Family edition

Crime Scene Lab: Blood Drops and the Angle of Impact

Ages 14-18 · about 50 minutes, in one sitting

Your child measures bloodstains in Crime Scene Lab and works out the angle each drop hit the floor at: a round stain fell straight down, a long one came in low, and the tail points the way it was going. Then strings along the drops show where they came from. The drops are from a cut hand at a break-in; nobody is hurt in the story.

What you need

- A computer or Chromebook with a current browser.
- The lesson link: mytekdev.com/try/crimescenelab?lesson=blood-drops-and-the-angle-of-impact&ref=fam-crimescenelab-3. No account, no email and nothing to install.
- A calculator with inverse sine, or the one in the browser.

Before you start: try it once yourself

Open mytekdev.com/try/crimescenelab?lesson=blood-drops-and-the-angle-of-impact&ref=fam-crimescenelab-3. A short guide opens over the app. Eight stains on the floor have already been photographed close with the scale: six in a fan by the trophy case, one round drop where the hand was held still, and one on the trail to the door.

1. **Measure.** `Lab` tab, `Spatter` station. Drag across the stain for the width, then along it for the length; the app snaps to the half millimeter and the table fills in. The stain is drawn from its true angle, so a careful drag gives the true number back.
2. **Build the formula.** Press the `function` slot and pick `asin`; then `width`, `/`, `length`. The working shows the division and the inverse sine. A wrong formula runs on every stain, and the check after hand-in says which angles were off.
3. **The strings.** On the floor plan under the formula, drag along a drop's long axis from its tail through its body. The app extends the string. Three strings along the fan's drops cross where the hand was shaken; the height follows from the angles and the distances.
4. **The chart.** `Setup`, middle school: the formula is replaced by a chart of five shapes, 90 to 15 degrees, and your child picks the nearest. The high school check allows five degrees; the middle school check twelve.

> The moment that lands is the trail. Every drop on the way to the door has a tail pointing at the door, and your child will say that means the culprit went that way. It does. It does not say who.

The ideas, in plain words

A drop that strikes a smooth surface at 90 degrees leaves an almost circular stain; as the angle of impact decreases the stain elongates, and its tails or spines extend in the direction of travel. The angle can be calculated from the stain's width and length: the sine of the angle is width over length, so a stain 5 mm wide and 15 mm long came in at about 19 degrees. Lines through the long axes of several stains cross at the area of convergence, where the drops came from on the floor; the area of origin adds the height, from the angles and the distances. These are the principles in the published guides the app's teaching notes cite.

The app's fan of drops came from one point, a hand shaken once by the case, so the strings converge. The trail to the door came from a moving hand, so its drops have tails in the direction of travel but no single origin, and the station says what a trail can say: where someone moved, not who. The still drops by the case fell straight down and are nearly round.

Common mistakes: measuring the length with the tail in, or the width across the tail; building acos or the ratio the wrong way up, which the working shows at once; drawing a string across a drop instead of along it. Measurements are to the half millimeter, so an angle a degree or two from the app's is not wrong, and the check allows five.

Do it together

1. Open mytekdev.com/try/crimescenelab?lesson=blood-drops-and-the-angle-of-impact&ref=fam-crimescenelab-3 together. A short guide opens over the app with eight stains already photographed. Open the `Lab` tab, then the `Spatter` station.

   > **You'll know it worked when:** A dark stain on the floor, with a 10 mm scale under it.

2. Drag across the stain the short way: the width. Drag along the oval the long way, leaving the tail out: the length. The table under the stain fills in.

   > **If you get stuck:** The chips under the stain say which measurement is next; `measuring the width` first.
   >
   > **You'll know it worked when:** A width and a length in millimeters.

3. Build the formula: press each slot and pick what goes in it, `asin`, `width`, `/`, `length`. The working appears underneath.

   > **You'll know it worked when:** Your child can do the division and the inverse sine on a calculator and get the same angle.

4. Measure two more stains, one of the round ones by the case and one on the way to the door. Compare the three angles.

   > **You'll know it worked when:** Your child can say which drop fell straight down and which came in low, from the numbers.

5. On the floor plan under the formula, drag along a stain's long axis, from its tail through its body: a string. Do three of the drops by the case.

   > **You'll know it worked when:** The strings cross near the case, and the app says about how high the hand was.

Talk about it

Ask these while you work together. A child who has understood the lesson can answer them without help:

- This stain is 5 by 15. What is the sine, and what is the angle?
- Why is the drop by the case almost round?
- Which way was this drop moving, and how can you tell?
- Where do your three strings cross, and what was there?
- The trail points at the side door. Does it point at a person?

> The last question is the real test: anyone who says the trail says where the hand went and nothing about whose hand it was has understood the limit of the evidence.

For younger and older kids

Younger: For a younger child, open `Setup` and pick middle school: the angle is picked off a chart of five shapes instead of a formula.

Older: For a teenager, figure the height by hand: the distance from the crossing times the tangent of the angle, and compare it with the app's estimate.

Keep going

- Figure the height by hand for one drop: the distance from the crossing times the tangent of the angle, and compare it with the app's estimate.
- Open the stains-as-data table under the strings, copy it, and compute every angle in a spreadsheet.
- Open the Stage tab, set the pace to ran, apply, and write how the trail's drops changed and why.

Bring it into other subjects

- Math: for one drop, figure the height from the crossing by hand: distance times the tangent of the angle. Then say why the app calls it an estimate.
- Physics: a drop in the air is a sphere held by surface tension. Explain why the stain's width is the drop's diameter whatever the angle, and why the length grows as the angle falls.
- English: write the fan and the trail as two sentences of a report: what each pattern shows, and what it does not.
- Computer science: copy the stains-as-data table under the strings into a spreadsheet and compute every angle with one formula.

For your records

Ready to copy into an hour log, a portfolio or a transcript.

LESSON	Crime Scene Lab: Blood Drops and the Angle of Impact
SUBJECTS	Forensic science, Math
TIME	50 minutes
WHAT WE DID	Measured bloodstains' width and length, computed the angle of impact as the inverse sine of their ratio by hand and in the app, and ran strings along the drops to find where they came from and how high the hand was.
SKILLS PRACTICED	Angle of impact; The sine ratio in an applied problem; Area of convergence

Activity sheet (optional)

Name: _____ Date: _____

Open the app: scan the QR code, or go to mytekdev.com/try/crimescenelab?lesson=blood-drops-and-the-angle-of-impact

Essential question: What can the shape of a drop tell you about where it came from?

Warm-up: The drop that fell straight down is the _____ one. The long one tells me _____.

1. **Vocabulary.** Angle of impact, area of convergence, area of origin, tail, passive stain: write each in your own words.

2. **The formula.** angle = _____ (_____ / _____)

3. **The measurement table.** For five stains: which stain _____; width ____ mm; length ____ mm; width over length _____; the angle by hand ____°; the app's angle ____°.

4. **The strings.** Three drops by the case, strings drawn. They cross at about (____ , ____) cm on the plan. The app's height: about ____ cm. What was there: _____.

5. **The trail.** A drop on the way to the door: its tail points toward _____. That tells me where _____ went, and nothing about _____.

1. Two stains have the same width. One is twice as long as the other. Which came in at the lower angle, and about what is its angle if the shorter one is round?

2. The strings cross by the trophy case. What does that tell you happened there, and what does it not tell you?

Quick check

Name: _____

1. A stain is 4 mm wide and 8 mm long. Its angle of impact is about: (A) 30 degrees (B) 45 degrees (C) 60 degrees

2. Lines through the long axes of several stains cross at: (A) the area of convergence (B) the tail (C) the area of origin

3. Draw a stain that came in low, mark its tail, and say which way the drop was moving.

Answers

QUESTION	ANSWER	WHY
1	A	Width over length is 4 over 8, 0.5. The angle whose sine is 0.5 is 30 degrees.
2	A	The crossing on the floor is the area of convergence; the origin adds the height from the angles.
3	A long narrow stain with a pointed tail; the drop was moving in the direction the tail points	The tail extends in the direction of travel. A long stain drawn with the tail and the direction named is a full answer; a long stain with no tail is half.

If your state or umbrella school asks, this lesson covers Common Core Math HSG-SRT.C.8.

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The app this lesson uses is free and runs in the browser, with nothing to install and no account needed. It is at mytekdev.com.

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