
Crime Scene Investigation: A Case of Deductive Reasoning^{2,3}

Insects are found in nearly every habitat on earth. Those who study insects are called **entomologists**. Forensic entomologists aid criminal investigations by applying their knowledge of insect activity to the circumstances of a case, usually a murder or suspicious death.

Many fly species rely on carrion, or dead animal carcasses, to serve as nurseries for their eggs and food for the hatched larvae. Once mature, the larva pupates. It will shrink away from its skin, which soon hardens to form a shell, or puparium. Inside its new shell, the pupa will mature into its adult form, recognizable as one of those annoying outdoor pests. After mating, an adult female fly searches for a suitable carcass on which to lay her eggs, thus restarting the life cycle. In warm or hot weather, any number of fly species will arrive to lay eggs almost immediately after an animal dies, guided by the smell of decaying flesh. Within the first hour after death, eggs are deposited in the orifices and/or wounds on the body, where larvae will find the easiest path under the skin. Hundreds of fly species have been studied so thoroughly that the timing of their life cycles is known to within hours or even minutes depending on temperature, time of day, and weather conditions. Based on these predictable cycles, a forensic entomologist can determine the approximate time that a fly first arrived at a body.

Oviposition, or egg-laying, can be calculated to determine the approximate time of death—or more properly, the **post-mortem interval (PMI)**. The PMI is the block of time that has elapsed between the moment

2 Contributed by Sarah A. Skorupsky-Borg, MSFS.

3 Instructors, please refer to the “Helpful Hints” in the *Basic Laboratory Exercises for Forensic Science Support Material* on MyCrimeLab.com.

of death and some point later, usually when the body was discovered. For investigative purposes, this kind of determination is considered to be as reliable as a medical examiner's opinion; in some cases, a body that has been dead far too long for a medical doctor to be of help can be successfully examined by a forensic entomologist.

As a side note, another variable that can be resolved by an entomologist is the geographical area of a crime scene. Insects have a limited range due to temperature, altitude, and humidity requirements. If a body is discovered in a location uninhabited by the insects it carries, this is a clue that the body has been moved to mislead investigators.

Samples collected from the crime scene are handled in two ways: some maggots are preserved in a protein fixative, and some are kept alive in a fly-rearing container. The preserved specimens are retained as evidence in the case. The live maggots are reared and allowed to pupate. Once the adult flies emerge, they are preserved and used to identify the fly species found on the body. This confirmation step supplies the necessary legal proof to validate the entomologist's findings.

When collecting insect specimens, the most important information to include is the date and location of collection. Without these data, the specimen is useless to an investigator. In total, each sample should be labeled with date, time and location, case identifier, specimen identification number, and the initials or signature of the collector. There will be eggs and larvae of varying ages, but the oldest of the cohort will provide the earliest possible time of oviposition. These eggs are usually found in the head or face of the victim. They are also the most essential specimens to determine how long the victim has been dead, which may differ significantly from how long the victim has been at the crime scene.

The average life cycle of the black blow fly (*Phormia regina*) is described in Exercise 16. This species is sensitive to temperature and will delay oviposition for 12 to 24 hours depending on the weather. It is important to note that blowflies will not deposit eggs during nighttime hours or in the rain.

CASE STUDY

08:00 MONDAY MAY 14—POLICE RESPOND TO A REPORT OF A MISSING PERSON AT MIDDLE STATE UNIVERSITY

Professor Kline, director of the Anthropology Department at MSU, was reported missing by his assistant, Marcy. She appears inconsolable as she tensely straightens the already perfect alignment of her stapler, penholder, and desk blotter.

She explains, "He was due back this morning from a last-minute field trip. I'm sure everything's fine, but I can't help feeling like something's wrong!"

Now breaking into full-blown sobs, Marcy adds, “I got worried when he didn’t come to work this morning or leave me a message . . . I always ask him where he can be reached, but I didn’t this time—he was in such a hurry to leave, I didn’t want to bother him! Now, I . . . I . . . I can’t tell you where he is!”

“I’m just so worried because Professor Kline always checks in when he changes his plans,” squeaks Marcy. “Oh, I have a terrible feeling about this!”

You ask Officer Stransky, a bewildered but harmless-looking rookie, to take Marcy’s statement. Thirty minutes and more than half a box of facial tissue later, he is able to relay her report. Mercifully, he has prepared an abridged version.

“According to Marcy, Professor Kline left for a field trip located near, uh, Jacob’s Falls at around 5:15 last Friday night, or, uh, 17:15 hours. She indicates that’s about 45 minutes from here. She said the Professor received a phone call from a Dr. Ralph Myers around 16:00 hours. He is an archaeologist and former student of, uh, Mr. Kline. Marcy says she answered the phone, as usual, and spoke to Dr. Myers briefly. Uh, she described Dr. Myers as sounding happy and upbeat, and anxious for the Professor to join him at what she called ‘the site.’ When I asked her what this means and what these two guys would be doing, she said she assumes, uh, Kline would assist Dr. Myers at an archie, archieo, . . . uh, scientific dig. She said it is new and pretty important. It’s somewhere along Cedar Creek, near Jacob’s Falls. Apparently that’s where this Dr. Myers guy is working. She also said that she called Dr. Myers’ office at the Community College twice this morning and got no answer. Oh, and if you can believe it, none of these guys owns a cell phone! I guess they’re trying to live in the Stone Age, not just study it, right?!”

After thanking Stransky for his failed attempt at levity and what, as it turns out, was his inaugural witness statement, you decide to investigate Dr. Myers in a more official way. A Motor Vehicle Services check shows that Dr. Myers has a home on the coast, some 250 miles away. You don’t like road trips, but it is definitely better than helping the Crime Scene Unit process Professor Kline’s office. Anyway, Officer Stransky offered to drive. He has been tolerable thus far, and he promised to not play country music. After some consideration you decide that’s the best deal you’re going to get all day.

08:30 TUESDAY 15—ARRIVAL AT THE MYERS RESIDENCE

Dr. Myers’ house is bright and clean, with handsome landscaping and a tire swing in the front yard. You and Stransky are greeted by his wife, Janine. She is covered in what appears to be finger paint, or maybe it’s mustard, and there is the unmistakable sound of child-borne bedlam coming from the kitchen.

“Ma’am, is your husband Dr. Ralph Myers?” you ask.

“I never know where he is or when he’s coming home,” Mrs. Myers replies, defensively, “He lives out of a motel in Jacob’s Falls. We see him when it’s too rainy to dig or when he runs out of clean clothes.”

“Actually, it’s the only motel in Jacob’s Falls, isn’t it?” adds Stransky.

“He has an office in the community college, right Mrs. Myers? Would it be all right with you if we searched there?”—you try to recover the conversation. Jeanine has drifted off, staring at her perfectly painted porch floor.

“Searched? . . . Yes, yes . . . sure,” she says in a surprisingly weak voice. “You don’t think . . . The last time I spoke with him was on Friday night. He called from the hotel to tuck the kids into bed. We hung up around 9:00 p.m. I reported him missing Saturday night when he didn’t call. He said he would call . . . around 8:30.” Jeanine trails off, looking worried.

“Thanks for your help. We’ll be in touch,” you say, making a quick exit.

“Gosh, I thought she was going to cry there for a minute,” says Stransky.

Knowingly you reply, “Yeah, she seems pretty shaken up.” Days have passed and no one has heard from either Professor Kline or Dr. Myers.

10:05 TUESDAY MAY 15—SEARCH OF DR. MYERS’ OFFICE

It’s getting late, so you and Stransky double-time it to the Community College to check out Dr. Myers’ office. You search his desk, bookcases, filing cabinets, and all the piles of papers and exams lying about—no luck. There is no indication of where he was digging, and if he kept a date book, it’s not here.

“Let’s get out of here; I’m starving! We missed breakfast, and I’m starting to feel faint,” says Stransky, rolling his eyes.

You consider how much effort it would be to drag him, swooning, out to the car. Just as you decide it would be best to leave him behind if he faints from hunger, a very young-looking student barges in.

“*What are you doing in here?!*” she barks.

Apparently Dr. Myers has a research assistant.

Emily Wilson, who looks way too young to be a graduate student, is unable to provide any new information concerning his whereabouts.

She explains, “Dr. Myers was a very secretive and competitive man. I could never get him to tell me exactly where the dig site is—and he’s always been so jealous of Professor Kline I’m surprised he would even tell Kline about it. I don’t know why Ralph talks to him at all. It’s like he wishes he could be as famous as his great mentor. Anyway, you need a

spectacular find to be famous in the field of archaeology . . . I got the impression he finally had one at Jacob's Falls."

"Where were you last weekend?" you ask, noting the disdain in her voice as she said those last few words.

"I was at a young archaeologist's conference all weekend. I wasn't even in town on Friday. I can get you the hotel bill and my conference materials if you like."

Thanking her, you examine her receipts and the conference registration packet. Each indicates that she was out of town from Thursday through Monday.

"Before we get going, I have one more question, okay?"

"Sure, but just one. I have to get to class; my professor doesn't like us to be late."

"Thanks . . . So, why didn't you report Dr. Myers missing when he didn't come in yesterday morning? Is it normal for him to stay home on Mondays?"

"Oh, . . . no, I, uh . . . I didn't expect him back until next week. He, um, he e-mailed me . . . Hold on, I'll print you a copy."

"Thanks." As Emily bounces off to Dr. Myers' computer, it is at this point that you realize Stransky has been very quietly blushing and staring at his shoes for the duration of the interview.

"Great," you mutter, "the rookie's got a crush on the co-ed."

Dr. Myers' e-mail said that he was taking the week off to spend time at home with his family. You enter this into evidence, along with her receipts, being sure to affix and sign the proper chain-of-custody documentation.

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Late Thursday evening, two Jacob's Falls teens happened upon a grisly scene. The decomposing body of a man later identified as Professor Kline was found lying supine along the banks of the creek. Since local weather conditions were quite warm all week, the level of decomposition and insect activity is extensive. Thus, the county medical examiner is left to rely on YOU, the State Police Forensic Entomologist, to determine the day and time the Professor died.

05:45 FRIDAY MAY 18—ARRIVAL AT THE SCENE

You begin your investigation by taking copious notes. The italicized passages that follow are excerpts from your investigator's notebook.

A search of the scene reveals no shoe or footprints. I see no visible wounds on the body due to maggot activity and the advanced level of decomposition. Even so, there are no weapons in the area, or man-made items of any kind.

The silence of this painfully early morning is interrupted when one of the officers wonders out loud, “How did the Professor’s body get to this area down here by the water? Was he carried? I don’t see drag marks anywhere.”

A check of the weather report indicates that heavy downpours and flooding occurred all day Saturday and light rain fell on Tuesday night. This would obscure any footprints or tidemarks made at the time of the disappearance. A deputy has included a copy of the National Weather Service report for May 11 through present with the case file.

As the entomologist, you are obligated to reply, “Insect activity will reveal whether or not Professor Kline was in the water, and if so, how long ago he washed up onto his final resting place.” You pause to record the location and time of the photos you are snapping. You take photos of the entire area and some of just the body; the rest are close-ups of the maggot-infested portions of the body.

There is heavy maggot activity on and around Professor Kline’s body, both feeding and migrating. The maggot mass is in his face and neck area. It appears that the soil around the body remained undisturbed during decomposition process. In addition, there is soil splashed up on the clothing, as it would be during a rainstorm. The body has likely been in this location since death or very soon thereafter.

As you collect maggot samples, you put some in jars filled with preservative. These you label with the date, time, location on the body, and your own initials. You also assign a unique number to each vial and record this in your notebook. Other maggots are put into fly-rearing chambers. These chambers are labeled in the same way. You will take these back to the lab and raise them to adulthood. This is the only way to positively identify the species colonizing poor Professor Kline.

In a clearing about 50 yards up the bank from Professor Kline’s body, investigators find the dig site along with the Professor’s vehicle.

The site is located on private property outside Jacob’s Falls, which is an extremely rural and sparsely populated area of the state. The site consists of a 12 × 18 foot tarpaulin canopy that covers a 10 × 12 foot hole in the ground. It looks like the site was ransacked.

Maps, papers, water bottles, notebooks, photography equipment, and digging tools are strewn about the site. The cameras, papers, and notebooks have all been damaged by the rain. Two camping tents are 25 feet from the canopy, left open with their contents in disarray. It seems obvious that one belonged to each of the missing men. The fly, or waterproof overlay, from Professor Kline’s tent is snagged on a tree a few yards away from the tent. One of the lines that connected it to the ground stake is missing.

The professor's vehicle is visible from the campsite. It is unlocked and everything appears to be in order. There is a conspicuous lack of evidence concerning Dr. Myers' vehicle, a Jeep Cherokee—it is nowhere to be found.

It is getting on into the breakfast hours and the deputies are starting to grumble about their collective hankering for some fresh coffee and pancakes. Over their complaints (and your own growling stomach) you can hear lots of vehicles and voices approaching.

The local media has reported the location of the site, no doubt lured by their police scanners and the State Police Helicopter performing an aerial search. By now, reporters, protestors, gold-diggers, and rubberneckers alike are arriving in droves on what is rapidly becoming a very muggy morning. “Should have brought bug spray,” you think, “but maybe that would damage my professional credibility? . . . I can see the headlines . . . ‘Forensic Entomologist Who Hates Bugs Investigating Disappearance.’” As you drift back to reality, you hear the crowd grow silent.

Emerging from the crowd to speak to reporters is Steve Thompson, an environmental conservationist and self-proclaimed spokesman for the state forestlands. He is barking mad that the local residents were not consulted before Dr. Myers began his excavation, and he is calling for the prosecution of Dr. Myers and his team for destruction of state property. Aware that Thompson is an avid hunter and has detailed knowledge of the area, the police chief interviews him after the excitement dies down.

“Can you tell me your whereabouts for the last 7 days?” grunts the Chief.

“I was in the company of my family,” Mr. Thompson politely replies. He seems a little tense, and his eyes keep darting in your direction.

“I have been seen around town. Any of my friends will tell you I have done nothing out of the ordinary lately.”

“So what you're saying is that you have no alibi?” says the chief.

“Right . . . So what?”

You will need to use deductive reasoning to eliminate distracting information and stay focused on the elements of the crime! (Hint: Keep a detective's notebook to write down your ideas as you go, keep a list of likely suspects, and establish a timeline of events. Include your calculations for the time of death and your conclusions concerning the most likely perpetrator. Don't be lead astray—some witnesses may not be telling the truth!)

Follow the clues and see if you can solve the mystery.

CASE REPORT

Prepare a case report outlining your findings, and be able to back up your assertions with facts derived from the exercise. Include your answers to the following questions:

1. What is the timeline of events surrounding Professor Kline's disappearance and death?
2. What is the earliest possible time/date of Professor Kline's death?
3. Who do you think had the means to commit the crime?
4. Who had a motive?
5. What, if any, further information would help you with this case?

EVIDENCE REPORT

You have identified the species *Phormia regina* after examining the adults raised in the lab. Using the entomological evidence and data tables below, you can calculate the shortest possible interval between the moment the first eggs were laid and the moment you collected the samples from the body.

Entomological Evidence From Professor Kline's Body

Maggot Mass—neck region—all stages of *P. regina* present, with migrating maggots present in the surrounding soil.

Data Tables

Time to reach life cycle stages: Black blow fly (measured in days)

Phormia regina

Temperature (°F)	65–up	50–65
Eggs	0.66	1.32
1st Instar Larvae	0.75	1.50
2nd Instar Larvae	0.46	0.92
3rd Instar Larvae	1.50	3.00
Migrating Maggots	3.50	7.00
Puparia	6.00	12.00
Total Days	12.88	25.76

National Weather Service data for Cedar Creek

Date	Day	Sunrise	Sunset	Nighttime Temp (°F)	Daytime Temp (°F)
5/11	Friday	5:27	19:54	74	86
5/12	Saturday	5:26	19:55	62	70
5/13	Sunday	5:25	19:56	67	84
5/14	Monday	5:24	19:58	68	90
5/15	Tuesday	5:23	19:59	52	63
5/16	Wednesday	5:22	20:00	56	70
5/17	Thursday	5:21	20:01	68	72
5/18	Friday	5:20	20:02	69	86
5/19	Saturday	5:19	20:03	68	82
5/20	Sunday	5:18	20:04	71	88
5/21	Monday	5:18	20:05	72	91
5/22	Tuesday	5:17	20:06	65	85
5/23	Wednesday	5:16	20:06	67	84
5/24	Thursday	5:15	20:07	74	86
5/25	Friday	5:14	20:08	70	84

Other Evidence

E-mail received by Emily, Dr. Myers' research assistant

Delivered at 2:33 pm, Monday May 14, 2001

To: EMWils@allweb.net

From: digger222@cccc.edu

Subject: going home this week

Emily,**I will be spending next week at home with Jeannie and the kids.****Need some time at home.****See you next Monday.****Ralph**

