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This magazine is best viewed with the pages in pairs, side by side (View menu, page display, two-up), zooming in to see details. Odd numbered pages should be on the right.
Finding Clues in Chaos

Summer 2017
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The Forensic Teacher Magazine

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By Mark Feil, Ed.D.
Joe Aube is an amazing guy with a special talent: he can look at the wreckage of an accident strewn all over the road and tell you how fast the cars were going, their direction, the point of impact, and a ton of other details. He took time out of his schedule to tell us how it’s done.

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www.theforensicteacher.com
Editorial

Sharpen the Saw

Stephen Covey rose to fame years ago with the book “7 Habits of Highly Effective People.” If you read it you realized the guy made a lot of sense. And one of his principles was “Sharpen the Saw.”

This means you have to allow yourself downtime, to take the opportunity to recharge your emotional and intellectual batteries. This is vital because if one uses a tool, even a sharp, effective one long enough, it becomes dull, often without the user being aware of it. Guess what? You’re the saw.

Maybe you attribute your current, thank-God-the-school-year-is-over attitude to having had the students from hell this year. Maybe it’s because you had five preps this time, or maybe it’s because you’ve reached the end of your rope for whatever reason. You’re looking forward to a cold drink or two, some time in a vacation spot, and silence, golden silence when midmorning arrives. Teachers need summer vacation more than students.

My favorite part of summer break is when I realize I don’t know what day of the week it is, and figuring it out is more trouble than I care to go through right then. Summer is the time to relax and recharge, but it’s not a time to get lazy. Sure, sleep in, order in, and take it easy, but after you feel yourself unwind a couple weeks or months from now take some time to think about you. Sharpen the saw.

What did you do this past school year that worked out great? Can you pinpoint why? Can you do it more often next year? What are your strengths? How did they affect your teaching? Can you use them more next year? How can you improve on your weaknesses? If you read Covey’s book (or zip through the summary on Wikipedia) you’ll see he doesn’t exactly mean it the way I do, but the principle is the same: invest in yourself. No matter who you are you can do better next year, you can teach more effectively, and you can find more joy in the classroom. Sharpen the saw so it works so much better.

Believe me, everything is easier when your tools have been sharpened.

Dr. Mark Feil
EXPERIENCE

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WHAT TEACHERS ARE SAYING

- “I AM DELIGHTED TO HAVE FOUND YOUR WEBSITE. IT BRINGS ALL THE CONTENT WE TEACH TOGETHER IN SUCH A REAL-LIFE WAY. IT’S FANTASTIC! THANK YOU FOR AN AMAZING RESOURCE!”

- “I FOUND THIS A FASCINATING SITE. I WENT THROUGH THE FIRST CASE BECAUSE I AM ASSIGNING IT TO MY STUDENTS AS PART OF A CSI UNIT. I CAN’T WAIT TO DO THE OTHER TWO CASES. THANK YOU FOR MAKING SCIENCE FUN.”

This work was supported in part by a grant from the National Science Foundation to the Fort Worth Museum of Science and History.
Mini-Mystery

An Unaccountable Death

ON THIS RAINY TUESDAY, as on many other Tuesdays around noon, Thomas P. Stanwick, the amateur logician, called on his friend Inspector Matt Walker in the inspector’s tiny, cluttered office in Royston. Walker usually had a case or two on hand that he knew would pique the interest and exercise the particular talents of his friend. This day was no exception. “We’ve got a shooting death on our hands, Tom,” said Walker, leaning back in his chair. “Herb Lombard, the manager of a small accounting firm in the Cumnins Building, was found dead at his desk late yesterday afternoon. He may have shot himself, but we’re not sure.”

Stanwick idly fingered the tip of his mustache. “Who discovered the body?” he asked.

“A client of his named John Morey, who works in another office down the hall. Lombard was working on some late personal tax returns for him. Morey says he was leaving work yesterday, shortly after five, when he passed the door of Lombard’s firm and decided to see if Lombard was in. The clerks had already left the outer office, but light was shining from under the door of Lombard’s inner office.

“Morey knocked, opened the door, and found Lombard slumped over his desk in a puddle of blood with a revolver in his hand. Morey was so scared that, without touching anything in the room, he ran down to a pay phone in the lobby and called headquarters.

“I arrived a few minutes later and accompanied him back to Lombard’s inner office. Snapping on the light, I found everything just as Morey had described. Lombard had been dead for less than an hour, and had a bullet wound in his head. The revolver had been fired once.”

Stanwick shifted slightly in his chair.

“Poor devil,” he remarked. “Did Morey find the door to the outer office open?”

“No, but it had been left unlocked,” replied Walker.

“I see.” Stanwick looked grim. “You’d better arrest Morey at once, Matt. He’s lying about this affair!”

Why does Stanwick suspect Morey?

Solution on page 55
New Products

The teacher’s perfect choice for a fiberglass fingerprint brush. The new Elite Fiber and Feather Duster have been treated to create up to 45% less friction with all surfaces, they now repel all moisture and contaminants! Get all the details and demonstration videos at www.lynnpeavey.com. Better print development. Better training results. Educational discounts available.

Koleid has a 100x digital microscope with an LED light that attaches to your smartphone at publication time on sale for $29.99. It fits all iOS and Android phones and is available at https://www.koleid.com/products/ppm

If you’ve ever wanted to (literally) pick a bone with someone you can’t go wrong with this collection of bone pens. We found a number of suppliers for these unique items, but your best prices are likely to be found at http://www.ebay.com/itm/like/361513042352. Scroll down and look at similar sets, most of which are available for under $1 with free shipping.

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Book Reviews

By Ricky Pelazzo

Jumped, Fell, or Pushed?: How Forensics Solved 50 “Perfect” Murders - Steven A Koehler, MPH, Ph.D. with Pete Moore, Ph.D. and David Owen. Available at Amazon.com for $13.33 or $0.99 used.

Jumped, Fell, or Pushed is a fun read that provides us with two things: a working stiff: two years, 262 bodies, and the making of a medical examiner by Judy Melinek, M.D. and T.J. Mitchell. At Amazon.com for $10.21 or $4.00 used.

While doing her surgery residency at a teaching hospital in Boston, Dr. Melinek suffered some issues that forced her to change her focus to pathology. This led to her interest in forensic pathology, which is fortunate for her readers. She brings to us a fascinating read about her time working at the Office of the Chief Medical Examiner of New York City.

Dr. Melinek shares her experiences of working natural and accidental deaths, homicides, and some occurrences that have made national and international news, including the terrorist attacks on the World Trade Center in 2001.

Dr. Melinek and her husband, T.J. Mitchell, provide well-written detailed descriptions of cases she’s worked along with everyday real-life in the medical examiner’s office, which is very different from what we see on television shows. They have also included her experiences of attending crime scenes with the medico-legal investigator and describe the differences in the roles of the ME and the medico-legal investigator in New York City.

I enjoyed the writing and descriptions and appreciated the respect showed to the cases she’s worked and the candor of the day-to-day workings and feelings of a medical examiner.

The chapter about the 9/11 terrorist attack gave us inside information of what that time was like for first responders and the medical examiners office, and the long grueling work of identifying the victims. She goes in-depth in the process that was used in the identification of the victims in a way that most people would not be privy to.

There were times when I couldn’t put this book down. It was fascinating to learn about the workings of the medical examiner’s office in New York City and the lives of those that do this important work.

By Ann Kosloski
brush up on areas for forensic science and a review of cases that were solved using different areas of forensics. Each chapter starts with a description of an area of forensics which include crime scene, trace evidence, DNA, body fluids, toxicology, ballistics, impressions, and writing and voice recognition. The description of forensics includes what the area of forensics is, tests and evidence collection, and a Day in the Life of someone who works in that area.

Each chapter ends with a real-life case that was solved using that area of forensics. The cases are from around the globe and include cases from the 1800s until present day. Each case is presented as a case study and includes the following sections: The Crime, The Case, The Evidence, and The Outcome. The cases range from individual murders to mass terrorist attacks such as the Bombing of the Federal Building in Oklahoma City and Flight 103 that crashed in Lockerbie, Scotland.

I enjoyed the forensics information and the cases were very interesting. I especially liked the older cases from the 1800 and early 1900s that used types of forensics that were in their infancy or were developed as a result of the particular case.

Jumped, Fell, or Pushed is a fun, easy read for the summer. The review of forensic areas in each chapter may spark some new ideas for lessons in your classroom. Some deeper investigation into the cases presented in this book can lead to some interesting case study projects for students.

By Ann Kosloski

The Steel Kiss by Jeffrey Deaver. Available at Amazon.com for $6.20 or $1.27 used.

The continuing stories of a protagonist in a series sometimes become stale and repetitive, but not so with Lincoln Rhyme in The Steel Kiss. Deaver’s paralyzed forensic expert is as fresh as ever in this thriller that grabs you and relentlessly pulls you in like the parts of a malfunctioning escalator does to its victim in the opening pages. As the book progresses Rhyme is forced to deal with disturbing wrinkles in his life that include his retirement from the NYPD, an angry Amelia Sachs who blames him for upending her world, a quadriplegic understudy, a killer who reveals himself not even close to Rhyme’s conclusions, and a desperate lover from Sach’s past.

One of Deaver’s underlying themes is our current, blind overdependence on technology, technology we take for granted, smart machines with computers for brains that can be quietly hijacked by someone with a talent for coding and a bent for murder. When household appliances, industrial robots, and even ordinary electronic devices can be reprogrammed for killing their users no one is safe, especially if the victims aren’t chosen at random. Tracking down the person behind the bloodletting is a whole new game where ordinary trace evidence like hairs and fibers are meaningless. Evidence is still to be had, but collecting it means climbing a learning curve and that takes time. Time is one thing the victims of this killer, Unsub Forty, have less and less of every day he’s on the street.

Deaver lets us in on the mental and emotional state of Unsub Forty, an interesting and disturbed landscape that somehow makes sense in a twisted, oddly logical way. And Deaver uses him and the characters loyal readers know and love to demonstrate he is still at the top of his game.

Converging subplots, rising tension, and more twists than a pretzel factory make The Steel Kiss a dangerous book because once you’re pulled in it doesn’t let go. Definitely a must-read for anyone who likes criminology, forensics, thrillers, or any combination of the three.


The title and description of this book do not do it justice. It sounds like a book for people on the front lines of criminal investigation and forensic science, but it is an interesting and enjoyable book for anyone who has an interest in this area.
Finding Clues in Chaos
Joe Aube (Obee) has a very special skill set: he can look at the mess left after an accident and tell you not only who hit who, but the direction of travel, the sequence of events, and how fast everyone was going. He and the men and women of the Delaware State Police Crash Reconstruction Unit are funny like that: nothing escapes their eagle-like gaze, they've seen it all, and they understand physics so good it's scary. Like Stephen Hawking scary.

We were fortunate enough to catch up with Joe and ask him about what he does, how he does it, and if a semi full of live chickens overturns if it's his problem. He also shed some light on why a major highway will be closed for hours after what appears to be a minor fender-bender when you finally get up to it.

Forensic Teacher: Your voice mail said the accident reconstruction team. That right? You don’t do it individually, you work as a team?

Joe Aube: Actually in the collision reconstruction unit, the CRU, there’s a team of us for each county, and Delaware only has three counties. In this county, New Castle, there’s a team of four of us; Sussex has four, and Kent County only has three; they don’t have quite the workload of the others.

FT: Does your team all work together, or each separately?

JA: We’re always on call in pairs so anytime a crash happens, there’s two of us working to go out to it. When they happen during the daytime, if we’re all here in the office, we will all go. Once the dust settles and we have the initial stuff taken care of, it pretty much falls to whomever is going to take the case. They do the follow-up and write the final report including witness interviews and any other follow-up.

FT: Did you ask for this specialty or did you just drift into it?

JA: I was a good math student through school and everything, and this ties into that a little bit. It was a spot that came up years ago. Like anything in our department, you put in an interest letter. If there are several candidates, there is a review board, or an oral board as they call it; they interview people that way and then make their pick. I was lucky enough years ago to get in here, and I’ve been doing it ever since. It’s been about 15 years.
FT: Of course, the more you do it the better you get.

JA: Yeah, I like to think so. You certainly get more confident the more experience you gain and the more times you do the math and see things work out. What makes all of us better officers in general, and even with this stuff, is testifying in court and doing depositions and things.

FT: What made you apply for it?

JA: Like I said, there're numerous different types of detective positions on the state police—your typical burglary or robbery, and during my time on the road I always enjoyed crash investigations and this certainly is a more in-depth and detailed way to do that. I was a pretty good math student and I enjoyed the math and the physics of it, and that kind of appealed to me. It's a chance to do something a little more specialized with the police work.

FT: Is this your main function on the state police, or do you do other things too?

JA: Yes, this is my main job. I’ll work some overtime stuff, but yeah, this is it.

FT: What sort of training did you have to go through to get into this?

JA: We teach our own class in this to maintain and upgrade rank. We have to take so many classes and have so many credits, and we take an advanced collision investigation course. I took that way back when I was on the road, and actually I teach that now, kind of walked right into that, and now I’m standing on the other side of the podium. But there are a few different places that teach this stuff as well. One we generally use is called the Institute of Police Technology and Management. They’re out of the University of North Florida in Jacksonville. Most of us in here have taken the same courses there. They called it their advanced accident investigation, and there is the accident reconstruction part, which is a two-week class where they just hammer the math into you the formulas we use. So, those are the minimums and they have various other one-week or two-week courses that I’ve had over the years, things like motorcycle accident reconstruction, things that are little more specific, a little more detailed.

FT: I didn’t think of that. When I think of accident reconstruction, I think of cars. But I forgot about bikes and pedestrians.

JA: Yeah, there’s everything. Unfortunately, we get an inordinate amount of pedestrian-involved accidents on highways we have around here. Why these people want to cross I’m not sure, but they continue to do so. [Ed. note: a number of people have been killed at night trying to cross Delaware Rt. 13, an eight-lane highway, at night, outside a designated crosswalk while wearing dark clothing.

FT: Tell me a little bit about your background, your education.

JA: I was born and raised here in Delaware, and I graduated from the University of Delaware. My bachelor’s is in physical education, of all things, but some things didn’t pan out with that, and I ended up with this job so many years ago. I followed my brother; he’s also trooper. You do the on-the-job training, and you learn what you like and what you don’t like, and accident stuff kind of fit with me, and here I am. About three weeks, in I had to go to an autopsy so I know a little bit about what I’m looking at and I can identify most of the parts and things like that.

FT: You mentioned your aptitude for math, and I’ll bet that really factored into what you are doing.

JA: Absolutely, because there’s a comfort level too. I’ve heard many people say, “I just can’t handle the math.” You just have to be comfortable with it, you know? There’s the basic rules and algebra and stuff like that. We are using computers and certainly calculators now, which makes things a world easier than what it used to be. But like I said, there’s a comfort level and I don’t mind diving right in and crunching the numbers.

FT: Well, it’s like you said, the more you do it, the more confident you get.

JA: Absolutely, and when I do teach the advanced class that we do annually, I will just sit there and instead of using the answer sheet I will sit and work the problems because it’s good practice, and it makes sure my skills stay sharp.

FT: What do you like best about accident reconstruction?
JA: It’s like putting a puzzle back together. To a layman an accident might look like chaos, but when we get there what we’re seeing is something different. To the trained eye we see the skid marks and we can work backwards from where the car is sitting to back to where they hit and the directions they were coming from. And the laws of physics apply each and every time. You can’t break them. We have to be able to gather that evidence and start from that chaos and bring it all the way back to where you can say how fast these cars were going, the directions that they were moving, and this why this crash happened. And that can be invaluable to someone who’s lost a loved one, or there could be millions of dollars at stake. And we are the first line out there that goes and gets the evidence, and other people down the line can manipulate that as they want to or need to. We just try to do it right and get the crash as best we can.

FT: What do you dislike about accident reconstruction?

JA: Dislike? That’s a tough one.

FT: I mean, besides working at 2 AM in the pouring rain.

JA: Yeah, that actually happened this week, but it was at 4 AM and it was pouring. Yeah, being on-call can be difficult because you have to make some adjustments. We take two cars to places sometimes, and literally, at any given time, there’s no pattern to it whatsoever, that phone can ring and you have to go. But otherwise my schedule can be fairly regular and sometimes it’s a slow week and you don’t get called out, but that doesn’t always happen.

FT: What’s the highest number of cases you’ve ever had in one week?

JA: Not me personally, but in our unit at one time we had eight accidents in seven days. I do remember that once we had like three in five hours. We were on one and then my pager started going off; this is back when we had them, and I thought that was kind of weird because here I am in the middle of the scene and somebody wants me. It was one of our other troops and they said they knew I was busy but had a case for me. My partner at the time was my sergeant, and it was another rainy night, and he took off for that one. In the midst of us driving to those two respective places, another one came in. So, he went to the third one while I went to the second one and we worked both of them by ourselves. Occasionally that can happen. I only recall one other time when there were two at once, and the two of us on call each took one. And the craziest day I remember is one I’ll never forget; it was statewide, and a perfect storm happened and there were seven in one day.

FT: Wow!

JA: There was one up here for us and then some of the smaller departments and cities like Wilmington and Newark would handle their own and they each had one. Then there was one in Camden and four in Sussex County all in the same day. It was the strangest day ever. And on the other hand, sometimes we will go for a whole month with nothing.

FT: Really?

JA: Really. It’s feast or famine—we will get hit with three a week and then nothing for the rest of the month or so. The average usually stays the same and usually they’re spaced out.
FT: What was your most memorable case?

JA: There’s been a lot, but in terms of, well, there’s actually one that happened pretty recently that still sticks in my craw because of the trial and everything. But usually, the ones that stick out, it’s sad to say, are the ones where it’s a little bit gory, like when people get run over multiple times because motorists can’t see the body in the road or something like that. Those cases stick with you. I’ve seen a couple of those. One was a motorcyclist who went down at night and nobody could see him. I’ve had a couple like that, actually. It really never is routine, and I’ll never say I’ve seen it all because the next time there will be something crazy I’ve never seen. Know what I mean? But every story is unique.

FT: What kind of advances have been made in technology in the field in the last 10 years?

JA: Probably the best thing we have now, that we didn’t before, is CDR technology—that’s crash data retrieval. That is hardware and software that allows us to plug into the airbag control module in a vehicle. This controls the airbags and decides whether they should deploy or not. Secondary to that, it also records the data about what was going on at that time, and why or why not it fired the airbags. So, by plugging into that we can get things literally, directly out of the car, like how fast it was going and whether the brakes were applied.

FT: No way! So it is like a little black box like what you see in an airplane?

JA: That’s what it is commonly referred to as, yeah. It’s different from an airplane’s black box in several ways. One, it doesn’t record voices, but it is monitoring the forces that a car feels and it makes a decision, in milliseconds, about whether to deploy the airbag or not. It’s an invaluable tool to have. And it’s not just a snapshot of the crash because you have to look at it in the context of what we do. We’ll do our traditional reconstruction and determine the speeds and that sort of thing; then you get that data from the vehicle and when it matches up, it’s gold because they verify each other. Here’s what the physical evidence says from the skid marks, and the collision and analysis and, low and behold, it matches and it’s fantastic. It’s great the technology we have now.

FT: Do you have a database that lists all the cars, their weights, the friction coefficients of every tire made and so on?

JA: We make a computer drawing of each one of our accidents and that has the data included, which means all the weights of cars and things like that. We check to see if there is an active recall on cars. Mechanical issues and those sorts of things aren’t really included. You read about those in the paper like when all the Firestone tires were blowing up and that sort of stuff, but it is not terribly common. I think I’ve only seen it twice where the problem was a mechanical issue. And going back to your previous question about a memorable case, I just remembered one where the civil litigation is still pending so I can’t get into too many details, but there was one case where I am 100% convinced that it was mechanical. There was an elderly couple in the car that just suddenly rocketed out of control and hit a hill and vaulted and hit a bridge and both people died. After taking a look at the scene and talking to witnesses, the crash data showed 100% throttle for the entire time. Since a 77-year-old man doesn’t generally drive like that, I am convinced a stuck throttle was the cause of that wreck. That was definitely one time when a mechanical issue was to blame. I did some research and found a number of similar stories just like that on the Internet. That case is still pending somewhere. I haven’t heard anything.

FT: What about texting? Do you get people’s phones after the accident and look and see what kind of activity they were doing at the exact time of the accident?

JA: Yes, yes we do, and that’s become almost commonplace. We’ll get their phone number and what carrier they have and we have our channels we go through; sometimes we have to get search warrants. Sometimes what I do, when it doesn’t appear to be one particular driver’s fault, (most people are cooperative when I explain that texting is a big issue now. I ask, can you show me your phone, and can you show me your last call or text? And they’ll show me right then and there at the scene, and their phones will show me they weren’t texting or talking, and I’m pretty satisfied with that because I believe that people, in the heat of the moment, are not thinking that they should take time to delete their history right now.

It’s obviously out there and we have seen it some. I do recall a case years ago where it was a big issue-, this girl crashing because it was a long series of texts leading right up to the time of the crash. Her last text was right before the 911 call. I’ve definitely seen it; I don’t think it’s the scourge that newspapers make it out to be, but the less you’re paying attention when you’re driving the worse it is, of course.

FT: You mentioned testifying; how often are you called upon to testify?

JA: For criminal cases, not very often because most of those
cases are pled out. The person realizes, “Hey, they got me.” I have had eight or nine trials in a criminal court, but what’s more common is the civil stuff, the lawsuits, people trying to get their money. I’ve had at least twice the number of those, if not more if a suit can’t get settled. And that involves depositions where you sit around the table with lots of lawyers and you answer questions for up to a few hours explaining every single piece of minutia.

**FT:** What do you think of the CSI effect? Does that ever come up in court?

**JA:** (Sighs) Yes, absolutely. That is 100% real. And in our cases we do everything like swab the steering wheel for DNA, and sort it out. Take a hit and run, for instance; the jury expects some kind of evidence that puts the defendant in the car, not just people saying it, not just a confession. Even prosecutors are going to want that DNA evidence. And more now than ever, you’ve got to have that hard evidence or they don’t believe it happened. Oh, it’s hundred percent real.

**FT:** Sounds like it’s a pain in the butt.

**JA:** Uh huh. It ends up making for a lot of extra work.

**FT:** What do you think is the biggest misconception the public has about accident reconstruction?

**JA:** It might have something to do with the black boxes we were talking about, that they expect every single detail will be in there, but it’s not. It’s another tool we use, but it doesn’t have every single piece of data you might want. And now that I think about it, a common misconception is that when a pedestrian is hit sometimes the families are very upset because they can’t understand why the person was hit. And you have to explain that they were crossing where they shouldn’t have been, it was very dark, they’re not wearing reflective clothing, etc. It’s callous to say, but it’s not that much different than a deer walking out in the road in front of a car. Most times it’s physically impossible to see someone like that before it’s too late. You don’t really see a deer in your headlights and you’re traveling at highway speeds; it’s impossible. And they just can’t accept that. It’s heartbreaking to tell them you’re sorry. I’m sorry you lost your loved one, but they shouldn’t have been walking there.

**FT:** Occasionally, I will hear about an accident on I-95 here in Delaware and the news will say later the two cars got into an accident and the road was closed for four hours. Is that because of cleaning up, or because of you guys?

**JA:** Depending on how serious it is, yeah, if there’s a fatality that’s our fault because we get that one shot at the evidence. When there is a fatality, the road is shut down because it’s a crime scene. If there’s a traffic accident sometimes we hand out traffic tickets all the way up to charging someone with vehicular homicide or manslaughter or something, depending upon something really egregious and depending on what the facts say. But the skid marks, the debris, the placement of the vehicles, and all that kind of stuff needs to be held until we can document it. That scene can’t be reopened because all that evidence will get erased or blown away as cars drive through it, so they have to hold it as a crime scene.

**FT:** I’m getting that you like puzzles, right?

**JA:** Sure.

**FT:** Was there anything in your childhood that pointed you towards this?

**JA:** No, I don’t think so. It’s just the enjoyment of being able to put something back together by using the physical evidence. But I’m the kind of person who likes to go out there and find clues and apply what I’ve found and what I’ve learned and been taught. It’s pretty gratifying.

**FT:** Especially because you know there is an answer out there somewhere.
JA: Yes – hopefully – most of the time there is. I mean, sometimes the dynamics of it don’t necessarily allow for a completely 100% scientific reconstruction, but we can always infer some things and do our best to fill in the blanks.

FT: You work for the State Police, but are there private accident reconstruction specialists who work for the private sector like insurance companies?

JA: Yes, yes there are. I’ve dealt with many of them over the years and they’re retired police officers, or whatever, and have worked directly for insurance companies. Some are private contractors that the defense attorney or civil attorney might hire to take a look at the evidence photos and give a second opinion on our reports. Unfortunately, in this day and age of litigation, they hope to have a completely different opinion than ours. Their opinion is the guy wasn’t going that fast and it wasn’t his fault and things like that. It depends on how it gets presented and what a judge and jury believe.

FT: When you get to an accident scene have the people been taken away or are they still there?

JA: It depends. If a pedestrian was hit and they need medical attention, they’ll be gone to the hospital, but the driver might be there because they haven’t been injured. Or, there might be nobody there because everyone was injured and they were transported. Or, it might just be one vehicle and a tree so they are deceased, and there’s no one to talk to. It could be any combination – one driver’s hurt, one driver’s not.

FT: Do they call you after they call the emergency medical people? I mean, do you get to an accident scene and there’s bodies?

JA: It’s possible, sure. If someone is deceased at a scene they are actually supposed to leave them there if it’s not a hazard because then the medical examiner investigator comes out to get them and take them directly to the Medical Examiner’s Office for autopsy. Yeah, typically when the crash happens, a witness or whoever calls 911 and the road troopers are going to get there first and if they determine this is serious enough to call us out then we’ll go. But sometimes the person will die there, and they’ll say hold everything and call us out maybe an hour after-the-fact.

FT: Walk me through it. When you arrive at the scene of an accident what do you do, what do you look for, what equipment do you use? Let’s say it’s a hit-and-run with a person.

JA: In general, for any scene, troopers and other personnel have already been there. Sometimes they will get the gist of what’s going on and we talk with them to get some of the basics of what might’ve happened. Then we are going to walk through the scene and try to form our own opinion, really looking for whatever evidence is there, whatever, the vehicles that happen to be there, or the evidence of where a person was, or where they got hit. It could be shoes or clothing or a spot of blood; the presence or absence of skid marks can tell us something too – if they could see the person or not, if they tried to avoid them, things of that sort.

Once that’s all done and we have a general idea of what happened, we will, ideally, if we have our equipment with us, use surveying equipment called a total station. We set up a transit that uses infrared or laser with a prism on the pole, and the transit becomes the center of its universe and all the measurements are taken from there. It measures the distances and the angles so we can map out an entire tire skid mark or mark several points leading to its final resting place, and any other location where debris landed. And all those measurements get downloaded into a software program that allows us to diagram the entire collision, and to use those measurements in any calculations we might need. For instance, if we need another length of the skid mark once we’ve shot it out there with the station, we download it so then we can use it. If the distance from point A to point B is 50 feet, we know it’s all to scale and we can draw out the entire roadway to demonstrate it in court if we have to. It’s another way to present the information other than just telling it in a narrative.

After that, it’s also the interviews. If we have witnesses at the scene we can talk to them or if information might have been left with the troopers there, and we follow up with a telephone interview. If we have some drivers or other occupants we can talk to – great. Often, in our collisions some people can’t talk to us, so we have to use that evidence to figure it all out.
FT: Do you have a database that contains the weights of all the cars on the road that you can use for your calculations?

JA: That drawing software I mentioned has the specs on just about any car all the way back to the early 70s, I think. And if it doesn’t have the exact model, for instance, it might not have a Buick Lacrosse but it might have the Chevy Lumina, which is basically the same car. It pretty much has everything we might need. Obviously, sometimes exotic vehicles get involved in a crash, but we have the ability to get a weight on that if we need to. Our truck team can take a portable scale out to the tow yard and weigh each axle and we add it up. That’s what they do when they are out and about doing their things. They can use a portable scale to weigh trucks to see if they’re overweight going down the highway.

FT: No kidding.

JA: We use the resources like that. This day and age, with the Internet, if you do enough research you can get the numbers you need from manufacturers’ websites and places like that.

FT: And you can factor that in with friction measurements from the road too.

JA: Absolutely. A friction measurement is something else that we’re going use as we are doing calculations. (It’s something that’s very important because if the speed changes the friction changes it’s going to be completely different than a dry road,). We want to get that friction measurement in similar conditions to what the crash was. If it’s dry and sunny like today, great, we can skid a car right there and get our measurements from that.

The computer we use is called a VC 4000; it’s an accelerometer we can mount on a dashboard and once we set it up and tell it we’re going on a breaking run, as you accelerate it measures the G forces and calculates the speed. When you hit the brakes it runs an algorithm and does its calculations a hundred times a second and it will give you the friction number you need.

FT: Wow!

JA: And we test it a number of times to make sure we’re getting a similar number, and once we get that we know we’re pretty accurate. A couple times a few years ago it was pouring down rain at the time of crash so we waited until it was pouring down rain another day and we got out there, shut the road down, and skidded in the pouring down rain because those were conditions similar to the crash.

The old-fashioned method is using something called a drag sled; that’s a weighted tire, a tire that’s been cut and filled with cement. A scale is attached to that and you pull it along the roadway or whatever surfaces you want to test. More commonly, we would use this on the grass because we don’t want to go skidding our cars on grass. It’s just simple physics, the force you’re pulling versus the actual weight of the thing; if it only takes 80% of the weight to pull it horizontally, it takes 8 pounds to pull a 10 pound sled. Now I know the friction of the roadway is 0.8. That’s how we would get the friction measurement on grass or if multiple surfaces were involved. It’s not practical to skid our car toward a building. We don’t need that kind of trouble.

FT: How long after you get all your measurements does it typically take before you know exactly what happened?

JA: It depends. We want to get a full, complete picture before we start crunching numbers. And if we can get the witness interviews done, your experience and your eyeballs tell you this was a really high-speed case, you might start crunching numbers that very week. You always want to do it multiple times to make sure that you are right and confident in it. We check each others’ math here in the office. For the entire case, especially with something like that, it’s going to take us a couple months to get it all done because we are waiting on reports from the Medical Examiner’s Office, toxicology, and things like that because those things take weeks. Even if we’re done we still have to wait on some other things like...
how complicated the case was. If we have what we call a momentum case, where two cars crash into each other and then separate, you have to be as accurate as possible with those angles so you’re going to run it multiple times. Then you’re going to change the angles and see if that skews the answer to see if there is a flaw in your data, which help zero in on the right numbers.

FT: So, I guess this is when experience comes into play. When you’ve seen two cars hit the front fenders and both of them spin around, then the more times you’ve seen this the more times you can say you know exactly what happened because you’ve seen it before.

JA: Absolutely. Experience is huge in terms of something like that. I might have mentioned before that something that looks like chaos to the novice, one of us might be able to look at and looking at the marks on the ground, and where cars are, we can kind of tell where they came from and what direction they were going and things. Occasionally, you end up correcting somebody. When I get there they’ll tell me something and I’ll look at it and think, ‘Nah, that’s not what happened.’ I will tell them that this car came from that direction and I’ll see the light bulb go on as they realize, ‘Yeah, that makes more sense.’ Physics doesn’t lie. It tells you a lot about where they came from and where they went.

FT: Here’s something that just occurred to me—a couple years ago a tractor trailer overturned on Delaware Route 141 N. It was carrying a full load of live chickens and birds went everywhere; they were running around and it took hours to round them all up. That wasn’t your problem, right?

JA: No, our unit is going to be called in when there are serious to fatal injuries. We are not doctors and if they call and say this guy looks really bad, depending on his injuries, we’ll come out for that if we’re asked to. A fatality is an automatic—we’re coming. Other cases we would handle by policy include any with emergency vehicles like police cars, ambulances, or whatever. So, it’s pretty much your serious injury crashes; so if it’s a mess like the chickens, they’re not necessarily going to call us out because it’s a big headache, but it’s really just that a vehicle fell over. Another case in point—do you remember about a year ago when a truck carrying penny blanks tipped over on I-95 North near I-295, and about $4 million worth of blanks when all over the roadway?

FT: I do! That was pretty funny.

JA: That was a pain in the butt for the entire county and probably beyond, but it had nothing to do with us because the guy didn’t have an injury. I was supposed to go to court that morning, but you couldn’t move anywhere because the road was closed for three hours. It ended up being a late court day because nobody else could make it there. That was terrible (laughs). [Ed. Note: Because pennies are not magnetic the authorities used trucks with industrial vacuums on them to retrieve the blanks.]

FT: Do you use any tools besides the surveying equipment, the accelerometer, and the computer program?

JA: That about covers it. Well, calculators, but even again we have some software that confirms our calculations. Everything I need folds up and fits in the trunk of my patrol car.

FT: Wait a minute. If there’s an accident and the first responders close the road the traffic is building and building, how do you guys get to the scene? Put on your lights and go up the shoulder?

JA: Yeah, the lights and siren help. But if a road is completely closed, we might get a call from somebody at the troop or if one of us gets there first they will call the other and say hey you might want to take this alternate route. You’re not getting here on this highway. Sometimes, it’s a challenge. But there’s other ways too. If a road is completely closed because of the crash, we might get a call telling us to take this crossover at whatever location and then come southbound on the northbound side. There’s no traffic moving northbound anyway. There are ways to get there; we just have to communicate with each other. I’ll get word from the scene itself about what the best way to get there might be.

FT: Let’s talk a little about education. When you were in college or in high school there had to have been some teachers who really made their subject come alive. When the period would end you’d realize you couldn’t wait to get back there
the next day. Do you remember those people?

JA: I had a good relationship with a French teacher in high school. There was a core of about 20 of us or so and because of the way scheduling worked out, we had the same guy for four years in a row. He was very animated and dynamic and he made the class fun. He made you enthusiastic about it. Though, in hindsight I should have taken Spanish because of our Spanish speaking population around here. I also took a calculus class in high school that got me college credits and I enjoyed that because it was, you know, solving math problems. If we were struggling with a problem our teacher would show us how to get through it. The light would go on and we’d say, “Oh that’s how you do it.”

FT: What qualities should a good teacher strive for?

JA: Know the kids in the class and what motivates them. If you can use that information to inspire and motivate them, you’re doing it right. You got to get their attention. When I teach I try to shake things up once a while and throw a joke in, or stories from real life to keep the subject fresh and keep the students awake.

FT: Plus, your subject isn’t it boring. You can show videos that make people sit up and watch.

JA: Oh yeah! You gotta love the Internet. Sometimes, when they’re working, I will load dash cam videos of crashes. There are hundreds of hours of it out there, all kinds of craziness that happens on our roads.

FT: Do you have any tips for students who might want to get into accident reconstruction, either as part of the police or a private firm?

JA: Well, just what I mentioned before. You need to have pretty solid math skills and don’t be afraid to sink your teeth into it.
At the end of every school year I spend the last two to three weeks with my students on a crime scene project. I have all seniors in my class and by mid-May they’re antsy about getting out of school. So, I have one last challenge. They have been through all the necessary units during the school year that will allow them to perform the analysis of any evidence presented in the project. I invite outside experts in the fire field for their assistance because I want this experience to be as close to the real thing as possible. If you choose to use this project in your classroom you will want to reach out to your local fire department and arrange to collaborate with someone appropriate.

The idea for this project was a collaboration between myself and a couple of friends who are experts, Mr. Bill Manley (yes, that’s his real name), the fire science instructor at my high school, and Mr. Andy Bacidore, the local fire chief. We had several meetings months ahead of time to go over the logistics of the project. This gave us time to collect the evidence and necessary materials. You should plan accordingly.

Andy and Bill were both insightful about the details of a fire scene and the types of evidence that could be collected, and any fire prevention/fighting experts you contact will do the same for you. Mr. Manley asked the building trades class and instructor if they could make an 8’ x 8’ room with a door, ceiling, and a window. Mr. Manley put wheels on the bottom so that the little building could be rolled to wherever needed. This little building, which resembles a garden shed, is now used for many projects, not only with my forensic science classes, but also the fire science classes for instructional purposes. This crime scene project can be done anywhere in the building or on your school campus, so our shed was a luxury you can easily do without.

We obtained furniture left on the street during the spring city-wide clean up, though you can find inexpensive furniture at your local thrift shop or by asking for donations in the faculty lounge. Very important: make sure to receive permission for this project from your school’s administration before you even start planning. The burning of the paper in a trash can can be done at home and brought to school for the project. Just make sure not to burn all the paper you load into the trashcan. I would suggest using a grill or fire pit and retrieving the burnt paper before it is totally consumed. In our case Bill burned it in the trash can for a few seconds and then used a fire extinguisher to exhaust the flames quickly enough to retrieve ink and handwriting.

The first day is always spent documenting, recording, collecting, and packaging evidence. I give students in each class a certain job (the list is already made up before they come to the crime scene). In this case; keeper of the supplies, photographer, sketcher, measurer, note taker, marker of evidence, fingerprint experts, shoeprint experts, blood collectors, fiber and other trace evidence collectors, packagers, and finally the collectors of the packaged evidence.

The Case of the Burned Shed
A safe, end-of-the-year student assessment

By Nancy Kochis
Students at this point in the year have been given the necessary instruction for the proper procedures for all parts of crime scene processing and COC procedures. Chain of custody (COC) is the procedure where anyone who touches the evidence bag has to sign their name and date on the bag for collection at the crime scene, transport to the lab, and analysis in the lab. The packaging of evidence is done in brown paper bags with evidence labels that I purchase at Lynn Peavey or Sirchie. The tape I use is the evidence seals from either of the above two companies or any of the other science websites that have some you can purchase. I use permanent markers for the labels and the initials that go over the seals. Some of the evidence is packaged in manila envelopes labeled using the same procedure as for the bags. I do not remind them of what evidence to collect, nor point out anything they miss. Likewise, they don’t need my assistance to process any evidence they find, nor do I offer it. Actually, many of them enjoy working independently from a structured class environment where only one type of evidence is processed each day. They’re on their own now and sometimes I feel they enjoy showing me what they know.

The supplies necessary for this part are from my classroom from earlier in the year. If you’ve done the units we have throughout the school year, you will already have these items on hand: notepads, tape measures and meter sticks, pens for writing and drawing, sketch paper for rough sketches, brown paper bags purchased from Walmart or a dollar store for collection of evidence, plastic disposable forceps for collecting evidence that can be purchased at any science website (I purchased tweezers (don’t tell the students they are tweezers)) from Walmart and clean them off each year, clear tape for sealing the bags of evidence and for lifting fingerprints, white notecards for placing tape lifts of fingerprints, I have a class camera (or students can use their cell phones) for photographing, plaster of Paris or dental stone for shoe print evidence (if using Plaster of Paris you will need something to mix it in, a stirrer and water as according to package directions) (dental stone comes prepared and all you have to do is break the water seal, mix, pour and spread out with a disposable plastic spoon), and gloves for each student (I tell the students they can purchase a box of gloves at the beginning of the year or they can buy a box with another student and share). As you look over the units the students will need to draw from to analyze the evidence, I’m sure you will already have most of what you need.

On day two the fire chief and the fire science instructor present information on arson evidence. A PowerPoint presentation about the types of evidence that can be retrieved from a fire scene is shown to the students, and a link to my presentation is at the end of this article. The presentation also demonstrates how some evidence should be packaged and why it is packaged that way. There is time allotted for student questions. If your students need a refresher on evidence, this presentation should be given on the first day of the unit.

The third day is dedicated to collecting evidence from each of three suspects: fingerprints, shoeprints, matchbooks, hairs, fibers, statements, handwriting and pens. If your suspects are not available to meet with each of your classes their evidence can be collected ahead of time and you can distribute them to your students in each class. For instance, rather than fingerprinting the suspects, pre-printed 10-print cards can be distributed. Likewise, shoeprints, hair and fiber samples, handwriting samples etc. can also be given out. And written transcripts of interviews with each suspect can be given to the groups too. Each of the groups is subdivided into smaller groups responsible for certain types of evidence. Evidence is packaged and labeled by students and set aside for the next day. The groups of students interviewing the suspects must brainstorm questions to ask their suspects.

On days four and five I place each group into smaller groups that will be responsible for analyzing a certain piece of evidence from the different suspects/ crime scene evidence. Each group will receive an analysis sheet for their suspect/ crime scene evidence and are responsible for filling out their own results. This way students will not see results until the last day, comparison day.

In addition, I was lucky enough to have the forensic scientist from the crime lab in Joliet spend one day, my choice, presenting on the analysis of fire evidence in the lab.
He talked about what happens to the evidence once it reaches him in the lab and the tests he performs on the analysis of accelerant evidence. He talked about some of his cases with the students. Since many readers will not have easy access to such a person I would suggest searching for such an expert well in advance and arranging to meet and audio or visually record the discussion for playback.

The last day is spent analyzing crime scene evidence and comparing it to suspects evidence in groups to come to a conclusion about whose evidence best matches the crime scene evidence. They understand they are not determining the guilt or innocence of a suspect, they are only trying to see if there is a possible match. Mr. Manley and Mr. Bacidore are present on the last day to show the students a video of the actual crime committed. It is exciting to see their faces when their evidence matches the person in their conclusion.

Students are only given the information about the crime scene and the three suspects. The suspects were chosen from the school, Mr. Manley, a janitor, and even a student. I have used administrators, firemen, and staff here at the school for suspects. They are always willing to help in the name of forensic science. I try to change the crime scene project every year. I have been blessed with the contacts I have made over the years by attending conferences. The crime lab director at the crime lab in Joliet is always willing to work with me by sending experts to my classes for presentations. The ballistics expert, Nicole Fundell from the crime lab, even came back at the end of last year for our crime scene project, “A Drug Deal Gone Bad.” I have several friends in the police department who have contributed their knowledge and assistance. I now have former students who are policemen and are always willing to help. They had so much fun helping with last year’s project that they can’t wait to start planning this year’s. I can’t wait to see what they come up with next. I hope you have as much fun planning your crime scene project as my students and I do. This was one hot case!
FORENSIC UNITS FEATURED.

My students revisit the following units to solve the crime:

- **Tool marks** (torn matches used to start the fire and possible matchbooks they were torn from, and possible hammer marks on the shed/room door)
- **Blood typing**
- **Hairs and fibers**
- **Footwear impressions**
- **Fingerprints**
- **Question documents** (handwriting and thin layer chromatography)
- **Chemical signatures of accelerants** (comparing mass spec signatures)

NOTE: If you have your own protocols for the units above, please skip the next section where I describe how they are handled in my classroom. However, I also list resources for each topic.

**Blood Typing**
For the blood lab I used different blood vials from one of my kits used for blood typing, one for each suspect (two of which are the same as the crime scene blood). I use beef blood that can come from my favorite butcher or from a package of meat purchased from the grocery store for the blood for my criminal. I then plant a drop of blood at the scene. This is used for a Kastle-Meyer test. The kits can be purchased from Carolina Biological at [http://www.carolina.com/](http://www.carolina.com/) or Wards Science at [https://www.wardsci.com/store/](https://www.wardsci.com/store/). For blood typing in the lab I use the kits for blood typing that can also be found at the same sites and should last several years. I place a sticker over the names on the bottles for the different suspects and crime scene evidence. Each group will test only their suspect’s blood. Comparison for crime scene evidence will be done on the last day. Procedure for this test can be found in the following video: [https://www.youtube.com/watch?v=2aPz_AV0t3U](https://www.youtube.com/watch?v=2aPz_AV0t3U)

Other helpful Blood type websites are the following (some sites have recipes for making homemade blood instead of purchasing the kits):

- [http://www.cfep.uci.edu/cspi/docs/lessons_secondary/Are%20You%20My%20Type.pdf](http://www.cfep.uci.edu/cspi/docs/lessons_secondary/Are%20You%20My%20Type.pdf)
- [http://www.scienceinschool.org/content/investigating-blood-types](http://www.scienceinschool.org/content/investigating-blood-types)

**Hairs and Fibers**
For the analysis of hairs found on jackets from and the crime scene, students will make slides of the hairs. The pet hairs came from Mr. Manley’s pet and were planted near the computer. The hair is placed in fingernail polish for a few minutes (usually 10 minutes) and then pulled out. This is done for cuticle comparison. The hair is then placed on the opposite part of the slide with a drop of water or clear nail polish and a coverslip is placed over them for medulla analysis. They then take their slide to the compound microscope to determine the medulla and cuticle patterns for species identification. I make two of the suspects have dog hairs and one have cat hairs. The following sites are resources for charts and diagrams that I place on the lab tables for those groups working on hair analysis. There are also YouTube videos that will aid in how to make a slide for hair analysis.

- [http://www.carolina.com/teacher-resources/Interactive/forensic-hair-analysis-activity/tr10879.tr](http://www.carolina.com/teacher-resources/Interactive/forensic-hair-analysis-activity/tr10879.tr)

For analysis of fibers I have the students make slides by pulling a fiber from the jackets of the suspects (all of the jackets will have a similar tear). All of the suspects were told to have a worn blue sweat jacket that can be used from which to retrieve fibers. However, the fibers that were found on the door hinge were taken from the criminal’s jacket (Mr. Manley used an old torn sweat jacket in this case). Carolina and Wards have lab kits for fiber analysis that give directions and sample fibers. The following FBI site gives information about fiber analysis under the microscope. [https://archives.fbi.gov/archives/about-us/lab/forensic-science-communications/fsc/july2000/deedric3.htm](https://archives.fbi.gov/archives/about-us/lab/forensic-science-communications/fsc/july2000/deedric3.htm)

**Footwear Impressions**
Shoeprint evidence was left in muddy soil that I placed in aluminum foil pans I bought from Walmart. The dental stone can be purchased from any of the science suppliers such as Carolina or online. If you do not want to use dental stone you could use...
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plaster of Paris. Carolina science has a lot of forensic supplies including the shoeprint kit to lift suspect’s shoeprints. I like this kit because all the necessary ingredients are in one bag and is less messy. Another way to lift suspect’s shoeprints that I learned from a CSI, is to take clear shoe polish and rub it on the bottom of their shoes. Have the suspect stand on a piece of white paper to transfer their print. Then take black magnetic fingerprint powder to the print. I like the magnetic because the rest does not go to waste. Useful shoe print websites are:

- https://www.youtube.com/watch?v=mquyNZaNbPo

The following websites will have dental stone for purchase: Carolina Biological at http://www.carolina.com/ and Arrowhead Forensics at http://www.arrowheadforensics.com/cgi-crime-scene/sb/productsearch.cgi

Question Documents
For the chromatography on the three pens and the note from the crime scene, I follow the directions from different websites that suggest you get the materials from your chemistry department without having to purchase new stuff. Carolina and Wards both have chromatography labs you can purchase. I use either two pens that are the same and/or one that is the same color but different manufacturer. My students have learned that just because a pen is black ink (different manufacturers) does not mean that those companies used the same formulas to make that ink. The differences will show up in a chromatography lab. After cutting the paper into strips (if not using chromatography paper) the students draw a line with a pencil 2cm from the bottom. They apply a dot with their suspect’s pen (or use the note from the crime scene) on the line. After placing 2cm of solvent in the beaker, they place the bottom of the paper in the beaker and watch as the solvent moves up the paper. Once it has almost reached the top they take the paper out and allow it to dry. They then measure the distance the dot traveled - Ds (distance spot moved) and record in the data table. They then measure the distance the solvent traveled - Df (distance the solvent traveled) and record in their data table. Using the formula - Rf = Ds/Df , they will find the Rf value and record in their table.

- https://www.teachengineering.org/activities/view/wst_environmental_lesson02_activity1

Handwriting samples were taken from the suspects. Those students responsible for handwriting exemplars were given instructions to have their suspect write a sentence. The sentence was to contain one or two of the words left in the note. The following sites are useful:

- https://www.youtube.com/watch?v=mSXvPUHIXfA

Fingerprints
Fingerprint cards are made from each suspect. I purchase a pack of 100 cards that you can find at the already mentioned websites. If you do not have the money in your budget then ask your local police department for free cards for your project. They may even come in and demonstrate how to make fingerprint cards during the lab analysis part of this project. In addition, photocopies of ten print cards are often easier to work with than the cards themselves.

The Henry System
When we studied fingerprints the students learned about the Henry classification number for a suspect’s fingerprints. Each group of fingers in the formula are assigned a number if there is a whorl. If an arch or a loop are present, then a 0 is given in that spot. A 1/1 is added at the end of the equation. The number will allow investigators to search for fingerprints in a more logical manner. This narrows down the suspect pool. Now investigators have AFIS (Automated Fingerprint Identification System) at their disposal. However, they are not given an exact match with the system. The examiner still has the final decision if the print matches the suspect or crime scene evidence.

The equation is:
R. Index/R. Thumb + R. Ring/R. Middle + L. Thumb/R. Little + L. Middle/L. Index + L. Little/L. Ring + 1/1
If a whorl is present in the 1st set a value of 16 is given in that spot, the 2nd spot receives an 8, the 3rd spot receives a 4, the 4th spot receives a 2, the 5th spot receives a 1
Example: Whorls are present in the R. Ring finger only
0/0 + 8/0 + 0/0 + 0/0 + 0/0 + 1/1 = 9/1. Do not simplify the number. This tells the investigator that a whorl is present in the ring finger only and the rest are arches or loops.
The following sites are useful for learning how to make fingerprint cards.

- https://www.youtube.com/watch?v=FMhuEjmRB-4
- https://www.youtube.com/watch?v=d7N-4UNAzsw
- https://www.youtube.com/watch?v=Dyh0tOe8wU8

**Tool Marks**

For the matchbook and matchstick analysis I found a box that contained books of matches at the cigarette store used to plant a match at the scene. I purchased a cheap flashlight from Walmart (or you can use one from around your house) and had the criminal plant fingerprints on it. The students had to lift the prints from a hammer on day three when taking evidence from suspects, flashlight and gas can at the crime scene using clear tape and a white notecard. You can purchase already prepared tape lifters from any of the websites previously listed. The notecard is not used until comparison day for comparing the prints of the suspects to the crime scene print.

The gas can came from my own garage, my husband had an old metal one that he wanted to get rid of. The receipt came from a convenience store where I purchased a few items that contained a date. Carpet remnants came from the extras left over from the carpet laid in my house. I have several hammers that I keep in the classroom for different projects such as this one. These can be purchased from Walmart. The note came from a new notepad that I keep for these projects. I used three black pens (one for each suspect, two of which are the same) that came from the school supply store. You can purchase pens at Walmart also.

**Gas Chromatography**

We did not have the time necessary to perform the accelerant lab. I had previously purchased the Forensic Science Lab manual from Vernier and followed their instructions. However I found the same lab on their website. I gave the students the numbers to fill in their own data tables for their suspects. On the last day they will compare their information to the other suspects. The second website has useful information about fire evidence.

- https://www.westminster.edu/about/community/sim/pdf/SUsingEvaporationRatetoIdentifyanunknownLiquid.pdf

The forensic scientist from the crime lab in Joliet spent one day presenting on the analysis of fire evidence in the lab. He talked about what happens to the evidence once it reaches him and the tests he performs on the analysis of accelerant evidence. He also talked about some of his cases with the students.

**Materials List:**

**General items:**
Gloves, goggles, aprons, forceps, microscopes and supplies

**Blood Typing Lab:**
Blood trays - different blood types from any kit, I use 2 that are the same as the crime scene blood type
Anti-A, Anti-B and Anti-Rh serums
Toothpicks

**Kastle-Meyer test (Presumptive Blood Test at the Crime Scene):**
Drop of beef blood at the crime scene
Q-tip swabs
Distilled water
Ethyl Alcohol (95%)
Hydrogen Peroxide (3%)
Phenolphthalein

**Fingerprint Lab:**
Ink pads (I use the inkless ones)  Fingerprint cards
Wipes to clean hands
Lifting Fingerprints:
Clear tape
White notecard
Fingerprint powder – black charcoal or black magnetic

Shoeprint Lab:
Shoes from the three suspects and shoe cast from the crime scene
I have the inkless shoeprint kit that I purchased from Ward’s Science
If you choose the procedure mentioned above you will need:
Hair spray in a can, large white paper for the shoe print, magnetic fingerprint powder and brush, and clear shoe polish (all of these items can be purchased at Walmart)

Hair Lab:
Collected pet hairs from the three suspects
Microscopes
Slides and coverslips
Clear nail polish
Distilled water
Anatomy of hair sheets for comparison of medulla and cuticle patterns that can be downloaded from any website

Fiber Lab:
Fibers from suspect’s jackets and door hinge at crime scene
Microscopes
Slides and coverslips
Distilled water or clear nail polish

Matchbook/stick Lab:
Matchbooks – three from suspects
Matchstick at crime scene
Stereoscopic microscopes

Handwriting Lab:
Note from crime scene
Three different notepads for the three suspects to write down their responses

Chromatography Lab:
From a purchased chromatography from Ward’s Science I have TLC plates, I use mason jars with lids, solvent from the kit, and ink pens from different manufacturers.
If using the website information then the following materials are needed:
Chromatography paper, coffee filters, filter paper (cut into 5cm by 10cm strips)
Beakers – 250 ml or you can use mason jars
Isopropyl alcohol (rubbing alcohol), water, or methanol
Black pens
Crime scene note

Accelerant Lab:
Gas can
Accelerants from the three suspect’s gas cans
I gave the students information for this part of the lab since we did not have time to do the analysis. Chromatographs for various accelerants are available with a Google search and can be given to students after a suitable time which simulates actual analysis time.
Evidence for the teacher to prepare and place at the crime scene with student expectations:

Note: By this time in the year students know how to find and process evidence. Do not point out anything they miss, nor coach them on techniques. This is part of the challenge.

1. Blood drop left by the door. Test for the presence of blood using the Kastle-Meyer test. Testing for blood typing and comparison to suspect’s blood type are performed back at the lab.
2. Fibers from clothing on a nail near the door – compare to fibers from the suspects jackets using a compound microscope, paying attention to fiber width, color, and shape etc…
3. Hairs left by the computer – test for species identification using a compound microscope. The test should confirm the presence of a dog.
4. Paper match found on the ground close to the scene that looks like it could have started the fire – compare to match stubs in match books found on each suspect using a stereoscopic microscope in the lab.
5. Shoeprints left by the shed – compare to shoes worn by each suspect. Lift the shoeprints and compare to exemplars of suspects.
6. Flashlight found inside on the floor– lift for fingerprints and compare to exemplars taken from suspects.
7. Gas can found outside shed/room – can compare accelerant used on the carpet in the shed/ room to accelerants from cans found on each suspect through spectrophotometry. Can also lift fingerprints.
8. Receipt for supplies – can interview workers at the store to see if they remember either of the suspects purchasing those items. Can also ask owner of the store for video from surveillance cameras. This is obviously optional.
9. Carpet fibers which students will find near or on the footprint– can also contain the accelerant used to start the fire and used for comparison.
10. Fingerprints – found on several areas of the crime scene, flashlight, and gas can.
11. Hammer – left on the floor; suspect could have used it to pry open the door. Examine for fingerprints and/or tool marks on the door.
12. A to-do list for purchasing materials for starting a fire - on ground a short distance from the shed/room - Can compare the ink used in the note to ink found on pens from each suspect using chromatography. Can also use to examine the handwriting in the note and compare to handwriting from suspects.

The author would like to acknowledge the kind assistance of fire science teacher Bill Manley, LaSalle Fire Chief Andy Bacidore, and building trades teacher Harold Burr and his students.
**Interview of Suspect: Bill Manley**

1. Where were you on the night of April 25th between the hours of 6:00 pm until 10:00 pm?
I was out driving around, trying to clear my head. I have a lot on my mind right now. I have to come up with money to purchase items for school that my budget will not cover. I don’t know where I am going to find the money to pay for things.

2. Do you have an alibi? If so what is his/her name?
My wife saw me leave before she went to bed. She had an early day at work the next day.

3. Do you know anyone who would want to burn down the shed?
Yeah, Rich Kowalcyzk. I suspect that he has been taking computer equipment from my department. Plus he does not want me to have this shed on the property. He thinks it is an eyesore.

4. Have you ever been in that shed before? If so, why?
Yes I have. I use the shed to store equipment frequently for the fire science class. Other people have access to it too, my students and the building and grounds guys.

5. Do you own a gas can? What type - plastic or metal?
Yes, it is a metal can.

**Interview of Suspect: Rich Kowalcyzk**

1. Where were you on the night of April 25th between the hours of 6:00 pm until 10:00 pm?
I was at home alone watching TV. My wife was out of town visiting relatives.

2. Do you have an alibi? If so what is his/her name?
No, but my wife called me on my cell phone at around 10:00 pm.

3. Do you know anyone who would want to burn down the shed?
Yes, Manley. I overheard him talking to himself about needing money for supplies for next year. If he didn’t get the supplies his program may be cut.

4. Have you ever been in that shed before? If so, why?
Yes, I am the Director of Building of Grounds. It’s my job to oversee the maintenance of all the buildings associated with the school.

5. Do you own a gas can? What type - plastic or metal?
Yes, a metal one.

**Interview of Suspect: John Doe**

1. Where were you on the night of April 25th between the hours of 6:00 pm until 10:00 pm?
I walked home from a friend’s house. My girlfriend just broke up with me and just I wanted to get some fresh air.

2. Do you have an alibi? If so what is his/her name?
Well, my friend saw me leave at 6:00 that night. I arrived home at approximately 9:00 and my parents saw me come home.

3. Do you know anyone who would want to burn down the shed?
Yeah, Mr. Manley. I overhead him talking to himself about maybe losing his fire science class next year.

4. Have you ever been in that shed before? If so, why?
Yeah – I was in his class, we all had access to the shed to get supplies.

5. Do you own a gas can? What type - plastic or metal?
Yeah, my dad has a plastic one for filling with gas for mowing the yard.
The Answer

It was approximately 6:00 pm when Bill Manley kissed his wife good-bye before he was to take a long drive to think over things. As he drove he became more upset at Rich Kowalcyzk’s remarks about the “eyesore” of his shed and the fact that he does not have enough in his budget to purchase the necessary materials for classes for the next school year. He wants to keep the class going at LP and peak the student’s interest, however if he can’t have the necessary tools to keep it going, the class might be dropped. Mr. Manley had a lot to think about on his car ride. He found himself driving closer to the school. An idea suddenly hit him. He would make it look like someone broke into the shed and started a fire. This way he could collect insurance money to buy his educational materials. He made a to-do list for items to buy to start a fire.

His adrenaline pumping, he decided to park his car a couple blocks away from the school in an empty parking lot. He got out of his car and opened the trunk to pull out a hammer and gas can. He walked to the nearest gas station to purchase gasoline and a flashlight. He already had a match book in his pocket, since he smokes cigarettes. He walked over to the parking lot of the school where the shed was located. He then broke open the door with the hammer to start the shed on fire. He wasn’t thinking clearly because he did not wear gloves. His fingerprints were all over the scene. A really good fireman would know that you need to wear gloves when entering a fire scene so that you do not add to the evidence. He started to pour gasoline on the carpet next to an old computer (added insurance money). He lit the match. The carpet and computer started to burn. While gazing blindly into the fire it suddenly hit him, “What did I do”. He took the fire extinguisher from the shed and put out the fire. On his way out he got cut on a nail in the door hinge and left some blood. His jacket was also torn in the haste to get out, leaving some fibers behind. He heard the sirens from the LaSalle Fire Dept. and decided to throw the gas can, hammer and flashlight outside. A receipt and torn to-do list had fallen out of his pocket onto the floor. He didn’t realize but he also left shoeprints in the dirt.

He made it back to his car only to find a patrolman waiting for him. Earlier that evening the patrolman found the car and called in the license plates. He knew that the Fire Science Teacher Bill Manley would not leave his car abandoned, especially since he does not live in the area. When the officer confronted Mr. Manley he told him that he thought someone stole his car. Manley explained his situation and that he was out for a walk to think things over. The two parted and Mr. Manley drove home.

Back at the school Fire Chief Bacidore found the fire was already put out and all that remained of a hint of a fire was smoke and some burnt carpet and computer. His team found other evidence that indicated someone had purposely started the fire. Bacidore decided to call Mrs. Kochis and her CSI team to investigate. After careful analysis of all the evidence, the CSI team came to the following conclusions:

1. The fingerprints found on the gas can, hammer and flashlight all belong to Mr. Manley
2. The blood type was consistent with belonging to Mr. Manley.
3. The hairs were found to be not human and consistent with a dog. Mr. Manley is the only one of the suspects that owns a dog.
4. The match found at the scene microscopically matched the torn match area from the matchbook found in Mr. Manley’s pocket.
5. A fragment of paper found in Mr. Manley’s pockets fit the rest of the list found at the crime scene.
6. The fibers were consistent with coming from the same type of jacket as Mr. Manley’s.
7. Ink chromatography results from the note matched the ink coming from a pen found on Mr. Manley.
8. The CSI team turned over the results to the lead investigators.

When investigators confronted Mr. Manley with the evidence he denied starting the fire. It was not until the investigators showed him the video footage from the school’s surveillance cameras that he finally confessed. He claimed to be overcome with grief as to the possibility of losing the one class he loved to teach. Once the fire started he realized what he had done and tried to put the fire out. Manley was charged with arson, but only received two years probation because of the limited damage. However, he was fired by the school district.

The author welcomes feedback and comments and can be reached at nkochis@lphs.net.
Student Analysis of Evidence Report

LP CSI Team Members: __________________________________________________________
___________________________________________________________________________
___________________________________________________________________________

Evidence Analysis from Suspect: ______________________________________________

Test 1: Hair Analysis

Medulla Type _________________________________________________________________

Cuticle Type _________________________________________________________________

Animal or Human _____________________________________________________________

Test 2: Fiber Analysis (Notes on fiber composition)

___________________________________________________________________________
___________________________________________________________________________

Test 3: Blood Type Analysis

Anti-A Anti-B Anti-Rh

Write positive (+) or negative (-) in the boxes above.
Blood Type ____________________________
What is the next step with blood evidence? ______________________________________

Test 4: Matchbook/Stick Analysis

Did the matchstick come from this matchbook? _________________________________
Test 5: Shoeprint Analysis (describe any individual characteristics found on the shoes)

__________________________________________________________________________________________

__________________________________________________________________________________________

Test 6: Note/Handwriting/Ink Analysis

Analysis of note

__________________________________________________________________________________________

__________________________________________________________________________________________

Handwriting Analysis ________________________________________________________

__________________________________________________________________________________________

Rf Values from the data table ________________________________________________________

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Ds</th>
<th>Df</th>
<th>Rf Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test 7: Accelerant Analysis

Your teacher will give you the evaporation information to fill in your data table below. Find the evaporation rates by subtracting the Tmin. From Tmax. Record in the data table.

What analytical instrument would test for the chemicals in the accelerants?

__________________________________________________________________________________________

EVIDENCE RECORD OF EVAPORATION RATES IN THE DIFFERENT ACCELERANTS

<table>
<thead>
<tr>
<th>Substance</th>
<th>Tmax (°C)</th>
<th>Tmin(°C)</th>
<th>Tmax – Tmin(°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Test 8: Fingerprint Analysis

Use the Equation for the Henry Classification System:

\[
\text{R. Index} + \text{ R. Ring} + \text{ L. Thumb} + \text{ L. Middle} + \text{ L. Little} + 1 = \text{primary classification number}
\]

R. Thumb  R. Middle  R. Little  L. Index  L. Ring  1

Numbers that are given for each pair if a whorl is present:
1\text{st pair} = 16, 2\text{nd pair} = 8, 3\text{rd pair} = 4, 4\text{th pair} = 2, 5\text{th pair} = 1

If a loop or arch are present then the value at that finger is a 0.

<table>
<thead>
<tr>
<th>Finger</th>
<th>Fingerprint Pattern</th>
<th>Subclass</th>
</tr>
</thead>
<tbody>
<tr>
<td>R. Index</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R. Thumb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R. Ring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R. Middle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. Thumb</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R. Little</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. Middle</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. Index</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. Little</td>
<td></td>
<td></td>
</tr>
<tr>
<td>L. Ring</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Primary classification number from equation above: ________________________________
Distinguishing marks/where/which finger ________________________________

__________________________________________________________________________
__________________________________________________________________________
### EVIDENCE RECORD OF EVAPORATION RATES IN THE DIFFERENT ACCELERANTS

<table>
<thead>
<tr>
<th>Substance</th>
<th>Tmax (°C)</th>
<th>Tmin(°C)</th>
<th>Tmax – Tmin(°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspect 1</td>
<td>23.6</td>
<td>9.0</td>
<td>14.6</td>
</tr>
<tr>
<td>Suspect 2</td>
<td>23.8</td>
<td>16.8</td>
<td>7.0</td>
</tr>
<tr>
<td>Suspect 3</td>
<td>24.6</td>
<td>19.9</td>
<td>4.7</td>
</tr>
<tr>
<td>Crime Scene</td>
<td>23.7</td>
<td>9.6</td>
<td>14.1</td>
</tr>
</tbody>
</table>

### INK CHROMATOGRAPHY OF THE DIFFERENT PENS AND CRIME SCENE INK FROM THE NOTE

<table>
<thead>
<tr>
<th>Evidence</th>
<th>Ds</th>
<th>Df</th>
<th>Rf Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspect 1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspect 2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Suspect 3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Crime Scene</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: The Ds measurement isn’t just the distance the spot travels. It should also includes measurements for each color band.
Tape Perforation and Tear Analysis Lab

By Robert Bruce Thompson and Barbara Fritchman

http://www.thehomescientist.com/kits/FK01/fk01-main.html

EQUIPMENT AND MATERIALS

You’ll need the following items to complete this lab session. (The standard kit for this book, available from http://www.thehomescientist.com, includes the items listed in the first group.)

MATERIALS FROM KIT

- Goggles
- Slides, flat

MATERIALS YOU PROVIDE

- Gloves
- Camera with microscope adapter (optional)
- Microscope
- Specimens, tape dispensers (see text)

WARNING

None of the activities in this lab session present any real hazard. It is still good practice to wear goggles and gloves to prevent contaminating specimens.

BACKGROUND

Many products are packaged in rolls. Some rolls—paper towels, toilet paper, some plastic bags, and so on—are perforated to deliver portions of fixed length. Other rolls—waxed paper, plastic wrap, aluminum foil, packaging tape, and so on—include a tear bar to allow cutting portions of any arbitrary length. In either case, microscopic analysis of the perforations and tear patterns as well as the material on either side of the cut may allow a match to be established between two adjacent portions of the material.
In some cases, only a class match can be obtained. For example, if cellophane tape is used to seal a letter bomb, subsequent examination of a tape dispenser found in the possession of a suspect may establish only that the suspect tape specimen was torn from a dispenser that was similar or identical to the dispenser found in the possession of the suspect. Although that may be useful information in itself, it remains class evidence because one roll of cellophane tape is difficult or impossible to discriminate from another similar roll, and similar tape dispensers are manufactured in large numbers.

In other cases, an individual match can be obtained. For example, plastic lawn bags are made from recycled plastic, and often show streaks and striations where different types of plastic were incorporated into the bulk mass of plastic from which the bags were extruded. In addition to perforation/tear pattern matching, forensic examination may be able to match these streaks and striations to establish that the questioned plastic bag was immediately adjacent to the next bag in a roll found in the possession of a suspect.

In this lab session, we’ll compare the perforated/torn edges of sticky tape specimens obtained from various dispensers to determine which of our specimens are consistent with originating from the same tape dispenser. The ubiquitous 3/4" (19 mm) Scotch Magic Tape in various dispensers is ideal for this lab session, although you can substitute masking tape, medical adhesive tape, packaging tape, or any other type of tape for which you can obtain specimens from a variety of dispensers. The important things are that the tape specimens should not be easily discriminated by naked eye and that you have a variety of different dispensers. (Make sure that you can identify each dispenser uniquely. If necessary, label each of them temporarily.)

### PROCEDURE VI-3-1: PRODUCE AND EXAMINE TAPE SPECIMENS

1. Ask a friend or lab partner to choose one of the dispensers, tear a short piece of tape from it, and apply that piece of tape to a microscope slide, with one of the ends near the center of slide, as shown in Figure VI-3-1.

![Figure VI-3-1: Mount the questioned specimen on a microscope slide](image)

2. Tear off a short piece of tape from one of the dispensers and place it on the unused side of the slide so that its perforated edge closely abuts but is not in contact with or overlapping the perforated edge of the questioned specimen.

3. Examine the edges of the two specimens at low magnification and note similarities and differences, including the number of points present in the tear bar and the angle of the cuts made by the tear bar, as shown in Figure VI-3-2.

4. Repeat steps 2 and 3 with known tape specimens from each of the dispensers. Determine which of the tape dispensers may have been the source of the questioned specimen and which (if any) can be ruled out on the basis of the tool marks they leave on the cut specimens.
Figure VI-3-2: Two tape specimens whose edges are dissimilar

REVIEW QUESTION

Q1: You have established to your satisfaction that a questioned tape specimen is consistent in every respect with a specimen from a known dispenser, and must therefore have come from that or a similar dispenser. What other unrelated tests might you do on the questioned tape specimen to attempt to establish a link between the questioned tape specimen and the suspect? Why?
The images on the next two pages comprise a crime. The idea is to present them to your students and challenge them to solve the crime by looking at the photographs and reading the descriptions.

If you want to make a class set of the pages and have your students work on them in pairs, you’re going to need a printer (and then a copier) capable of printing in color or gray scale. A printer or copier that only turns out black and white products just isn’t going to work. OR, you could transfer the images to a projector that allows every student to see them all at once.

These pages are from Scotland Yard Photo Crimes, used with permission of Dorling Kindersley Publishers. The answers are on page 55.

Get started now
LOCKED ROOM MYSTERY

Like all locked room situations, this has something of the "impossible" about it. But when the impossible has been eliminated, what remains must be the truth, no matter how improbable.

1 Dr. Crumborn had lost a patient — Mrs. Cavendish of "The Bungalow." Something about the case bothered him so he called in at the police station for a chat with his friend, young Police Constable Derek Coombes.

Crumborn's tale

2 He had called to see Mrs. Cavendish about 10 p.m. the previous evening. She had had a severe chest cold, and had been taking an ordinary cough mixture. He had left a bottle of linctus in case the cough became troublesome. As he left, Mrs. Cavendish had asked him to tell the maid she would not be wanted. He had promised to call in early the next morning.

3 When he arrived, the maid said she had taken a breakfast tray along as usual, but her mistress seemed to be asleep and her door was locked. He was shown into the study.

4 A minute later the maid came running in saying she was afraid something had happened. The bedroom door was locked and the key was on the inside. "I knocked and called to the Mistress," she said, "but she didn't answer. Mr. Cavendish has been out since before nine. What should I do?"

5 Dr. Crumborn did not like to force the door in the husband's absence, but he tried the side window and got in.

6 Mrs. Cavendish was dead. The appearances suggested morphine poisoning. The linctus he'd left contained a tiny percentage of morphine, but could not account for the symptoms.

7 Beside the bed, however, was a small empty laudanum bottle not there the night before. Some of the linctus had been drunk. "Poor woman," the doctor thought. "Could she have taken the laudanum by accident, or did she have more worries than anyone knew?"
8 Taking a quick look round he did not observe any signs of disturbance. There was, however, a small piece of wood about 8 inches long, rounded and with a point, which he found on the floor.

9 When he checked the door, he noticed that the lock had recently been oiled. The key was an old-fashioned type. There were no marks or scratches of any kind on it.

10 The maid informed him that Mr. Cavendish had come in and was now in his study. The doctor went across the hall into the study to meet him and to break the sad news.

11 Mr. Cavendish seemed shocked when Dr. Crumborn told him about his wife's death. He said that he had not seen his wife since six o'clock the previous evening. He explained that he had been out to dinner and it was after midnight when he returned home. Naturally, he had not wished to disturb her, so he slept in the study.

12 Through his sobs, Cavendish went on to say he'd gone to work that morning without awakening his wife to say good-bye.

13 The doctor had emphasised that the window had been securely fastened and the door definitely locked from the inside. He decided to phone Inspector Black for advice.

Coombes was puzzled.

The answer is on page 55.
Introduction

This fascinating and inexpensive activity is sure to captivate, intrigue and motivate your students. Using a grocery store chicken, students will observe and document the chemical and physical changes of a corpse's (chicken) decomposition while getting a close-up view of the amazing and colorful world of forensic insects. The ever-changing habitat of a decomposing chicken provides new niches for the succession of insects feasting on a decomposing corpse. Watch as insects and scavengers feed and compete for food. Observe the mating behaviors of blowflies and beetles. Watch how insects aggressively defend their territory. Marvel how nature and evolution have tailored both structures and behaviors that enable insects to lay their eggs in a warm and protected environment.

Students are encouraged to design their own experiments to demonstrate how changing the environmental abiotic factors such as temperature, amount of sun or shade, amount of rain, amount of wind, or presence or absence of clothing, or depth of gravesite can influence the rate of decomposition and insect infestation. Discover how forensic scientists help solve crimes by applying their knowledge of the science of decomposition and insect succession to estimate post mortem intervals (PMI), or the time between when a body was discovered and the estimated time of death.

Why Use A Grocery Store Chicken?

Observing a small grocery chicken left outdoors in a warm, environment demonstrates how bacteria, molds and most importantly insects can reduce the corpse's body to just bones and skin in one week. (Temperatures averaging at least 80°F). Besides being readily available and relatively inexpensive, the main reason to use a grocery chicken is because no student gets upset observing a decomposing, headless and featherless chicken. Using road kill as a corpse may require a special permit, involves handling potentially harmful bacteria and parasites but worst of all, it pulls at the heart strings of many students.

Set-up

Your decomposition site should be in a warm, outdoor location away from human or animal traffic. Any decomposition site will generate foul decomposition odors so locate your study in an area away from neighbors. Place the chicken in a shady rather than sunny area because blowflies, the first arrival on the chicken, will not lay eggs when it is too sunny, too windy or too hot.
Start by doing a simple demonstration where students observe how decomposition and insect succession progresses on a chicken (or chickens). The photos in this article are from the decomposition study we conducted in the woods behind our home during the summer when the daytime temperatures averaged at least 80°F.

Before placing the chicken on top of ground leaves in a shady wooded area of the woods, I simulated an injury site by cutting into the breast and leg of the chicken. Being headless, the open neck provided another injury site. A ruler should be placed near the chicken to provide scale on any photos.
To prevent wild animals from eating or moving the chicken, I covered the chicken using a plastic file crate. The crate allows movement of insects in and out of the crate. Four wooden 6 inch spikes were secured to the opened end of the crate using plastic securing strips. Push the inverted crate with wooden spikes into the ground over the top of the chicken. A large paving stone was placed on top of the crate. The paving stone and crate could be easily removed to observe and to take photos and videos.

The plastic file crate set-up had to be modified the next day after some unknown scavenger managed to reach into the plastic crate and rip off one of the chicken's legs. Note in the photo below how the injury site attracted both flies and beetles. Leg bones were later found 3 ft. from the crate.

My decomposition site was modified by adding a heavy metal fire pit ring wrapped in plastic gardening webbing on all sides (next page). The heavy paving block was placed on top of the metal fire pit ring to prevent further intrusions of scavengers. The additional red bricks were added along the sides of the plastic crate to block the larger openings in the file box to prevent further scavenger activity (Figures 9 and 10).
Photography

Before taking photographs or videos, remove the bricks, fire pit and plastic crate surrounding the chicken. Allow sufficient time for the insects to return to normal after this disturbance before filming. Always include a ruler or an object for scale (dime, quarter). Students can use their camera phones to capture still images or to make movies. Film the chicken study using an iPad. A group of students will see the enlarged images on the tablet screen more easily than close-up views directly on the chicken. This movie can later be viewed and edited. Ideally, have a student set up a video cam that will continually document the progress of the chicken decomposition study.

Day 1 Blowfly Arrival, Feeding And Egg Laying

Due to the keen sense of smell, female blowflies arrive on the decomposing chicken within minutes. Females can be distinguished from males by their widely spaced eyes. Male eyes (left) are so close together, that they appear to almost touch. Another distinction between male and female blowflies is the long, thin, pointed ovipositor, an egg depositing structure, found on the posterior end of the female. (See figure 20-21)
Egg deposition does not occur until after the blowflies have consumed food, usually two hours after the blowflies arrival. Adult blowflies do not consume the flesh of the chicken, instead they "vacuum" the body of decomposition fluids. Flies secrete digestive enzymes onto the flesh and then use a retractable sponge-like proboscis to "mop up" and absorb any seepage released from the decomposing chicken or moisture from injury sites, eyes, or other body openings on the chicken.

After feeding, the blowflies deposit eggs, mostly in moist areas: the open wounds created by the scissor's cut, inside the body cavity of the headless chicken or other body openings (Figure 16). Individual eggs appear as white, rice-like structures approximately 2 mm in length. Note that eggs are laid in clusters (Figures 17, 22). Pheromones (species-specific hormones) are released that attract other blowflies to lay eggs in the same location. This evolutionary behavioral adaptation provides both safety from predators and warmth within the egg mass enhancing the survival value of the developing eggs.
Watching how blowflies deposit their eggs is fascinating. Using an iPad, I captured still photos and videos of blowflies laying their eggs. The female’s long thin ovipositor (egg depositor) can be seen poking in and out of the egg mass as each new egg is carefully placed and deposited within the ever increasing egg mass. By using the iPad, it's possible to enlarge the image of the flies while observing and filming the flies from above the decomposing chicken.
Day 2 Decomposition and First Instar Larvae

**Decomposition:** Evidence of decomposition of the chicken can be noted in the dryness and slight discoloration of the chicken's skin along with the detection of decomposition odors (Figure 24). The chicken had all internal organs (and intestinal bacteria) removed by the butcher. Therefore, the typical bloating resulting from bacterial putrefaction and subsequent skin splitting usually visible in this early stage of decomposition, is not visible. Skin marbling will not be visible because all of the blood of the chicken has been removed. These are some of the limitations of using a grocery store chicken instead of a complete animal's body.

**Blowfly First Instar** The time from egg to first, second and third instar larval stages varies with environmental conditions. Usually within 24 hours in this environment, blowfly eggs develop into miniature (5 mm) almost translucent, wiggling larvae known as the first instar stage. Unlike the adult blowfly, the larva feed on the flesh of the decomposing chicken. These small first instar larvae are usually visible on day 2 and are visible for approximately 20 hours before they develop into the larger second instar larva. (10 mm)
**Blowfly Larva Anatomy:** The tapered *anterior* (front) end of the larvae along with two black *hooks* (Figure 26, red arrow) enable the larvae to enter and scrape off some of the decomposing flesh of the chicken. *Setae*, bristle, hair-like structures, serve to anchor the larvae onto the meat and assist with locomotion. (Setae are seen more easily seen on the second or third instars viewed under a stereomicroscope). Ingested food is stored in a *crop* (green arrow) visible on the anterior, *dorsal* side (front uppermost side). Note the thin dark line of the *dorsal blood vessel* (blue arrow). The more rounded *posterior* end contains two circular regions containing *spiracle slits* for breathing. (yellow arrow). The two circular structures are not eyes but they are used to obtain oxygen. Like mosquito larvae, blowfly larvae breathe "through their butts." These structures enables the larvae to dig deep into the decomposing flesh and feed while also maintaining the ability to obtain oxygen. The configuration of the spiracle slits (when viewed under a stereomicroscope) is used to identify the larvae as first, second or third instar stages.

**Day 2 Carrion and Burying Beetle Arrival**

After flies have laid their eggs, *carrion* (cadaver) eating beetles attracted by the decomposition odors, arrive on the chicken. These well camouflaged dark brown or black beetles are one half inch in length. Many carrion beetles display a defensive bright yellow or orange or red color on their shoulders (*pronotum*) as a warning to predators that the animal is poisonous. In addition to consuming the flesh of the cadaver, the beetles' diet is supplemented by consuming the eggs and larvae of the blowflies and other
insects. Both blowfly larvae and carrion beetle larvae compete for the decomposing flesh. When the adult beetles consume the blowfly larvae and eggs, this reduces competition for food and enhances the survival value of the developing beetle larvae.

The flexible bodies of the carrion and burying beetles enables them to easily move under dead animals where they deposit their eggs. Pieces of decomposing flesh from the cadaver are added with the eggs providing food for their newly emerging beetle larva. These beetles benefit the environment by quickly removing dead carcasses and reducing decomposition odors. This is just one example of how efficiently nature recycles.

Figure 27. American carrion beetle. Note the yellow pronotum that signals its toxicity. © Bertino

Figure 28. Red breasted carrion beetle feeding on blowfly larvae. © Bertino

Figure 29. Day 2 Two large blowfly larvae masses are found in the injury sites. Carrion beetles consume the meat, fly larvae, and eggs prior to mating. © Bertino

The Forensic Teacher • Summer 2017
Observing the red breasted carrion beetle activity on the decomposing chicken reminds me of images of Roman orgies. I witnessed a frenzy of beetles consuming copious amounts of fly larvae followed by multiple matings. Some beetles multi-task and eat while mating! Although there may be hundreds of fly larvae, I found two beetles fighting over a single larva pulling the larva in two opposite directions.

**Animal Behavior** There are so many different types of alluring animal behaviors demonstrated on this mini-ecosystem of a decomposing chicken. In addition to observing feeding and mating behaviors, students observe insect defensive postures displayed while defending their territory. One hairy rove beetle captured my attention for over an hour as I watched her defend a pile of blowfly eggs and recently hatched larvae. The hairy rove beetle "marched" around her supply of fly eggs and larvae and aggressively approached any flies, bees or ants who dared to venture into her territory. Two large yellow brightly colored "eyespots" on the hairy rove beetle's posterior end were displayed and waved up and down mimicking the appearance of two large intimidating eyes of a larger predator (Figure 32).
**Day 3 Symbiosis**

Tiny "hitchhiking" mites scrambling over the body of the burying beetles were observed on Day 3 (Figure 33). The very interesting burying beetles tear off pieces of the dead carcass and bury the morsels underground along with their eggs ensuring a feast for their newly hatched beetle larvae.

The small body size of the mite limits the mite's ability to find decomposing food. This problem is solved by the mites riding on the back of the burying beetle. The mite helps the carrion beetle by consuming fly eggs and small larvae reducing the carrion beetle's competition for the decomposing flesh. This mutualistic symbiotic relationship is a win/win for both organisms and demonstrates a clever example of co-evolution of two different species.

**Day 3 Maggot Masses**

Wound sites, the mouth, eyes, ears, genital, and anal areas are common locations for egg and maggot masses on decomposing bodies. Given an ample food supply, small blowfly larvae dramatically increase in body size as they progress from first instar larva stage approximately 5 mm, second instar stage of 10 mm to the third instar of 15 mm. It is not uncommon to see bubbles of carbon dioxide being emitted due to the extensive amount of respiration occurring within the maggot mass. There is so much activity in these congested areas that the maggots may suddenly emerge from deep in the flesh in an effort to reduce their body temperature.
Forensic scientists look for maggot masses to provide clues to any injury sites on a badly decomposed body. If a victim was injured due to a knife or bullet wound, a maggot mass alerts the investigator to closely examine that area for physical evidence.

Sometimes it is difficult to obtain sufficient tissues from a decomposing corpse to perform a toxicology test for drugs or alcohol. If maggots are still present on the decomposing body, forensic scientists can extract the contents of the maggot's crop and determine the presence or absence of toxins or drugs from the body that maggots were consuming.

**Feeding in Blowfly Larvae**

Blowfly larvae feed by burrowing their tapered anterior ends into the flesh of the chicken. The presence of anterior mouth hooks and setae (fine, bristle-like structures) along the sides of the larvae help it to move into the decomposing flesh.

Usually you will see clusters of larvae feeding in one large area. This close proximity of larvae provides warmth and protection from predators. When viewed from above the chicken, only the circular rounded posterior ends of the larvae are visible (Figure 37).
Spiracles And Breathing In Blowfly Larvae

Two circular areas found at the posterior end are the spiracles or breathing slits. At first glance students mistake these to be eyes. Like mosquito larvae, maggots "breathe through their butts" through these spiracle slits. The posterior placement of the spiracles enables the larva to feed non-stop and still be able to take in oxygen.

Students can view the internal shape of the spiracle slits under a stereomicroscope to determine if the stage of larval development is the first, second, or third instar. A forensic scientist will estimate the post mortem interval (PMI, the time between when the body was found and when the body died) based on the stage of insect development and the environmental conditions for that crime scene area.

Day 4 Decomposition Continues With A Major Loss Of Body Mass

By Day 4 much of the flesh of the chicken in the wounded areas is reduced to skin and bones. Feeding blowfly larvae migrate to other areas of the chicken that still contains flesh. Any remaining flesh on the chicken will be consumed by blowfly larvae, mites, carrion, burying beetles, and scavengers.

There are significantly fewer adult beetles feeding on the remaining flesh. The ever changing habitat of the decomposing chicken results in different populations living and feeding on the remains.

Blowfly larvae have increased in mass and size from 10 mm of 2nd instar to 15 mm of the third instar stage. (approximately six days after the chicken was placed outside). Third instar larvae will stop feeding and the food mass stored in the crop, visible through their skin, is depleted. At this stage, the larvae are getting ready to leave the moist, decomposing remains to move to drier areas to pupate.
Day 5  Changing Habitats And Migrating Blowfly Larvae

What originally attracted the flies to the moist fresh cadaver or the beetles to the cadaver covered with fly eggs and larvae has changed. A second generation of flies or beetles will not develop because this changed habitat is no longer suited to their survival.

Third stage blowfly larvae are sometimes referred to as migrating larvae. A forensic investigator arriving at a crime scene must search the victim and the crime scene area thoroughly to find insect evidence. If the area is in sunlight, the larvae will move to darker areas: under the victim or inside pockets of their clothing. Leaf litter surrounding a body may contain migrating larvae or pupae 10 feet away from the victim.

Once in their new location, the 15 mm third instar blowfly larva reduces in size to 9 mm. This change from pre-pupa to pupa may take 4-8 days. A newly formed pupa is light brown in color. Later stage pupae become dark brown. Time spent in the pupa stage varies depending on environmental conditions. It can remain in the pupa stage sometime between 6-12 days or longer. When estimating post mortem intervals,
the forensic entomologist must obtain accurate environmental conditions from the time the body was found until the estimated post mortem interval (PMI).

The carrion beetles' eggs hatch into larvae that will feed on any flesh that was buried underground and on the decomposing carcass. After the flesh is totally gone, the beetle larva will pupate. Adult beetles can winter-over in the ground.

**Day 6-7 Advanced Decomposition**

Within a week, the chicken remains consist of skin and bones and a greasy black residue. A new series of insects, those adapted to consuming bone and dried flesh, will replace the blowflies and carrion beetles. This predictable succession of insects helps forensic entomologist estimate PMI.

**Post Mortem Interval (PMI) Estimations**

Post mortem interval, or the time between when the body died and when a body is found, is an estimate based on multiple individual estimates by forensic scientists, medical examiners and pathologists. Varying environmental conditions found at the crime scene such as ambient temperatures,
degree of sunlight, humidity, amount of rainfall, absence or presence of wind affect the PMI estimate. The victim's body condition: clothed or naked, buried or exposed, ill or healthy at the time of death, type of injuries or activities experienced prior to death also influence the estimate. The time of death is an estimate, it is not precise.

Forensic entomology provides insight into when a death occurred because insects follow a predictable sequence of appearance on dead bodies. Blowflies arrive within minutes of death and start the series of insect succession described in this chicken decomposition study. If a crime scene investigator found blowfly eggs on the victim, he or she could estimate that PMI was less than 24 hours (assuming conditions were similar to those described in this article with temperatures in the 80 degree range). If first instar larvae were present, then it would indicate that PMI was probably between 24 hours and 48 hours. The appearance of second stage larvae would indicate that the PMI estimate to be somewhere between 48-72 hours. Third stage larvae would indicate a PMI between 4-12 days. Unopened pupa cases could place time of death somewhere between 18-24 days. If empty pupa cases were found, then a complete life cycle of blowfly had time to develop. Keep in mind that these time approximations vary with environmental conditions. A forensic entomologist can provide a more precise PMI estimate by factoring in the daily average temperatures for the area where the body was found and calculating *Accumulated Degree Hours (ADH)*.

![Figure 46. Empty pupa case of an emerged blowfly. When the fly emerges, it uses a self-inflating fluid filled balloon-like structure (*ptilium*) to "pop the top" of the pupa case. Empty pupa cases tell an investigator that a body was there long enough for the blowfly to complete its entire life cycle. © Berino](image)

Before estimating the PMI, the forensic scientist needs to collaborate with other forensic scientists. Other indicators of PMI include but are not limited to: algor mortis (body temperature), livor mortis (the color of death), rigor mortis (stiffness of death), conditions of the eyes, state of digestion of food in the stomach, and the state of decomposition. The medical examiner, medical pathologist, and toxicologist also contribute information regarding the medical condition of the deceased. It's important to emphasize that post mortem intervals are not precise and depend on input from many different specialists.

**Conclusion**

Even the most tentative students have found this investigation to be both fascinating and intriguing. At first, some of the students shy away as they emit sounds of "Ewww." However, those "Ewwws" soon become "Aaaaahs" as they observe the behaviors of the tiny world of insects and microbes. The opportunity to witness firsthand the various stages of decomposition, stages of ecological succession, animal behaviors, and symbiotic relationships excites, motivates and fascinates students. Doing biology is so much better than reading about biology from a textbook!

This activity provides extensive opportunities for individual students to investigate and explore. Students might be motivated to design and conduct experiments similar to a mini-Body Farm investigation exploring how different environmental factors or abiotic factors can influence the rate of
decomposition. Data collection of air, soil and body temperatures, and humidity should be documented during the study. It would be interesting for students to compare the grocery store chicken decomposition with the decomposition of an entire organism such as a dead squirrel or road kill. Because the entire body is involved, students will observe the effects of putrefaction from intestinal bacteria normally associated with decomposition. Those students with an interest in photography can document the changes that occur over the course of the week and photograph the many and varied insects involved in decomposing a body. Students who are technically skilled might consider time lapse photography or video cams that record live images. Encourage students to explore what is the best method of collecting, pinning or preserving insects so that they can be identified and used to help estimate PMI. Those students who would prefer not to work directly with the decomposition study could research and report on actual case studies where forensic entomology was a key factor in solving a case.

For teachers who do not have the space or time to do this study at school, consider having a student or team of students conduct and document the project at home. Then again, there are always summer vacations for you to conduct and video tape the project. Next fall share your summer movie with your students!

Patricia Nolan Bertino and Anthony (Bud) Bertino have extensive background experience in teaching high school science, each having 34 years of high school teaching experience. They are the co-authors of the high school forensic textbook entitled: *Forensic Science: Fundamentals & Investigations*, Cengage/National Geographic Publishing, 2nd Ed. The Bertinos are currently involved with forensic teacher education through conference presentations and in-house professional development workshops for teachers. The chicken decomposition study and forensic entomology along with other forensic topics will be featured at 2017 fall science teacher workshops. For more information about their conference schedule, textbook, professional development teacher workshops or free teacher resources, view their website, [www.Bertinoforensics.com](http://www.Bertinoforensics.com)
Locked Room Mystery (from page 37)

If only some of our detective sergeants were as perceptive as Dr. Crumborn! After receiving a phone call from young Coombes, I went straight to the station and asked the good doctor some very specific questions about the Cavendish home. When he made his evening visit to Mrs. Cavendish, there had been two knitting needles in the wool on her table. The next morning, there was only one. He found part of a broken needle on the floor, he saw the other part of it, with string tied round it, first in a drawer in the study, and later peeping out of Mr. Cavendish’s pocket (see pics, 3 and 11), Cavendish must have been in his wife’s room the night she died. Dr. Crumborn suspected him of pouring laudanum into the linctus, which would have disguised the taste. The key to the locked door mystery lies in the broken knitting needle and the piece of string. My sketch of how this apparatus works helped Crumborn and Coombes understand how Cavendish carried out his devious crime. The device works very well on a well-oiled door. After the key has been turned, the needle falls out and can be pulled through to the other side as long as the door has a good clearance underneath.

Photo Crime Solutions

An Unaccountable Death Mini Mystery (from page 4)

Morey said that he had touched nothing after finding Lombard in his lit office, yet when Walker arrived he had to snap on the lights. Morey later confessed to killing Lombard after the accountant had found tax fraud and threatened blackmail.

Book Review (from page 7)


The preface of the book starts with early law enforcement before we had police departments and the evolution and growth of forensic science. The history of DNA and forensic analysis is fascinating and includes the discovery of DNA decades before molecular biology became a discipline, what DNA is, and how it is used today.

The influential figures chapter is very comprehensive and includes some old favorites of forensic scientists and many that were new to this reader. The cases in this book also include some well-known cases and some lesser known, but very interesting cases solved by forensic science. I really appreciated the Pros and Cons chapter in this book. The author talks about the realities of forensic analysis with the cons giving me some food for thought. The glossary is very comprehensive and would be a good starting point for student research projects.

Forensic Analysis and DNA in Criminal Investigations was a very interesting book that I would recommend to any teacher or anyone interest in the area of forensic science. There are also many uses for this book in the classroom such as: biographies of forensic scientists, case studies, and research projects.

By Ann Kosloski
Forensic DNA Profiling Using STR Data

Theory, examples, and exercises all in one spot.
By Brian Bollone

Since the onset of CODIS, the Combined DNA Index System, in 1996, law enforcement personal have come to rely on its powerful database to generate investigative leads in crimes where biological evidence is recovered. However, the term “CODIS” is often misrepresented in popular culture and little to no attention given to short tandem repeats (STRs) and the process used to generate victim identification as applied in forensic investigations of mass fatalities. The activities described in this article helps students understand the structure of STRs, and how STRs are an excellent means for identification of unidentified human remains.

Short tandem repeats are areas within eukaryotic DNA where repeat base pair units are between two and six bases in length. The number of repeats a STR marker exhibits are variable among individuals (polymorphic) making them ideal for human identification. Scientists have created databases which map the frequency a specific locus appears within major populations and subpopulations throughout the world. The activities described in this article helps students understand how the random inheritance of genetic material can help determine the identity of an individual or their remains.

In the United States, the Federal Bureau of Investigations developed CODIS which stores and permits searches for 20 core STR loci. All of them have been characterized for the United States, and eleven subpopulations of STR loci frequencies have been published for statistical analysis. Subpopulations include, but are not limited to, African-American, Bahamians, Caucasian, Trinidadians, and Southwest Hispanic. For illustrative purposes the allele TPOX is comprised of a four base pair repeat unit (5’-AATG-3’) and is most commonly inherited as a repeat occurring eight (TPOX 8) times in U.S. African-American (\( f=.37209 \)) and Caucasian (\( f=.53477 \)) populations. Within a genome, TPOX 8 would appear as:

\[
5’-\text{AATGAATGAATGAATGAATGAATGAATG}-3’
\]

After providing the students with a number of examples of STR loci, including examples with flanking regions which serve as primers for amplification during the polymerase chain reaction process, a discussion of microvariants is warranted.

Not all STR loci have an exact number of repeats. A microvariant is an STR allele that contains an incomplete repeat unit at the end. For example, allele TH01, which is a four base pair repeat unit (5’-AATG-3’) is most commonly found in U.S. Caucasians as TH01 9.3 (\( f=.3676 \)). In specific terms, the four base pair pattern repeats nine full times and a partial repeat of three (hence the .3) bases 5’-ATG-3’. Specifically, TH01 9.3 would look like this:

\[
5’-\text{AATGAATGAATGAATGAATGAATGATG}-3’
\]
A complete listing of U.S. STR allele frequencies and subpopulations data can be found at: [http://www.hartnell.cc.ca.us/faculty/jhughey/Files/allelefrequenciesstr.pdf](http://www.hartnell.cc.ca.us/faculty/jhughey/Files/allelefrequenciesstr.pdf) or for a state-by-state listing of STR allele frequencies, go to: [http://www.theforensicteacher.com/Free_articles_files/CODISSTRLocidatafrom41Sample.pdf](http://www.theforensicteacher.com/Free_articles_files/CODISSTRLocidatafrom41Sample.pdf)

Using the CODIS allele STR frequencies, in compliance with the National Research Council (NRC II, 1996) recommendations, students can analyze a pedigree tree of an unidentified/missing persons in a real world situation—mass disasters such as a plane crash, burned victims, or building collapse. “A pedigree tree is a graphical representation of the relationship of the missing person with two or more relatives” (FBI.gov). By applying Mendelian inheritance, each parent contributes one of two possible STR alleles per gene, so students can analyze a set of STR results. For example, in each example below a victim profile has been matched to living family members (father and mother). Students draw an arrow from each living family members’ STR Loci, which may account for the victim’s STR loci, and circle any victim STRs which cannot be accounted for. Thus, students can identify if a victim has been correctly or incorrectly matched. Students must understand that a set of parents cannot be a match to a victim even if three or more of the STR loci cannot be accounted for.

**Correctly Matched Victim:**

<table>
<thead>
<tr>
<th>THO1</th>
<th>THO1</th>
<th>TPXO 1</th>
<th>TPXO 2</th>
<th>CSF1 1</th>
<th>CSF1 2</th>
<th>D16S359 1</th>
<th>D16S359 2</th>
</tr>
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<tr>
<td>6</td>
<td>7</td>
<td>10</td>
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<td>11</td>
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<td>10</td>
<td>12</td>
<td>13</td>
</tr>
</tbody>
</table>

Father, Victim A

Profile, Victim A

Mother, Victim A

**Incorrectly Matched Victim:**

<table>
<thead>
<tr>
<th>THO1</th>
<th>THO1</th>
<th>TPXO 1</th>
<th>TPXO 2</th>
<th>CSF1 1</th>
<th>CSF1 2</th>
<th>D16S359 1</th>
<th>D16S359 2</th>
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<td>12</td>
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<td></td>
</tr>
</tbody>
</table>

Father, Victim A

Profile, Victim A

Mother, Victim A

Provide students with a number of example sets (worksheet #1) and ample time to practice this process. Let students know it does not matter which parent the STR loci came from (the arrow),
so long as a single loci came from each parent. For example, in the TPOX loci below, either student answer is correct.

**Correctly Match TPOX Loci:**

<table>
<thead>
<tr>
<th>TPOX 1</th>
<th>TPOX 2</th>
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<tbody>
<tr>
<td>10</td>
<td>11</td>
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<td>11</td>
<td>11</td>
</tr>
<tr>
<td>9</td>
<td>11</td>
</tr>
</tbody>
</table>

Father, Victim A

Profile, Victim A

Mother, Victim A

However, as seen below, this is **not** an acceptable match for TPOX because both loci cannot originate from the same parent:

<table>
<thead>
<tr>
<th>TPOX 1</th>
<th>TPOX 2</th>
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<tbody>
<tr>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>10</td>
<td>13</td>
</tr>
<tr>
<td>9</td>
<td>11</td>
</tr>
</tbody>
</table>

Father, Victim A

Profile, Victim A

Mother, Victim A

Posting an answer key in a public area while walking around the classroom, monitoring completion, offers immediate feedback to students who solve a given problem, without waiting for the classroom teacher.

Students must understand basic concepts of inheritance and variation from the *Next Generation Science Standards, HS-LS3* (NGSS Lead States 2013), to solve a pedigree tree. In addition, pedigree trees allow students to evaluate the impact of mutation. According to The American Association of Blood Banks, “an opinion of non-paternity shall not be rendered on the basis of an exclusion at a single DNA locus, single inconsistency”(Butler, p 533). The mutation rates for STR loci have been documented from 1 to 4 per 1,000 (0.1%) (The National Institute of Standards and Technology). The two-exclusion rule is commonly accepted in paternity testing. That is, if three or more STR alleles are different between the alleged father and the child, the alleged father can be excluded as the biological father.
Once students become acquainted with matching pedigree trees, show them real-world applications of the process, such as, “Enhanced Kinship Analysis and STR-based DNA Typing for Human Identification in Mass Fatality Incidents: The Swissair Flight 111 Disaster.” (Leclair, B., 2004) and/or, “Bioinformatics and Human Identification in Mass Fatality Incidents The World Trade Center Disaster.” (Leclair, B., 2007) Provide students with a set of STR loci from a fictional mass fatality incident, including both the victim and living parents (worksheets 2 & 3). In the example set below, parent set 8 can be matched to the remains of victim 6. Please see the following video for the step-by-step process for matching parents to victim:
https://www.youtube.com/watch?v=eRmn43sXXeM&feature

Remind students, not all victims of a mass fatality will have living parents (or offspring) who can provide DNA samples for identification; and a set of parents may be attributed to a victim, even if one STR loci can not be accounted for. After students are familiar with matching parents to victims, ask students what other options law enforcement have for identifying victims of mass disaster if obtaining parent DNA is not an option.

Short tandem repeats have become the DNA markers of choice for human identification purposes. While students may not perform actual STR analysis in a high school setting, there are a number of models, such as the ones described in this article, which can assist student understanding of STR loci. Once students grasp the concept of STR pedigree trees, a possible extension would be to introduce the mathematical processes necessary to compute a random match probability using current Federal Bureau of Investigations STR population data. It is
important to remember that STR’s are inherited, variable, have low mutation rates, and degrade slowly.

References:

I have attached a copy of two STR activities (all in one document) which are referenced in the article above. The Excel document, when printed landscape, will print the activities without the answers. For pages 4-18, I photocopy each page on cardstock paper, each victim set on a different color, and cut the STR data into strips for student use (see photographs.) If a teacher does not want to use strips with the STR data, they could give each student page 1. It has all the victim data on one page.

Student sheets can be downloaded [Here](#).

The author welcomes feedback and comments and can be reached at bbollone@nvps.net.
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- Forensic Genetics
- Forensic Entomology
- Forensic Anthropology

Written by a Science Teacher - edited by a Cop!
Ask the Morgue Guy

Q: A club of local businessmen gets together every week or so for lunch and they have approached me about speaking to them about what’s real and what’s not in the field of forensics. The presentation will last about 45 minutes and will include PowerPoint and samples I can pass around. They previously contacted my principal who has already given permission and it looks like I’ve got green lights all around. The problem, though, is my husband.

Hank’s been a state cop for 20 years and he’s extremely knowledgeable about forensics, both in practice and in theory. I’ve been teaching forensics for eight years and he’s been a frequent visitor to my classroom. His bulletproof vest is discernible under his uniform, and his mace, taser, and gun are on his belt. When the business club initially contacted me I told them Hank would be a better speaker, but they said no. When I pushed back they said Hank was the real reason they only wanted me.

After the San Bernardino massacre this group passed a rule that no guns were allowed in meetings (not that anyone had tried to bring one in) and they were opposed to Hank bringing a gun. I explained he was a peace officer and he was not allowed to be on duty without his weapon, but they dug their heels in. Now my principal keeps asking when I’m going to speak to the group. What are my options?

Anne Ng, Wytik, FL.

A: The group knows where you stand, so politely decline if they call again, tell your principal what’s going on, and forget about it. These close-minded fear mongers don’t deserve you or your husband. If they persist politely tell them to go pound sand.

2017

8/9 - 10
Interview and Interrogation Principles. FL Inst. Forensic Anthropology & Applied Science This 12-hour course (8 hours of instruction on August 9 and 4 hours on August 10) will cover the following topics: History of the detection of deception, Physiological basis of detection of deception, Proxemics (relationship of interviewer to individual), Neuro-linguistic programming, Qualities of a good interviewer/interrogator, Verbal and non-verbal traits, Introduction to statement analysis, Diagnostic interviewing, Steps of the interrogation, Theme development, Cognitive interviewing, Role playing (practical application of principles). For more information go to: http://www.forensics.usf.edu/.

8/14 - 16
International Conference on Evidence Law and Forensic Science. Maryland. On August 14-16, the Sixth International Conference on Evidence Law and Forensic Science will be held in Baltimore The previous conferences have been held in Australia and China. The sixth conference is cosponsored by the University of Maryland, the Offices of the Chief Medical Examiner and Attorney General of the State of Maryland, China University of Political Science and Law, and Dian Diagnostics The first day of the program will focus on the relationship between evidence law and forensic science, the second day on the judicial standards for admitting expert testimony, and the third day on bridging the gap between science and law. For more info go to: http://wwwicelfs2017 theiaescom

10/5/17 - 3/8/18
Diploma course in Forensic Medical Sciences. Academy of Forensic Medical Sciences, UK. It is a part time evening course aimed at those interested in learning about a range of forensic topics. The Course will consist of 30, two hour sessions and will be available by completion in classroom and online. Students may also choose to complete the course as part attendance, part online; please contact the A.F.M.S. office for further details. The DipFMS course will be held on Tuesday and Thursday evenings from 5pm - 7pm starting on the 5th October 2017 through to 8th March 2018. The online learning can be accessed anytime and anywhere in the world. For our distance learning students, we offer the full lecture recording with documentation online. For more info go to https://www.facebook.com/Academy-of-Forensic-Medical-Sciences-235898273154842/.

10/10 - 14
FORENSIC ODONTOLOGY IN A MEDICAL EXAMINERS OFFICE. This newly structured five day interactive seminar held at one of the largest medical examiner’s offices in the country will allow participants of all levels of knowledge and experience to interact with many forensic science disciplines. Participants who complete the five day program will have enough points to apply for full membership in the Odontology section of the American Academy of Forensic Sciences (AAFS). For more info go to www.tulane.edu.

11/1 - 3
Search Strategies for Clandestine Burials. Ever have to search for a buried body? The Florida Institute for Forensic
What's Going On?

If, for some strange reason, you are worried about enrollment for your forensics class you can take the class to prospective students. Some units in a forensics curriculum have a definite wow factor to them. An example is fingerprints and the way your students' faces lit up the first time they visualized a print on a surface. Other topics might include hair and fibers where images from a microscope can be imported to a PowerPoint presentation, forensic anthropology, where images of bones with the telltale marks and damage to them can be described, or even photographs of blood which are enhanced with Luminal.

Although this suggestion comes a little late in the school year, you might want to keep it in mind for the next. Approach other teachers about holidays like Thanksgiving or Christmas or after finals when class sizes might be down or they have students who are absent, bored, or a little antsy. It won't be hard to find the students in your classes who would thrive as forensic ambassadors. These are the kids who are always excited about every class of yours, the ones who tell their friends about your class in the cafeteria, the ones who are the first to volunteer for every unit.

Once you get the go ahead from other teachers to do a short 10 minute visit you can start preparing those kids to take their favorite units on the road. Working in pairs they have to design their presentation according to a rubric and give a demonstration to your class. They’ll be pumped and so will many of the younger students in the target classrooms.

Just for Fun
Make Ambassadors

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Do you or your organization have a workshop, seminar, conference, training opportunity, or announcement you’d like to share and have included free? Please email us at admin@theforensicteacher.com and tell us about it!

Online Forensic Education

Please search “online forensic education” with Google. We regret we do not have the space to present the list here. However, you’ll be pleasantly surprised at what you find.

Anthropology & Applied Sciences (IFAAS) and the Pasco Sheriff’s Office at USF is hosting a 3-day course (24 hours) to provide detectives and crime scene technicians with the skills necessary to locate human remains from surface scatter and clandestine burials. This course will provide classroom instruction and hands-on fieldwork; participants will search an area in the FIRST Outdoor Forensic Facility and learn how to effectively use ground-penetrating radar (GPR). Learn to: Develop a methodological strategy to search burial sites, scan the scene for analysis and documentation using 3D forensics, and apply concepts with hands-on, practical exercises in remote sensing and field methods, including GPR, historic imagery, GIS, and GoogleEarth. For more info go to http://www.forensics.usf.edu/.

12/4 - 8
SOLVING COLD CASE HOMICIDES. It is estimated that there are more than 240,000 unsolved homicides in the United States since 1980! This course is intended to provide attendees with information that could assist in organizing, investigating, prosecuting, and bringing these cases to a successful resolution. The seminar will bring together some of the nation’s leading experts in cold case investigation and prosecution. Topics will include how to form and sustain a cold case unit, behavior analysis of the crime scene, and how to conduct interviews in a cold case investigation using DNA and blood patterns, 3D visualization and historic imagery, and prosecution strategies in no-body cases. The Vidocq Society will review your case! As a special feature, members of the world-renowned Vidocq Society will be on hand to review and consult on some of your cold cases. NOTE: To arrange for your case to be reviewed, or for more details about the seminar, contact: Tom McAndrew at thmcandrew@gmail.com or 570-233-3212 or go to http://www.forensics.usf.edu/.

Do you or your organization have a workshop, seminar, conference, training opportunity, or announcement you’d like to share and have included free? Please email us at admin@theforensicteacher.com and tell us about it!

www.theforensicteacher.com

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Stoopid Crooks

The police just dream about geniuses like these guys...

A truckload of live chickens was on its way to processing plant near Hall, Georgia, when the driver of the truck called 911 and said a woman had not only rammed his truck, but backed up and did it again. He said he wasn’t injured but the woman had fled the scene. He gave a description of the car and her license plate, which she left behind along with the wreckage of her front end. The police tracked her down and talked to her through the door at her house before she emerged and was taken into custody. Judith Moriah Armstrong, 26, was not only charged with hit-and-run, but also obstruction of justice and driving under the influence. Her reason for attacking the truck? She said she was vegan and wanted to protect, “All those baby chickens.”

Timothy Lee Trammell, 36, of Jonesville, South Carolina, found himself in trouble when a police deputy observed him kneeling next to a car in the parking lot of a convenience store and scrawling a word in spray paint on the car’s door. Apparently, Trammell’s girlfriend, who worked at the store had been unfaithful and Tim had decided to get revenge. The deputy caught up with him a short while later after a brief chase. The cop found marijuana in his car to add to the charges and the young man hopefully learned the error of his ways. While he was painting he spelled cheater C-H-E-E-T-E-R.

Last September John Ripple of Kansas City, Kansas, robbed a bank because, as he told police, “being with my wife has become so unbearable I would rather be in jail than at home.” This week a federal judge sentenced Ripple, who faced up to 30 years in jail, to six months of home confinement and 50 hours of community service.

Anthony Berden, 19, of Tampa, Florida, was arrested after he walked into a local park because, as he told police, “he wanted to participate in a dinosaur flash mob.” Apparently, Berden got some bad information about a spontaneous gathering of dinosaurs like the one seen at https://www.youtube.com/watch?v=5bEqI7Q6KmU. The only problem was that under his costume he wore a black ski mask and a military style tactical vest. He also carried a rifle which police later determined was an Airsoft gun. Fortunately, for the young man, he was only charged with disorderly conduct and wearing a mask while committing an event in a public park.

Spencer White of Santa Clarita, California, isn’t a stoopid crook, but he did something noteworthy when he broke the law. He bought a 35 year old vintage sports car and couldn’t wait to take it out for a drive. He was so proud of it he and his mother headed out onto a highway to see what it could do. His mother noticed they were going very fast and asked him what their speed was. He noticed it was 85 mph and thought, “What the hell, let’s take it a little faster.” A few minutes later a California Highway Patrol officer pulled up behind him and flashed his lights. White pulled over and smiled at the officer who sported a big grin himself. You know how fast you were going?” the officer asked. “Yup,” White said, “I was going exactly 88 miles an hour.” The officer verified the speed on his radar gun as 88 mph before both of them cracked up laughing. The cop wrote White a ticket for the 1982 DeLorean. “You got a flux capacitor in there?” the cop asked.

Christopher Durkin, 35, of Glenshaw, Pennsylvania was in Pittsburgh traffic court to face charges of driving with a suspended license. Afterwords Durkin walked to another person at the back of the courtroom and began talking to him. The man did not appear interested in what Durkin had to say, left the courtroom, and walked up to a deputy and said Durkin tried to sell him narcotic painkillers. Durkin was arrested and charged with possession of a controlled substance and intent to deliver.
Stoopid Movies

More stoopid criminals; these guys are priceless.

Click on the cameras below to see the movies (internet connection required).