

The Case of the Barn Bucks



STUDENT WORKSHEET — ANSWERS

The Case of the Barn Bucks is a wildlife forensic activity designed to be “hands-on” and interactive.

Wildlife forensics is an exciting part of solving crimes related to jobs of the Wildlife Conservation Officer. Wildlife cannot speak for itself but when a crime has been committed towards wild animals, the Wildlife Conservation Officer, using forensic evidence and crime scene investigation, can sometimes speak for the animal and bring the violator to justice.

You have been chosen to speak for wildlife in this activity. You will be given clues and information that you will need to research, analyze and make a final decision. Good luck!



**Pennsylvania
Game Commission**





THE CASE OF THE BARN BUCKS

You are a Pennsylvania Wildlife Conservation Officer (WCO). It is early December and an unusually mild winter (55° F) in the middle of deer hunting season. You get a call from a local informant who tells you that he overheard a conversation at the local feed store about a neighbor of his who was bragging about shooting several big buck deer over the last week. The story has it that he has all the deer hanging in his barn. The informant goes on to tell you that after he heard the story he drove past the neighbor's barn, which sits very close to the road, and he could see several deer hanging from a rafter. To prevent being noticed by the owner of the barn, you get in your personal vehicle and in plain clothes you too drive by the barn and see the deer hanging. With this information, you contact the local District Magisterial Judge and secure a warrant to search the man's barn. You arrive at the barn at 9:00 AM with the warrant, you see that the door is now closed and the owner is quite upset. Because you have the warrant, you do enter the barn and find three large buck deer hanging from a rafter. None of the deer have any field tags attached to them and one of them has a foul smell coming from it. (Note... all deer harvested in Pennsylvania need to have a field tag filled out and attached to the deer's ear prior to removing it from the place at which it was killed). The owner of the barn refuses to give you any information other than his name and his hunting license. The license he gives you still has all of his harvest tags attached to it.

Your task now is to try and determine the time of death (TOD) of the three deer. Read the following information and then fill in the blanks and answer the questions at the end. For your convenience, there is a glossary of forensic terms listed on the last page of this activity.

One forensic technique used to determine TOD involves insect identification and measurement.

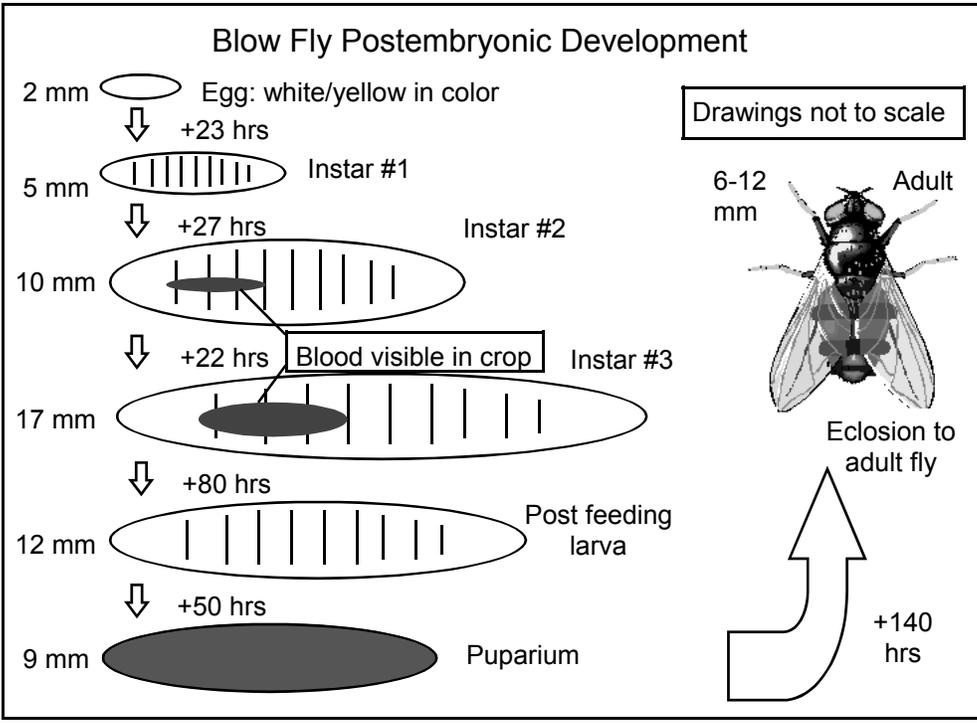
After closer inspection of the three deer you notice that the smelly deer, we will label him deer #1, has some small white moving objects on it as well as flies buzzing around. You photograph the deer and take some close ups of the adult flies and what appear to be maggots, crawling on the deer. Using your small insect net in your forensic kit, you catch one of the flies and using an insect field guide you identify it as a blow fly, which are also called bottle flies. You also collect several of the maggots so that you can measure them to help determine TOD. This technique can be more involved but for our activity we will stick with this procedure.

Before you get started you should have some background information on the blow fly life cycle. The following paragraph coincides with the life cycle chart on the next page. Read the paragraph, check out the chart and then get to work on your maggots!

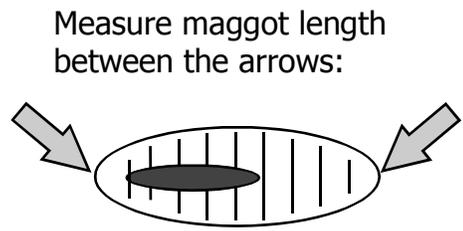


After finding a corpse or carcass, the adult female fly lays up to 250 eggs on the natural body openings as well as any open wounds. The eggs hatch into the first instar or stage in less than 24 hours. These feed and then molt into second instar maggots which now begin to show a visible crop or gut which is filled with the blood they are consuming. These maggots feed for approximately 24 hours and then molt into third instar maggots, which is the largest size that

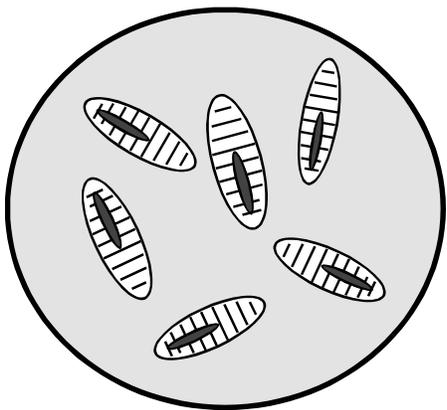
they will get and continue to show a visible crop. Masses of these third instar maggots produce heat and can actually change the temperature of the corpse or carcass by up to 10 degrees C. After more feeding, the third instar maggots move away from the corpse or carcass and are termed a post-feeding maggot. This form will grow an internal layer of white gelatinous material that will cover or hide the visible crop and is significant in helping to determine a definite stage of the maggots' growth. The maggot then turns brown to black in color, is covered with a hard shell, termed a puparium, and is known as the pupal stage. The puparium or covering is sometimes mistaken by investigators as a rodent dropping. Close examination of this puparium will show whether it is rounded on both ends which indicates that the maggot is still inside or whether it has a cut off appearing end which will reveal a hollow shell indicating that the fly has emerged or that eclosion has occurred.



Wow, now that's a lot of blow fly biology! Let's check out the chart and then on to your maggots.



Measure all six of the maggots found on deer #1 and collected in the Petri dish below. Record the measurements in the appropriate spaces below and calculate an average length. By comparing the average length to the life cycle chart above, estimate the number of days or hours that these maggots have been alive.



Length of maggots (mm):
 *Answers for length in no particular order

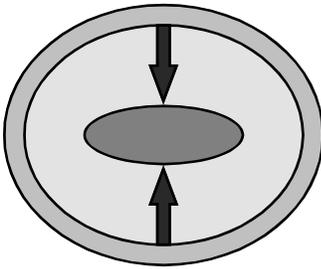
1. 17	4. 18
2. 18	5. 16
3. 17	6. 16

Average lengths of maggots (mm): 17
 Estimated TOD (hours): 72
 Estimated TOD (days): 3

Another forensic measurement used to determine TOD is vertical pupil diameter. Immediately after death, if you shine a flashlight into a deer's eyeball you will get a reflective luminescence or glow that is round in shape. However, as time goes by after death, the vertical pupil diameter will begin to get more and more narrow and the luminosity will begin to fade. The horizontal measurement will stay about the same this is why we measure the vertical length. Taking these measurements and then comparing them to known data can help to determine TOD. Below is an example of a deer vertical pupil diameter eye chart from a wildlife forensic field manual.

Photos not to scale.

To calculate vertical pupil diameter, measure distance between two arrows



2 hrs—15-16 mm



5 hrs—12-13 mm



9 hrs—8-9 mm



3 hrs—14-15 mm



6 hrs—11-12 mm



10 hrs—7-8 mm



4 hrs—13-14 mm



7 hrs—10-11 mm

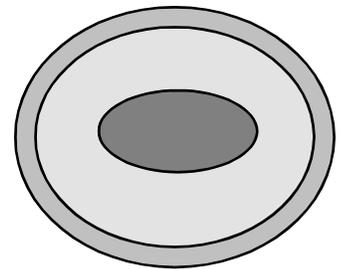
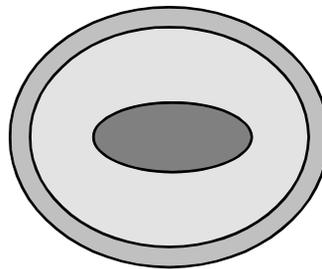
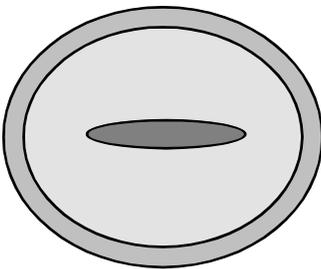


11 hrs—6-7 mm

*Special Note: All TOD measurements, including pupil diameter, are dependent on ambient temperature as well as the location and handling of the carcass. After 11 hours, the pupil will continue to shrink.

Excerpt from the Association of Midwest Fish & Game Law Enforcement Officers Wildlife Forensic Field Manual

Use a metric ruler and take accurate measurements of all three of the deer's vertical pupil diameters and record them in the appropriate spaces. Compare them to the chart above to estimate TOD.



Deer #1 Diameter: 4 mm

Deer #2 Diameter: 9 mm

Deer #3 Diameter: 11 mm

Estimated TOD: 11+ hours

Estimated TOD: 9 hours

Estimated TOD: 7 hours

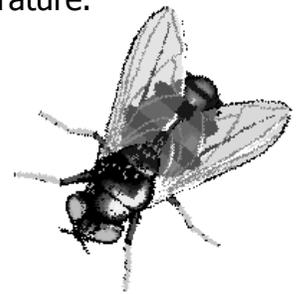
Body temperature is a third measurement that you can use to determine TOD. A normal healthy live deer has a temperature of 102° F. After death this temperature will cool down according to the air or ambient temperature in its surroundings as well as other factors like if the deer is lying on ice or in a wet environment versus a wooden floor in a building. We measure a deer's temperature in two different locations. Using a long thin thermometer we insert it into the nostrils for a nasal temperature. We can also use a shorter pointed meat thermometer and insert it 2-3 inches into both of the deer's inner thighs.

By using the Body Temperature/TOD Reference Chart, compare the nasal and thigh temperatures from the deer found in the barn (provided in the chart below) and determine the TOD.

Body Temperature/TOD Reference Chart (measurements are approximate)

Hours	Thigh Temperature (F°)	Nasal Temperature (F°)
0-1	100-102	97-102
1-2	98-99	80-96
2-4	83-97	71-79
4-8	69-82	65-70
8-12	62-68	59-64
12-18	53-61	50-58
18-24	41-52	39-49

*Special note: Body temperatures may stabilize when it reaches ambient temperature.



Deer #	Thigh Temperature (F°)	Nasal Temperature (F°)	Estimated TOD Range?
1	56	55	12-18
2	71	68	4-8
3	69	67	4-8

Questions

Your investigation has led you to some interesting findings. To be used in court as evidence, various methods to determine TOD should be performed. Conclude your investigation by filling in the table below with the estimated TODs from the three techniques used. Use this information to estimate a TOD (in hours) for each deer. This is the TOD you will use if needed in court. Keep in mind that, if a deer was dead for multiple days, several of these techniques may only be useful in supporting another technique.

Deer #	TOD by insects	TOD by pupil diameter	TOD Range by temperature	Estimated TOD (Range if applicable)
1	72	11+	12-18	72
2	N/A	9	4-8	4-9
3	N/A	7	4-8	4-8

Based on your investigation, would there be enough evidence to cite the owner of the barn with possessing deer that were not tagged and are most likely illegal? Yes / No (circle one)

During what period of time was deer #3 shot? 1-5 AM

Glossary of forensic entomology terms relating to the Case of the Barn Bucks:

Ambient temperature: The current air temperature.

Blow fly: A family of flies known as the Calliphoridae, also commonly called bottle flies.

Carcass: A dead animal.

Corpse: A dead human body.

Crop: Pertaining to an animal's gut or stomach.

District Magisterial Judge: A local judge in a lower level court.

Eclosion: The process of hatching from the egg or of emerging as an adult.

Forensic: Pertaining to the law.

Forensic entomology: The study of insects and related arthropods from a legal aspect.

Gelatinous: A substance mixed into a jelly-like form.

Informant: One who provides information to law enforcement like WCOs or the police.

Instar: Each of the successive incremental growth steps terminated by a molt.

Larvae: The primary feeding and growth stage of invertebrates. Usually it is the stage following hatching of the egg.

Maggot: The larva of the fly. It sheds its skin twice and has three growth instars prior to pupariation.

Maggot-mass: The collectively, closely packed mass of fly larvae occurring in decomposing carrion.

Nasal: Pertaining to the nose or nostril.

Postembryonic: The stage after birth.

Postfeeding larva: The wandering, fasting phase of the third instar-maggot, terminating in pupariation.

Pupa: That immature stage between larva and adult in insects having complete metamorphosis. In flies, the pupa is found inside the puparium.

Pupariation: The immobilization of the postfeeding maggot with the shrinking, hardening and darkening of its outer skin.

Puparium: The hardened outer shell or skin of the final larval instar within which the pupa of the fly develops.

Rigor mortis: The progressive rigidity of a carcass or corpse following death caused by an accumulation of lactic acid in dying muscle tissues. This is a temporary condition lasting 12 to 36 hours.

Warrant: A legal document allowing law enforcement to enter a private residence or vehicle.

Wildlife forensics: The study of wildlife crimes or cases from a legal aspect.

