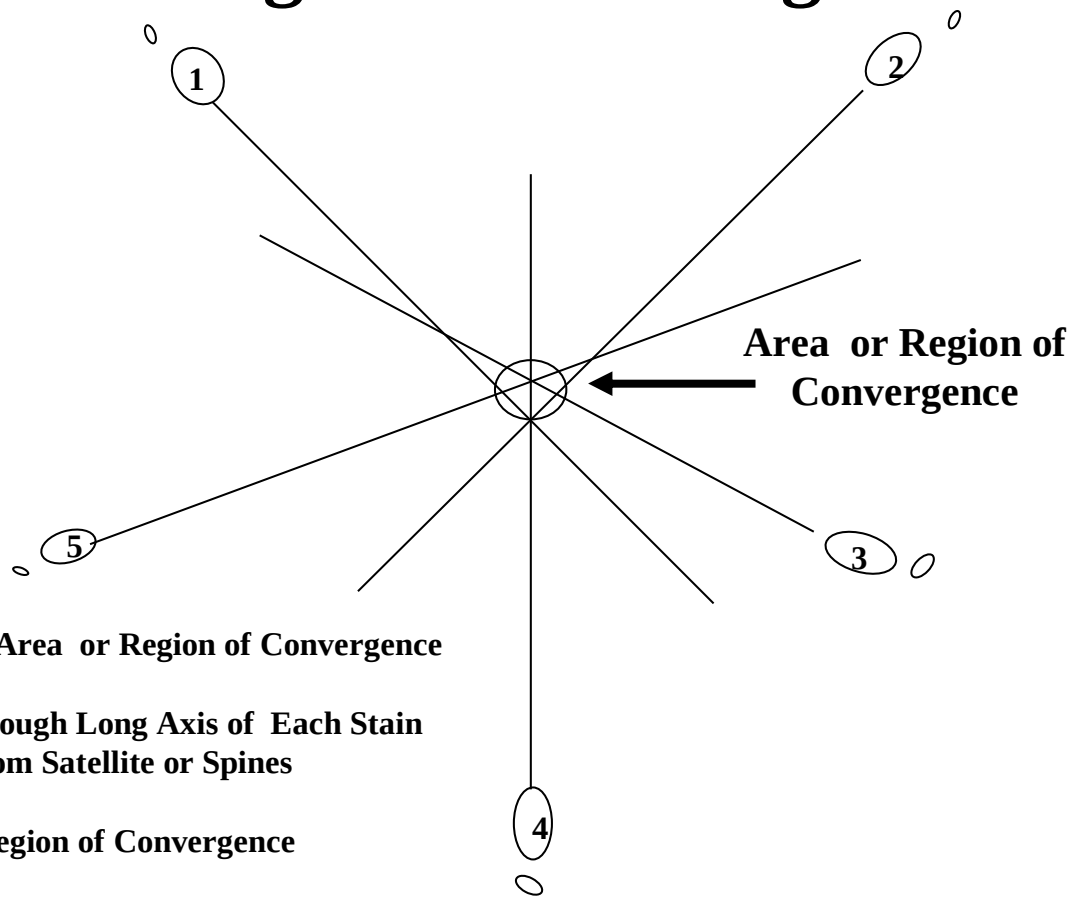
  Stain C: W/L=10/16 39^0

  Stain D: W/L=7/19 22^0

- How did you do? Questions?
- Narrow bloodstains (small angles) give the most accurate results!

Area of Convergence

Area or Region of Convergence

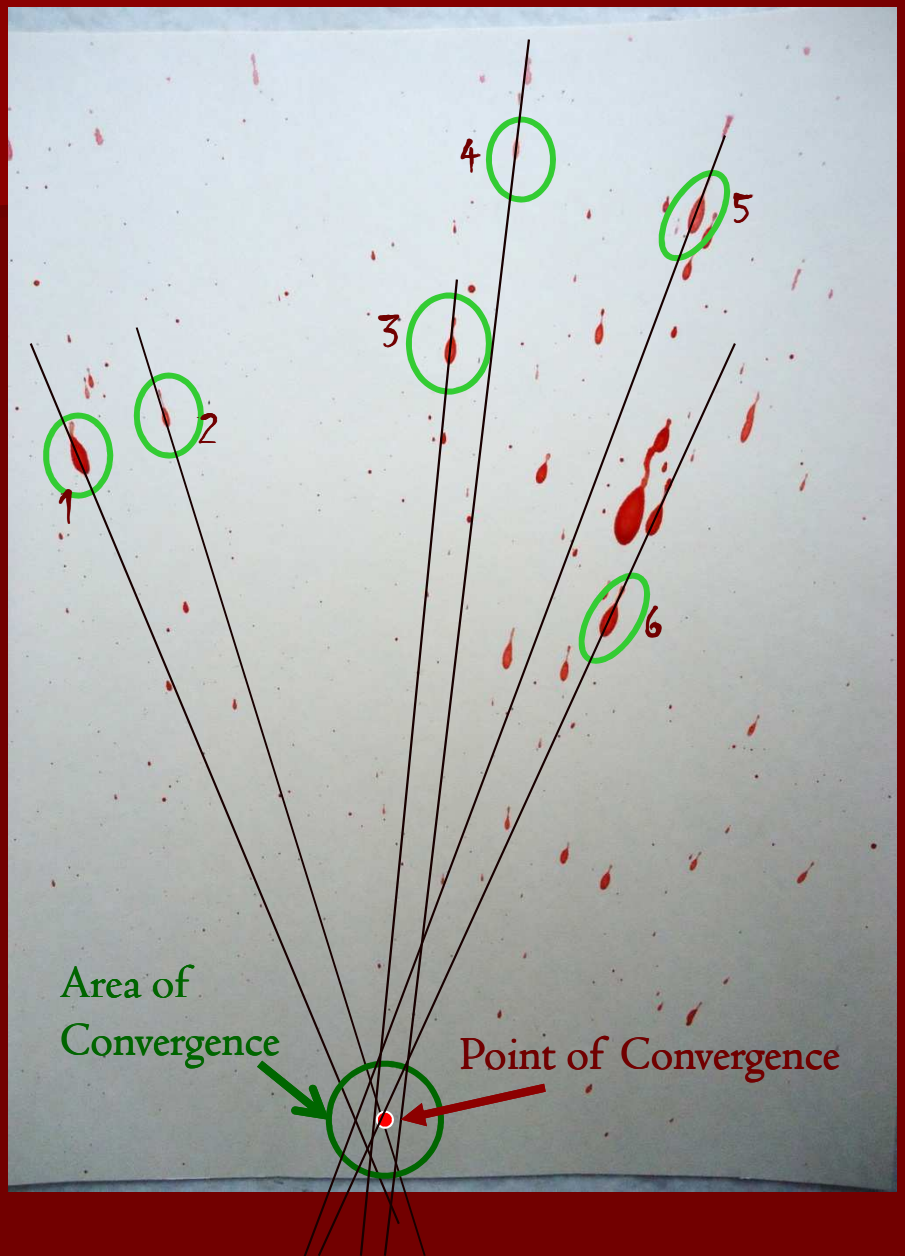


Steps to Determine Area or Region of Convergence

1. **Contruct Ray Through Long Axis of Each Stain Leading Away From Satellite or Spines**
2. **Locate Area or Region of Convergence**
3. **The Center of that Area is Working Point for Origin**

FSW 1998

Area of Convergence & Point of Convergence



- This is the two dimensional point of origin
- From this point the third dimension-Z plane will be determined using trigonometry

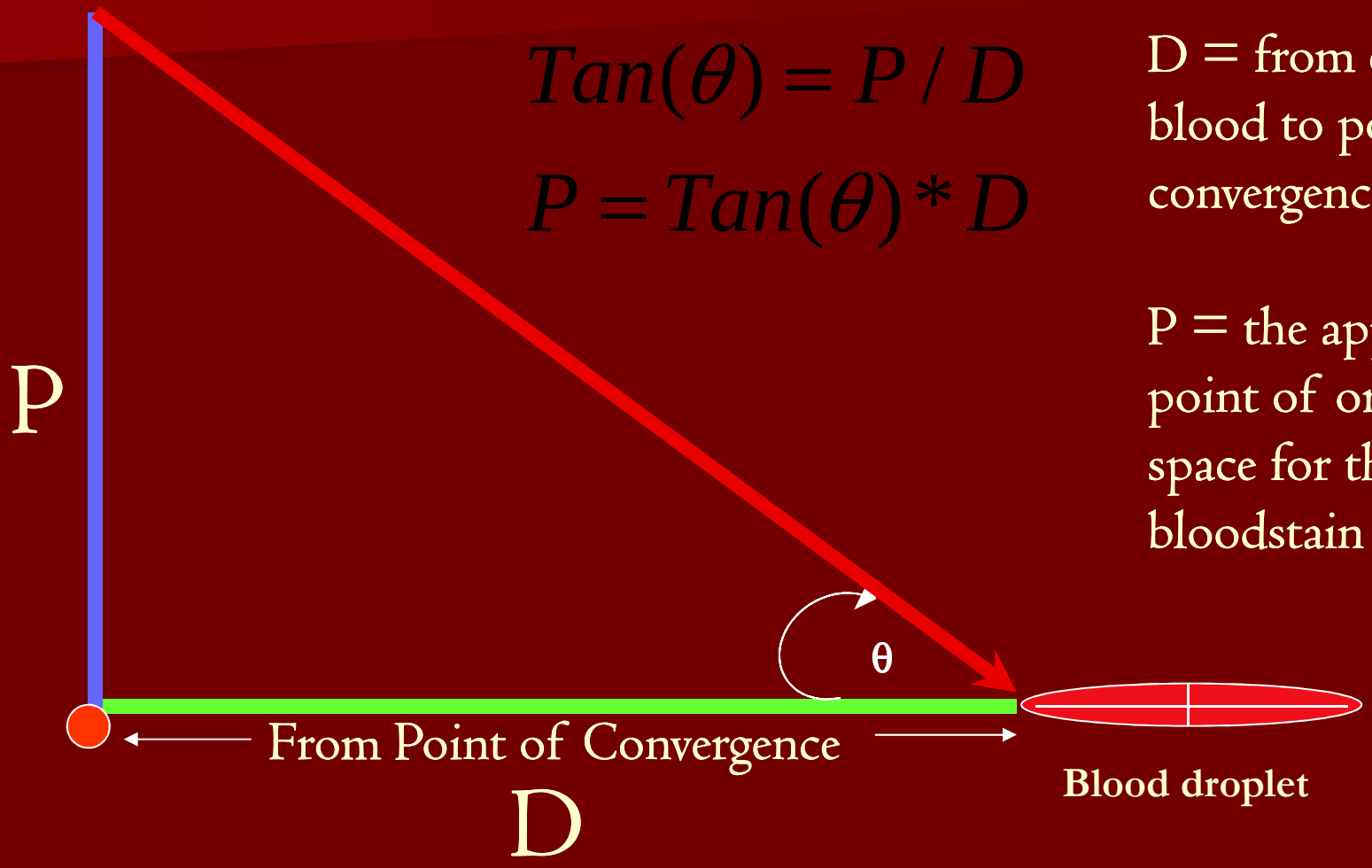
Finding the Third Dimension

$$Tan(\theta) = P / D$$

$$P = Tan(\theta) * D$$

D = from edge of blood to point of convergence

P = the approx. point of origin in space for the bloodstain



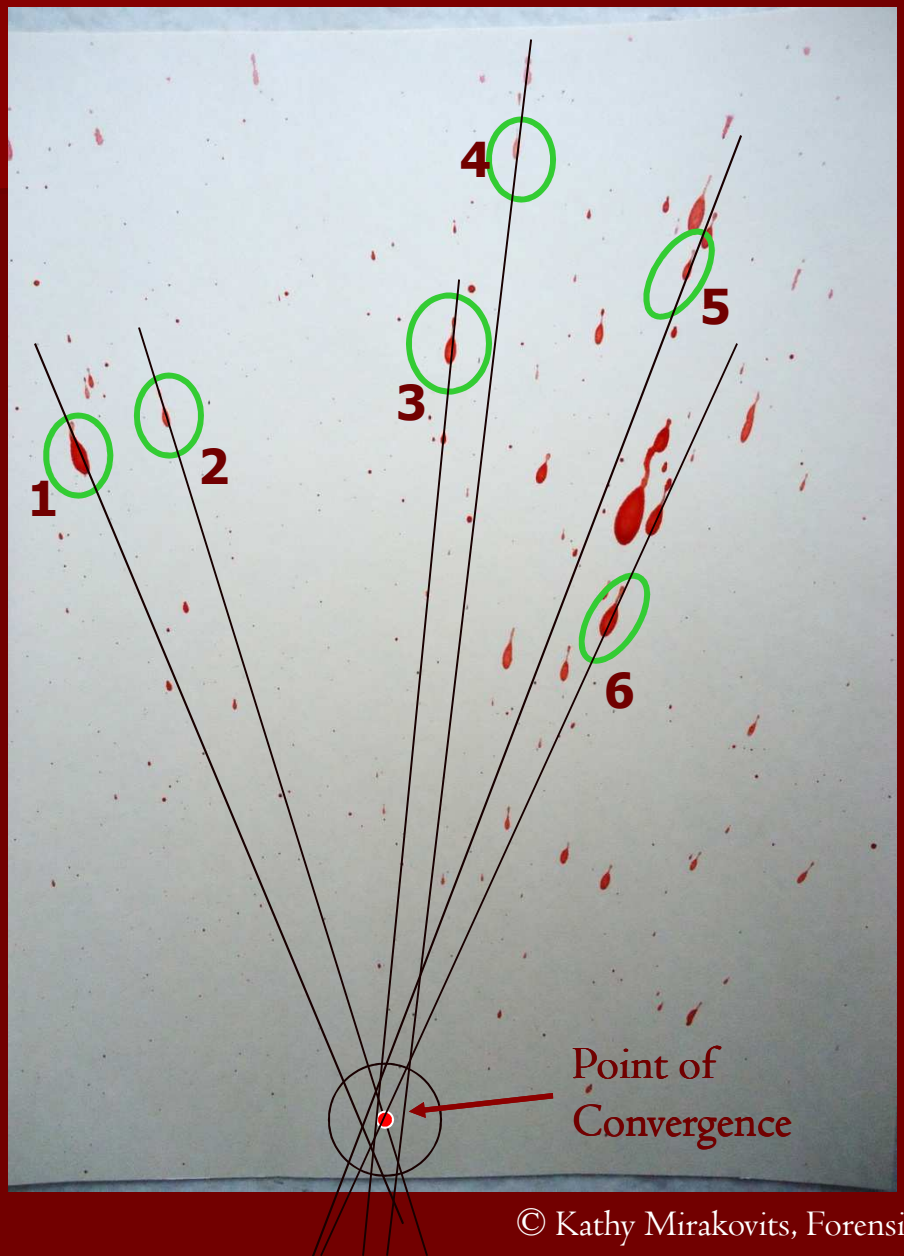
Projectile Motion: Blood In Flight

Impact Angles

1. 2.5/6 25^0
2. 1/3 20^0
3. 2/5 24^0
4. 1/3 20^0
5. 1.5/3.5 25^0
6. 3/5.5 33^0

D (cm)

1. 16 .0cm
2. 16.6 cm
3. 17.7 cm
4. 21.8 cm
5. 20.5 cm
6. 13 cm



$P = D (\text{Tan } \theta)$

1. 7.4 cm
2. 6.0 cm
3. 7.9 cm
4. 7.9 cm
5. 9.6 cm
6. 8.4 cm

Conclusion:

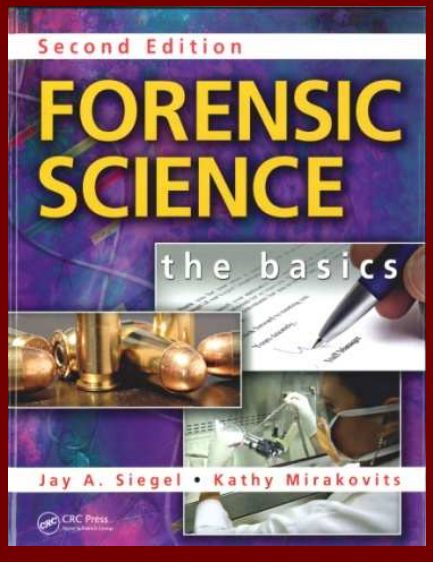
The source was 6.0 to 9.6 cm above the Point of Convergence

Thank You—Questions?

- Contact Information:

  Kathy Mirakovits kmirakovits@gmail.com

- Forensic Science Workshops Summer 2012
  - June 12-14 Atlanta, GA
  - June 26-29 Portland, OR
  - July 9-13 Southfield, MI (Lawrence Tech Univ)
  - July 17-20 IUPUI (Indianapolis)
  - July 30-Aug 3? Portage/Kalamazoo
- Textbook? www.crcpress.com



Supplies for Activities

My recommendations for supplies:

- ✓ Blood Spatter Kits from Wards Natural Science

  Introduction to Blood Spatter Analysis: 36 V 0047

- ✓ Advanced Techniques in Blood Spatter Analysis. 36 V 0048

- ✓ Simulated Drip & Projected Blood. 37 V 5310

  Simulated Transfer Blood. 37V5311