There are numerous situations that qualify as animal cruelty: starvation, dehydration, untreated medical problems, failure to provide relief from extreme environmental conditions, hoarding, embedded collars, physical or sexual abuse, poisoning, animal fighting, and so on. Physical abuse cases often have neglect as a component of the crime. Animal cruelty is basically any action or lack of action that results in unjustifiable or unnecessary suffering, illness, injury or death of an animal. It is important that veterinarians have an understanding of their animal cruelty laws to they can respond appropriately and assist the investigators and prosecutors in the potential case. Reporting suspected abuse does not mean the alleged perpetrator will be arrested – it means that an investigation will be undertaken. It takes all parties to fulfill their role in the investigation to prove and disprove possible elements of the crime.

Abused Animals in the Practice Setting
It is very difficult for veterinarians to realize and accept the fact that animals who are victims of abuse will be brought into their practice. The Munro and Thrusfield study published in a series of articles titled the Battered Pet Syndrome in 2001 demonstrates how common this actually is. The person who brings in the animal may or may not be aware that the animal has been abused. That person, or a child, may also be a victim of abuse in the home. Often, the person bringing the animal in has a close relationship with the abuser. It is very important for veterinarians to realize that their discussions with the owner may elicit important information, including possible confessions. The study by Munro and Thrusfield reported that in several cases a family member was implicated by the owner. In twenty-five of the cases the owner admitted to committing the abuse. It is of particular interest that in five of the cases, the admission came after the veterinarian had merely discussed the possibility of abuse as the cause of the injuries. Another common scenario is hoarders who bring animals into the hospital. Animal hoarding is defined as someone who has accumulated a large number of animals that overwhelmed their ability to provide a minimum of care including adequate nutrition, sanitary conditions, and veterinary care. Animal hoarding is about the need to accumulate and control animals which supersedes the needs of the animals.

It is important to have an SOP for a veterinary hospital to handle and report suspected abuse cases. Depending on the jurisdiction, the responsible agency for investigating cruelty may be one or more agencies, i.e. police, animal services, department of agriculture, depending on the type of crime or the species involved. The prosecutor responsible for animal cruelty cases should also be identified – this may be different people depending on the level of crime: solicitor vs. district attorney. All staff should be trained on the SOP and the animal cruelty laws and practice act affecting reporting of suspected abuse. Some areas have mandatory reporting requirements, liability protection and/or clear rules for record confidentiality. These should be part of the staff training and SOP. The SOP should include several key components: agency(s) responsible for abuse investigations including all contact information; name of head cruelty officer in your area including cell number for emergencies; from responsible investigating agency: ‘after hours’ contact and reporting/response protocol; protocol for handling of animal after report: cruelty officer and/or prosecutor should
provide input on legal protocol for retention and protection of the animal (live or deceased); protocol for handling of live and deceased animal: documentation, chain of custody, photographs, records. The key is to establish a relationship early with the investigating agency/officers and the prosecutors. Invite them to come to your hospital to provide training on the law, liability, reporting and response.

Taking History in a Potential Abuse Case: Things may not always be what they appear to be when examining a victim of animal cruelty. The suspicion of non-accidental injury should be raised when there is significant discrepancy between the history provided and the clinical findings. Suspicion should also be raised when explanations are vague, inconsistent, or contradictory. It is important to get a more thorough history in animal abuse cases than routinely performed in veterinary medicine. In abuse cases, certain questions need to be answered in order to investigate, charge, and prosecute these crimes. Questions should be asked to determine who had access to the animal (including other animals), what did the animal have access to, when did the event occur, where did the event occur, how did it happen, and why did it happen. Details are needed about the environment including whether the animal had access to the outside, if allowed outside unattended, and when outside is the animal confined and how is it confined, and if there is a gate present on the fence and if it is locked. If the animal lives strictly indoors then the layout of the home is needed including the presence and location of stairs. Specific information is needed regarding where the animal was found, what was present around the animal (such as blood or other bodily fluids), and the initial symptoms of the animal. In addition, a history should be obtained regarding what food the animal eats (including brand, dry or can), how often the animal is fed, if it is known when the animal last ate or drank, and when the animal last had access to food or water. The behavior of the owner may raise suspicion as to the cause of the animal’s injury. The owner may be apathetic, uneasy, angry with routine history questions, embarrassed, or their responses may be generally inappropriate to the situation, especially as they are apprised of the gravity of the situation.

Veterinarians often make the incorrect assumption that what a client tells them is admissible in court. This is considered hearsay and is not admissible even with a witness to the statement or a signed statement. An exception to hearsay is when a person makes a statement against self-interest. For example, if a person makes a statement implicating him or herself in the crime it is not considered hearsay. Otherwise, whatever a client tells the veterinarian or staff must be repeated to an officer of the law in order for the statement to be admissible in court.

Documentation: When examining an animal, there must be full documentation of all the findings (see www.veterinaryforensics.com for forms). The exam should include written and photographic and/or video documentation. All notes, diagrams, recordings, photographs, and reports are considered evidence and will be reviewed by the investigator, prosecutor, defense attorney, and judge. It is important to do a complete physical exam, blood work, fecal, and radiographs on victims of animal cruelty. Every effort should be made to collect evidence prior to treatment to prevent contamination of the evidence. After treating the animal, it is vital to document the process of the animal’s recovery including weight gain and by repeating appropriate tests. As the animal recovers, the medical records and/or reports should include the timelines for treatments and assess the reasons for the animal’s recovery.
Chain of Custody and Evidence Collection
Any evidence related to a crime must follow a chain of custody. This refers to a recording process where the evidence is accounted for at all times. “Evidence” is anything collected at the scene of the crime, from the animal, all samples, all photographs taken, the photo card or negatives, radiographs, and the animal itself. It is acceptable to make a CD copy of the photo card and hold that as the evidence containing the photographs so that the photo card may be re-used. In all cases of suspected cruelty it should be the police or animal control that transports the body to the veterinarian. All evidence must be labeled with date and time, a description of the item, where it was collected from, and the person who collected it. The container should be sealed with some kind of tape and the person collecting should initial or sign across the seal with the date. An evidence log must be maintained showing the same information and the location where the item is kept. All evidence should be kept in a locked cabinet with restricted access. If the evidence is transferred to another person, location or laboratory, this must be noted with time and date and time, the purpose of the transfer, and a signature obtained from the recipient- this is following chain of custody. This also applies to the body of the animal. See www.veterinaryforensics.com for checklists and appropriate forms.

It is important to have the proper tools to conduct your exam and collect evidence. Clean tools should be used for collecting evidence and cleaned, or rinsed several times, between each collection. Paper envelopes or bags should be used to package most evidence collected. Do not place evidence in plastic bags because moisture can compromise the integrity of the sample. If an item is wet it may be wrapped in paper (butcher, roll craft paper) and then placed in the paper bag/envelope. The containers should be sealed with tape, evidence or scotch tape and the collector’s signature or initials placed across the tape with the date. Each evidence container should be labeled with the date, time of collection, collector’s name, item collected, and location collected from. Swabs of wet evidence may be taken, allowed to air dry and then placed in a paper envelope. For dried fluid evidence, the swab is moistened with sterile saline or distilled water prior to swabbing. Trace evidence should be placed inside a paper using a pharmaceutical fold: tri-fold the paper from top to bottom then again from side to side; re-open the paper and place the trace evidence in the center and refold; place inside a paper envelope. Ballistic evidence should be placed in a protective container such as a cardboard box or wrapped in paper towels and placed inside an envelope. Botany evidence should be placed inside newspaper or other absorbent paper, pressed flat between cardboard. Small botany evidence may be placed in pharmaceutical fold paper and placed in an envelope. Large plants may be folded accordion style and placed in cardboard presses.

Crime Scene Investigation
Often times the environment holds the key to what happened to the animal or contains vital information that is pertinent to the investigation and the ultimate prosecution of the case. The environment is best evaluated with a veterinarian and/or veterinary technician. You need to consider that more than one type of abuse may have been committed and be thorough. You also need to consider that other crimes may have been committed at the scene. At the beginning of every investigation it is imperative to consider all possibilities and gather all the evidence. At the scene, there is so much going on, so much evidence, that it can be difficult to assess all pertinent findings. The scene must be recorded for later analysis using photography and/or videography keeping a photo log. Make sure the evidence is photographed in situ prior to collection. It is important to take
pictures of the general area, the housing, all areas the animal could have had access to, the animals, any insects on the animal, any fluids, weapons, and so on. Ideally, a video should be taken of the scene and of the animal. It is important to show any weakness, limping, injury, or vocalizing. In starvation cases it is also valuable to show the animal’s response when offered food or water. You should receive a copy of all photos and video taken by others to analyze along with the physical exam findings. You need to note the housing of the animal, the condition of the food and water bowls and the contents of each. Always ask the owner what food they normally fed the animal – this will be crucial in poisoning cases to compare it to the stomach contents. It is important to find out what and when the animal last ate. You should note if they had access to water. You need to note if there were items that show evidence of being chewed on and collect them as evidence. If the animal was tied up measure the length of the tie and save it, taking care to preserve any knot. Any heavy chain that is used to tether an animal should be removed and weighed. The weight of the chain is a significant piece of evidence. You need to look for blood, note the location and the quantity by taking measurements of the blood stain. Remember, as a general rule animals bleed less profusely than humans. If there is a blood soaked item blood loss can be calculated. Look for a clean similar item for comparison. Samples of any blood should be taken. Take pictures, measurements, and draw a diagram of all blood spatter found.

Animal DNA forensic testing is available at several specialized laboratories. Parentage verification, sex determination, species identification and mitochondrial DNA testing is also available. DNA tests may be performed on blood, buccal (cheek) swabs, urine, feces, tissue, and teeth or bone. The lab will usually want to speak to investigators prior to any samples being submitted. They also want to discuss the particulars of the case to help prioritize what needs to be tested. A buccal swab is taken using a sterile cotton tipped applicator swabs, swirl or rub between the cheek and gum for 10-15 seconds, let the swab air dry for 10-20 seconds, then place in a paper envelope sealing with tape.

You need to look for and note the location of any bodily fluids such as vomit, urine, or feces. The condition of the feces needs to be noted such as diarrhea, formed, or moldy. Animals will lose bladder and bowel control under extreme fear or distress and the stool is often very soft. Samples of urine, vomit, or feces must be taken for possible DNA, toxicology, or parasite analysis. The feces need to be inspected for foreign material. When an animal is starving, he may ingest inanimate objects in order to fill his stomach. After impound, the first bowel movement should be collected and inspected for clues to what the animal had recently ingested.

It is not always obvious what injuries the animal has or what it died from. You need to look for possible poisons including chipmunk and snail bait or antifreeze. You need to look for evidence of any weapons, bullets, and shell casings. If there are burns on the animal you need to look for accelerants or chemicals. You need to look for medications – OTC, prescription veterinary or human drugs that could have been used on the animal. If the medication was prescribed for an animal, the name of the veterinarian, veterinary hospital, animal’s name it was prescribed for, the date and the expiration of the drug need to be documented. You need to look for papers related to the animals including veterinary invoices, adoption papers, kennel license, and rescue license. These are crucial pieces of evidence as they may provide the key to proving a felony. You should consider collecting items such as toys, brushes or any property that can be linked directly to the animal through DNA testing or if the location of these items is important to proving an element of the crime.
Examination of the Live and Deceased Victim

There are many different types of non-accidental injuries. They include penetrating injuries, non-penetrating injuries, burns, gunshot wounds, asphyxia, drowning, poisoning, ritualistic crime, sexual assault, and animal fighting injuries. There are several considerations to first determine if the injury is a result of accidental versus non-accidental causes. The veterinarian must draw on their own experience with known accidental injuries and compare those findings to the evaluation. Another source of information is emergency veterinarians who have a wealth of knowledge and experience with trauma though some of their cases may have been undetected abuse. The information provided by the caregiver and/or the investigator is critical to properly evaluate a possible case of cruelty, whether the animal is alive or deceased. A necropsy should never be performed without investigation findings and crime scene information including photographs of the scene. The environment and husbandry for the animal directly affects the health of the animal and must be analyzed along with physical exam findings. Animal cruelty should be suspected in every case where the history, crime scene findings, and environmental conditions do not support the exam findings. Aberrant findings should not be disregarded for they are often the key piece of evidence that the injuries sustained are non-accidental.

Neglect

The legal definition of neglect varies by jurisdictions. It has traditionally been defined as a passive act or the lack of action that results in the neglect of an animal. It has also been viewed as an act without malice and therefore most jurisdictions treat neglect of an animal as a misdemeanor versus a felony. This is often the case even if the neglect results in the death of the animal. In severe or chronic neglect, there is a point on the continuum of the failure to act that the severity of the animal’s condition and suffering has to have been obvious to the caregiver. At this point, when there is still failure to act it becomes a lack of action with malicious intent. This is when a neglect case can be potentially charged at a higher level as a felony. It is critical for the veterinarian to understand the nuances of the laws including local, state, and federal, in order to properly assist the investigator and prosecutor on the case. Neglect can be anything the causes the animal to suffer. It can also be defined as anything that is inadequate or inappropriate for the animal taking into account environmental conditions, the species, gender, size, and age of the animal. Neglect can take many forms that negatively impact the animal’s physical and mental well-being. These include the lack of or inappropriate: shelter, food, water, bowls for food and water, tethering, preventative health care, medical treatment, embedded collars, and heavy chains. Another consideration in neglect is the mental well-being of the animal in the form of boredom, distress, and emotional maltreatment. Consideration must be given to the species, gender, breed, and age of the animal to determine what the mental needs of that particular animal are. Confinement and lack of stimulation leads to another form of suffering, boredom, which has physical and psychological impacts on the animal. The degree of boredom for an animal is most evident when one observes the behavior after the environment is changed to enriched conditions. Distress manifests as a result of how an animal copes with an unpleasant affect (physical or emotional) such as boredom, pain, thirst, hunger, loneliness, or fear. Evidence of unpleasant emotions in animals are fear, phobias, anxiety, separation anxiety, loneliness, boredom, frustration, anger, grief, helplessness, hopelessness and depression. Emotional maltreatment refers to the link between emotional states and physical health. Emotions can cause distress, anguish, and suffering. They can be associated with long term...
problems such as separation anxiety, decreased learning, depression, difficulty with social interactions, or even physical manifestations of illness.

When looking to the cause of neglect you are looking for the cause of the animal’s failure to thrive. The veterinarian’s job is not to determine the guilt or innocence or consider mitigating factors for the defendant. That is the investigator and prosecutor’s responsibility. Often, there are multiple forms of neglect, multiple causes, and multiple animals affected. Disease is often present in neglect cases such as respiratory infections, intestinal parasites, and skin infections. In every animal cruelty case, a full laboratory work-up must be performed to determine the current health of the animal. This should include a CBC, chemistry panel, endocrine testing, fecal, urinalysis, heartworm, viral testing. Radiographs of the animal should be performed to look for occult injuries or problems. The veterinarian must then determine what was due to neglect and what may have been pre-existing and left untreated. In apparent starvation cases, it is critical to determine if there is an underlying health issue that is the cause. This often requires working with the investigator who interviewed the defendant, evaluating the crime scene findings, and reviewing any previous medical records. Sometimes the test results can indicate the chronicity of the problem, such as monocytosis. The cause of neglect is often due to a multiple of factors and problems. It is important to list every problem with the animal, environment, and husbandry in the report. Whenever possible, each item should be identified as primary and secondary problems. It is also crucial to include in the report what steps could have been taken to prevent the suffering of the animal, especially when they were simple and low-cost. Every judge and jury has their own level of experience with animals and their own minimum standards for the care of an animal. One never knows what will stick out as significant to the judge or jury so it is imperative to include every finding in the report and testimony.

There are psychological factors in some neglect cases which are a consideration of where and how to look for evidence as well as for the prosecution. Munchausen syndrome by proxy may be an issue of there is a history of repetitive unusual medical problems for the pets in the family. Animal hoarders are animal abusers whose actions are the results of a complex and poorly understood mental condition. Animal hoarding is defined as someone who has accumulated a large number of animals that overwhelmed their ability to provide a minimum of care including adequate nutrition, sanitary conditions, and veterinary care. Animal hoarding is about the need to accumulate and control animals which supersedes the needs of the animals. In addition, animal hoarders usually hoard other items such as newspapers, magazines, clothes, videos and so on. Often, hoarding is precipitated by a personal loss or some other major negative event in their life. There are some large scale animal cases that are not truly hoarders but instead are cases of sadism and/or serial animal killers. Each case must be examined looking at the totality of the problem to determine the proper action by investigators and prosecutors. As discussed earlier, neglect is traditionally viewed as a passive act without malicious intent. Depending on the circumstances, the case may have elements of malicious intent – where the defendant acted or failed to act with malicious intent. There is something in the legal system known as the “Reasonable Person Standard”. What this refers to is ‘the result a reasonable person would expect with the given set of actions or inactions’. This is where the veterinarian’s expertise comes into play in the case. A veterinarian can testify as to the condition of the animal and give an estimation of the time the animal has been in such condition. This is done by establishing timelines. There are several ways to establish timelines on neglect cases. Sometimes one may only be able to say several weeks or months. At the scene, the
vegetation can give a clue to the chronicity of the conditions. The lack of vegetation indicates the animal has been in that area for awhile. The high growth of weeds indicate nothing has been on that area for period of time. The lack of feces in the area of the animal indicates either the area was cleaned up, the animal has not been ingesting food in order to produce feces, or exhibiting coprophagy. The high build up of feces can be used to give an estimate of time for the conditions. Using a minimum of one bowel movement a day, one can develop a rough timeline. The build up of dirt and debris around a gate opening indicate the lack of use for an extended period. The utility records can be obtained to determine usage. The dating on mail can also help establish the presence of the defendant. Any veterinary medications and records can help determine length of ownership. Wounds that have granulation tissue can be biopsied and the granulation tissue measured to determine the estimated time for healing. The granulation bed forms 3-5 days after injury. It forms at the edge of the wound at a rate of 0.4-1 mm/day. In general, granulation tissue grows at a rate of 1mm/day and slows as the lesion ages to 1cm/month. It is not uncommon to find maggots infesting the wounds of an animal if in the appropriate climate when flies are still active. This is called myiasis. The maggots can be used to give an estimate for the length of time for the wound. The maggots are attracted to the smells associated with decay and infection. They will lay eggs on live animals with necrotic, bloody, infected wounds. These maggots should be collected, along with appropriate weather data, and submitted to a forensic entomologist.

One cannot give an exact time frame for an animal to have lost a certain amount of weight. It depends on the life stage of the animal, their initial body condition score, the amount of food fed, quality of food, and frequency of feeding. What veterinarians can say is the minimum time frame based on their clinical experience. An animal does not reach the lowest body condition score due to starvation in a matter of two weeks. All veterinarians have seen animals in private practice that have not eaten for two weeks. So, one can say it has to have been several weeks, greater than two. Remember, an animal will succumb to dehydration before starvation. The exam findings in conjunction with crime scene findings and interview results by investigators should help to establish more accurate timelines.

Non-Accidental Injuries
The causes of non-accidental injury are limited only by the perpetrator’s imagination. To try and surmise the cause and/or weapons used, one must first examine the body for injury patterns. These will give the greatest clues as to the cause of injury. When weapons are used, either in penetrating or non-penetrating injuries, a corresponding weapon pattern may be found on the body. These can be in the form of distinct bruising, skin injury, or damage to bones. If a significant time period has elapsed since the injury occurred, the bruising may spread obscuring any distinct weapon patterns. The skin injury may present as patterned hair loss due to crushing forces, abrasions, or full-thickness defects. A rubber cast should be made of any weapon pattern on bones or full-thickness skin defects. Mikrosil is used for rubber casting and is available from most criminal supply sources. Mikrosil comes in different colors and brown is the preferred color for tool mark examiners. The rubber cast is then used to help identify what type of weapon may have been used or confirm any suspected weapon. In some cases, the weapon may have left residue, such as oil or wood fragments, on the fur, skin, wound edges, or embedded inside the wound. All areas should be carefully examined with a magnifier to detect any evidence and collected appropriately.
Bone fractures are caused by certain physical forces. Each fracture must be evaluated considering the type of force required to produce that particular type of fracture. In addition, the type of bone, the age of the animal, growth plate closures, the size of the animal, the density of the bone, and the location of the fracture are all factors in determining accidental versus non-accidental causes. A transverse fracture is caused by a perpendicular blow to the bone. Rotational forces to a bone will cause spiral fractures. An adult dog that presents with a transverse fracture of the humerus; the history is the dog jumped down off a table to the ground, injuring the leg. The history does not match the type of fracture produced, the age of the dog, the location of the fracture, and the density of the bone. If the history were true, the dog should have a spiral fracture of the lower leg, not a transverse fracture of the humerus which is caused by a direct blow. Weapons may cause depression fractures or, if a wide object is used, there may be a several fractures over the area hit. There may also be corresponding fractures on the opposite side of the body if the blow to one side of the animal caused the body to impact a hard surface on the opposite side with enough force to cause a fracture. This is most commonly seen on the skull when the zygomatic arch on the opposite side impacts a hard surface due to a blow to the head. Organized dog fighting can produce punctures in bones, depression fractures, and gouges to bones. Tail injuries are common in animal cruelty cases. The tail may be used to hold the animal up, either by hand or ligature. There may be evidence of a ligature with trace evidence on the fur, ligature patterns on the skin, skin abrasions, or degloving injuries. There may be fractures or dislocations of the tail indicating crushing or pulling forces were used. The rule-outs for accidental trauma to the tail are getting caught in a door or stepping on the tail. These particular injuries should be located at the distal aspect of the tail.

Burns may be caused by a variety of methods including chemicals, thermal, scalding, and fire. The appearance of the burn provides several clues as to the cause of the burn. Burns are usually a patterned injury that reflects the cause of the injury. It is the proper interpretation of the burn patterns can reveal the exact nature of events which may support or refute the history. A determination of where the burn started on the body may be made when there are more severe burns confluent with more superficial burns. Splash or spill burns have trickle-like areas that are usually more superficial than where the liquid first contacted the body. A burn pattern that is evenly distributed with the same degree of injury is indicative of an even rate of burn.

There are seven main objectives when analyzing gunshot wounds: determining entrance and exit wounds, retrieving gunshot residue, retrieving the projectile, retrieving any bullet cartridge or casing, determining trajectory, determining gunshot range, recording injuries. There are some basic rules for determining entrance and exit wounds. In animals there is the advantage of fur being forced in or out, respectively. In general, entrance wounds are smoother and smaller than exit. Entrance wounds may have singed fur or skin indicating direction of travel. Abrasion rings may be found at entrance wounds where the bullet rubs raw the edges of the hole. The ring may be concentric or eccentric if the bullet entered at an angle causing a “bunching up” of skin. Entrance wounds may also have micro-tears at the edges if caused by a high velocity gun. If the bullet entrance is at an area of thick skin or it is a distant gunshot to the head the wound will usually have a stellar appearance. Contact gunshots produce splintered or star-shaped wounds because the bullet has a degree of wobble when first exiting the barrel of the gun. Exit wounds are usually larger and more irregular. They can be stellar, slit-like circular, crescent or completely irregular. “Shored” exit wounds have abraded margins because the skin was next to something firm when the bullet exited causing abrasions. Exit wounds through tight skin such as the head tend to be larger. Those
through loose skin can be small and slit-like. When retrieving projectiles, care should be taken not to cause damage that will interfere with the rifling marks on the surface of the bullet. These marks can be matched to the gun it was fired from. Use your fingers or cotton wrapped forceps to grab the bullet. In shot gun injuries get a representative sample of the projectiles and any wadding if present. Place items in a paper envelope and then a small box for protection. Ejected cartridges and casing may contain fingerprints. Exercise caution not to compromise their integrity during collection. All animals with gunshot injuries should have full body radiographs. An exit wound does not necessarily mean the bullet exited. The bullet could have propelled bone fragments and tissue out then rebounded back. Bullet emboli are possible.

Photograph each bullet wound before and after cleaning and shaving the wounds taking long range and close up views. Assign a number to each entrance wound and describe the location with a measurement to a landmark such as nipple, midline and the animal’s muzzle. Describe the appearance of the wound, path of the missile, injuries produced and exit or lodgment site. Save any powder grains and describe such as flake, ball or cylindrical. Shave and note powder tattoo patterns, abrasion rings and muzzle imprints. When taking measurements you can use a clock reference identifying the dorsal spine or head as 12 o’clock. Record the injuries created by the missile path.

For all trauma cases, the most common rule-outs are motor vehicle accidents (MVA) and dog attack. With MVA injuries, there should be certain findings that are supportive of this type of cause. There should be dirt and debris on the fur; skin abrasions from the animal sliding on pavement or dirt; the abrasions should be lateral on the down side and medial on the opposite side; and frayed nails (most commonly found with cats). These findings are in addition to any injuries sustained from being hit, rolled under, or run over by a car such as blunt force trauma and fractures. In dog attacks, there should also be supportive findings of the cause. There is often dirt and debris in the mouth where the animal was dragged and shaken on the ground; head and oral trauma from being shaken by the neck or grabbed by the head; saliva on the fur which causes spiking of the fur; fur caught in the nails where the victim fought the attacker (especially cats); punctures of the skin which may be triangular or elliptical; and abdominal organ lacerations from compression and shaking with or without associated skin punctures.

Detailed photo documentation should be made of all injuries including a photo scale next to the affected area. Detailed measurements of each injury should be made including a measurement from a landmark on the body. For multiple injuries, a letter or number system should be used to identify each injury. There should be at least one photograph of each injury and piece of evidence that will accurately portray what happened and can be blown up for courtroom use. It is helpful for investigators and the prosecutor to use a diagram of an animal or anatomical area to mark the injured areas.

**Forensic Necropsy Procedure Considerations**

The necropsy procedure involves a process of documentation and examination of the external and internal body. Photography starts with the body still in the package or bag. Photos with and without a photo scale should be taken of any evidence where the size is important. The external body should be examined for trace evidence, foreign material, bodily fluids, and obvious area of trauma. External wounds or evidence of injury such as contusions should be shaved and measured. The
necropsy may be performed in lateral or dorsal recumbency. The skin should be reflected to identify underlying injuries. The dissection, and opening of body cavities should be done based on the apparent injuries avoiding major blood vessels which can contaminate the field and distortion or alteration of wounds. Flap dissection should be used to analyze and follow wound tracks through tissue such as gunshot wounds or sharp force penetrating injuries. It is important to consider skin tension lines and avoid manipulation of skin or wound tracks which can distort the weapon characteristics. It is best to examine the skin and soft tissue wound characteristics first without manipulation and then with gentle manipulation to restore skin tension. Scotch tape may be used to re-appose the wound edges to discern blade characteristics such as serration. The use of a necropsy exam form and diagrams are recommended to ensure complete examination and documentation. The form also corresponds to the forensic report form making report writing easier. The deceased animal intake form is used to document case information when receiving the body. The evidence-chain of custody log and photo log are also forms that should be used.

With every animal cruelty case, one must consider the animal suffered blunt force trauma in addition to any other injuries. Contusions are very hard to see on the skin surface of animals unless there is light colored skin and the fur is parted all over the body to inspect for discoloration. It can take hours for bruising to show up on a live animal so re-inspection of the body should be done every few hours. In deceased animals, the skin should be reflected all over the body to reveal subcutaneous hemorrhage. Sometimes the hemorrhage is in the deeper muscle next to the bone, such as the rib cage, and does not extend to the subcutaneous layers especially if the survival period was very short after the injury. Careful dissection of the muscle layers can reveal the deeper evidence of trauma. The size and shape of the contusions can help determine what was used to cause the injury. There may be a denser area of hemorrhage with seepage into the surrounding tissues. It is the denser area that provides the clues to the cause. Petechiae may be seen on the pinnae and horizontal ear canal with blunt force trauma to the head. The petechia in the ear canal is a unique finding in dogs and cats due to the shape of their ear canal. Frank hemorrhage may be seen inside the ear due to a ruptured tympanic membrane. The common rule-out for any hemorrhage is clotting disorders which have a wide variety of causes so a full work-up should be conducted.

Proving Sequence of Events
It is important to try and determine the sequence of injuries which re-creates the crime scene events. The veterinarian’s knowledge of animal behavior, clinical experience, and common sense must be used to evaluate injuries. There are several considerations to make this determination depending on the type of injury. In deceased victims, the first thing to determine is the fatal injury and then backtrack from there. For contusions and areas of hemorrhage, one must remember that hemorrhage requires a beating heart. In multiple stab wounds, there may be little to no hemorrhage around an injury that was made when or after the heart stopped beating. But, if there is minimal blood supply to the area then it could account for the minimal amount of hemorrhage. With multiple fractures or injuries, a diagram can help in the evaluation of the number of blows and determining sequence of events. With multiple fractures of the skull, one blow may cause concentric or radiating fractures. Evaluation of where these lines stop and start can help determine the number and type of impacts. Consideration must be given to the impact each injury would have had to the animal. This includes how the injury would have compromised the animal such as severe pain, the ability to move, vocalize, or fight back. In addition, the veterinarian must consider what the animal’s response
would have been to each injury. This is critical in courtroom where the veterinarian must testify about the expected reaction and vocalization to each event/injury as part of their expert witness testimony.

**Proving Time of Death/Injury**
Proving time of death is usually an estimate at best. It requires taking into account several exam findings in addition to eye witness statements. Rigor mortis, algor mortis, and gastric emptying time are all variable depending on the events prior to death and the environmental conditions. The most accurate time of death can be provided using insect evidence. Maggots can aid in determining TOD, location of death and provide DNA and toxicology evidence. Maggots can help determine the time of death by providing the post mortem interval. Flies lay eggs during certain environmental conditions, at certain times of day after an animal has died depending on the species of fly. These eggs then hatch into maggots based on environmental conditions. The larvae develop at a certain rate, depending on the species and environmental conditions, and can be aged by a forensic entomologist. Blow flies are attracted to the body postmortem so by dating the time of colonization (laying of eggs), the time of death can be estimated. It is important to note that in some cases, maggots may be found on live animals, known as myasis. This is usually due to fecal soiling or wound necrosis present on the animal that attracted the flies. In this case, the time estimate will be for the time of trauma. Other insects are forensically important such as beetles which feed at different times post mortem.

A sample of all insects, pupae and pupa casings on the body should be collected noting the location on the body they were found. If there is a mass of maggots, then a temperature of the mass must be taken by inserting a thermometer in the center. The mass of maggots generates heat affecting their rate of development and affecting the entomologist’s analysis. In some cases there may be pupae casings present indicating the fly has gone through at least one life cycle and these should be collected. If maggots are present then it is important to get a sample of the adult flies to assist maggot species identification. One should also get a sample of any beetles if present which appear on deceased bodies at certain time intervals after death. Maggot samples should be collected and shipped for testing, taking care to get the largest larvae.

Forensic entomology analysis is dependent on the ambient temperature readings. Weather data for the past 2-3 wks as well as temperature of where the body had been held prior to examination is needed for accurate analysis. When the body is moved from the scene temperature of the transport vehicle and the time of transport must be recorded. If the body is held in a cooler prior to maggot sample collection, the temperature and time in the cooler must also be recorded. The entomologist needs certain information in addition to the weather data. They need photographs of the animal and the environment it was found in. They need to know if there were any unhatched eggs on the body and the location. They need to know the position of the body when found at the scene – sternal, lateral, curled, anything covering the body, any if the body was in direct sunlight or under shade taking special note of the head and perineal area. It is also helpful to provide them with any information regarding the crime scene and the presumptive cause of death.

Every effort should be made to get a sample of live flies at the scene where maggots or maggot eggs are present for species identification. Blow fly egg masses should first be photographed and their location documented. Using forceps, break a small piece of egg mass off approximately the size of
a dime, taking care to collect from the center as the eggs at the edge may be desiccated and no longer viable. Each egg mass collected from each location on the body should be kept separate. The mass collected should be broken in half and one half placed in 75% ethyl alcohol. The other half should be placed in a larval-rearing pouch. These pouches are made taking a piece of aluminum foil and folding it to create a three-dimensional rectangular pouch, crimping the corners together. A small piece of beef or pork liver should be placed inside as a feeding substrate should the larvae hatch. The top should be crimped together sealing the sample. This pouch should then be placed inside a plastic container for shipment with approximately one inch of soil or vermiculite in the bottom and small air-holes punched into the plastic top. This substrate absorbs any fluids that leak from the pouch and, for late stage larval samples, provides a burrowing substrate. Two labels should be created for the larval feeding pouch with the date and time, case number, location of the sample collected, and the sample number. These should be filled out in pencil to avoid any destruction of the writing. There should always be a double labeling system used where one label is placed inside the plastic container and the other affixed to the outside of the container. For all samples, note the time they were placed in the container and when they were shipped.

When collecting maggots for analysis, you are looking for the oldest (largest) larvae because they are the ones that first hatched and in turn were the first eggs laid. At first, the body and the surrounding area should be examined for prepupal maggots (post-feeding). These will most likely be found off the body but may be found in the fur, carpet, the first 3-5 cm of soil, or up to 50 meters from the body. If none are found then samples of the largest instar larvae should be collected, noting their location on the body. Temperature recordings and time of collection should be documented as described above. A sample of the collected maggots should be preserved at the scene. Place a sample of the largest maggots and some of the next size down into hot or boiling water for five minutes to kill and blanch them documenting the time of blanching. They should then be transferred to a vial of 70-85% isopropyl alcohol. They may be placed in 70-85% isopropyl alcohol at the scene if hot water is not available for blanching. The vial should be double-labeled as described with egg masses, with one label in the liquid and another affixed to the outside. Another live sample of the maggots should be preserved for examination using the larval-rearing pouches. Do not put too many maggots in the pouch because they need air and too many could cause the majority or all of them to die. The migratory larvae and puparia may be found usually within 20-30 feet of the body, depending on the species. They may be found under surface debris, in the top few inches of soft soil, vegetation, under rocks, or on tree trunks. The presence of the empty pupa cases indicates that a complete blow fly life cycle has taken place on the body and indicates a minimum elapsed time since death. These casings are often mistaken for rat droppings. They may be found in the same areas as the prepupal maggots and the pupae. Newly emerged adult flies should be collected in dry vials and a description of their appearance noted, as it will change by the time it reaches the forensic entomologist. As time goes on, there is sequential colonization of the remains by other insects. Analyses of these later appearing insects can help with the estimate of the postmortem interval.

**Decomposition**

Decomposition involves the two processes of putrefaction and autolysis. Autolysis is a chemical process by the intracellular enzymes that causes the breakdown of tissue and organs. Heat accelerates autolysis while cold slows it down. Freezing can stop the process and in some cases significant heat can inactivate the intracellular enzymes. Organs that have higher enzymes will
undergo autolysis faster, such as the liver and pancreas. Decomposition usually occurs in from 6 to 36 hours depending upon the condition of the animal and the environmental conditions of the exposed body. Microscopic exam may reveal autolysis of the tissues with no immune or inflammatory reaction. However, the presence or absence of an inflammatory reaction to an area of injury can help determine a time interval between injury and death. Depending on the cause of death or the type of injury hemorrhage, neutrophils, and/or edema fluid may be present with hours of the injury. The inflammatory responses may be affected by the age of the animal, the tissues affected, medications, and the health of the animal. An injury without an inflammatory response is indicative it occurred in close proximity to death. The nature of any inflammatory response may also determine a time interval such as in the case of peritonitis that resulted from intestinal rupture caused by blunt force trauma. The microscopic examination may have evidence of chronic inflammation including fibroblasts and hemosiderin. Putrefaction involves bacteria and fermentation and is often used interchangeably with the term decomposition. After death, the bacteria from the gastrointestinal tract spread throughout the body. Putrefaction is accelerated in animals that are septic prior to death and this process may continue even with refrigeration of the body. In addition to the body, the development of putrefaction is dependent on the environment. In high temperatures the rate of decomposition is accelerated and the body can reach an advanced state of putrefaction within 24 hours. In cold temperatures the rate slows down and may even stop in extreme cold. Even under refrigeration, a non-septic body may still continue to decompose. If the body is constricted in any way decomposition may be delayed. If the animal is overweight, has a heavy fur coat, or is wrapped in something to retain heat, putrefaction may be accelerated. Decomposition may be asymmetric occurring more rapidly in areas of injury. Decomposition may progress to skeletonization in only one part of the body due to insect feeding in areas of injury.

The sequence of decomposition in humans begins with a greenish discoloration of the abdomen. This discoloration then develops on the head, neck and shoulders along with bacterial gas formation causing bloating of the face. Marbling occurs in these areas due to hemolysis of the blood within the vessels and the hemoglobin reacting to hydrogen sulfide, developing a greenish-black discoloration along the blood vessels at the surface of the skin. The then body develops generalized bloating where the eyes may bulge and the tongue protrudes from the mouth. This is followed by development of vesicles on the skin, skin and hair slippage, and the color of the body is pale green to green-black. The weight of the internal organs actually decreases with decomposition. A red-colored decomposition fluid, known as purge fluid, will drain from the mouth and nose and may be found in the body cavities. This may be mistaken as secondary to an injury but the amount of fluid is usually small in the body cavities in contrast to the amount expected with injury. Decomposition also causes hemolyzed blood to leak out of the broken down blood vessels into the surrounding tissue (imbibition) usually within 12 to 24 hours after death. This can be mistaken for antemortem bruising so careful examination of lividity and concurrent injuries must be done to differentiate the two. Microscopically this is represented by hemolysis of erythrocytes in the blood vessels whereas the hemorrhage from antemortem bruising is represented by erythrocytes outside the vessels in the surrounding tissues.

Changes in the eyes are difficult to interpret and depend on whether the eyes are open or closed. With closed eyes, a white scummy deposit develops on the cornea making it cloudy by 24 hours postmortem. If the eye is open and exposed to the air, occasionally a brown to black band may form on the sclera or cornea due to drying called tache noire. Following the wet decomposition, the
surface tissues begin to dry, collapse, and darken developing a leathery texture. The organs and tissues will become desiccated and shrink. The body may become mummified or skeletonized. The time frame for skeletonization of the body depends on environmental conditions, insect activity, and scavengers. Mummification can occur in hot, dry conditions when the body rapidly dehydrates. The skin will appear brown or black and leathery. Decomposition continues with the internal organs turning them blackish brown with a putty-like consistency. Adipocere is a grayish-white to brown, firm, wax-like material made up of the fatty acids oleic, palmitic, and stearic acids. It is found primarily in the subcutaneous tissue and other fatty deposit areas. When a body is found immersed in water or in a damp, warm environment, adipocere formation may occur. It may also be seen in bodies that have been placed in bags. In these warm moist environments, fat undergoes hydrolysis by endogenous lipases and bacterial enzymes to free fatty acids. These are then converted to hydroxyl fatty acids by bacterial enzymes, primarily *Clostridium perfringens*. Adipocere formation can take weeks to several months to develop and is resistant to chemical bacterial destruction. For the severely decomposed/skeletonized or burnt body the fragile body should be handled very carefully and samples taken for possible testing. The body should be photographed, measured, weighed, and radiographed. Radiographs may reveal gunshots or broken bones. Depending on the decomposition, samples of kidney may reveal ethylene glycol poisoning. Stomach contents may still test positive for poisons. Examination of bones may reveal evidence of trauma.

Livor mortis, also referred to as hypostasis or lividity, is the pooling of blood due to gravity in dependent body sites after the heart stops beating. Lividity is most useful in determining the body position at time of death and if the body was moved. It is usually visible in light-colored skin, the buccal mucosa, and the sclera. It is also found on the internal body surfaces and internal organs where it is most noticeable on the surface of the lungs. Lividity on internal organs can be mistaken for congestion. At first appearance, contusions may be grossly difficult to differentiate from postmortem lividity. When pressure is applied to the area there will not be any blanching. To differentiate between bruising and lividity, incise the area in question. A bruised area will have diffuse hemorrhage into the soft tissues whereas lividity is characterized by blood confined to within the blood vessels. A contusion involves hemorrhage into the soft tissue and when incised the blood cannot be wiped or squeezed out. This is not the case in areas of lividity. Another factor to consider is the pattern and location of the discoloration – if it is more consistent with lividity based on location and other discolorations in the body or isolated which is more characteristic of injury. Over time, decomposition can make it very difficult to differentiate antemortem bruising and lividity. Hemolysis of the red blood cells creates diffuse discoloration of the soft tissue. The blood within the vessels and the erythrocyte leakage due to the breakdown of the blood vessels from decomposition will hemolyze. The erythrocytes in the soft tissue from antemortem bruising will also hemolyze making it impossible to distinguish from an area of livor mortis.

References:
3. www.veterinaryforensics.com – Forensic Forms