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.
The Forensic Teacher Magazine

Forensic Geology

Plus, more blood labs for your students
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By Mark Feil, Ed.D.
Dr. Ray Murray has forgotten more about geology than most of us will ever know. He pioneered the field of forensic geology and helped solve a lot of crimes no one had a clue about how to approach. He dropped some nuggets of wisdom in our lap when we asked him about the field.

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Editorial

Not Long Now

Christmas is a long way off, but the most wonderful time of the year is right around the corner. The kids are getting antsy, the teachers are too, and the end of the year just can’t come soon enough.

Our issue addresses a topic we’ve never touched: forensic geology. We’ve got a number of goodies for you if you’ve ever thought about doing a lab where trace amounts of soil or clay were tracked from a crime scene to a suspect’s home. It’s easier than you think and we’ve included everything you need to pull it off. And that’s not all.

If you’re not into geology, fear not. We’re proud to present a blood test lab from a teacher with her finger on the pulse of the topic that looks at blood from six different angles. Is it blood? Is it human? She’ll guide you through the lab like the seasoned pro she is.

Last issue was all about blood, and while we presented it thinking that, from an engagement standpoint, bloodier was better, but not all of our readers agreed. Some of them reminded us that encouraging violent behavior (hitting the simulated head of a victim hard with the intent of producing copious amounts of blood spatter) probably isn’t appropriate with relation to 13- and 14-year olds, especially since there might have been an element of glee involved. We apologize for suggesting such, and trust our readers will use their discretion.

Please let us know if you like something or if there’s anything you’d like us to cover. Write to us at admin@theforensicteacher.com.

Finally, be aware that if you begin the next school year with a different email address you won’t hear about new issues. In fact, please sign up again as soon as you know what your email address will be in the fall, even if you’re sure you’re on the list. If you’re on there twice you’ll only get one email when the next issue is done.

Enjoy!

Dr. Mark Feil

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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.

The subtitle to this book is “forensic geology and criminal investigation,” and it’s no accident it was written by the man who literally invented the field of forensic geology. At first glance it appears to be a collection of stories about how the author used the field to solve crimes, and there is a lot of that in this book. Murray’s style of writing is engaging and full of facts without being dry or boring. He takes the reader on a gentle trip that begins with talking about forensic geology in the news and using materials from the Earth as evidence. There’s a number of examples throughout each chapter that describe how criminals screwed up by not paying attention to clues and evidence left behind, or took with them that included dirt and rocks.

I trained as a biologist because I was fascinated by life and the various ways it exists. Plus, I like animals. I never once considered geology as a major, maybe because I thought it was boring because it was all about rocks, which, to my ignorant young eyes, were cold and unmoving. They’d been around forever and no one was discovering new ones in the Amazon rainforest or on the ocean bottom, But this book made me feel differently about the field. I still don’t want to be a geologist, but the way the author leads you through the application of geology to the field of forensics by using real-life examples and by gradually building your knowledge of rocks and soil made me want to keep reading, even after the book was done.

Some authors of many introductory books about a field of science with which you’re not familiar can’t resist the urge to bombard you with vocabulary they expect you to know instantly. Murray doesn’t do that. He gives you just enough geology so you can understand his next application of the field to forensics to keep you interested. He doesn’t try to jam your head with a lot of unfamiliar terms and concepts, which can easily cause you to lose interest in the new, field of study.

Gradually, this book covers everything from the minerals in clay to types of pollen to grading scales to types of clay and glass, abrasives, and commercial types of sand. When the author discusses how to examine rocks and sand and soils he takes it step-by-step starting with color and moving to particle size, the tools of the trade, common evidence, luminescence, gradient columns, light properties, and there’s even a whole chapter devoted to searching for bodies as only geologists can.

The book is filled with real life examples of real criminal cases, all tied to, and solved by, the application of forensic geology. It’s great reading for anyone interested in forensics, and lends itself easily to groups of students who want to work in small groups so each can present a chapter. If you’re looking for summer reading this one is worth a look.

Dr. Saferstein has been writing forensic textbooks for a long time, and he’s getting better with each one, especially with this edition, which is aimed squarely at high school students. The author and the publisher have put together a package that even the most jaded millennial will have a hard time being bored with. Adults, likewise, will have a hard time putting this baby down.

This book has a number of really good things going for it right out of the gate: the chapters are in the same order as most forensic curriculums, each chapter begins with a criminal case most students will have heard of, and no block of text goes very far before there’s another graphic, heading, or example, which makes it hard for a reader to get bored, even one in their teenage years (hormones and short attention span included). The use of graphics and white space throughout the text belies the quality of information given—the layout looks so good it’s easy to get swept along as you read, and learn without realizing you’re picking up valuable, relevant facts.

Each chapter features case studies to make the material real as well as examples from real life, for example, an actual evidence submission form or an actual crime scene diagram. One thing this reviewer especially liked about this edition is the terrific attention to detail, and to primacy and recency—the information about the chapter is given right upfront in the form of learning objectives, and it’s also hammered home via quick reviews spaced throughout the text to summarize preceding sections.

There is a chapter review at the end of each to highlight the main points as well as thoughtful review questions for students and teachers to see how much they comprehended. Each chapter also ends with a related critical thinking exercise. Of special note is that every chapter finishes with a relevant laboratory experiment that can easily be done. Like many outstanding science texts on the market, terms are defined in the margins. This edition is different from previous editions because it adds a chapter about death investigation and another about mobile device forensics.

In addition, if your class or school adopt this textbook you will also receive online access via the publisher for many of the resources in the book including flashcards, practice tests, PowerPoint presentations, and access to and number of engaging, informative, and tasty activities for you and your students at mycrimelab.com. While there you and your students will also have the opportunity to watch and explore, among other things, firearm identification, expert witness testimony, questioned document examination, a working gas chromatograph, how blood alcohol levels are measured, a working SEM, polarizing microscope and other specialized visualization devices, how DNA works, assume the perspective of the first responder to a violent crime scene, assume the duties of a CST, explore gel electrophoresis, CODIS-DNA matching, search and collect evidence at a murder scene, see how autopsies are performed, how bullets fire, cast a footwear impression, practice matching bullets in 3-D, the strange journey an email travels, and much more.

The previous editions of this book were outstanding resources to use in the forensics classroom, but this one ups the standard to a whole new level. It’s not only well-written and the content well presented, but considerable effort has been put into making sure the format and material ties into the mind and fleeting attention span of that often maligned and misunderstood animal, the teenager.

The book ends with a chapter about careers in forensic science and includes a description of the major disciplines, education and training necessary for each, and career opportunities for anyone interested in that discipline. The chapter also names many, but not all, universities offering forensic science degrees and then gives a list of the types of courses students can expect to take while in a program.

This edition is the strongest of Saferstein’s yet, written for secondary education, and it would be useful in many post secondary curriculums too. If you or your school is shopping for a forensics textbook this is one of the nicest we’ve seen.
Mini-Mystery

Theft in a Knordwyn Shop

ENGLAND WAS ONE of Thomas P. Stanwick’s favorite summer destinations. Among the amateur logician’s regular haunts was the beautiful Northumbrian village of Knordwyn. Its cobbled streets, crooked streams, and surrounding green hills were particularly soothing to his eye, and the peculiarities of its inhabitants were particularly intriguing to his mind. Half of them never told the truth, and the other half never lied. His powers of deduction were therefore often tested.

One day in late August, Stanwick arrived in Knordwyn, checked into the Grey Boar Inn, and took a long late-morning walk through the village. After lunching at a pub near the village square, he walked down a nearby street and knocked on the door of an old friend, truth teller Winston Langworth, who was the chief constable in Knordwyn.

“Thomas!” boomed Langworth when he answered the door. His large, ruddy face, framed by a Lincoln beard, showed his surprise. “I wasn’t expecting you, but do come in. We thought you would be here for the Queen Anne Festival, which ended ten days ago.”

“Sorry I couldn’t attend the festival this year,” said Stanwick as he was ushered to the front parlor of Langworth’s small home. “I had an editing project to finish up back home.”

“Pity. There was an especially good juggling troupe this year. Ah, well, you’re just in time.”

“In time for what?”

“To help me unravel a little robbery case.”

“Oh?” Stanwick eased himself into an armchair and lit his pipe. “Who’s been robbed?”

“David Ashton, the dispensing chemist up on High Way. A bag of cash receipts was taken from behind the counter of his shop this morning.”

“Hmm.” Stanwick reminded himself that a dispensing chemist in Britain was the same as a pharmacist in the States. He also suppressed the impulse to make a bad pun about High Way robbery.

“Behind the counter. Is his Clerk suspected?”

“No. Like Ashton, Marianne Witherby is a truthteller, and she denies stealing it. When I visited the shop, I saw that anyone could have reached under the cash register, where the bundle had been kept, and taken it. Marianne says the bag was there at nine this morning when she added some notes to it for a later bank deposit. “The only entrance to the- shop is the front door,” continued Langworth, “and a bell rings whenever the door opens. Only three people visited the shop this morning, all at different times. Any of them might have gotten near the counter while Marianne was busy elsewhere. When she returned to the counter at noon to prepare the deposit, the bag was gone. No customers were there at the time, but she raised the alarm with Ashton, who was in the back room having tea.”

Stanwick gratefully accepted a cup of Earl Grey.

“Was Marianne able to identify that morning’s three customers?”

“She was. All three are villagers, but we don’t know whether they are liars or truthtellers. I called them and asked them to come by here for a chat.”

The first arrived a few minutes later. Jane Speakman, a barmaid - in her late twenties, sported a black jacket, a black skirt, and black boots. Her blue eyes helped set off a small nose ring. She was followed shortly by Joseph Sweeney, a garage mechanic in his thirties. His red beard was framed by a cap and grease-stained overalls.

Langworth’s final visitor was Robert Snow, a clean-shaven solicitor in his early forties who wore a three-piece suit. He nervously ran his hand through his thinning sandy hair as the five of them sat down in the parlor.

“Thank you all for coming;” said Langworth blandly. “I told each of you on the phone of the theft at the chemist’s this morning. You three were the only visitors during that time, and I have reason to believe that the clerk is innocent. One of you must therefore be the thief. And perhaps those who are not know who is.”

“I’ve never stolen anything in my life,” said the barmaid emphatically. “The three of us hardly know each other, in any case.”

“She’s right;” added Sweeney. “I certainly didn’t steal the money.”

“In fact, we three know each other rather well;” said the solicitor.

“Either I did not steal the money or Sweeney here is innocent.”

Langworth frowned and cleared his throat. “I can assure you that I will get to the bottom of this matter.”

“Indeed, constable, you already have,” remarked Stanwick languidly, with only a hint of gentle sarcasm in his tone. “Congratulations on a brilliant interrogation. The identity of the thief is quite clear.”

Who stole the money from the shop?

(Answer on page 29)

Stan Smith was the author of three books of Stanwick mini-mysteries that have been published in nine languages and sold over 120,000 copies.
Hot Sites

http://www.aafs.org/resources/forensic-links/
A list of organizations for whatever branch of forensics tickles your fancy. If you can’t find it here chances are good it ain’t to be found.

http://ithare.com/a-beginners-guide-to-computer-forensics/
If you or your students have any interest in computer forensics this is a site not to miss. There’s more info here than you can shake a laser pointer at about all aspects of the field.

http://web.mst.edu/~rogersda/forensic_geology/Geoforensics%20Case%20Histories.htm
A ton of neat cases where forensic geology was used to solve crimes. If you think rocks only relate to crime as weapons this site will change your mind.

This is a monster 450-page guide to doing forensic experiments at home, and pages 35-73 are devoted to forensic soil analysis. If you EVER wanted to know how to do something in your classroom start here!

https://www.nhn.ou.edu/assets/reu/Soils_Module.pdf
A 90-page work of art if you ever want to do a unit on the role of soils in environmental forensics. Nicely done.

A nice introduction to trace evidence for teachers thinking about adding a unit to their curriculum.

Do you have a topic you’d like us to cover?
Do you have a lab you’d like to feature?
Email us, tell us about it!

admin@theforensicteacher.com
Tracking Crime
A Forensic Geologist
It’s not a forensic discipline for everyone. It’s not as glamorous as DNA, blood spatter, or ballistics. But when your stones are in the grinder you want a forensic geologist in your corner. While it wouldn’t be kind to suggest Dr. Ray Murray is older than dirt, it is worth noting he literally wrote the book on forensic geology. From a young man unsure about what major to study in college to one of the world’s leading experts on using rocks and soil to nail criminals, Murray is the man to talk to when the stone chips are down.

The man is as nice as he is professional, and we were fortunate to catch up with him at his home in Montana.

By Mark R. Feil, Ed.D.

Forensic Teacher Magazine: I was very curious to talk to you because we have never done anything with forensic geology. I’ve always been fascinated with it but it’s not the most common discipline. Most high school curriculums have a year of Earth science in the schedule. The students learn what they have to and then they forget it, but I’ve always been fascinated how it can be used in forensics and that’s what prompted me to search you out. Looking over your background on your website I see you’ve had quite a career. You live in Montana; did you grow up out west?

Ray Murray: I grew up in Massachusetts, about 50 miles west of Boston in Fitchburg, Massachusetts.

FT: How did you get interested in geology?

RM: I went to Tufts and I was pre-law, but at that time everybody had to take a science course, and they said you could probably pass this geology class, but you’re probably not going to pass a chemistry, physics, or math course. So I took the geology course and a lab instructor on a field trip said to me, “have you ever thought about being a geology major?” And my reaction was, “No.” And I thought about it a little more and did some reading and I became a geology major.

FT: What was it that changed your mind?

RM: I don’t know. I mean, it was a fascinating subject, and just seemed the right thing to do.

FT: I have a biology background so when I think of geology I think of rocks and cold minerals and not a lot of clues at first glance. So what was it about geology that made you choose it?
RM: It just clicked.

FT: I see from your website that you turned to forensic geology in the 1970s—tell me the story of how that happened.

RM: I was in my office at Rutgers when an agent from the Bureau of Alcohol Tobacco and Firearms came through the door with a couple bags of dirt. I had never heard of forensic geology. There were two groups of nasty people throwing rocks and Coleman fuel through windows into a house. They used local rocks so there was nothing you could do with that. Another case was a power plant explosion at Pickatinny arsenal, and I guess I was able to help with that by looking at the material they recovered. He then introduced me to the chief chemist of the New Jersey State police, and that was Dick Saferstein, and Dick introduced me to the forensic geologist at the FBI. I became fascinated with the subject. I was going to write a paper and turn that into a book and then I joined with a friend at Rutgers in the soils department, John Tedrow, and we wrote the first book on subject. And then more followed.

FT: So, I take it you like mysteries?

RM: (Laughs) it’s interesting. It’s good evidence, it’s interesting evidence. It’s not as common as blood, but where it exists, if it’s collected it can be extremely useful.

FT: So, I guess you could say the evidence is carved in stone?

RM: (Laughs) I wish I had said that.

FT: How much call is there for forensic geologists for civil cases versus criminal cases?

RM: It don’t know exactly. My guess is that civil cases, in the broadest sense, would be far more common. And when you say in the broadest sense you’re getting into soils engineering.

FT: A separate field?

RM: Yes. Rather than the type of case where you want to know who put the abrasive in the oil pan of the airplane. I remember a civil case, an interesting one, from New Jersey. It was a very simple civil case. Someone dug up a yard to put a water line in for a house, and in that part of New Jersey you had red soil on top of red rock. When they dug they threw pieces of the hard rock up onto the grass. They cleaned up afterwards but they’d didn’t find all the pieces of rock. Someone came along with the lawnmower and threw a piece of rock and it seriously injured someone.

Now, because it was a piece of hard rock that would not have existed at the surface unless it had been dug up from below, this tied the hard rock to the accident to those who put the water line in. There are lots of those kinds of civil cases. Criminal cases? There are two variations of these types of cases. The first is physical evidence, like grains of sand. The other is a search where you’re looking for a buried object and this is a subset of forensic geology. Buried jewels, buried bodies, buried guns. And of course that has been big business in Northern Ireland, Kosovo, and Colombia. There are groups of people in Great Britain who do this and there are groups of people, of course, in this country who do this.

To answer your question, I guess it depends on how broadly you think of the field.

FT: You mentioned earlier about when you’re looking at soils under the microscope?

RM: Sure, you want to know the relationship between what you’re looking at and another sample. In a sense you’re trying to place someone at a specific location. There are forensic geologists in the evidence area who look at two samples to see if they are consistent. You look at a sample in the second type of case and you want to know where did it come from? That’s the soil on the body that does not match the location where it’s found. Another type of case is where you simply have to identify the material and that would be art fraud, gem fraud, or mine fraud.

And another area of increasing importance is intelligence. You have never been to a certain location, but why do you have fragments of rock on your shoes or in your suitcase that came from there? And there’s a whole series of variations on that. Where did something come from? IEDs are not made in clean rooms.

Soils of varying degrees of particle size
FT: No. I guess that’s something terrorists don’t really think about.

RM: One hopes.

FT: You laughed earlier when I asked if you liked mysteries. Why?

RM: Each element of science is a mystery, and you’re essentially solving a problem. That’s why ordinary geology and forensic geology are essentially the same—you use the same techniques to solve a problem, it’s only a different type of problem. It’s not finding metals or oil or contaminants. It’s a different type of problem.

FT: How many forensic geologists are there? I had no idea the specialty existed until I started digging, no pun intended.

RM: I don’t know the exact answer to that. I mean, we have email lists and such. Remember, the lawyer may go to a professor at a local university and say, “Look at this for me.” This happens all the time. But working forensic geologists? I would say about 100 around the world, in that sense, maybe more. Now, if you count the people who were actually employed doing this the number would be much smaller.

FT: Do lawyers ask you to testify or just submit your reports?

RM: I’ve done both.

FT: When you testify, how much background do you have to give the jury on your field?

RM: That depends a lot on the attorney’s approach to presenting evidence.

FT: For one of our previous issues the person I was interviewing said one of the first things he has to do when he takes the stand is tell the jury that what they see on TV about forensics is wrong.

RM: (Laughs) Absolutely! As a matter of fact, the effect of the leading TV program is really disturbing. One, they give the impression that you do things fast and the results come out easily. But the scariest part is where they look into the microscope, jump up, grab the rifle, and go out to chase the bad guy. And there you mix the investigative function with the forensic function, and they should never come together.

FT: I know what you’re talking about—the guy swabbing blood that looks at the bullet then into the microscope and in the next scene he’s wearing a gun and interrogating a suspect in the interview room.

RM: And you know what that creates—the impression of the lack of integrity or isolation of the examiner. And that’s very disturbing.

FT: And the sad part is, I’m sure there are students in high school and college who are thinking they’re going to go into forensics, drive high-speed chases, shoot bad guys, analyze evidence, and close the case, all in the same day.

RM: With the law people at the Montana crime lab we have a course we give every once in a while for senior citizens and it’s titled, “Montana CSI: crime lab—The Real Blood, Sex, Guns, and Drugs.” It’s standing room only. Over the course of six weeks we have six people, each discussing a different discipline—firearms examination, DNA, medical examiner, forensic geology, and two others. Each talks to the group for an hour and a half, and they give the message of being careful of what you believe versus what you see. It’s not like that and let me show you why it’s not like that, and it’s very effective.

FT: What type of learner are you? Are you the type of guy who learns best by picking things up and examining them with your hands? I imagine geology would lend itself well to this kind of learning.

RM: I don’t know, but now that you mention it, when you pick up a rock your fingers become very sensitive to the texture of that rock. And it’s amazing what you learn from it by looking at it and holding it. On the other hand you have a whole background of training in trying to identify these things. And forensic geology is identification, characterizing, giving it a name, and isolating it to a class.

FT: Which leads me to my next question: you said you had an undergraduate course in geology and the instructor asked
you to think about becoming geology major. What was it that helped you decide? Was it the teacher, was it the subject?

**RM:** At that time the teacher was a lab assistant, but he went on to become a very distinguished geologist. We were on a field trip to Nantasket Beach outside Boston that day. Maybe it was the field trip; maybe it was the samples we had seen because there were a lot of interesting ones that day. I don’t know the answer to your question. The decision just seemed right.

**FT:** That’s all it takes.

**RM:** And my parents agreed.

**FT:** Excellent. Did you have any teachers who really lit a fire under you, or was it all about the subject?

**RM:** As a matter of fact—thinking about it—in high school I took the general science course, and we had field trips and we looked at rocks and those sorts of things and that really caught my attention. And that was in high school and it was a general science course. And I really developed an interest in rocks and in geology by the time I went to college. I’m sure it never occurred to me, at that time, that one could earn a living doing that.

**FT:** Did your parents ever wonder if you’d be able to make a living doing this?

**RM:** I’m sure they did (laughs). But they were very supportive.

**FT:** That’s great! Now, I have to ask: Do you have any advice for students who are interested in geology who might want to follow the same path you did?

**RM:** No, that’s two questions. One is geology and I think I’d say the same thing you would probably say—if it’s what you really want to do, go do it. As for forensic geology—it well, I get lots of emails from students who say I want to be one, and my standard answer is, take as many math, physics, chemistry, and biology courses as you can. Particularly biology. And then get a Masters in forensic science because you will never get a job as a forensic geologist, period. But if you get a masters in forensic science you can get a job as a trace evidence examiner, which is in high demand, and then try to convince your organization they want to do soils in addition.

**FT:** Ahh. Very good.

**RM:** If you think about it, the number of jobs in this country for a forensic geologist as such, doing just soils, well, there are three with the FBI and one with the ATF. Even the forensic geologist with the postal inspection service does other things. The California Department of Justice usually has one or two doing just soils.

**FT:** So, get your degrees in forensics and then convince your organization to take advantage of the extra skills you feel the passion for.

**RM:** That’s correct. But you know in this country, and throughout the world, that the cost of forensic science is going up. If you don’t have 15 cases a year in a particular subspecialty they’re not going to continue doing it. But, if you also do other things, other types of examination then you’re more hire-able.

**FT:** I just thought of a joke.

**RM:** Tell me.

**FT:** What do you call a forensic geologist without a wife or girlfriend?

**RM:** I don’t know.

**FT:** Homeless.

**RM:** (Laughs) That’s good.

**FT:** Did you have a mentor? Someone who stepped up and believed in you and really encouraged you?
RM: Quite a few. Bob Nichols, professor at Tufts, encouraged me in my geologic education and afterwards. Very influential, an amazing man. I say that because of the advice and opportunities he gave me. Also, Charlie Sterns, another professor at Tufts encouraged me and gave me opportunities. There were a whole series of faculty members at Wisconsin. And in graduate school. But then Shell research organization hired me and I worked for them for 12 years. A man by the name of Gus Archie hired me and was my boss all that time. Fantastic guy—more opportunities and encouragement.

FT: Do you have any advice for teachers who want to help students discover their passions in science or forensics?

RM: Take an interest in them as individuals and provide opportunities and advice that guides them rather than just being the great mentor standing aloof and just smiling.

Mineral trace under a light microscope

PHOTO CRIMES

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 29.

Get started now
A RENDEZVOUS with DEATH

Strangulation is one of the most commonly encountered methods of killing. When carried out with bare hands it is an unmistakably deliberate form of murder and can never be confused with an accident or suicide.

1 One breezy mid-March morning George Halliday made his way along a track in Littlewick Wood and stopped near a large old tree. He took a letter from his pocket and reread it. "I'll give this fellow a big surprise," he thought. He looked around nervously, but could see no one.

2 Five minutes later another man came down the same path, halted abruptly and dodged behind some bushes. He peeked out carefully. Had he been seen?

A few minutes later Halliday was dead!

3 A forest keeper, making his usual morning rounds, had heard a muffled scream. He searched all round, came out into a clearing, and ran right into tragedy. A man was stretched out on the ground. No one else was in sight. The keeper ran to the main road and sent a car to the police station. Soon Inspector Black arrived.

4 The Inspector knew most of the residents in the district and he recognised Halliday at once. He had been brutally strangled. Inspector Black examined the stick which was lying near the body.

5 Then the detective turned his attention to the scene of the crime, making a close examination of the ground underneath the tree where the dead man lay. He noticed an envelope, addressed to Mrs. Halliday, the dead man's wife.
Next he picked up the hat which was a few feet away from the body and checked it carefully. He found a hair inside, which, when held up to the light, proved to be very black and curly.

A letter which spoke volumes

In the dead man's pocket was a letter to Mrs. Halliday. This young woman was often the subject of gossip, as she was something of a flirt. Currently, there were two men of the town who were known to be involved with her, and one had sent this letter.

When the Inspector called in on Phillip Sykes, a gentleman farmer who was often seen riding with Mrs. Halliday, the young man was cleaning his boots. "You must have been out in some pretty muck," the Inspector observed. Then he told Sykes all about the body found in Littlewick Wood.

"You've no reason to haul me off to gaol," Sykes said defensively. "A man's free to have a walk if he wants."

The Inspector then visited Mrs. Halliday's other "friend", a solicitor named Percy Carrington. He noted the hat and gloves on the table, as well as the stick, which had fresh mud on it. Carrington said he had just returned from seeing a client.

The answer is on page 29.
Supplementing the section on tire tread marks, and to emphasize the importance of geology in forensics, the students are introduced to soil (sand) sample analysis. This will be my third year teaching this subject in a low income, high risk high school. Martin High School is also changing to block schedule so I have had to reduce a complete year curriculum to two new school years in one. Most of the equipment I already have from when I first started teaching and I had everything stored away. I have one or two labs per week and almost everything in the labs I have either bought or created. I make my own prepared slides. The students make their own black lights using their cell phones, additional microscopes using their cell phones, fingerprint powder from used ink toner cartridges, and makeup brushes for fingerprint bushes. Everything is homemade except for the school microscopes. Please see the sidebar for more details.

After the tire tread mark lab I give a small introduction to geology with how to visualize percentages of soil (sand) samples. The samples are taken at locations within a mile perimeter from the high school.

Students must view each sample side-by-side with evidence samples under a stereo microscope. They must note differences in colors, the sand shapes, the sand textures, and come to the conclusion of whether they have the correct matching location, or they do not. If they find a match then they will examine the Laredo (our area) map from which they can tell where that sample was taken and thus locate the crime scene.

Included below are teacher instructions for how to take soil samples and for preparing the sand samples. I had sand samples in my geology lab that were used instead of soil. It’s easier on the students because sand is larger in particle size and therefore easier to view. If you do not have sand on hand you can take your own soils samples. Here in Texas much of our soil is sand.

If you take a sampling of soils from around your location at intervals of a mile apart, and you have those samples on prepared microscope slides, then it is easier to locate the possible site of a crime which has soil samples as evidence.

Materials:
- Six prepared soil slides in a microscope slide box identified by GPS Number, or location
- Sample of soil from crime scene in a Ziploc bag (CS evidence)
- Six prepared slides
- Scoopula
- Micropipette
- Small plastic containers
- Six sandwich baggies with different sands labeled (knowns)
- Map of home town
- (Wall-e) Stereo Microscope (2x-4x)
- (Photos 1 & 2)
- Beaker with water
- Sandwich baggies with unknowns

TEACHER SLIDES:

Materials
- Six clean slides per group of 4 students (I have 24 students)
- Six Clean slide covers
- Six Microscope slide box
- Six original soil samples from six different locations
- Six Ziploc bags
- Toothpicks
- Superglue

Procedure
1. Take a clean microscope slide and place a drop of superglue in the center.
2. Take a sample of soil sample #1 and place it on the glue.
3. Identify sample number one by writing Sample #1 on the Ziploc containing that sample soil and the microscope slide. If using other identification markers such as GPS coordinates, make sure it’s the same on the Ziploc and the prepared slide. If using the actual Location, make sure it’s on the Ziploc and the prepared slide.
4. Using the toothpick spread the soil sample on the slide carefully, evenly, and not clumped together.
5. Place the slide covers carefully on the slide.
6. Let the slides dry overnight.
7. Place six different slides in each Microscope slide box.
8. Now you can place each box with the other student materials on each lab table and let the researching begin.

**HOW TO TAKE A SOIL SAMPLE**

In order to take a good soil sample for a forensics lab, first get a map of the area surrounding your school. This can be a paper map from your local tourist board or Chamber of Commerce or one from Mapquest.com or Google Maps. Using the legend, mark off a perimeter you have easy access to. Only take soil from dry areas. Make sure the tools you will be using are clean if not new. (You do not want to contaminate the sample) Remember to treat this like your laboratory. If your school allows field trips you could take your students to help you with this.

**Materials:**

- Local area map (Paper or digital)
- 1-6 Soil-sampling probe(s), auger(s), or simple spade(s) or shovel(s) (DO NOT use galvanized or brass tools, they may contaminate the soils samples)
- 1-6 Small clean plastic container per sample
- 1-6 gallon size Ziploc© bag(s)
- Sharpie© or marker (any color)
- 1-6 Small brush(es) (car whisk broom, or 5” paint brush)

**Procedure**

1. After acquiring a map, use the legend of make your own legend to select six or more sample sites.
2. With a Sharpie© or marker make a mark on your sample sites. You can also use GPS coordinates.
3. Using one of the four mentioned digging tools go to the first site. I prefer to use a garden spade, you can find one at the Dollar Tree, and they are light and inexpensive.
4. When you get to the first sample site, brush the area lightly to remove erosion soil until you see the area topsoil (harder soil). **Remember** to thoroughly wash the brush after use or use a new (clean) one on the next sample site.
5. Dig a V-shaped hole, approximately 4-6” deep.
6. Cut a thin slice (approximately ½ “ down the side of the V-shape,
7. Place your first sample into the plastic container. Take two more samples from the first sample site using the sample procedures and place sample into same plastic container.
8. Mix the samples well in the plastic container.
9. Fill a gallon Ziploc© bag approximately 1/3 of the bag and label the bag with the Sharpie© with Sample 1, the exact location (Street Names) and/or GPS coordinates.
10. DO NOT forget to fill the holes back in with the hole soil and other unused soil to avoid tripping accidents.
11. Continue following steps 3-11 for the other 5 sample sites.

After you take your labeled Ziploc© baggies back to school you can prepare the slides for the lab and choose your crime scene location slide.
STUDENT SLIDE PREPARATION PROCEDURE:

**Step 1:** Arrange your prepared slides in a comfortable order. Some place them by number, some be GPS numbers, some by location description. The system depends upon what is more comfortable for the researcher. (Photos 3 & 4)

**Step 2:** Take the sample of the evidence and prepare a slide. To do this follow the remaining steps. (Photos 3 & 4)

**Step 3:** Place a drop of water in the center of a clean microscope slide.

**Step 4:** Taking some of the evidence sample and place it on the water in the center of the slide.

**Step 5:** Using a toothpick spread the sample around, evenly and not clumped, but not too spaced out.

**Step 6:** Apply the clean slide cover and label it with the Crime Scene (CS) Evidence number.

**Step 7:** Turn your compound microscope on. (Photo 3)

**Step 8:** Take your first prepared slide and place it side by side with the CS sample. Write notes or sketch samples. (Photo C)

**Step 9:** View both slides through both microscope magnifications and check for similarities and consistencies in color, shape, and size of grains. Also check for included vegetation if applicable.

**Step 10:** Go through all your prepared samples using the same procedures. View each side by side with the CS sample until you find the correct location and identify it for the CSI team.

**IMPORTANT:** Remember to take your time. If working with groups of more than two, let all students view the samples and write their own notes. After all students have viewed all samples compare notes and see if you all confirm. If not then go back and see why there is a difference.
This is a very dirty photo.
Is it blood?

Is it human?

A lab that explores it all

By Nancy Kochis
Forensic serology is one of my favorite topics to teach, along with fingerprints and drugs, of course. This lab follows a blood lab where the students analyze simulated blood for type and Rh factor. The test is followed up with comparison of crime scene blood to that of several suspects’ blood using the same protocol. Instruction is given about the importance of antigens, antibodies, proteins, and enzymes in blood that differentiate ones blood from another. The students then work on finding probabilities of blood types, proteins, and enzymes in different combinations. They then receive instruction about the different types of catalytic color tests that are presumptive including the Kastle-Meyer and Hemastix strips to determine if a stain is blood, and Luminol to determine if blood is hidden. They learn about Takayama and Teichmann tests for blood using the microscope to observe crystal formation indicative of blood. The next step is for species identification of blood using the precipitin test to detect the presence of human blood. Students then learn that DNA tests are performed on the blood if it is human to specifically identify a person. Other labs in this unit are measuring the angle of impact, determining point of origin, and direction of travel in blood spatter.

I originally came up with using the Kastle-Meyer test for the presumptive blood lab when I purchased a kit. I had the students test 10 different stains in each group. I modified this a little as explained below. I want my students to experience many different types of tests so I search different websites for supplies that I can use in the classroom. The only supply that I ask of my students is to bring in their own box of gloves they can use all year. Also I buy the cheap paper plates by the 100s from Wal-Mart.

For the blood exercise I divided it into several parts. Part I is the presumptive test for the presence of blood using the Kastle-Meyer Test. The students usually watch a prelab video on Google Classroom that would demonstrate the lab procedures and answer questions before coming to class. I have utilized the skills of students, teachers, and community members for the videos. However I have not had time to make a video for this lab yet (next year). So I had to demonstrate the procedures for the entire class as a whole. I also have the directions on each lab table just in case. I have material already stained with five stains and numbered, three are animal blood, the other two come from coffee or something that reacts similarly to blood stains. Where do I get the blood you may ask? I had used the blood from meat that I purchase at the market at first. The last two years I have asked my favorite butcher for containers of blood; pork, beef and chicken. You should see the looks from other customers when I ask him. He is so happy to accommodate me that his stock reply stuns them even more, “Sure I can get you all the blood your little heart desires.” I used to get samples of material and stain each one five times for five different lab tables. This took me forever: five swatches of material per lab group for each stain. Now, I use five pieces of cotton material that I cut to fit a manila folder. I learned this trick from a crime scene examiner who teaches classes through a company called Imprimus. I happened to take his class one summer at the College of Lake County. I am really glad I did. He taught us little tricks to save time and money in the classroom.

To perform the Kastle-Meyer, I moisten a cotton swab with distilled water, then wipe the swab over stain number one on the material. I then apply two drops of ethyl alcohol to the swab. The next step is to apply 2% phenolphthalein. Students are to watch to make sure they do not get a reaction at this stage because this would be a false positive. If there is not a color reaction, then I apply 3% hydrogen peroxide. I then separate students into five different lab groups and let them have fun with the testing. The first reactions they perform are controls for positive and negative reactions. I purchase at least five presumptive blood kits from Carolina Science website: http://www.carolina.com/. The kits cost $25.95 each. The company says that each kit is enough for 30 tests. I found that if I place each bottle of solution on its own paper plate and label the plate then there should not be any cross contamination. The materials have lasted me over 10 years teaching three classes per school year. I just recently had to order new ones for next year. You may have access to these solutions from your chemistry colleagues. You might also want to purchase the solutions in dry form and make up enough for each year. The shelf life would be longer. I purchase Q-tips from Wal-Mart in packages of 200. This can last for years too, especially if you have them use both sides for different stains. I save responses to analysis questions for last.

Part II of the lab is Kastle-Meyer sensitivity test. I ask for students to come up and demonstrate so that the test is performed only once. To save time I have the test tubes already set up in the rack, labeled and filled. Students are amazed when we get a color reaction on the last swab. We talk in class about how sensitive the test is, and for them to see it in person is always gratifying to me. Again I ask them to wait until all tests are performed before answering any analysis questions. If they cannot finish the questions they can take do it for homework. This way they see all of the test results in class. You do not have to purchase anything for this part.
have all the supplies from part one, swabs, and blood. There are plenty of test tubes and racks always sitting around the storeroom just waiting to be used.

Part III is to determine if any of the five samples are blood using another test called Hemastix strips. I purchased a package from Ward’s Science website: wardsci.com. I clicked on the forensic page and search for Hemastix. There are 50 strips in each container. That is enough for 10 years for me since I only have the students test 5 stains. Here again I save time and supplies by having one group of students perform the test and use the results for all three classes. The strips are laid out on the table (covered in paper from my butcher) for the whole class to see the results. Student responses to questions can be filled out later.

Part IV is the mammal identification test. I ask the students which of the blood results do they think are mammal blood. Since we cannot use real blood in the classroom anymore, I supply my own blood. No, I don’t cut myself in front of the students. I am diabetic, so when I test for sugar in the morning I stick myself again to get enough blood for a Band-Aid. I do this part of the test in class for my blood. You can always find a colleague or family member with a cut to use their Band-Aid. My friend that teaches anatomy and physiology sometimes has a cut and is always willing to give up her Band-Aid for the cause. However you can still use pork or cow blood from the butcher.

For the stains that were positive in Parts I and III I have the students demonstrate again only one time. Hemident I purchase from Arrowhead Forensics website: http://www.crime-scene.com/index.shtml. For a box of 10 tests it is $19.00. This lasts me 2 years. Lynn Peavey also has them at the same price: https://www.lynnpeavey.com/.

Part V is the Hexagon OBTI test for species identification. I have the students use the cow and pig blood along with mine for this test (if the students didn’t know before that chicken is not mammalian they do now). I have a group of students perform this test only once for the whole class. I do my blood from the Band-Aid. Students are always amazed at the results. I guess they think teachers aren’t human. I purchase the tests from the Crime Scene store for $30.00 for 4 tests: http://www.crimescene.com/store/. Lynn Peavey has a box of 6 for $41.40.

Part VI is to determine what type of instrument made the impression. I learned this test when I took a summer class at Dr. Henry C. Lee Institute for Forensic Science in Connecticut. For the impressions I coat different items in blood and touch each to white paper so they leave bloody marks. I use some toys I purchased for two other labs, my photo lab, and the individual versus class evidence lab. I bought the toys around Halloween when all of the crazy things are out like a Jason Vorhees blade, zombie knives, and other bloody items. I also use a brick that has two holes in it, a switch plate cover, different tools, combs, and forks. I place the sheets of stains at another lab station and have the students go in lab groups so that they are not congregating at the same table. At the end of the lab I show the objects used for the stains. Students usually can’t guess the stain caused by the hammer edge. I give a completion grade for this part since the students are hypothesizing about the stain. Students answer the analysis questions at the end of each test. For those students who do not finish, homework is inevitable.

As Dexter would say “Blood never lies”. Also a Danish Proverb says that “Good blood always shows itself”. The students actually got to see for themselves the tests that forensic scientists use. I love seeing their reactions when they realize coffee or cola were the other stains on the material and not blood. Many of them hypothesized that the stains were blood in their data table. I hope you have as much fun with this lab as my students and I have had.
Is It Blood? If so, is it Human?

Name ____________________________________________________________________________

Part I: Kastle-Meyer Test

First, hypothesize about which of the stains on the material you think may be blood. Write your responses in the data table. Then follow the directions below to determine if each spot is blood.

Directions:

1. Moisten a cotton swab with distilled water, then wipe the swab over stain #1 on the material.
2. Apply two drops of ethyl alcohol to the swab.
3. Apply 2% phenolphthalein. Watch to make sure you do not get a reaction at this stage because this would be a false positive.
4. If there is not a color reaction, then apply 3% hydrogen peroxide.
5. The first reactions you perform are controls for positive and negative reactions.

Record your responses in the data table as to the color on the swab after the reagents are added.

<table>
<thead>
<tr>
<th>Evidence Number</th>
<th>Hypothesis: Positive or negative?</th>
<th>Results after Phenolphthalein (color)</th>
<th>Results after H₂O₂ (color)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive control strips</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Negative control DW</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Analysis Questions:

1. What is the function of performing a positive and a negative control test?

2. Based on your color reactions, which specimens gave positive results and which gave negative results?

3. What substance is in the animal blood that causes the color change?

4. Will the test be positive for non-human blood? Why or why not?

5. What vegetables were tested? Did they give a false positive reaction?

6. Why would a reaction occur between some vegetables?
Part II: Kastle-Meyer Sensitivity Test

Procedure: You will be using bovine blood to make a serial dilution. Set up a lab station using six test tubes in a test tube rack. Label the test tubes 1 through 6. Place undiluted blood in the first test tube (this is the pure sample). Add 18 drops of water in each of the other 5 test tubes. Using a pipette take some of the blood from tube 1 and add 2 drops into tube 2 and gently mix. Add 2 drops of liquid from tube 2 into tube 3 and mix. Repeat the progression until the serial dilution is complete.

Perform the Kastle-Meyer test on each of the six test tubes using a clean swab for each. Be careful not to contaminate solutions by using a swab more than once. Place each used swab behind the correct test tube in the rack. Record your observations in the data table below.

<table>
<thead>
<tr>
<th>Test Tube</th>
<th>Dilution</th>
<th>Color Observation</th>
<th>Positive or Negative Reaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pure Sample</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1/10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1/100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1/1000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>1/10,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>1/100,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Analysis Questions:
1. Which test tube, if any, did not show a color change?
2. What is the sensitivity of the Kastle-Meyer Test in this test?
3. The Kastle-Meyer test is a very sensitive test. What advantage is this at the crime scene?

Part III: Hemastix Test

Hemastix is a test strip that will indicate the presence of blood in general. It is a test that is used in hospital labs to detect the presence of blood in urine samples. This will alert the doctor if there is an infection in the urinary tract.

First label the opposite end (the end that does not have the yellow part) on the Hemastix strip with numbers 1 through 5. Then place a couple of drops of distilled water on a cotton swab. Place the moistened swab onto the suspect stain. The cotton swab is then gently placed onto the yellow end of a Hemastix strip. For a positive reaction the strip will turn a greenish color.

Analysis Questions:
1. Which of the samples 1 - 5 tested positive?
2. Were the results the same as the Kastle-Meyer test?
Part IV: Mammal Identification Test – Hemident

Hemident (McPhail’s Reagent) is a presumptive test for mammal blood. For a positive reaction the solution will turn a blue-greenish color in a matter of a few seconds. The procedure is to swab the suspected stain with a moistened cotton swab. Place the swab in the center of the pouch. Break off the head of the swab and close the pouch. The left ampoule is broken first by squeezing the center of the harness. Agitate the pouch to wet the swab. Break the right ampoule next and watch for a reaction. You will use the evidence from the material that tested positive for the Kastle-Meyer and Hemastix tests. Label the pouches with their correct evidence number that came from the material in test I.

Analysis Questions:

1. Which, if any, of the evidence specimens turned a positive color?

2. Why do you think only some gave a positive reaction?

Part V: Species Identification Test – Hexagon OBTI

Hexagon OBTI is a confirmation test for the presence of human blood. A sample of material containing blood is placed in a solution in the bottle. Hemoglobin in human blood will react with the reagents in the solution. Two drops of the solution are placed in the well of the testing medium. For a positive reaction there will be 2 lines, the first line indicates that the test is working properly and the second line indicates that the sample contains human blood. A positive reaction will occur in 2-3 minutes. However, there will also be a positive reaction with primates, ferrets, and skunk.

Analysis Questions:

1. Which, if any, of the samples tested positive for human blood?

2. What would be the next test after species identification to find out whose blood it actually is?

Part VI: Blood Stain Impression Patterns

Determine what type of instrument or tool made the following bloodstain impression patterns on the sheets of paper.

<table>
<thead>
<tr>
<th>Pattern Number</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
</tbody>
</table>
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Rendezvous With Death

Percy Carrington was the vile murderer. What gave me the first clue was Halliday’s walking stick. It wasn’t his at all, at least, not the one found near the body. Halliday must have leaned heavily on his stick while waiting for his rival, for there were circular impressions in the ground around the tree, and also one on the envelope. But the ferrule of the stick picked up was much too small to have made impressions like that. If you have a keen sense of sight, you would have noticed Halliday’s bandaged leg—he must have been using a stick with a rubber tip for safety reasons.

But Carrington’s stick was perfectly clean from the tip upwards for a space of about two inches; the end of the stick had been protected. The fellow obviously grabbed the wrong stick in his haste and later, seeing his mistake, threw the rubber tip away. If you thought that the bit of dirt on Sykes’ boots was real evidence against him, your name is mud!

Mini-Mystery Answer (from p. 6)

Theft in a Knordwyn Shop

Since the three visited the shop at different times, only one could have taken the bag. Snow’s second statement that, in effect, he and Sweeney are not both guilty must therefore be true. Snow is therefore a truth-teller, so his first statement is also true. Since this statement contradicts Speakman’s first statement, she is a liar, and since Sweeney says she is right, he’s also a liar. His second statement is therefore false, so he is the thief. Speakman must have stolen something sometime in her life, but not this time!
Imagine you had an array of hundreds of mousetraps, each with a ping pong ball loaded on the spring. You toss a ping pong ball into the array. It trips the spring and two balls bounce away onto more mousetraps.

The number of bouncing ping pong balls grows, faster and faster: 2, 4, 8, 16, 32 etc… Eventually it reaches a maximum speed, and then begins to slow down. This is because the number of loaded mousetraps decreases. The slow down in the rate at which ping pong balls are released follows a pattern.

When the rate of release is maximal, a loaded mouse trap has a certain probability of being hit. When half the remaining loaded mouse traps are emptied, the probability of hitting a loaded mouse trap is cut in half, and the rate of release is cut in half.

When half of that half of remaining loaded mouse traps are emptied, the probability of hitting a loaded mouse trap is cut in half again, and the rate of release is cut in half again as well. As a result, the amount of time it takes to empty half the mousetraps is constant regardless of how many mousetraps you have.

Similarly, radioactive substances are like an array of loaded mousetraps, because when they decay, they release high energy particles that act like ping pong balls.

As the process proceeds, the amount of radioactive material decreases. This causes the number of high speed emissions to decrease. The fewer emissions there are, the slower the decay process becomes. As a result, large samples of radioactive material decay at a faster rate than small samples. In fact, as the sample size decreases, the rate of decay slows in such a way that the amount of time it takes for half the sample to decay is constant regardless of the sample size. In other words, it takes 500 g of uranium the same amount of time to decay into 250 g of uranium as it does for 2 g of uranium to decay into 1 g of uranium. The amount of time it takes for a radioactive sample to decay to half its original mass is called the **half-life**.

The easiest way to solve half life problems is to set up a table like the one on the next page. Then examine the examples on the following pages.
Sample Problem: How much $^{42}$K will be left in a 320 g sample after 62 h?

**Step 1:** Look up the half life in Table $N$, the table of Selected Radioisotopes, on this page.

**Step 2:** Set up a table showing the mass, time elapsed, the fraction remaining, and number of half lives starting with the initial conditions and ending when the full time has elapsed. For each half life elapsed, cut the mass in half, increase the time by an amount equal to the half life, cut the fraction in half, and add one to the number of half lives.

<table>
<thead>
<tr>
<th>Mass (g)</th>
<th>Time (hours)</th>
<th>Fraction</th>
<th>Half Lives</th>
</tr>
</thead>
<tbody>
<tr>
<td>320</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>160</td>
<td>12.4</td>
<td>½</td>
<td>1</td>
</tr>
<tr>
<td>80</td>
<td>24.8</td>
<td>¼</td>
<td>2</td>
</tr>
<tr>
<td>40</td>
<td>37.2</td>
<td>1/8</td>
<td>3</td>
</tr>
<tr>
<td>20</td>
<td>49.6</td>
<td>1/16</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>62</td>
<td>1/32</td>
<td>5</td>
</tr>
</tbody>
</table>

Following this procedure it is possible to determine the final mass, the time elapsed, the fraction of the original sample, and/or the number of half lives elapsed.

**Practice Problems (remember to look at the examples on the next two pages):**

1. How long will it take for 30 g of $^{222}$Rn to decay to 7.5 g?

2. How many grams of $^{16}$N will be left from a 16 g sample after 21.39 s?

3. How many half lives will it take for 50 g of $^{99}$Tc to decay to 6.25 g?

4. What fraction of a sample of $^{32}$P will be left after 42.84 d?

5. How long will it take for a 28 g sample of $^{226}$Ra to decay to 3.5 g?

6. How long will it take for 50% of a sample of $^{131}$I to decay?
Radioactive Dating

Radioactive dating is a procedure to determine age by comparing the amount of a naturally occurring radioactive isotope and its decay products.

### Carbon dating
- Carbon-14 is radioactive and has a half life of 5,700 years.
- Carbon dioxide in the air contains carbon-14.
- Plants take in carbon dioxide and make carbohydrates as long as they are alive.
- Animals eat plants as long as they are alive.
- As soon as an organism dies, it stops taking in carbon, so its amount of C-14 begins to decrease.

### Uranium dating
- Uranium-238 is radioactive and has a half life of 10⁹ years.
- Uranium-238 is found in igneous rock.
- Uranium-238 decays into lead.
- After the rock cools, the amount of uranium-238 in the rock begins to decrease and the amount of lead begins to increase.

---

### Using a Table

Half life problems of all types can be solved by setting up a table that shows the number of half lives, the mass, the time elapsed, and the fraction left. (Any of these 4 variables can be the unknown.)

#### Sample Problem
An ore that once contained 320 g of $^{60}$Co now contains only twenty grams of the radioactive material. How long has it been decaying?

**Step 1:** Make a table and divide the mass in half repeatedly until it is reduced from 320 g to 20 g.

**Step 2:** Look up the half lives (hl's) and fill in the rest of the table.

<table>
<thead>
<tr>
<th>Number of hl's</th>
<th>Mass</th>
<th>Time elapsed</th>
<th>Fraction left</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>320 g</td>
<td>0 γ</td>
<td>1 (100 %)</td>
</tr>
<tr>
<td>2</td>
<td>160 g</td>
<td>5.26 γ</td>
<td>$\frac{1}{2}$</td>
</tr>
<tr>
<td>3</td>
<td>80 g</td>
<td>10.52 γ</td>
<td>$\frac{1}{4}$</td>
</tr>
<tr>
<td>4</td>
<td>40 g</td>
<td>15.78 γ</td>
<td>$\frac{1}{8}$</td>
</tr>
<tr>
<td>5</td>
<td>20 g</td>
<td>21.04 γ</td>
<td>$\frac{1}{16}$</td>
</tr>
</tbody>
</table>
Calculating Without a Table

- **Variables**
  - \( T_e \) = Time elapsed
  - \( t_{\frac{1}{2}} \) = \( \frac{1}{2} \) life
  - \( n \) = number of \( \frac{1}{2} \) lives
  - \( f \) = fraction left

- Each time a half life elapses, the amount of time that passes IS the half life.
  - As a result, the time elapsed is the product of number of half lives and the half life.
  - \( T_e = n(t_{\frac{1}{2}}) \)

- Each time a half life elapses, the amount of radioactive material is cut in half.
  - As a result, the fraction of radioactive material remaining is \( \frac{1}{2} \) raised to the number of half lives.

Applying the Equations

**After 19.1 days, how much of a 67.2 g sample of Rn-222 will remain?**

- **Step 1:** Look up the half life.
  - \( t_{\frac{1}{2}} = 3.82 \text{ d} \)

- **Step 2:** Determine the number of half lives.
  - \( T_e = n(t_{\frac{1}{2}}); \ 19.1 \text{ d} = n(3.82 \text{ d}); \ n = 5 \)

- **Step 3:** Determine the fraction remaining.
  - \( f = (\frac{1}{2})^n; \ f = (\frac{1}{2})^5; \ f = \frac{1}{32} \)

- **Step 4:** Determine the number of grams remaining.
  - \( (67.2 \text{ g})(\frac{1}{32}) = 2.1 \text{ g} \)

After you master the practice problems you can apply your skills to a real-life forensics problem on the next page.
Forensic Problem:

The American Museum of Natural History in New York has the opportunity to acquire three items of interest, but doubts have been raised as to the objects’ authenticity. Using carbon dating please verify the age of each object and make a recommendation to the board as to whether or not the objects are valuable.

The objects are a Peruvian mummy (at least 2,500 years old), a woolly mammoth tusk (12,000 years old), and a Babylonian chair (3,100 years old). The objects once contained 2, 10, and 4 grams of $^{14}$C, but now contain 1.29g, 2.33g, and 3.1g of $^{14}$C respectively.

How old are the objects actually, and should the museum buy them? Why or why not?

<table>
<thead>
<tr>
<th>No. of half lives</th>
<th>Mass</th>
<th>Time elapsed</th>
<th>Fraction left</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: This worksheet can either be photocopied and distributed to each student, or it can be projected and worked on either individually or as a class.

Evan Silberstein has a wealth of chemistry resources for visitors to www.evanschemistrycorner.com.
### Half Life Answers

1. **How long will it take for 30 g of $^{222}$Rn to decay to 7.5 g?**

<table>
<thead>
<tr>
<th>Number of HL’s</th>
<th>Mass</th>
<th>Time Elapsed</th>
<th>Fraction left</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>30. g</td>
<td>0. d</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>15. g</td>
<td>3.823 d</td>
<td>$\frac{1}{2}$</td>
</tr>
<tr>
<td>2</td>
<td>7.5 g</td>
<td>$7.646 \text{ d}$</td>
<td>$\frac{1}{4}$</td>
</tr>
</tbody>
</table>

2. **How many grams of $^{16}$N will be left from a 16 g sample after 21.6 s?**

<table>
<thead>
<tr>
<th>Number of HL’s</th>
<th>Mass</th>
<th>Time Elapsed</th>
<th>Fraction left</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>16. g</td>
<td>0. s</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>8. g</td>
<td>7.13 s</td>
<td>$\frac{1}{2}$</td>
</tr>
<tr>
<td>2</td>
<td>4. g</td>
<td>14.26 s</td>
<td>$\frac{1}{4}$</td>
</tr>
<tr>
<td>3</td>
<td>2. g</td>
<td>21.39 s</td>
<td>$\frac{1}{8}$</td>
</tr>
</tbody>
</table>

3. **How many half lives will it take for 50 g of $^{99}$Tc to decay to 6.25 g?**

<table>
<thead>
<tr>
<th>Number of HL’s</th>
<th>Mass</th>
<th>Time Elapsed</th>
<th>Fraction left</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>50. g</td>
<td>0. s</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>25. g</td>
<td>$2.13 \times 10^5 \text{ y}$</td>
<td>$\frac{1}{2}$</td>
</tr>
<tr>
<td>2</td>
<td>12.5 g</td>
<td>$4.26 \times 10^5 \text{ y}$</td>
<td>$\frac{1}{4}$</td>
</tr>
<tr>
<td>3</td>
<td>6.25 g</td>
<td>$6.39 \times 10^5 \text{ y}$</td>
<td>$\frac{1}{8}$</td>
</tr>
</tbody>
</table>

4. **What fraction of a sample of $^{32}$P will be left after 42.9 d?**

<table>
<thead>
<tr>
<th>Number of HL’s</th>
<th>Mass</th>
<th>Time Elapsed</th>
<th>Fraction left</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0. g</td>
<td>0. d</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>14.28 d</td>
<td>$\frac{1}{2}$</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>28.56 d</td>
<td>$\frac{1}{4}$</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>42.84 d</td>
<td>$\frac{1}{8}$</td>
<td></td>
</tr>
</tbody>
</table>

5. **How long will it take for a 28 g sample of $^{226}$Ra to decay to 3.5 g?**

<table>
<thead>
<tr>
<th>Number of HL’s</th>
<th>Mass</th>
<th>Time Elapsed</th>
<th>Fraction left</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>28. g</td>
<td>0. d</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>14. g</td>
<td>1599. y</td>
<td>$\frac{1}{2}$</td>
</tr>
<tr>
<td>2</td>
<td>7. g</td>
<td>3198. y</td>
<td>$\frac{1}{4}$</td>
</tr>
<tr>
<td>3</td>
<td>3.5 g</td>
<td>$4797. \text{ y}$</td>
<td>$\frac{1}{8}$</td>
</tr>
</tbody>
</table>

6. **How long will it take for 50% of a sample of $^{131}$I to decay?** 8.021 d
Collecting Crime Evidence From Earth

By Raymond C. Murray.
As with so many other types of criminal investigation, forensic geology began with the writings of Sir Arthur Conan Doyle, who wrote the Sherlock Holmes series between 1887 and 1927. He was a physician who apparently had two motives: writing salable literature and using his scientific expertise to encourage the use of science as evidence.

In 1893, Hans Gross, an Austrian forensic scientist, wrote the book *Handbook for Examining Magistrates*, in which he suggested that perhaps the dirt on someone’s shoes could tell more about where a person had last been than toilsome inquiries.

It was only a matter of time before these ideas from an author of fiction and criminalists’ handbook would appear in a courtroom.

A century later, the use of geologic materials in criminal and civil cases is commonplace. Public and private laboratories for analyzing soils and related materials include the FBI laboratory in the United States, La Polizia Scientifica in Italy, the Centre of Forensic Sciences in Toronto, the National Institute of Police Science in Japan, Microtrace in the United States and many others.

Forensic geology studies vary in scope. A common type of investigation involves identifying a material that is key to a case - for example, examining pigments in a painted picture or material in a sculpture when authenticity or value is at issue. Identification is also important in questions of mining, mineral or gem fraud to determine if the material is what its sellers claim it to be. And identification of fire-resistant safe insulation on a person or individual’s property may provide probable cause for further investigation.

Beyond identification, forensic geologists can also look at the origin of particular material. Here the examiner needs a broad knowledge of the geology and the best geologic and soil maps to answer questions. For example, if the soil on a body does not match the location where the body is found, from where was the body moved? Similarly, examiners can compare two samples, one associated with the suspect and the other collected from the crime scene, to see if they had a common source: Does the soil on the suspect’s shoe compare with the soil type collected at the crime scene, for example?

Another new developing area of forensic geology is its use in intelligence work. A person, for example, may claim to have never been to a particular location, but is then found with rocks from that spot, thus linking the individual to a geographic location. Remember the outcrop you saw behind Osama bin Laden on TV after September 11. What was the location? A geologist who has done field work in the area would be able to locate that outcrop, and that actually happened: Geologist John Shroder was able to identify the region where bin Laden had been sighted in Afghanistan in 2001 (see Geotimes, February 2002). Geologic evidence rarely provides a unique solution for which the geologic mind cannot imagine another possibility. But there are some exceptions, as illustrated by the following two cases.

**MURDER AND THE POND**

The murder of John Bruce Dodson produced one of the most interesting cases in the entire history of forensic geology. Here, the geologic evidence is unequivocal in that it tied the suspect directly to the crime and eliminated the suspect’s alibi. Most importantly, the investigator of the crime recognized the potential importance of the geologic evidence and arranged for the examination of that evidence. The testimony of the forensic geologist was critical to the prosecution of the case. The case began on Oct. 15, 1995, when John Dodson was found dead while on a hunting trip with his wife of three months, Janice. The scene was a crisp autumn morning high in the Uncompahgre Mountains of western Colorado.

At first glance, it appeared to be a hunting accident. However, the autopsy revealed two bullet wounds to the body and one bullet hole through John’s orange vest. Western Colorado District Attorney Frank Daniels points out in his book on the case, *Dead Center*, that if there had been only one bullet, there never would have been an investigation and the death would have been ruled an accident.

The investigation showed that the Dodsons were camped near other hunters, one of whom was a Texas law enforcement officer. He responded to Janice’s frantic call that her husband had been shot. She was standing about 200 yards from the camp in a grassy field along a fence line. The officer determined that John was dead and started the process of getting help. Prior to calling for help, Janice had returned to her camp and removed her hunting coveralls, which were covered with mud from the knees down. She later told investigators that she had stepped into a mud bog along the fence near camp. Investigators found a .308-caliber shell case approximately 60 yards from the body. In addition, they found a .308-caliber bullet in the ground on the other side of the fence, which created a direct line from the location of the case to the body to the bullet.

Janice’s ex-husband, J. C. Lee, was also camped three-quarters of a mile from the Dodsons. Janice knew the site was his favorite camp location. He naturally came under suspicion. However, Lee was hunting far away from camp with his boss at the time of the shooting. Most importantly, Lee reported to investigators that while he was out hunting, someone had stolen his .308 rifle and a box of .308 cartridges from his tent. Winter comes early at 9,000 feet in the Uncompahgre, and little more could be done at the scene. However, investigators Bill Booth, Dave Martinez and Wayne Bryant returned during the summers of 1996, 1997 and 1998 and searched for the rifle and other evidence. They tried to search every place a weapon could have been hidden. They combed the entire area, including ponds, with metal detectors in hope of finding the rifle; it has never been found. During the final search of the pond near Janice’s ex-husband’s camp, Al Bieber of NecroSearch International (a nonprofit consulting company for law enforcement agencies) commented that the mud in and around a cattle pond near Lee’s camp was bentonite, a clay that someone brought to the pond to stop the water from seeping out of the bottom. That evening, Booth and Martinez
were camped near the crime scene. They were discussing the evidence in the case when investigator Booth said, “The mud.” He was referring to the dried mud that was found on Janice Dodson’s clothing. If Janice had obtained the rifle from Lee’s camp, she would most likely have stepped or fallen into the bentonite clay that drained across the road from the cattle pond. Remembering Janice’s statement that she was returning to camp on the morning of the crime and stepped into a mud bog near her camp, Booth and Martinez decided they needed to obtain dried mud samples from the bog near the Dodsons’ camp, the area around a pond nearby the camp, and the human-made pond and runoff near Lee’s camp.

Booth and Martinez packaged the dried mud from each location and sent the samples along with the dried mud that had been recovered from Janice’s overalls to the laboratory section of the Colorado Bureau of Investigation in Denver, where it was examined by Jacqueline Battles, a forensic scientist and lab agent. Battles is a highly respected forensic scientist with considerable geologic training, who, like many of the others in the profession, got her early training with Walter McCrone. She concluded and later testified to the fact that the dried mud found on Janice Dodson’s clothing was consistent with the dried mud recovered from the pond near Lee’s camp. The dried mud that had been recovered from Janice’s overalls was found not to be consistent with the mud bog or the pond near her camp. This was a breaking point in the case that allowed Booth and Martinez to put Janice Dodson in her ex-husband’s camp around the time his rifle had been stolen. There are no other bentonite-lined ponds in the area and no bentonite deposits.

Booth and Martinez went to Texas and served an arrest warrant on Janice. She was extradited to Colorado, tried in court and convicted in the murder of John Bruce Dodson. The jury understood the results that followed Booth’s insightful “mud” exclamation. Janice is now serving a life sentence without the possibility of parole in Colorado’s state prison for women. The mud samples collected from Janice’s clothing are still in the sheriff’s office evidence room where they have been since 1995.

SLICKS AND SANDS

A case that illustrates many of the Issues comparing soil and related material occurred in Canada a few years ago. The body of eight-year-old Gupta Rajesh was found alongside a road outside of Scarboro, Ontario. The back of his shirt had a smear of oily material, and the preliminary conclusion was that he was the victim of a hit and run accident, with the oily material coming from the undercarriage of a vehicle. But examination of the oily material and the particles suspended in it by forensic geologist William Graves of the Centre of Forensic Sciences in Toronto told a different story.

Investigators had collected samples of oily material on the floor of an indoor concrete parking garage where a suspect, Sarbjit Minhas, parked her Honda automobile. Analysis of the samples showed that the sand and other particles within the oil from the victim’s clothes and the parking garage were similar. Analysis of the oil from the victim’s shirt and garage floor showed them to be both similar and different from oil collected on the floor of 10 other garages in the area.

Particles in samples from the victim’s clothes and the suspect’s parking place provided considerable information. The sand from both samples was sieved, and subsamples produced of the various size grades for the two samples. When compared after the oil had been removed, the color of each pair of subsamples was identical.

Additionally, the heavy minerals in both samples were similar, and three distinct kinds of glass were found in the two samples: amber glass, tempered glass and light bulb glass. Each of the different glasses was identical in refractive index value (the amount a ray of light bends when passing through the glass into another medium). Small particles of yellow paint with attached glass beads were found in both samples. This type of paint is often found on center stripes of highways and reflects light.

Graves concluded that there was a high probability that the body of Gupta Rajesh had been in contact with the concrete floor of the garage at the place where the suspect parked her car. Interestingly, the same oil and particles were found in the suspect’s Honda. Whether the oil and particles on the victim came from inside the vehicle or the floor of the garage, the presence and distinctiveness of the samples still strongly associated those two areas with the victim.

Minhas was tried in the Superior Court of the Province of Ontario in November 1983 and convicted, with help from testimony by Graves.

This case illustrates an important concept in the presentation of soil evidence and perhaps all physical evidence, except DNA. We have become awed and impressed by the high probabilities that result from DNA evidence. Some people expect that other types of evidence should have similar statistical information. But in the Minhas case, we see a conclusion based on at least 10 different materials and observations. Because we do not know the probability of a tempered glass fragment, a particular group of heavy minerals, or sand of the same color being on a particular parking place in a concrete garage in Scarboro, Ontario - and in all likelihood we will never know - a frequency statistic cannot be generated. A useful database of sands, particles, glass, oils and heavy minerals would be too difficult to generate.

Additionally, it may not apply to any one specific case because of the variability of mineral particles - the very distinctiveness that makes geologic materials such good evidence. Thus, we rely on the skilled and honest examiner to reach a conclusion expressed in words rather than in numbers to inform the jury or judge so that they can reach a verdict. In this way the expert is a teacher, instructing the judge, attorneys and jury in the basic concepts and premises that allow them to do the work they do. The triers of fact must be schooled in the methods of production of the evidence (how light bulb glass is made, for example), the procedures used to analyze it, and what makes the evidence significant.
That understanding will lead the courts to an appreciation of unquantifiable evidence and give the jury a basis for weighing its significance.

Geologic evidence will continue to be developed and presented in courtrooms around the world. The quality of evidence collection and examination will improve, and new methods will be developed. The results will be to the benefit of justice.

MEDICAL LINK

A recent case does not fit the pattern of most soil evidence, but clearly illustrates the contribution being made by forensic geologists. Washington State Patrol Forensic Geologist Bill Schneck became involved in the investigation into the serious illness of a small child caused by arsenic poisoning. The suspected person was absolved when an examination of the child’s house revealed a number of mineral specimens left in the house and the yard by a former occupant who was a mineral collector. Many of those specimens were arsenopyrite, an iron arsenic sulfide. The child had been eating and chewing on the material. This case is a good reminder that lead is not the only material that can cause health problems in children.

Forensic Geology: Yesterday, Today and Tomorrow
Raymond C. Murray

The use of geological materials as trace evidence in criminal cases has existed for approximately one hundred years. Murray (2004) provides an overview and reminds us that it began, as with so many of the other types of evidence, with the writings of Sir Arthur Conan Doyle. Doyle wrote the Sherlock Holmes series between 1887 and 1927. He was a physician who apparently had two motives: writing salable literature and using his scientific expertise to encourage the use of science as evidence (Murray and Tedrow 1992). In 1893 Hans Gross wrote his book Handbook for Examining Magistrates in which he suggested that perhaps one could tell more about where someone had last been from the dirt on their shoes than from toilsome inquiries. A German chemist, Georg Popp, in 1908 examined the evidence in the Margarethe Filbert case. In this homicide a suspect had been identified by many of his neighbours and friends because he was known to be a poacher. The suspect’s wife testified that she had dutifully cleaned his dress shoes the day before the crime. Those shoes had three layers of soil adhering to the leather in front of the heel. Popp, using the methods available at that time, said that the uppermost layer, thus the oldest, contained goose droppings and other earth materials that compared with samples in the walk outside the suspect’s home. The second layer contained red sandstone fragments and other particles that compared with samples from the scene where the body had been found. The lowest layer, thus the youngest, contained brick, coal dust, cement and a whole series of other materials that compared with samples from a location outside a castle where the suspect’s gun and clothing had been found. The suspect said that he had walked only in his fields on the day of the crime. Those fields were underlain by porphyry with milky quartz. Popp found no such material on the shoe although the soil had been wet on that day. In this case, Popp had developed most of the elements involved in present day forensic soil examination. He had compared two sets of samples and identified them with two of the scenes associated with the crime. He had confirmed a sequence of events consistent with the theory of the crime and he had found no evidence supporting the alibi.

Rocks, minerals, soils and related materials have evidential value. The value lies in the almost unlimited number of kinds of materials and the large number of measurements and observations that we can make on these materials. For example, the number of sizes and size distributions of grains combined with colors, shapes and mineralogy is almost unlimited. There are an almost unlimited number of kinds of minerals, rocks, and fossils. These are identifiable, recognizable, and can be characterized. It is this diversity in earth materials, combined with the ability to measure and observe the different kinds, which provides the forensic discriminating power.
There have been many contributions to the discipline over the last 100 years. Many have been made by the Laboratory of the Federal Bureau of Investigation, in Washington D.C., McCrone Associates in Chicago, The Centre for Forensic Sciences in Toronto, Microtrace in Elgin, Illinois, the former Central Research Establishment at Aldermaston, Kenneth Pye Associates Ltd in Great Britain, The Japanese National Research Institute of Police Science, The Netherlands Forensic Institute, as well as other government, private and academic researchers.

Because much of the evidential value of earth materials lies in the diversity and the differences in the minerals and particles, microscopic examination at all levels of instrumentation is the most powerful tool. In addition, such examination provides an opportunity to search for man-made artifact grains and other kinds of physical evidence.

Individualization, that is, uniquely associating samples, from the crime scene with those of the suspect to the exclusion of all other samples is not possible in most cases. In this sense earth material evidence is not similar to DNA, fingerprints and some forms of firearms and tool mark evidence. However, in a South Dakota homicide case, soil from the scene where the body was found and from the suspect’s vehicle both contained similar material including grains of the zinc spinel gahnite. This mineral had never before been reported from South Dakota. Such evidence provides a very high level of confidence and reliability.

One of the most interesting types of studies is the aid to an investigation. There are many examples of cases where a valuable cargo in transit is removed and rocks or bags of sand of the same weight are substituted. If the original source of the rocks or sand can be determined, then the investigation can be focused at that place. In a high visibility case, DEA agent Enrique Camarena was murdered in Mexico (McPhee 1997). His body was exhumed as part of a cover-up staged by members of the Mexican Federal Judicial Police. When the body was found later, it contained rock fragments that were different from the country rock at that place and represented the rocks from the original burial site. With the combination of petrographic examination of those rocks and a detailed literature search of Mexican volcanic rock descriptions, the original burial location was found and the cover-up exposed.

Most examinations involve comparison. Comparison aims to establish a high probability that two samples have a common source, or conversely that they do not have similar properties and thus are unlikely to have come from the same source. In comparison studies of soils, it is difficult to overestimate the value of findings artifacts in the soil or some other unusual type of evidence. In an Upper Michigan rape case, three flowerpots had been tipped over and spilled on the floor during the struggle. It was shown that potting soil on the suspect’s shoe had a high degree of similarity with a sample collected from the floor and represented soil from one of the pots. In addition, small clippings of blue thread existed both in that flowerpot sample and on the shoe of the suspect. The thread provided additional trace evidence which supplemented the soil evidence.

In a New Jersey rape case, the suspect had soil samples in the turn-ups of his trousers. In addition to glacial sands grains that showed similarity with those in soil samples collected from the crime scene, the soil contained fragments of clean Pennsylvania anthracite. Such coal fragments are not uncommon in the soils of most of the older cities in eastern North America. However, in this sample there was too much coal when compared with samples collected in the surrounding area. Further investigation showed that some 60 years earlier the crime scene had been the location of a coal pile for a coal burning laundry. Again, the combining of soil-evidence with an investigation of an artifact and local industrial history increased the evidential value.

A new and evolving type of study is one done for the purpose of intelligence gathering. An example might involve identifying mineral material on an individual who had claimed to have recently been to a particular location. In such a case the question would be asked whether the mineral material supports the claim and could have come from that location. Identification of the mineral material alone can be useful in...
the case of mine fraud, gem fraud and art fraud by providing information that demonstrates the fraud.

The alertness of those who collect samples, and the quality of collection, is critical to the success of any examination. If appropriate samples are not collected during the initial evidence gathering, they will never be studied and never provide assistance to the court. There is the case in which an alert police officer happened to look at an individual arrested for a minor crime. He observed, “that is the worst case of dandruff I have ever seen.” It was not dandruff but diatomaceous earth, which was essentially identical with the insulating material of a safe that had been broken into the previous day.

The future of Forensic Geology holds much promise. However that future will see many changes and new opportunities. New methods are being developed that take advantage of the discriminating power inherent in earth materials. Quantitative x-ray diffraction could possibly revolutionize forensic soil examination. When developed to the point that this or similar methods become routine laboratory techniques, it will be possible to do a quantitative mineralogical analysis that is easily reproducible. However, the microscope will remain an important tool in the search for the unusual grain or artifact. Sampling methods, plus the thorough and complete training those people who collect samples for forensic purposes, will be improved. Soils are extremely sensitive to change over short distances, both horizontally and vertically. Soil sampling in many cases is the search for a sample that matches. The collection of all the other samples serves only the purpose of demonstrating the range of local differences. In collecting soil samples for comparison, we are searching for one that would have the possibility of matching. Screening techniques applied during sampling that eliminate samples that are totally different are often appropriate. For example, a surface sample offers little possibility of matching with material collected at a depth of four feet in a grave.

Studies that demonstrate the diversity of soils are important. One approach is to take an area that one would normally assume was fairly homogenous in its soil character and collect a hundred samples on a grid. Each pair of samples would then be compared with each other until all the pairs are shown to be different. Starting with colour and moving on to size distribution and mineralogy, different methods are used to eliminate all of these pairs as appearing similar. Junger (1996) performed several such studies and suggested methods for soil examination.

The qualifications and competence of examiners are a very major problem. How do you learn to do forensic soil examinations? This requires a thorough knowledge of mineralogy and the ability to effectively use a microscope and the other techniques used in earth material examination. It is also important that examiners be familiar with the other kinds of trace evidence plus the law and practice of forensic examination.

REFERENCES


Murray, R. C. 2004, Evidence from the Earth, Mountain Press, Missoula, MT

Presented at the International Conference on forensic Geology, London, 2003
The objects are a Peruvian mummy (at least 2,500 years old), a woolly mammoth tusk (12,000 years old), and a Babylonian chair (3,100 years old). The objects once contained 2, 10, and 4 grams of $^{14}$C, but now contain 1.29g, 2.33g, and 3.1g of $^{14}$C respectively.

### Peruvian Mummy

$T_e = n \left( \frac{t}{2} \right)^n$; 2500 = $n(5715)$

$n = \frac{2500}{5715} = 0.4374$

$f = \left( \frac{1}{2} \right)^{0.4374} = 0.7385$

$m = (2)(0.7385) = 1.477$

**Result:**  ✓

1.29 Low $\rightarrow$ OK

### Mammoth Tusk

$T_e = n \left( \frac{t}{2} \right)^n$; 12,000 = $n(5715)$

$n = \frac{12,000}{5715} = 2.100$

$f = \left( \frac{1}{2} \right)^{2.100} = 0.2332$

$m = (10)(0.2332) = 2.332$

**Result:**  ✓

2.33 Right on $\rightarrow$ OK

### Babylonian Chair

$T_e = n \left( \frac{t}{2} \right)^n$; 3100 = $n(5715)$

$n = \frac{3100}{5715} = 0.5424$

$f = \left( \frac{1}{2} \right)^{0.5424} = 0.6866$

$m = (4)(0.6866) = 2.746$

**Result:**  ✗

3.1 High $\rightarrow$ No Way

In other words, the mummy is older than 2,500 years and is a good buy. The tusk is about 12,000 years old, and the table is much younger than billed. The tusk is a good value, but the table is a reproduction and a rip off.

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A Day in the life Of...

A Forensic Geologist

By Bill Schneck

How long have you been a forensic geologist? I have been practicing forensic science/geology as a trace evidence examiner for 29 years. I specialize in the examination of soil and building materials in criminal and civil litigation. Others may work in the cement/hardened concrete areas such as civil engineering where failure analysis of say bridges or parking decks are involved. Others work in what is known as Search using geophysics such as seismic methods, gravimetrics, magnetic, ground penetrating radar and remote sensing.

What education does one need to get into the field, minimum? A minimum is a B.S. degree in geology/earth sciences/soil sciences. Those with M.S and Ph.D.s not uncommon.

Where does one go for training? There are no schools offering a degree in this area, it would be taking additional courses at a local university in soil science, field botany, and specialized classes in pollen, spores and diatoms. Classes in petrographic microscopy are essential along with instrumental analysis using scanning electron microscopy/energy dispersive spectrometer (SEM-EDS), x-ray spectroscopy and x-ray diffraction (XRD). Specialized classes can be taken by private laboratories such as Microvision Northwest-Forensic Consulting, MicroTrace, McCrone Research Institute and the California Criminalistics Institute. Regional forensic associations around the US often have workshops in trace evidence and sometimes that will include soil. Look up ASTEE (American Society of Trace Evidence Examiners), American Academy for Forensic Science and Zenos Forensic web site for information.

How long does training and/or education take before one is qualified to work independently? After a minimum of a BS in geology or soil science a training program in a crime lab can take up to a year or longer depending on previous experience.

Who do forensic geologists work for? Federal government (FBI, Postal Service lab,), state, city and county government labs, and private practice independent labs.

What is a forensic geologist’s official job description if there is one? No official description. Any time legal issues come to bear involving geology.

How does one investigate a scene? What does one look for? Ok, we are then usually referring to a criminal investigation. We are part of a much bigger team effort which involves law enforcement officers, medical examiners, crime scene technicians, possibly physical anthropologists, etc. But the following is just an example from personal experiences. Someone finds human remains in a wooded area and calls the police. Police go to scene and find evidence of a disturbed shallow grave with human remains. A suspect has been detained and their vehicle is searched. In the vehicle a crime scene responder often from the crime lab will process the vehicle for evidence. They may find clumps of soil on the driver’s floorboard and wheel wells, and /or footwear and clothing in the vehicle. Anything with adhering soil is collected. Any shovels or tools that may be suspected to play a part in the case are also collected. The crime lab is called
and responds to the scene. With the exception of federal government labs the scientist is not a forensic geologist, but hopefully someone having training in trace evidence collection. At the grave site soil samples are collected from the surface and sub-surface at any change in color or soil structure. Soil is collected from on top the body and also from under the body. Carefully the soil is placed in containers and sealed. If the soil is moist or wet it is dried before final packaging. Look at the scene for any other signs of disturbed soil which could be a sign of digging, dragging, etc. Also remember tire tracks and footwear impressions need to be documented and soil collected from these areas too. Collect reference or control soil from the area in all directions from the scene and from areas the suspect may say the soil in or on him originated from, often called alibi samples.

**How long does a forensic geology investigation typically take?** Variable, from days to weeks. The crime scene investigation at the scene of a buried body may take an entire day or more to process. The soil is then transferred to the lab where numerous tests are performed. In the above scenario, the soils would be dried, weighted, photographed, and sieved which separates grain size. The soil color is important. Often during the early stages of an examination if the questioned and known soils are distinctly different in color they probably did not originate from the same source. If they are similar further work is performed. Color is determined by examining the very fine clay and silt using Munsell Soil Color Charts or an instrument known as a colorimeter. The samples are separated into types such as botanical components; grass, leaves seeds, rootlets, wood, bark, nuts etc. The man-made components such as bits of road asphalt, paint, concrete, wood are separated out. The microscopic particles including minerals and possibly pollen and diatoms if present are identified using both a variety of microscopes and analytical instruments such as the SEM-EDS and XRD as mentioned above. After the known samples and questioned are characterized and minerals identified the samples are then compared to determine if the questioned soil from the suspect’s car could have originated from soil similar to that found at the grave.

**Do you do more than the job requires?** As a forensic geologist I/we can perform many other functions in the crime lab. Most of us are training in trace evidence; the examination of small particles that can transfer from people to people, people to things and things to things. Examples of that would be the examination, identification, and comparison of fibers, glass, paint, plastics, impressions, explosives, and food and gastric contents.

**What is a typical day or week like for a forensic geologist?** I am involved in more than soil/mineral examination, therefore a typical week could involve the analysis of minerals using a microscope, writing up a report on the findings of an examination, and performing analysis in the other areas mentioned above. I could be in court testifying as an expert witness on any of a number of cases I worked over the past year or so. There are times when some specific research projects are required or possibly the collection of known soil samples from a particular location are needed. A lot of time is spent in front of a computer sending messages and communicating with my peers in other labs all over the world.

**How do you know a scene is going to be difficult to process?** I assume when you say process, it means at the crime scene. Multiple locations, bodies that are re-buried having soil from multiple locations are challenging. It often involves the weather and terrain. Rainy days are a mess, steep slopes and ravines are difficult to work in. If there is snow forget about it! But there are always exceptions to the rule. Of course decomposition of human remains presents its own complications in a grave with intermixing of fluids, fats and tissues in the soil. There are actually specialists that study soil decomposition and how it travels over time through the soil.

**How do you know a scene will be simple to process?** Seldom are any scenes simple, but processing a vehicle for trace evidence without a body in it, or bloodstains and bullet holes can be easier than some.
What hours does a forensic geologist work? Typically 8-5 in the lab, unless it’s a high profile or rush case or a case going to court soon. Field work can be 24 hours straight, depending on travel time, and complexity. But sleep is important so you make good decisions.

Are working conditions dangerous? Not very often. Urban setting in dense developments with lots of people milling around is unsettling at times. Unlike CSI we are usually not carrying guns or have a ballistic vest. But some metro area responders do. Other dangers are the evidence itself. It may be bloody and infectious so proper protective clothing is necessary.

Do they work alone? If not, with who? We do not work alone, in the field we are part of a bigger team as described above.

What does a forensic geologist analyst wear to work? At the crime scene; cargo pants, possibly a uniform. Lots of pockets to carry gear including cameras, flashlights, notetaking supplies, and possibly notebook computers. Sturdy work boots are essential too, no high heels. Within the crime scene perimeter, depending on the scene, I could be wearing Tyvex protective clothing, gloves, masks. In the lab we wear lab coats, jeans, collared shirts, and often business-casual clothing. Never flip flops or T-shirts. We are required to wear more formal attire such as sport coats and ties for court.

What kind of demand is there for forensic geologists? Low demand at present, but we are actively promoting the need for more in the field.

What type of person would be well suited for this job? Motivated, enjoys diversity of work, (remember forensic geologists usually do other trace evidence analysis too). Outdoor person, inquisitive about how things are made, origin of the universe, love of microscopes,…

How much testifying does the job require? Really not that often, 1-6 times a year.

What do you like best about the job? Being part of a team, searching for the answers to difficult questions/puzzles. Identifying a microscopic mineral or particle. Serving the legal community. Letting the evidence tell the story.

What do you like least? Bureaucrats and inflexible individuals that are ignorant of the science that we do.

What is it about the job that made you stick with it for so long? Variety of cases. No two are alike. Identifying particles/minerals using microscopes.

Bill Schneck has been a practicing forensic scientist for 29 years, having a Bachelor of Science degree in both Allied Heath Science and Geology from Georgia State University and a Master’s of Science degree in Geology from Eastern Washington University. In 1990 he was instrumental in the start up of the Microanalysis section of the Washington State Patrol Crime Laboratory in Spokane, Washington. His responsibilities involve the analysis of a wide range of materials including soil, building materials, explosives, fibers, hairs, glass, paint, wood, paper, botanical traces, bloodstain patterns, food, and gastric contents.

In 1995 Bill started Microvision Northwest-Forensic Consulting, Inc, (www.microvisionforensics.com) teaching workshops in forensic microanalysis and performing both criminal and civil forensic examinations throughout the U.S. He is a member of the Organization of Scientific Area Committees-Geological Materials sub-committee (OSAC), the International Union of Geological Sciences-Initiative on Forensic Geology, a Diplomate of the American Board of Criminalistics, a member of the Northwest Association of Forensic Scientists, the American Academy of Forensic Science, and the American Society of Trace Evidence Examiners.
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Bloomin’ Easy!

One of the best things about teaching forensics is watching your students mature intellectually. Benjamin Bloom first published his taxonomy of thinking skills in 1956. As teachers we have an obligation to help students learn to use their minds in more powerful ways. The chart below lists suggestions for you to push your students mentally to higher places. Give them a try; often the difference between an easy forensic assignment and a challenging one is what you ask of your students.

<table>
<thead>
<tr>
<th>Level</th>
<th>Type of Activity or Question</th>
<th>Verbs Used for Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lowest level</td>
<td>Knowledge</td>
<td>define, memorize, repeat, record, list, recall, name, relate, collect, label, specify, cite, enumerate, tell, recount</td>
</tr>
<tr>
<td></td>
<td>Comprehension</td>
<td>restate, summarize, discuss, describe, recognize, explain, express, identify, locate, report, recall, review, translate</td>
</tr>
<tr>
<td></td>
<td>Application</td>
<td>exhibit, solve, interview, simulate, apply, employ, use, demonstrate, dramatize, practice, illustrate, operate, calculate, show, experiment</td>
</tr>
<tr>
<td>Higher levels</td>
<td>Analysis</td>
<td>interpret, classify, analyze, arrange, differentiate, group, compare, organize, contrast, examine, scrutinize, survey, categorize, dissect, probe, inventory, investigate, question, discover, text, inquire, distinguish, detect, diagram, inspect</td>
</tr>
<tr>
<td></td>
<td>Synthesis</td>
<td>compose, setup, plan, prepare, propose, imagine, produce, hypothesize, invent, incorporate, develop, generalize, design, originate, formulate, predict, arrange, contrive, assemble, concoct, construct, systematize, create</td>
</tr>
<tr>
<td></td>
<td>Evaluation</td>
<td>judge, assess, decide, measure, appraise, estimate, evaluate, infer, rate, deduce, compare, score, value, predict, revise, choose, conclude, recommend, select, determine, criticize</td>
</tr>
</tbody>
</table>

Chart courtesy of Dr. Alicia T. Wyatt, McMurry University, Abilene, TX
Ask the Morgue Guy

Q. I have known for a while I was born to teach forensics. I push my students hard and make every assessment challenging. My reputation around the school as the “CSI Guy” means that every time something goes missing other teachers call on me to solve the case. And I’ve nailed some students after examining the evidence.

Lately, I’ve been thinking about offering my forensic services to the community. Seriously, I’m that good. I have all the materials I need to do everything except GCMS and DNA. I’ve even had some gang members at school offer me insane amounts of money if I’ll teach a class on how to leave no evidence behind. What do you think? I could be a real life Sherlock Holmes on steroids.

— Luther McGavin, Austin, TX

A. Whoa there, Tex! Just because you can teach fingerprinting to high school juniors doesn’t mean you’re ready to be the next Gil Grissom. Unless you have a degree in science, several years of experience in a law enforcement forensic setting, and connections you’re not ready to run with the big dogs. Disagree? Call your local police and ask if you can observe or shadow their forensic people for a week this summer. Ask your new buddies at the end if they think you can make it on your own.

Don’t forget to ask them when you get to sit in on interrogations, shoot a gun at bad guys, and do all the forensic labwork by yourself. Also, be on the lookout for that hot co-worker who won’t be able to keep her smoldering eyes off you.

Then, when you come back to reality take a deep breath and enjoy your students.

What’s Going On?

2016

6/6-10
Outdoor Human Remains Recovery, San Marcos, TX. This course is designed for persons that want to enhance their knowledge of forensic recovery techniques in an outdoor context. The course will include two days of lecture and three full days of hands on recovery at the Forensic Anthropology Research Facility. Participants of the course will gain practical knowledge and experience identifying, recording, and recovering scattered and buried human remains. Lecture topics will include basic methods for estimating the post mortem interval, basic human osteology, and the role of the forensic anthropologist in medicolegal death investigations including forensic archaeology. http://www.txstate.edu/anthropology/facts/workshops/fieldrecovery.html

6/6-10
Advanced Bloodstain Pattern Analysis Workshop, Bethlehem, PA. Designed for practitioners who have successfully completed basic instruction in bloodstain pattern analysis and have a desire to build on that fundamental knowledge while working toward expertise in the discipline. This workshop will begin with a brief review of the basic concepts and will continue with the student applying those concepts in mock crime scene settings. The crime scenes with the associated clothing and physical evidence will be completely analyzed through documentation and stain selection, report writing and verbal presentation and defense of findings. http://mai.mercyhurst.edu/applied-forensic-sciences/forensic-anthropology-summer-short-courses

6/13-17
Death Scene Investigation Course (DSIC), Davis, CA. The DSIC focuses on training crime scene responders in the proper documentation and collection of evidence found at death scenes. This course is unique in that it presents 10 realistic reconstructions of diverse death scenes, staged with actual in situ human decedents, together with exactingly reproduced evidence. http://glencraiginstitute.com/courses/

6/20-24
Forensic Anthropology Methods, San Marcos, TX. This is a laboratory based course held at the Grady Early Forensic Anthropology Laboratory using the Texas State Donated Skeletal Collection. The course is designed for advanced undergraduates, graduate students, and professionals interested in expanding their knowledge of forensic anthropological methods for developing a biological profile, establishing positive identification, and interpreting bone trauma. Topics include human versus non-human osteology, skeletal inventory, estimation of biological characteristics (age, sex, ancestry, stature), identification methods, and trauma interpretation. http://www.txstate.edu/anthropology/facts/workshops/FAmethods.html
The Forensic Teacher • Spring 2016

Going On?

7/11-15
**Forensic Science for Educators**, Southfield, MI. Interested in developing a forensic science course in your school? Want to learn how to set up a crime scene? Need more information about forensic techniques? CSI:Lawrence Tech, designed for educators, can help you develop your coursework, engage your students, and teach forensic science using an integrated science approach. You will work alongside police officers and experts trained in forensic science. [http://www.ltu.edu/community_k12/forensic-science-educators.asp](http://www.ltu.edu/community_k12/forensic-science-educators.asp)

7/15-19
**Forensic Science for Teachers**, The Henry C. Lee Institute of Forensic Science, New Haven, CT. The Henry C Lee Institute of Forensic Science will be presenting in a comprehensive 5-day course. The Institute offers this hands-on course which is aimed at the educator who is already teaching, or is interested in teaching forensic science in a high school or middle school setting. The course will be taught in two different perspectives, from a scientist perspective and from the eyes of a crime scene investigator. [http://www.henryleeinstitute.com/?p=814](http://www.henryleeinstitute.com/?p=814)

12/5-9
**Introductory Bloodstain Pattern Analysis Workshop**, Miami, Fl. Introductory Bloodstain Pattern Analysis Workshop presented by the Specialized Training Unit at the Miami-Dade Public Safety Training Institute, Doral, Florida. This is an introductory level bloodstain pattern analysis workshop. The workshop is designed to be the first training step to becoming a bloodstain pattern analyst. The student will learn basic bloodstain pattern identification, reconstruction, preservation, and documentation through hands-on laboratory exercises, practicals, lectures, and case studies. [http://www.miamidade.gov/mdpstl/library/2016_stu_training_catalog.pdf](http://www.miamidade.gov/mdpstl/library/2016_stu_training_catalog.pdf)

Online Forensic Education

Please see the listing of online forensic learning opportunities on this page in the previous issue or search for "online forensic education" with Google. We regret we do not have the space to present the list here.

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!

Just for Fun

**Put their smartphones to use for you**

Teenagers love interacting, competition, and their smartphones. By combining the three everybody wins including you and your curriculum. Or, if you prefer to use laptops or tablets instead of phones that’s OK too. And it’s all made possible through a website called Kahoot.

In a nutshell, it’s a free website where you can either create your own multiple choice quizzes or use one made by someone else. If your school has wifi your students will go to http://kahoot.it, select your quiz/game and they’ll get a game PIN that they enter on their device followed by their name. Students’ names will begin appearing on your screen which should be projected because that’s where questions will appear.

Just like the trivia games you might play at happy hour each question has a timer and correct answers are worth more the faster students answer. Each question ends by displaying who scored what.

You begin by going to getkahoo.com and signing up for a free account. Then you can make your own quizzes/games. A great overview is available at [https://www.youtube.com/watch?v=BJ3Er1-IC-Mc](https://www.youtube.com/watch?v=BJ3Er1-IC-Mc), or search Youtube for “kahoot classroom.”

If you do decide to use Kahoot please let us know it went. We’d love to hear from you at admin@theforensicteacher.com.
Benny Hamilton, 31, of Dayton, OH walked into a convenience store with a knife and a black mask over his face and confronted the cashier and demanded money. “Are you kidding me?” she screamed several times and each time he answered, “No.” A few minutes later he began laughing and pulled off the mask. “I’m just messing with you,” he said before leaving the store. To hammer home his sincerity the man’s roommate entered the store the following morning and told the manager his friend was, “really sorry.” Police seized this lead and Benny was arrested soon after.

Simon Chaplin, 62, of Hebron, near Whitland, Carmarthenshire, UK was a big James Bond fan. He wanted his car to act like the one 007 drives. He installed a bucket, pumps, and pipes leading to his exhaust to turn diesel fuel into a humongous smoke screen for anyone trying to follow him. He waited for the chance to try it out. That came when a police cruiser signaled for Chaplin to pull over for speeding. Our hero activated the smoke screen and blinded the lawman trying to keep up. Unfortunately for the Bond-wannabee, the cop quickly realized that if he dropped back the billowing, blinding smoke would work perfectly as a means to track the car. When Chaplin eventually ran out of diesel fuel the police were there to arrest him.

When a masked, knife-wielding robber confronted the staff at a chicken restaurant in Tosu City, Japan, as they were about to close and demanded money, one of the staff paused then asked, “Aren’t you our manager?” Because his voice was familiar she added, “Are you Mr. Sato?” Sato then removed his mask and claimed his actions were a training exercise for the staff in case of robberies. He then walked away. However, the next day Sato called the Japanese equivalent of 911 and reported two people had just stolen $2,600 from the restaurant. The ensuing investigation showed Sato had embezzled money from restaurant sales, leading police to believe Sato tried to rob the place to cover his theft. Authorities charged him with attempted robbery and embezzlement.

Eboni Jones of Richmond, VA recently placed a number of items in her Wal-Mart cart and tried to leave the superstore without paying. When members of the store’s security team moved to confront her she ran to another store. Before Wal-Mart security could call the police Eboni left the other store wearing a change of clothes. A car pulled up, she got in, but Wal-Mart security personnel gave a description of the vehicle to police who pulled the car over a short distance away. The innocent driver of the car, an Uber employee, was not arrested. Jones was.

Ronald Taylor walked into a Golden Corral restaurant in Clarksville, TN and asked for a drink. When it arrived he showed the waitress a concealed handgun and matching badge and said, “The drink is usually free.” The next man in line asked Taylor if he was law enforcement and Taylor said he was and he was assigned to the Department of Homeland Security and showed him the same gun and concealed permit badge he’d shown the waitress. At this point the other man identified himself as a Clarksville PD detective and identified Taylor as a phony. Tayor, an insurance agent from Kentucky was arrested for impersonating an officer.

Justin Fay, owner of Base Camp Brewing in Portland, OR called 911 seven times in ten minutes to complain about the homeless outside his home. When officers arrived at his house they observed Fay descending the stairs carrying an AR-15 style assault rifle which they took away from him only to discover the weapon was loaded with a full 30-round magazine and the safety was off. In addition, the barrel had been modified so it was eight inches shorter than the legal minimum. Plus, Fay smelled strongly of alcohol and begged officers to let him return to his house because he wanted to get another gun and shoot the cops. Fey demonstrated he wasn’t a quitter when he kicked the roof and divider of the police car designated to take him downtown. He also kicked out the left rear door window. Fey eventually made bail, but not before being charged with seven counts of improper use of 911, first and second-degree criminal mischief, and possession of an illegal weapon.
Stoopid Movies

More stoopid criminals; these guys are priceless.
Click on the cameras below to see the movies (internet connection required).