Alberta Distance Learning Centre

Forensic Studies 35 (3 Credit)

Module 1
Forensic Toxicology

Module 2
Law Enforcement Protective Equipment and Police Canines

Forensic Studies 35

LDC 3569

Module 1

Forensic Toxicology

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Forensic Studies 35 - Table of Contents

Welcome to Forensic Studies 35! 

Forensic Studies 35 is a three-credit course intended for students interested in the use of basic scientific concepts and technologies to solve crimes. Through the study of forensic science techniques, students are given opportunities to explore and understand further how basic scientific concepts apply to this field of study.

Disclaimer

A central component of the course involves the analysis of realistic scenarios and case studies. The course has some controversial or sensitive components including

- the examination of illegal drug abuse
- the analysis of arson and explosives
- the study of photographs of human remains
- the use of firearms
- the study of deviant behaviour

Forensics 35 has six modules:

Module 1: Forensic Toxicology

Module 2: Law Enforcement Equipment and Police Canines

Module 3: Arson and Explosives

Module 4: Forensic Ballistics

Module 5: Criminal Profiling

Module 6: Anthropology and Forensic Entomology

Contrary to popular opinion, forensic science is not an independent field of science. Rather, it uses scientific concepts and techniques from various scientific fields such as biology, chemistry, physics, anthropology, entomology, toxicology, and psychology to analyze and interpret evidence gathered during crime scene investigations. Forensic science is a valuable component in many complex police investigations.

During the last century, numerous advancements have been made in forensic science. Procedural advances respond to the ever-increasing complexities of our judicial system. If a criminal suspect is to be convicted of a crime, credible evidence is required to prove guilt. The onus for proving an allegation rests with the prosecuting attorney; therefore, the more credible the evidence, the greater the likelihood that an accused person is convicted. Finding credible evidence is the task of police investigators who may use scientific techniques to analyze and interpret evidence found at crime scenes. They may even send evidence to specially trained forensic scientists for further analysis and interpretation.

One individual cannot be an expert in every area. A forensic scientist is not capable of analyzing and interpreting every type of forensic evidence despite the common portrayal of television. Therefore, each item of evidence is directed to a person considered an expert in analyzing that particular evidence.

Course Navigation

As you progress through the course, you will encounter various icons with instructions to direct you to complete certain activities or to link you to objectives or answers. Some of the icons you may encounter in the course are charted below:

 Objective	An ***Objective*** icon appears at the top of each introductory page noting the objectives of the lesson.
 Take Notes	Any time you see the ***Take Notes*** icon, you should read the material carefully and take notes on what you read.
 Example	The ***Example*** icon indicates a case study or sample case that illustrates the concepts you are learning.
 Assignment	The ***Assignment*** icon directs you to your next assignment.

Please refer to the glossary at the back of the book for word definitions.

Evaluation

Your mark in this course is based on two components:

1. Assignments

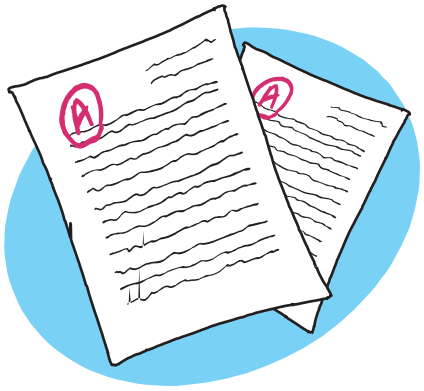
This course has six modules and each module has an assignment booklet. These booklets are completed and sent in to your teacher for marking. In total, these six assignments are worth 50% of your final course mark.

2. Final Exam

The final exam is worth 50% of your final course mark. This exam represents the entire course and is given when the course is complete, presumably at the end of the semester.

Note: ADLC policy is that, if a student receives a score of less than 40% on the final exam, the student's final exam mark shall be the final course mark. In other words, if a student has a 90% average going into the final exam but scores only 30% on the final test, the student's final course grade is 30%.

When you are ready, please continue to Module 1 to begin the course!



"There is no such thing as forensic science; instead, it is a collection of scientific techniques and principles that are begged and borrowed from the real sciences such as chemistry, biology, physics, medicine and mathematics."

- Introduction to the Encyclopedia of Forensic Sciences, 2000

Module 1: Forensic Toxicology

Overview

The sale and distribution of illegal drugs involves a global black market with an estimated retail value totalling more than US$320 billion. Law enforcement agencies have engaged in attempts to prevent the distribution and sale of illegal drugs since the growing problem was first recognized in the early 1960s.

Financial incentives drive the sale of illegal drugs: dealers want to get rich and be powerful. The result is often high levels of property crime, murder, and social disorder. Law enforcement agencies, therefore, work towards reducing the extent of the drug trade to prevent such crimes from becoming more frequent.

Each year, numerous injuries and deaths result from the use of illegal drugs. Forensic toxicology has an important role in the investigation of such incidents and their related crimes.

The ingestion of a poison or toxin (usually by swallowing or injecting) can lead to life-threatening injuries and/or death. Ingestion may be accidental or deliberate, and it includes cases of suicide and murder. Accidental poisonings and suicidal acts stemming from the consumption of poisons and/or toxins are non-criminal matters. The deliberate poisoning of an individual or group of persons is a criminal matter that typically results in a police investigation. The science of forensic toxicology has an important role in successfully investigating and prosecuting such criminal matters.

- Lesson 1 introduces two categories of physical evidence with examples of each type. It examines the physiological effects of illegal drugs upon the human body. This lesson identifies some of the most common illegal drugs and describes the harmful side effects of drugs upon the human body. Also, this lesson explores the subject of drug-impaired driving.
- Lesson 2 describes various types of poisons and toxins and explains the physiological effects of poisons and toxins on the human body.
- Lesson 3 identifies and describes some of the toxicological tests used by forensic scientists.
- Lesson 4 examines the details of two historical crimes and one fictional crime that relate to forensic toxicology.

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Module Learner Objectives

By the end of Module 1, you should be able to…

- appreciate that the field of forensic toxicology involves the identification of various types of drug(s) and/or poison(s) found within an individual's system
- recognize that illegal drugs have harmful side-effects upon the human body
- review the harmful effects upon the human body of various types of illegal psychoactive drugs (e.g., *opiates, marijuana, barbiturates, cocaine, amphetamines*)
- recognize that the illegal drug trade has a direct relationship upon other crimes and that it causes social disorder
- discuss the dangers of driving a motor vehicle while under the influence of drugs and the need for drug testing devices for police officers
- recognize that drugs, poisons, and toxins are extracted from the body using procedures that involve acid-base extraction
- understand the mechanics of various toxicology testing procedures used to screen for drugs or poisons (e.g., *colour testing, microcrystalline testing, immunoassay testing, gas chromatography*)
- explain how the toxicological testing technique of mass spectrometry is used to confirm the presence of specific drugs or poisons within the human body
- identify various types of poisons (e.g., *cyanide, carbon monoxide, arsenic, strychnine*) and their harmful side-effects upon the human body
- analyze historical crime cases and/or fictional crime cases that involves forensic toxicology

Did You Know?

In Canada in 2005, more than 92 000 individual criminal arrests involved illegal drugs.

Lesson 1: The Effects of Illegal Drugs upon the Human Body

Lesson Objectives: *The student will...*

- appreciate that forensic toxicology involves identification of various types of drugs or poisons found within an individual's body
- identify various types of illegal drugs (e.g., opiates, THC, cocaine, and amphetamines) and their harmful side effects

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Defining Forensic Toxicology

Toxicology is the study of the origin, nature, and properties of various drugs, poisons, and toxins. Toxicological specialists work in hospitals where the identification of an overdose can mean life or death.

The terms ***drugs***, ***poisons***, and ***toxins*** have subtle and often overlapping definitions.

- **Drugs** are usually *substances ingested intentionally to produce a change that results in better health, pain relief, or pleasure.*
- **Poisons** are usually *substances ingested unintentionally that cause poorer health*. Most drugs can be taken at high doses to become poisons. One common method of attempting suicide is to take too many drugs or to ingest poison intentionally.
- **Toxins** are *harmful environmental chemicals that cause negative health effects, usually after prolonged exposure*. However, exposure to toxins at high concentrations can quickly cause harmful effects or even death. Intentionally exposing someone else to a toxin is a crime.

Forensic toxicology is the application of toxicology in the pursuit of solving criminal cases. It generally is concerned with the detection and identification of drugs, poisons, or toxins that cause adverse ***physiological*** effects. Law enforcement agencies and medical examiner's offices require the services of forensic toxicologists. The main responsibility of a forensic toxicologist is to detect and identify the presence of drugs, poisons, or toxins in body fluids, tissues, and organs.

The work of a forensic toxicologist is generally in three main categories:

1. Testing for alcohol in blood and/or urine samples
2. Detection of drugs, poisons, and toxins in body fluids, tissues, or organs
3. Identification and measurement of the specific type of drug, poison, or toxin found within a subject

© *photos.com*

Did You Know?

In Canada in 2012, the rate of drug crime increased 10% despite the downward trend in the overall crime rate. Cannabis-related offences were up 13% while cocaine related offences dropped 5% from the previous year. The highest provincial drug crime rate was in British Columbia. However, the rate of cannabis-related crimes in the Northwest Territories and Nunavut is between 2.5 to 3 times as high as the rate in B.C..

Source: Statistics Canada website: www.stat.can.ca

How Drugs Affect the Human Body

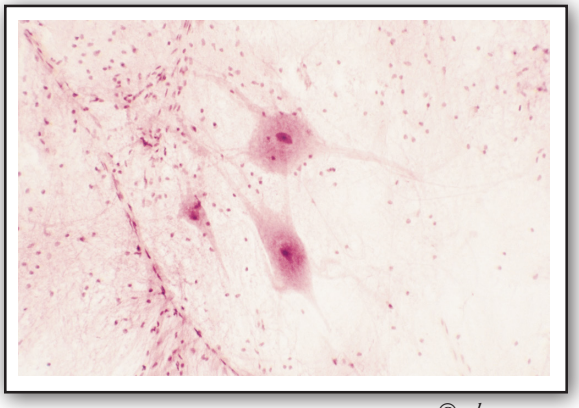
Most illegal drugs are ***psychoactive drugs***; that is, they alter a person's perception or mood. Some psychoactive drugs are known as *depressants* because they reduce an individual's sense of alertness by causing relaxation (e.g., marijuana). Other psychoactive drugs are known as *stimulants* because they intensify an individual's sense of alertness to cause hyperactivity (e.g., cocaine).

Psychoactive drugs can be taken orally, through injection or absorbed through body membranes such as those located in the nose, lungs, rectum, or vagina. To influence the human body, any type of drug must be absorbed into the bloodstream and transported to the body region where it has an affect. Initially, a drug can be detected both in the region it targets and throughout the bloodstream.

Drugs that are taken orally go through a slightly different process. Any drug absorbed through the digestive tract and into the bloodstream must first pass through the liver before travelling to the body region that it affects. As the drug passes through the liver, some of the drug is broken down into metabolites. The amount of the drug that gets metabolized depends on a number of factors including the polarity and stability of the drug, the rate of absorption of the drug, and the form of the drug ingested (tablet, capsule, liquid etc.). Rates of metabolism also differ from individual to individual as determined by genetics and other environmental factors. Almost always, the metabolites of the original drug will have a different effect on the body region it targets than the original form of the drug. Sometimes, metabolism renders a drug completely inactive and it passes harmlessly out of the body but in other cases, the metabolite might be just as active as the original drug although it may target a slightly different body region or uses a different pathway to achieve its effect. It is also possible for the original drug to be ingested in an inactive form that must be metabolized by the liver before it becomes active and has any effect on the body region. The effects of orally ingested drugs usually have a delayed onset when compared to other methods of drug delivery because of the additional time required for the drug to pass through the digestive tract to be absorbed into the bloodstream and the time required for metabolism by the liver.

Pathway #1

drugs taken orally → digestive tract → bloodstream → liver → body region they affect → liver → kidneys → excreted



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Drugs that are injected or are absorbed through body membranes pass immediately into the bloodstream and travel to the body region they affect.

Pathway #2

drugs injected or absorbed through body membranes → bloodstream → body region they affect → liver → kidneys → excreted

Once the drug travels to the region of the body that it affects, it may also be broken down by that organ or system. Every time the blood circulates through body, more and more of the drug is broken down by the ***liver*** and is eventually transported to the ***kidneys*** and ***excreted*** into the urine. The overall length of time that it takes the body to completely metabolize a drug into an inactive metabolite determines how long an individual will experience an effect from that drug. Therefore, forensic toxicologists may look for a drug or the active or inactive metabolites of a drug in three areas:

- the blood
- the urine
- the target region.

Metabolism of a drug happens over time. As a result, depending on what metabolite they are testing for, forensic toxicologists can detect the presence of a drug hours, days, weeks and months after the drug was originally taken. Rohypnol, the date rape drug, can now be tested for in urine up to 8 days after the original dose was taken where as cocaine can be tested for in hair up to 3-6 months after it has been used.

Most psychoactive drugs target the cells of the central nervous system (CNS), which consists of the brain and the spinal cord. Psychoactive drugs tend to alter the activity between the cells of the CNS known as ***neurons***. More specifically, psychoactive drugs change or ***mimic*** the actions of the ***neurotransmitters*** released by the neurons. When stimulated, neurotransmitters are released by a neuron, and they move from that neuron through a space (called the synapse) towards a receptor neuron. When neurotransmitters come into contact with the receptor neuron, responses are triggered. After a neurotransmitter has triggered a receptor neuron, it is broken down quickly so it no longer produces an effect. Examples of responses that may be triggered by receptor neurons within the CNS are muscle and heart contractions, increased or slowed heart rate, the sensation of pain, the interpretation of visual images, emotions, and sleep.

Psychoactive Drugs and Their Effects upon the CNS

Many psychoactive drugs exist; some are legal and others are illegal. Forensic toxicologists analyze psychoactive drugs that are most often illegal. Illegal psychoactive drugs are of several types, each having its unique effects upon the body. Two general categories of psychoactive drugs are depressants and stimulants.

Depressants

Depressants (also called narcotics) are psychoactive drugs that cause drowsiness, sleep, and insensibility. Many depressants prevent the release of neurotransmitters. This stops neuron stimulation, which produces feelings of relaxation. Other depressants mimic neurotransmitters that prevent the feeling of pain and cause a dull, relaxed state of mind. Most depressants are available only through prescriptions from medical doctors. However, one of the most powerful and addictive of all depressants is alcohol—and it is legal. The three most common types of illegal depressants are the opiates, marijuana, and the barbiturates.

Opiates: Drugs are derived from the milky secretions of the poppy flower bulb before it opens. Opiates are thought to mimic the effects of neurotransmitters in the CNS that prevent the feeling of pain, causing a ***euphoric*** trance-like state. Frequent use of opiates results in disruption of blood flow, increased risk of infections, and addiction.

The most common types of opiates include morphine, codeine, heroin, Demerol, and methadone.

A Poppy

© *photos.com*

Did You Know?

The death rate for heroin addicts is more than twice the normal rate. The main cause of death of heroin users is overdosing. Heroin addicts do not use the drug for pleasure; they use it to prevent severe withdrawal symptoms.

Source: Beryl Simpson and Molly Connor-Ogorzaly. *Economic Botany — Plants in Our World.* Toronto: McGraw-Hill Publishing Company, 1986. (p. 394)

Take Notes

Marijuana: Marijuana is produced primarily from the dried leaves of the Cannabis sativa plant. The active ingredient in marijuana is the chemical, tetrahydrocannabinol (THC). THC is thought to prevent a neuron's uptake of a common neurotransmitter called acetylcholine, thereby preventing neural stimulation. Marijuana is also classified as a hallucinogen because it alters the users's normal thoughts and mood. Marijuana intake causes relaxation and gives one a sense of well-being. It also impairs a person's coordination and visual acuity. Consequently, being high on marijuana severely interferes with one's ability to operate a vehicle. Heavy use of marijuana has also been linked to various serious lung disorders, addiction, and low sperm counts.

A Cannabis sativa plant

© *photos.com*

Hashish is a highly addictive form of marijuana derived from the resin secreted from the leaves and flowers of *Cannabis sativa* plants grown in dry, hot conditions. Hashish causes the same physiological effects as marijuana; however, it does so more quickly and more distinctly.

Barbiturates: Barbiturates (also called *downers*) are manufactured derivatives of barbituric acid. Twenty-five barbiturates are known, five of which are prescribed legally by physicians. Barbiturates are pills taken orally that suppress the CNS and cause one to feel relaxed and sleepy. Some barbiturates affect the user for long periods and tend to be slow acting; other barbiturates are fast acting. The fast-acting barbiturates tend to be the most popular among illegal abusers. Abuse of barbiturates leads to severe addiction, insomnia, muscle spasms, and convulsions.

The most common types of barbiturates that are illegally abused include amobarbital, pentobarbital, and secobarbital.

Stimulants


Take Notes

Stimulants are psychoactive drugs that increase alertness and ***metabolism***, cause hyperactivity, stimulate sexual arousal, and repress hunger. Some stimulants prevent the breakdown of neurotransmitters, causing neurons to fire continuously. Other stimulants mimic the effects of neurotransmitters, resulting in an increase of neural stimulation in the CNS. Most stimulants are available only through prescriptions from medical doctors. The two most common types of illegal stimulants are cocaine and the amphetamines.

Cocaine: Cocaine is derived from the leaves of the *Erythroxylum coca* plant. Cocaine is thought to prevent the breakdown of neurotransmitters in the brain, causing neurons to fire continuously. Cocaine causes the user to feel overly excited, invigorated, and without appetite. Some cocaine users may in engage in uncontrollable, violent behaviour. Abuse of cocaine may result in confusion, ***paranoid psychosis***, ***insomnia***, ***impotence***, addiction, and birth deformities in the babies of women who abused the drug while pregnant.

Did You Know?

A deadly cocaine overdose can occur quite easily. A lethal dose of cocaine is only 1.2 grams, or about 1/4 of a teaspoon.

Source: Beryl Simpson and Molly Connor-Ogorzaly. *Economic Botany — Plants in Our World.* Toronto: McGraw-Hill Publishing Company, 1986. (p. 398)

© photos.com

Take Notes

Crack cocaine is derived from powdered cocaine by dissolving it in a mixture of water and ammonia or water and sodium bicarbonate. The resulting solution is then boiled until a solid substance forms. The solid is removed from the liquid, then dried and broken into small chunks or rocks that are smoked. Crack cocaine produces an immediate high and is more addictive than cocaine. Abusers of crack cocaine run the risk of cardiac arrest, seizures, or lung trauma, and they may exhibit aggressive or paranoid behaviour.

Amphetamines: Stimulants that are created from ***synthetic*** chemicals and not directly from plants are known as amphetamines. Most amphetamines mimic the affects of certain neurotransmitters in the brain, causing an increase in neuron activity. Amphetamines increase sensory perception and feelings of excitement and can cause violent behaviour, anxiety, confusion, and ***insomnia***. Abuse of amphetamines can cause inflammation of the heart lining, blood vessel damage, skin ***abscesses***, and fetal deformities in babies of women who abused the drug while pregnant.

Common amphetamines are Speed, Crystal Meth, and Ecstasy.

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Did You Know?

The illegal amphetamine, Ecstasy, is considered a type of neurotoxin. A study in non-human primates showed that exposure to Ecstasy for four consecutive days or longer caused damage to neurons in the brain evident six to seven years later.

Source: National Institute on Drug Abuse, website (www.nida.nih.gov/Infofacts/ecstasy.html)

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Drug Use and Crime

Conventional wisdom suggests that drug addiction leads to higher rates of property crime as an indirect result of the overwhelming desire for drugs. The motivation driving the drug trade often results in competition among those who choose to sell illegal drugs, often producing violent incidents ranging from simple assaults to drive-by shootings.

Specific examples of the relationship between illegal drug use and other crimes include high rates of property crime and petty theft, social disorder related to open-air drug markets, and an increase in murder rates when competing criminal gangs engage in "turf wars" to protect drug distribution networks.

The use of marijuana and heroin increased in North America during the latter half of the 1960s during which time crime rates increased dramatically. The early 1980s were characterized by the increasing popularity of cocaine, the importation of which led to gang warfare and localized crime and disorder in large cities. These social effects were further magnified by an increase in the use of 'crack' cocaine, which is several times more addictive that other forms of cocaine. Annual drug-related arrests have more than tripled since the 1970s.

Did You Know?

Surveys of Canadian high school students in 2003 produced some disturbing information:

- **20% of high school teens reported they had driven a vehicle while high on marijuana.**
- **23% of high school teens reported they had been passengers in vehicles driven by people who had been using drugs prior to driving.**

Source: www.madd.ca/english/news/pr/p06may30.htm

CRIME CASE STUDY 1.1: Drug-Imparied Driving – A Deadly Mix


Example


Take Notes

A Drug-Impaired Driving Tragedy

On the night of June 27, 1999, four vehicles carrying fourteen teenaged friends returning from an end-of-the-school-year party were involved in a multi-vehicle crash just outside Perth, Ontario. One of the four vehicles, driven by a 17-year-old male under the influence of marijuana, pulled into the oncoming lane to pass on a straight stretch of highway. It struck a pick-up truck towing a trailer with a car inside. The collision caused a multi-vehicle collision that killed five of the teenagers in the four cars and seriously injured the two occupants of the pick-up truck.

Detecting Drugs in a Driver

Perhaps surprisingly, motor vehicle collisions caused by drug-impaired drivers are thought to occur just as frequently as those caused by alcohol-impaired drivers. Detecting signs of drug impairment during traffic stops is much more complicated than detecting drivers impaired by alcohol. No roadside-screening device can quickly and accurately assist police officers to determine impairment by drugs. By comparison, alcohol impairment is relatively easy to detect with standard roadside testing procedures.

Although saliva and sweat can be tested for the presence of drugs, the highest concentration of the by-products of drug breakdown is contained in blood and urine. As a result, blood and urine are the most reliable body fluids to be analyzed. However, Canada has not yet enacted legislation to provide law enforcement officers with the authority to demand and seize such samples in cases of drug-impaired driving. In some Canadian jurisdictions, police officers are trained to seek voluntary tests from persons suspected of drug-impaired driving during impaired driving investigations. Law enforcement agencies in the United States benefit from "implied consent laws" that compel drivers to submit samples of their breath or blood in criminal investigations. In Canada, police officers currently rely on the cooperation

of suspected drug-impaired drivers. Police are unable to continue investigating should the suspect decline to participate. Canadian police officers, by law, cannot demand participation in drug-related field sobriety testing.

To get more drug-impaired drivers off the road, law enforcement agencies require accurate and portable roadside screening devices to test for drug impairment. The most common roadside drug screening devices are small hand-held single-use devices that are wiped in the mouth or on a suspect's skin. The devices test saliva and/or sweat for the presence of cocaine, marijuana, opiates, and amphetamines. These devices do not indicate how much of the drug has been ingested by the suspect. To confirm the presence and determine the actual quantity of a drug(s) in a suspect, urine or blood samples must be analyzed by a forensic toxicologist. Canadian police agencies do not use roadside drug-screening devices because no legislation allows for this type of evidence to be used in court. Also, these roadside drug screening devices are not 100% accurate. Because false positive results can occur, a blood or urine analysis by a forensic toxicologist is the only certain test.

Possible Changes to Drug-Impaired Driving Laws

Since 1999, the Canadian Government has been studying ways in which provisions of the Criminal Code relating to the investigation of drug-impaired driving can be strengthened.

Currently, police officers who conduct drug-impaired driving investigations rely upon a suspect's driving pattern, witness testimony, and informal methods of detecting signs of impairment exhibited by the suspect. Police officers do not have authority to make formal demands for urine or blood samples during drug-impaired driving investigations, except in very specific circumstances involving motor vehicle collisions involving injury to others. Only samples provided voluntarily by the accused can be presented as evidence in court.

In November 2006, the Government of Canada proposed to amend Canada's Criminal Code for the purpose of stricter control on drug-impaired drivers. Suggested changes could give police new powers to apprehend and test drivers suspected of drug impairment and increase penalties for such offences.

Did You Know?

In a 2005 study in Germany, 97.1% of the saliva and blood samples tested positive for drugs while only 82.4% of the urine samples from the same individuals tested positive for drugs. Of the cases with drugs detected in the blood or the saliva, 19.1% appeared not impaired. More persons with drug-positive urine samples appeared not impaired (32.7%). The data demonstrates that saliva appears to be superior to urine in correlating with blood sample results.

Source: Toennes *et al. Driving under the influence of drugs — evaluation of analytical data of drugs in oral fluid, serum and urine, and correlation with impairment symptoms.* Forensic Science International, 2005 Sept. 10; 152(2-3): 149-55.

New laws proposed by the federal government would provide police with the authority to conduct the following procedures during drug-impaired driving investigations:

1. Standardized Field Sobriety Tests administered at the roadside when there is a reasonable suspicion that a driver has taken drugs

2. Drug Recognition Expert (DRE) evaluations used when a police officer believes a drug-impaired driving offence has been committed (These evaluations would be administered at a police station and include examination of pupil size, observation of eye movement, standard sobriety tests, a physical examination including measurements of blood pressure and heart rate, and an interview with the suspect to gain additional information related to possible drug ingestion.)

3. A toxicological examination (i.e., sample of blood or urine) should the DRE officer identify that the impairment was caused by a certain class of drugs (The analysis of blood or urine is intended to support the findings of the initial DRE evaluation and would proceed only if reasonable grounds exists to make such a request.)

Refusal to comply with any of these demands would constitute a criminal offence, punishable in the same manner as refusing to comply with a demand for breath samples. Penalties for a first offence generally consist of a $600 fine and a brief licence suspension often concurrent with a suspension levied under provincial law. Second offences typically result in a higher monetary fine and possible jail time of up to 14 days. These penalties may increase if proposed amendments to federal legislation are passed in Parliament.

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Did You Know?

In 2003, alcohol and/or drugs were involved in 1257 fatalities, 47 181 injuries, and 161 299 property-damage-only crashes involving 245 174 vehicles. The total financial and social cost of these losses is estimated to be as high as $10.95 billion.

Source: G. Mercer. *Estimating the Presence of Alcohol and Drug Impairment in Traffic Crashes and their Costs to Canadians: 1999 to 2003.* (www.madd.ca/english/news/stories/n20061121gb.htm)

Related Questions: Crime Case Study 1.1 *(Note that this does not have to be submitted for marks.)*

1. Can the Breathalyzer device or Intoxilyzer device detect drugs? If no, state why.

2. List four body fluids that contain the by-products of drug breakdown.

3. What body fluids contain the highest concentration of the by-products of drug breakdown?

4. Explain why the evidence obtained from a roadside drug-testing device cannot be used to convict a suspected drug-impaired driver?

5. What would the drug-impaired driving legislation allow police officers to demand from a suspected impaired driver?

Check your answers in the Module 1 Appendix in the back of this book.

When you are ready, please complete the assignment for Lesson 1 in the Assignment Booklet.

Did You Know?

In a 1993 study completed in Memphis, Tennessee, 59% of the drivers who did not appear impaired by alcohol did test positive for drugs in a urine test. More than 13% of these drivers tested positive for cocaine, 50% tested positive for marijuana, and 18% tested positive for both drugs.

Source: Brookoff D, Cook CS, Williams C, Mann CS. *Testing reckless drivers for cocaine and marijuana.* New England Journal of Medicine, 1994, August 25; 331(8), p. 518-22.

Lesson 2: The Effects of Poisons and Toxins

Lesson Objective: ***The student will...***

- identify various types of poisons (such as *cyanide, carbon monoxide, arsenic, strychnine*) and their harmful side effects upon the human body

General Description of Poisons

Poisons are chemical compounds that can cause injury, illness, or death when sufficient quantities are absorbed into the body. They cause damage by inhibiting normal chemical reactions occurring in the body. Poisons can cause harm to the body through a single massive dose or after high levels accumulate over time. Poisons are most commonly absorbed through ingestion (eating) and inhalation (breathing).

Prompt treatment combats poisons, and treatments vary according to the specific type of poison absorbed. If a poisoning is not treated swiftly, permanent damage or death is possible. Organ damage caused by poisons is often repairable; however, when a poison targets the brain or spinal cord, damage is often permanent. Poisons that are ingested in large doses are usually identifiable by the very distinct symptoms that each causes. Poisons that are absorbed more gradually can be a problem to identify because their symptoms are similar, initially, to a wide variety of diseases.

Toxins are poisonous compounds produced in living organisms (such as substances released by certain mushroom species or released by bacteria that cause tetanus or botulism). Even at very low concentrations, toxins can typically affect humans and often are detectable using only sensitive analytical instruments. Some toxins have ***antidotes*** and others do not. Animal toxins are known as venoms, such as those from snakes, insects, or stingrays, which cause their effect through injection (sting or bite).

Did You Know?

Alberta's Poison Control Hotline: 1-800-332-1414

Examples of Venomous Animals: Snake and Stingray

© *photos.com*

Examples of Poisons

Hundreds of poisons exist. Symptoms caused by some well-known poisons such as carbon monoxide, arsenic, cyanide, and strychnine are described below. Note that these are only a few of the existing poisons. Criminal investigations involving poisoning do not necessarily involve only these types of poisons.

Carbon Monoxide: Carbon monoxide is one of the most common poisons in accidental or suicidal poisoning cases. Carbon monoxide (CO) is produced from the incomplete combustion of carbon based fuels and may be released into living spaces by defective gas appliances (such as ovens, furnaces, and heaters). When CO is inhaled, it prevents oxygen from attaching to the ***hemoglobin*** molecules within red blood cells. When excessive amounts of CO are absorbed, an individual ***suffocates*** to death because oxygen cannot reach the cells of the body. An obvious symptom of CO poisoning is the bright red appearance of the skin and internal organs.

Did You Know?

In September of 2006, Australian celebrity, Steve Irwin (The Crocodile Hunter), died suddenly at the age of 44 after being fatally pierced in the heart with the barbed, venomous stinger of a stingray's tail.

Human deaths due to stingray attacks are extremely rare because stingrays generally do not attack. Rather, they tend to swim away when threatened. Humans are usually stung in the feet after accidentally stepping on stingrays. When this happens, the stinger often breaks off causing an open wound, pain, and swelling from the venom in the stinger. Death from a stingray wound is rare because, despite the venom being a powerful nerve toxin that affects the heart, it is easily broken down by heat (such as most fish toxins). Therefore, initial treatment of a stingray wound is simply immersion in hot water for 30 to 90 minutes.

Sources: en.wikipedia.org/wiki/Steve Irwin/Stingray and www.elasmo-research.org/education/topics/lh_stingray_city.htm

Carbon monoxide poisoning by either hooking up a hose to the exhaust pipe of a car or running a car inside a closed garage used to be a common method of suicide. The amount of carbon monoxide produced in car exhaust is dependent on many factors. However, since the development of catalytic converters, the percentage of carbon monoxide in car exhaust has been greatly reduced.

Arsenic: Arsenic is a semi-metal (***metalloid***) found on the periodic table. It is used in various agricultural insecticides and as a material semiconductor in integrated electrical circuits. Arsenic ingestion causes multi-organ failure by interfering with ***ATP*** production, inhibiting ***enzyme*** and ***mitochondria*** activity, and increasing hydrogen peroxide production. The taste of arsenic is disguised easily by food. The symptoms of arsenic poisoning include nausea, stomach cramps, and burning in the throat. If a person is given small doses of arsenic over time, the effects may be mistaken for food poisoning.

Cyanide: Cyanide (CN) is any chemical compound that contains a carbon atom triple-bonded to a nitrogen atom. The CN group is found in many kinds of compounds that may be solids, liquids, or gases. Cyanides are used in mining, electroplating, photography, and the making of blueprints. They are also used in many insecticides. Cyanide is an enzyme-inhibitor; it breaks down an important enzyme in the mitochondria of cells, thereby preventing ATP production. Without the energy from ATP, body cells die. Cyanide tends to target cells in the brain, spinal cord, and heart – and causes quick death.

Strychnine: Strychnine is a colourless crystalline compound found in the seeds of a tree native to India. The most common use for strychnine is as a pesticide for rodents. Strychnine is both poisonous and very bitter. Only 1/50 of a gram can kill a person. Strychnine blocks important amino acid receptors in the brain and spinal cord causing intense muscle spasms throughout the body. When strychnine inhibits the activity in the ***medulla oblongata***, the victim's heart and lungs stop, resulting in death. When death occurs, ***rigor mortis*** sets in immediately regardless of the position of the victim. Typically, the victim's eyes remain wide open.

Did You Know?

In an average adult, a carbon monoxide blood saturation level greater than 50 to 60% will cause death. However, if an average adult has a blood-alcohol concentration level at 0.20%, a carbon monoxide blood saturation level as low as 35 to 40% will kill.

Source: Richard Saferstein, Ph.D: *Criminalistics—An Introduction to Forensic Science*. New Jersey: Prentice-Hall, Inc., 1998. (p.317)

The chart below identifies several additional common poisons and some of the symptoms caused by each.

Name of Poison	Related Symptoms
Acids (nitric, sulfuric)	Burns around mouth, lips, eyes and digestive tract
Lead	Weight loss, sluggishness, vomiting
Mercury	Brain damage, birth defects, death
Thallium	Diarrhea, abdominal pain, skin rash, abnormal heart beat

Did You Know?

The UN standard symbol for a poisonous substance is the Jolly Roger, or skull and crossbones (see below left). However, many companies consider this symbol negative for purposes of marketing. Therefore, in North America the symbol, Mr. Yuk (see below right), is replacing the Jolly Roger. Companies argue that the skull and crossbones symbol may attract children because of its association with pirates, but Mr. Yuk does not.

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AP/Ted S. Warren

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Incidence of Poisoning

Paracelsus, the father of toxicology (1493-1541), said, *"Everything is poison, there is poison in everything. Only the dose makes a thing not a poison."* Deaths due to poisonings do not always involve the consumption of a true poison. Rather, they may also be caused by the accidental or intentional overdose of a substance that is not even considered poison (such as Aspirin®, alcohol, or household cleaners).

The actual number of poisonings in North America is unknown because not all cases of poisonings are detected or reported. Approximately 2 million cases are reported voluntarily to poison control centres each year. About 700 deaths by poisoning are reported in North America each year. Children less than 6 years of age account for the majority of reported poisonings, most of which are accidental ingestion of household cleaners. In contrast, adults account for the majority of deaths by poisoning, most of which are intentional suicides rather than accidental or intentional poisonings.

Notice in Charts A and B on the following page that the type of poisons most frequently reported are not the same as the types of poisons most frequently causing death. The majority of reported poisonings (Chart A) are accidental overdoses that do not necessarily cause death. For example, a small child drinks some window cleaner left within his or her reach. Poisonings causing death (Chart B) are due to accidental overdoses or intentional suicides. Most suicides involve intentional overdoses of pain relievers (such as Aspirin® or Tylenol®), antidepressant drugs, or carbon monoxide. Other deaths due to poisons in Chart B are ordinarily the result of accidental overdoses.

Did You Know?

The poisonous gas, hydrogen cyanide (HCN), smells like bitter almonds. Because of inheriting a recessive genetic trait, approximately 40% of the population cannot smell hydrogen cyanide.

Source: en.wikipedia.org/wiki/Cyanide

CHART A: Most Frequent Causes of Reported Poisonings	CHART B: Most Frequent Causes of Death by Poisoning
1. Household cleaners	1. Antidepressant drugs
2. Aspirin® and Tylenol®	2. Aspirin® and Tylenol®
3. Cosmetics	3. Illegal non-prescription drugs
4. Cough and cold remedies	4. Cardiovascular drugs
5. Plant scrapes and insect bites	5. Alcohol
6. Pesticides	6. Carbon monoxide
7. Topical creams and lotions	7. Asthma therapies
8. Gasoline and kerosene	8. Industrial chemicals
9. Antibacterial soap	9. Pesticides
10. Sedatives and anti-psychotics	10. Household cleaners
11. Food poisoning	11. Anticonvulsant drugs
12. Alcohol	12. Food, plants, and insects

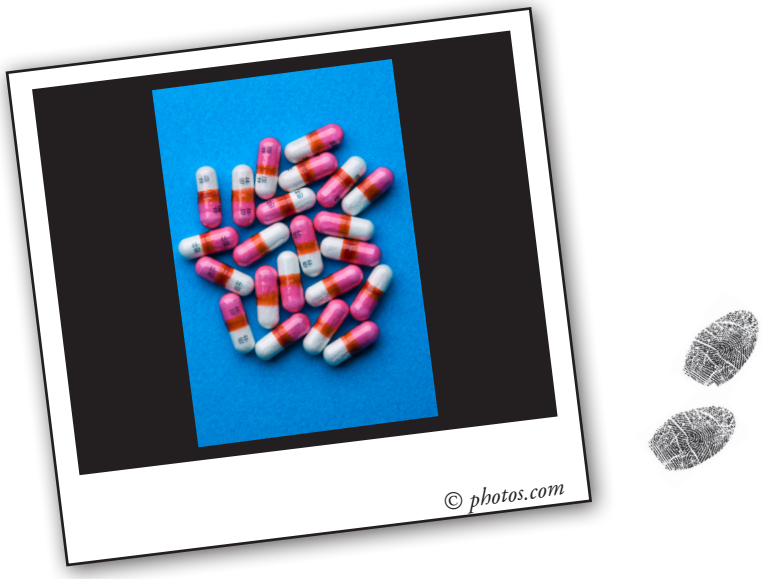
Homicides due to intentional poisonings are rare. Estimates indicate only 1% or less of all homicides are the result of poisoning. Two possible reasons for this are

- the most potent and easy-to-disguise poisons are not readily available to the average consumer
- intentional poisonings take much planning and preparation because the killer requires some knowledge of the precise amounts necessary of specific poisons to cause death

Did You Know?

During the 1904 Olympic Games, American Thomas Hicks collapsed after winning the marathon. Revival took several hours, but he survived. He later admitted to drinking brandy laced with strychnine believing this would help him win the gold medal.

CRIME CASE STUDY 1.2: The Tylenol® Murders



Example

The infamous Tylenol® murders occurred in 1982 when seven people in the Chicago area of the United States died after consuming Extra Strength Tylenol® capsules that had been laced with cyanide. This was the first known serial murder case caused by deliberate product tampering.

Take Notes

The Victims

On the morning of September 29, 1982, a 12-year-old girl who had a headache died after taking a single capsule of Extra Strength Tylenol®. On that same day, an adult male who had also taken a capsule of Extra Strength Tylenol®, died in hospital. The next day, two members of the male victim's family died, his brother and sister-in-law, after each taking a capsule from the same bottle. Between September 30 and October 1, 1982, three women all living separately but near Chicago died after taking capsules of Extra Strength Tylenol®.

The Police Investigation

After forensic toxicologists detected cyanide in each of the seven victims, they informed police investigators who soon discovered the *Tylenol®* link among the victims. Police then broadcast urgent warnings to the public through the media and by driving through Chicago neighbourhoods shouting warnings over loudspeakers.

Police determined that each of the five tampered Tylenol® bottles came from different factories. Therefore, the possibility of sabotage at the production stage in the factory was eliminated. Investigators supposed the culprit(s) had entered various stores in the Chicago area over several weeks and had tampered with bottles of Tylenol® by adding solid cyanide to some of the capsules within. The addition of the cyanide was likely done at another location because no witnesses ever came forward saying they had seen the tampering being done in any of the stores. After the culprit(s) added the poison to the capsules, he or she somehow

put the capsules into the bottles, placing the full, sealed bottles on store shelves. Then, as usual, people bought them. After a massive product re-call of Extra Strength Tylenol®, three more tampered bottles were discovered at various stores in the Chicago area.

The Company's Response

Extra Strength Tylenol® is a product of the company called *Johnson & Johnson*. When *Johnson & Johnson* was told of the poisonings of their product, it distributed warnings to hospitals and distributors, stopped all Tylenol® production, and suspended their advertising. *Johnson & Johnson* then issued a nationwide recall of all 31 million bottles of Tylenol® products.

After forensic investigators determined that only Tylenol® capsules were tampered with, *Johnson & Johnso*n offered to exchange all capsules purchased with solid tablets. In addition, the company offered a $100 000 reward for the capture and conviction of the "the Tylenol Killer".

About the time of the killings, the price of Tylenol® stock collapsed from $35 to $8, but it rebounded in less than a year. *Johnson & Johnson* soon reintroduced Tylenol® capsules in a new, triple-sealed package. Within several years, Tylenol® again became the most popular over-the-counter pain medication in North America.

Related Arrests

James W. Lewis was arrested after he contacted *Johnson & Johnson* telling them that he would stop the murders after he was given a large sum of cash. Later, investigators determined that Lewis was not responsible for the tampering, and that he was simply trying to extort money. James W. Lewis served 13 years of a 20-year prison term for this extortion attempt.

Police investigated Roger Arnold for the Tylenol® murders, but he was cleared of the killings. However, the intense media attention caused Arnold to have a mental breakdown during which he tried to kill the man he thought was responsible for turning him into the police. However, due to his confused mental state, Arnold killed a complete stranger. Roger Arnold was found guilty of second-degree murder and served 15 years of a 30-year prison sentence.

Conclusion

The Tylenol® serial murder case has never been solved but in a weird twist, in 2011, the FBI launched an investigation into Ted Kaczynski's (aka the Unabomber's) possible involvement in the 1982 murders. Ted Kaczynski is currently serving a life sentence for a series of homemade bombs that he sent through the mail that killed 3 and injured 23 people.

The Tylenol®murder case led to changes in the packaging of over-the-counter drugs and in federal anti-tampering laws in Canada and the United States. For example, all over-the-counter drugs now require tamper-proof safety seals. The Tylenol® murders also prompted drug companies to reduce the production of capsules because foreign substances such as poisons are easily placed inside capsules without obvious signs of tampering. Many drug companies have replaced capsules with solid tablets.

Related Questions: Crime Case Study 1.2 *(Note that the answers to these questions do not have to be submitted for marks.)*

1. What type of poison was added to the Extra Strength Tylenol® that killed seven people in the Chicago area in 1982?

2. Describe how investigators think the killer added the poison to various bottles of Extra Strength Tylenol® in this case.

3. Why were police investigators able to rule out the possibility that the poison was added to the Tylenol® capsules during their production?

4. Outline specifically how the poison used in this case causes death in a victim.

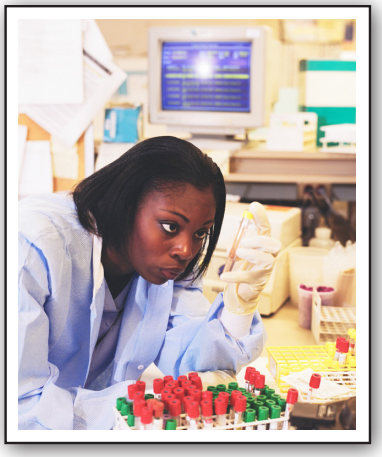
Check your answers in the Module 1 Appendix in the back of this book.

When you are ready, please complete the assignment for Lesson 2 in the Assignment Booklet.

Lesson 3: Forensic Toxicology Testing Techniques

Lesson Objectives: ***The student will...***

- understand the mechanics of various toxicological testing procedures used to screen for drugs or poisons (such as *colour testing, microcrystalline testing, immunoassay testing, and gas chromatography*)
- explain how the toxicological testing technique of mass spectrometry is used to confirm the presence of specific drugs or poisons within the human body



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The Role of Toxicology in Forensic Investigations

Forensic toxicologists have the task of identifying which drugs, toxins, or poisons an individual involved in a criminal investigation has in his or her system. This is a huge undertaking because of the thousands of drugs and poisons. On some occasions, police investigators supply the victim's symptoms, his or her personal effects, and empty drug containers to toxicologists to help them identify substances of interest.

Drug overdoses, alcoholic poisonings, and drug-impaired driving cases are the most common criminal cases involving forensic toxicology. However, forensic toxicologists are also involved in attempted homicide, homicide, and suspected suicide cases where intentional poisoning or drug overdose is suspected.

Did You Know?

Words are, of course, the most powerful drug used by mankind.

Source: Rudyard Kipling (http://quotes.prolix.nu/Drugs/)

Blood is the most common substance analyzed to identify the drugs and determine their concentrations in a suspect or victim, living or dead. Hair, saliva, sweat, and urine may be examined. Other organs and tissues examined for drugs include bone, brain tissue, liver tissue, and stomach contents.

© *photos.com*

Extraction of Drugs, Toxins, or Poisons

For a forensic toxicologist to determine the identity and quantity of drugs or poisons within an individual, the suspected substances must be extracted and isolated from the body fluid, organs, or tissues. The several procedures used to isolate and extract drugs and poisons involve acids and bases.

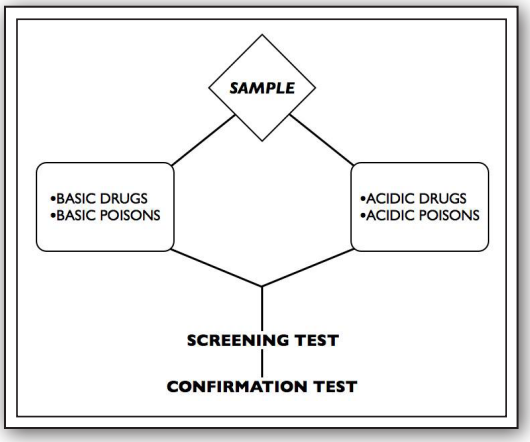
An ***acid*** is any substance that releases hydrogen ions (H+) when dissolved in water. A ***base*** is any substance that accepts hydrogen ions (H+) when dissolved in water. Most drugs and poisons are either acids or bases. For example, most barbiturates have a pH below 7; therefore, they are acidic. Most amphetamines have a pH above 7 and, therefore, are basic.

Did You Know?

Because he was only 42, the death of Elvis Presley on August 16, 1977, was a shock to the public. Forensic toxicologists determined that his death was due to an overdose of prescription drugs. Reportedly, ten drugs were found in significant quantities in his bloodstream. Whether this drug overdose was accidental death or intentional suicide is still unclear. Clearly, Elvis was addicted to prescription drugs. In 1977, for example, Elvis consumed more than 10 000 individual prescription pills—all prescribed by his personal physician.

During an acid-base extraction procedure, body fluids, tissues, or organs are placed in an acid solution and/or a base solution. Acidic drugs or poisons are easily extracted from an acid solution; basic drugs or poisons are easily extracted from a basic solution.

After these acid-base procedures are completed, the drug or poison is identified as an isolated sample. The isolated sample(s) then goes through a screening test and, finally, through a confirmation test.



Initial Screening for Drugs or Poisons

After an isolated sample has been collected by a forensic toxicologist, it is then screened to identify any drugs or poisons such as alcohol, marijuana, or arsenic. Common toxicology screening techniques include colour testing, microcrystalline testing, immunoassay testing, and gas chromatography.

Colour Testing

Colour testing is a fast and simple technique used to determine if an individual has drug or poison in his or her system. This technique narrows the type of drug or poison present. However, colour tests exist for only certain substances, and they cannot indicate the quantity of the suspected substance. Because of this, colour testing is always followed by a confirmation test.

Did You Know?

Since 1999, Toronto-Dominion (TD) Bank is the only private company (besides bus and trucking companies) in Canada that gives drug tests to all its new employees. According to the TD Bank, "...drug testing is necessary to safeguard bank, customer and employee funds and information as well as to protect the bank's reputation.".

Source: Nancy Holmes. *Drug Testing: Legal Implications*. Government of Canada website: http://dsp-psd.communications.gc.ca. November 1999, (p. 7).

In one type of colour testing, a small test strip is dipped into a urine sample. The strip changes to a specific colour when exposed to a certain drug or poison. In another colour testing technique, certain chemicals are combined with an isolated sample. A reaction that causes a colour change indicates the presence of a certain drug or poison. In the Marquis colour test, an isolated sample combined with a formaldehyde and sulfuric acid solution turns purple indicating opiates in the isolated sample.

Microcrystalline Testing

In this technique, a small amount of an isolated sample is combined with a specific chemical reagent. If a certain drug or poison is present, a chemical reaction occurs, producing a ***crystalline precipitate***. The crystalline structure and colour vary according to the drug or poison being tested. After the precipitate has formed, it may be analyzed under a microscope to confirm its identity.

Microcrystalline testing can be more accurate than colour testing. However, like colour testing, it does not indicate the quantity of the suspected substance. Also, microcrystalline tests can test for only certain substances such as cocaine and methamphetamines. Because of this, microcrystalline testing is always followed by a confirmation test.

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Immunoassay Testing

Immunoassay testing identifies and measures the level of a drug or poison in an isolated sample. It uses the chemical reactions of ***antibodies*** to their specific ***antigens***. Immunoassay testing is common because it is able to detect and accurately determine the concentration of the drug or poison in an isolated sample.

Antibodies for drugs and poisons are produced in animal test subjects by combining the drug or poison with a protein to produce a drug-protein complex. Then, this is injected into the animal where it is perceived by the animal's immune system as an antigen. Consequently, the animal's immune system produces specific antibodies against this complex. Then, these antibodies are collected from the blood of the animal and used in immunoassay testing.

For example, the breakdown-products of marijuana are combined with a protein and then injected into an animal test subject. Antibodies of this THC-complex are created and collected from the animal's blood. These THC antibodies are then added to an isolated sample. If marijuana is in the sample, the THC antibodies react. If no marijuana is in the sample, the antibodies do not react. If THC antibodies do react, then estimating the number of THC antibodies that react determines the quantity of marijuana in the sample. To determine the quantity of antibodies that react, they must be labelled either with an ***enzyme*** (enzyme immunoassay technique, or EIT) or a ***radioactive isotope*** (radioimmunoassay, or RIA).

Some organic substances have similar chemical structures to certain drugs and poisons. As a result, these may react with the immunoassay antibodies to produce a false positive result. Because of this, immunoassay testing is always followed by a confirmation test.

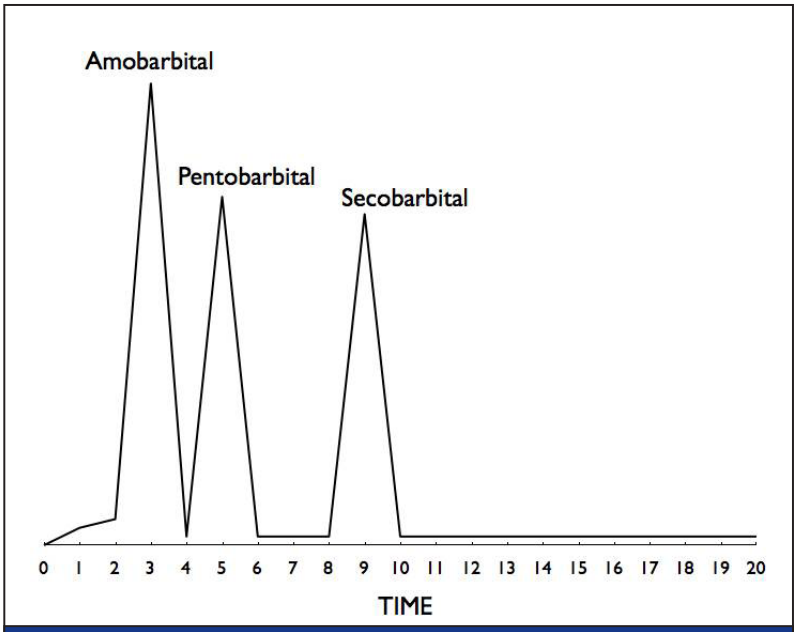
Gas Chromatography

Gas chromatography separates an isolated drug or poison sample into its distinctive component chemical parts. Gas chromatography is common because it is highly accurate and any complex sample is separated in only a few minutes. The basic steps involved in the gas chromatography technique include the following.

1. The isolated sample is placed in a heated injection chamber.
2. Small amounts of the isolated sample and some nitrogen gas are injected into narrow, coiled glass or stainless steel tubing that is 2 to 6 metres long. The inside of the tubing contains a thin film of liquid.
3. As the isolated sample passes through the tubing, its components are separated because they diffuse at different rates into the liquid.
4. By the time the isolated sample reaches the end of the tubing, its components are completely separated.
5. The individual components of the isolated sample enter a detector. This detector generates a series of electrical signals that produce a chromatogram.

A standard chromatogram is a graph with a series of peaks that correspond to the individual chemical components of a substance (see diagram on the next page). Each drug or poison creates a predictable and distinctive peak or series of peaks that emerge at predictable times. Therefore, each can be identified easily in a chromatogram. The quantity of the individual drug or poison corresponds to the height of the peak(s) on the chromatogram. Thus, the higher the peak(s), the higher the concentration of drug or poison within the individual sample.

Because some organic substances have similar chemical structures to certain drugs and poisons, similar chromatograms may be produced by organic substances and the drugs. Therefore, false positive results are possible. Because of this, gas chromatography is always followed by confirmation testing as is immunoassay testing.



EXAMPLE CHROMATOGRAM OF THREE TYPES OF BARBITURATES

Confirmation Testing for Drugs, Toxins, or Poisons

After the identification and possible quantification of a drug or poison is completed through a particular screening test, a confirmation test will either reinforce or ***refute*** these results. The most common device used by forensic toxicologists is the mass spectrometer.

In order to get a confirmation from a mass spectrometer analysis, the drug of interest must first be isolated. If the sample has already been analyzed using gas chromatography, the drug and/or its metabolites have already been separated from one another so it makes sense that gas chromatography and mass spectrometry are often used in conjunction with one another. Once an isolated sample has been separated into its components by gas chromatography, those components are sent one by one into a mass spectrometer where they are analyzed individually.

Did You Know?

Both cocaine and marijuana can be detected in the bloodstream up to three days after a single dose has been ingested.

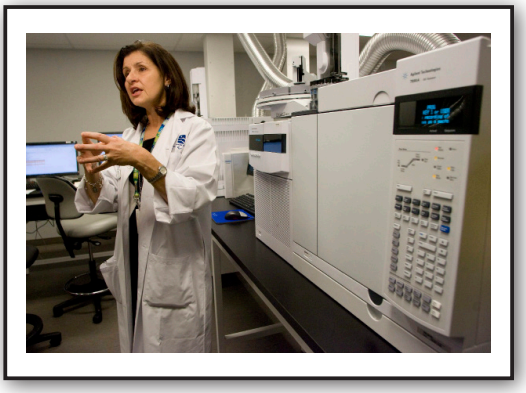
Source: Fact Sheet: Drug Testing in the Criminal Justice System. US Department of Justice: Drugs and Crime Data, March 1992.

Mass Spectrometry

In a mass spectrometer, a beam of high-energy electrons is directed towards the isolated sample. The electrons collide with the molecules in the isolated sample, causing them to lose electrons and become positively charged ions. These positively charged ions are unstable and break into fragments that pass through a magnetic field where they produce a unique 'fragmentation pattern' according to their individual masses. No two substances break into fragments in the same way because their chemical composition is unique. These results are then recorded and stored by a computer. Each fragmentation pattern is then compared to a database of known drug, toxin, and poison fragmentation patterns, and a match is determined.

Every drug or poison produces a distinct fragmentation pattern according to its unique individual chemical structure. No two patterns are exactly alike. Because of this, the results of mass spectrometry are highly accurate. Mass spectrometry is an excellent way to confirm the presence of a particular drug or poison.

The Mass Spectrometer Used to Test Samples from Athletes at the 2010 Vancouver Olympics



The Canadian Press/Richard Lam

Did You Know?

Alcohol and cocaine account for 90% or more of all the toxic agents encountered by forensic toxicologists in a typical toxicology laboratory.

Source: Richard Saferstein, Ph.D: *Criminalistics — An Introduction to Forensic Science*. New Jersey: Prentice-Hall, Inc., 1998. (p. 313)

CRIME CASE STUDY 1.3: The Poisoning of a Russian Secret Service Ex-Agent

Alexander Litvinenko, former KGB spy and author of the book ***Blowing Up Russia: Terror from Within*** *2002 (AP/ Alistair Fuller)*

Alexander Valterovich Litvinenko was an ex-***KGB*** agent and ex-***FSB*** lieutenant colonel. After working in those services for many years, he made accusations that his superiors had ordered the assassination of Russian billionaire Boris Berezovsky, who had close ties with former Russian President Boris Yeltsin. After these public accusations, Litvinenko was fired from the FSB in 1998 and arrested in 1999. He was charged with abusing his power while in command during a FSB anti-terrorism operation. After a month in prison, he was released. He signed an agreement that he would not leave Russia.

In 2000, Litvinenko illegally left Russia for Turkey where he met his wife and son. Later that same year, the Litvinenko family left Turkey for the United Kingdom where they claimed political asylum. In 2002 and 2003, he published two books in which he severely criticized Russian President Vladimir Putin and his government. In his first book, Litvinenko alleged that FSB agents were involved in a 1999 bombing of an apartment block that killed more than 300 people. Russian officials blamed the explosions on Chechen separatists. They confiscated over 4000 copies of Litvinenko's first book in Moscow before they could be sold. In his second book, Litvinenko alleged that President Vladimir Putin, during his time at FSB, was personally involved in organized crime.

On November 1, 2006, after meeting with two former KGB agents, Litvinenko suddenly fell ill and was hospitalized. The report is that he met these agents to discuss details concerning the October 2006 killing of Anna Politkovskaya, a controversial Russian journalist who had written articles critical of President Vladimir Putin and his government.

Initial screening tests by forensic toxicologists suggested that Litvinenko was poisoned by radioactive thallium. Thallium was a common ingredient in rat poison, but its use was banned in the 1970s. Thallium is colourless, odourless, and water-soluble. Among the distinctive effects of thallium poisoning are hair loss and damage to peripheral nerves.

However, confirmation testing of these results did not reinforce the screening test results that Litvinenko was poisoned with thallium.

On November 23, 2006, Alexander Litvinenko died in the London hospital where he was being treated. Forensic toxicologists from the Health Protection Agency in the United Kingdom established that Litvinenko died after being poisoned with the ***radioactive isotope*** polonium-210. The poison had either been eaten or inhaled by Litvinenko.

The radioactive isotope, polonium-210, does not naturally occur in significant quantities. Its only known source is artificial production in a specialized nuclear reactor. Polonium-210 is used in photographic anti-static brushes, as a heat source to power thermoelectric cells in manmade satellites, and as a heat source to prevent the internal parts of lunar vehicles from freezing.

The use of polonium-210 as a poison had never been documented officially before. When absorbed in humans, polonium-210 causes hair loss, nausea, spleen damage, and liver failure. Without a working spleen, the human body has difficulties fighting infection, but an individual can live without a spleen because the liver and lymphatic system compensate for its absence. However, if a person's liver fails, he or she will die within 24 hours because the body is unable, among other things, to regulate blood sugar, to break down fats or old red blood cells, and to produce blood proteins.

Alexander Litvinenko dying in hospital, November 20, 2006

Image courtesy of flickr user nbackline

Police investigators found traces of polonium-210 at Litvinenko's home, at a London hotel that Litvinenko visited before he became ill, and at a sushi restaurant where he ate on November 1. Forensic scientists and police investigators traced the source of the polonium used to poison Litvinenko to a nuclear power plant in Russia. Then, in December 2006, police investigators found traces of polonium-210 on two British airplanes that had flown between London and Moscow. The announcement about the source of the polonium and the presence of polonium on the airplanes has lead many to suspect that the murder of Alexander Litvinenko was coordinated by an individual or a group of individuals in Russia. At time of writing, this criminal case remains unsolved.

Did You Know?

In highly decomposed bodies where common sample tissues such as blood, hair, or other tissue may no longer be available, the fluid inside the eyeballs (called vitreous humour) may be analyzed for drugs or poisons.

Related Questions: Crime Case Study 1.3 *(Note that the answers to these questions do not have to be submitted for marks.)*

1. Explain one reason the initial screening of Litvinenko indicated that he had been poisoned with radioactive thallium rather than polonium-210.

2. What specific poisoning symptom caused Alexander Litvinenko to die?

3. What is the likely source of the unusual poison used to kill Alexander Litvinenko?

Check your answers in the Module 1 Appendix in the back of this book.

When you are ready, please complete assignment for Lesson 3 in the Assignment Book.

Lesson 4: Crime Case Studies Involving Forensic Toxicology

This lesson focuses on three criminal case studies that involve forensic toxicology. Two of the case studies entitled *The Poisoning of a Politician* and *The Jonestown Tragedy* are based on actual events. The last criminal case study entitled *Murder or Suicide—That is the Question* is fiction.

You are expected to answer related questions about these criminal case studies in your assignment booklet.

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Lesson Objectives: ***The student will...***

- complete a research project or case study based upon a historical criminal case that involves the use of forensic toxicology

Did You Know?

In December 1984 in Bhopal, India, more that 40 tonnes of methyl isocyanate, a poisonous gas, were accidentally released by a pesticide factory. More than 2000 people were killed and more than 4000 were injured.

CRIME CASE STUDY 1.4: The Poisoning of a Politician

Left - **July 2004 (before dioxin poisoning),**
Right - **November 2004 (after dioxin poisoning)**
Images courtesy of Associated Press

Viktor Yushchenko

Example

Background

Viktor Yushchenko was an accountant and economist appointed head of Ukraine's national bank in 1993, shortly after the country gained independence from the former Soviet Union. From 1999 to 2001, Yushchenko was Prime Minister of the Ukraine. In 2004, he ran for the office of President.

Take Notes

On September 5, 2004, Viktor Yushchenko had dinner at the home of the head of Ukraine's Security Service. The next day, he experienced severe abdominal pains and vomiting. After several days of no improvement and barely able to walk, Yushchenko was rushed to a medical clinic in Austria where doctors discovered that his liver, pancreas, and intestines were swollen and damaged. After several days in hospital in Austria, Yushchenko returned to the Ukraine to continue campaigning in the presidential election. During this campaign, Yushchenko used painkillers heavily to help him deal with his discomfort.

In November 2004, his opponent, Yanukovych, won the election, but when the election appeared to be fraudulent, a re-vote was conducted in December 2004. The pro-Western Yushchenko won this second election by a narrow margin of roughly 52% to Yanukovych's 44%. When Yanukovych contested the results, the Ukraine's Supreme Court ruled that the results of the second vote would stand. Viktor Yushchenko was inaugurated as President of the Ukraine on January 23, 2005.

Description of the Poison

Forensic toxicologists confirmed that dioxin was the poison that caused Viktor Yushchenko's ailment. He had 1000 times the normal concentration of dioxin in his blood. His initial severe abdominal pains suggested that the poison had been placed in his food.

Dioxins are highly toxic chemical compounds produced in small concentrations when ***organic*** substances are burned in the presence of chlorine. Dioxins are by-products of factories that use chlorine in the cleaning and manufacturing of paper, textiles, pesticides, and plastics. Major sources of dioxins are coal-fired utilities, metal smelters, diesel trucks, and the burning of wood treated with preservatives. Dioxins are also in cigarette smoke from cigarettes that contain chlorine-based pesticides or chlorine-bleached paper. Because dioxins are found in a wide range of common substances (such as food packaging, tampons, etc.), all people receive small doses of dioxins. However, relatively small doses do not seem to pose health hazards.

One of the most obvious symptoms of dioxin poisoning is *chloracne*, a condition of painful blisters that cause the face to be swollen and greyish colour. Chloracne is not harmful to a person's overall health, but it does make the victim appear much older. Other immediate symptoms of dioxin poisoning include nausea, vomiting, and abdominal pain.

The long-term effects of dioxin poisoning include cancer, liver damage, reproductive organ damage, diabetes, and heart disease. Doctors predict Yushchenko's damaged liver will return to normal functioning, but because dioxins remain in the body for long periods, some of the long-term effects of dioxin poisoning could appear later in his life.

Conclusion

Viktor Yushchenko's supporters accused his political opponent, Viktor Yanukovych, of the poisoning, claiming that the Russian government was responsible for supplying the dioxin. Yanukovych and his supporters have denied any involvement. After Yushchenko was elected, he announced he would provide proof that his political opponent had tried to assassinate him. To date, this proof had not been revealed by Yushchenko or his supporters.

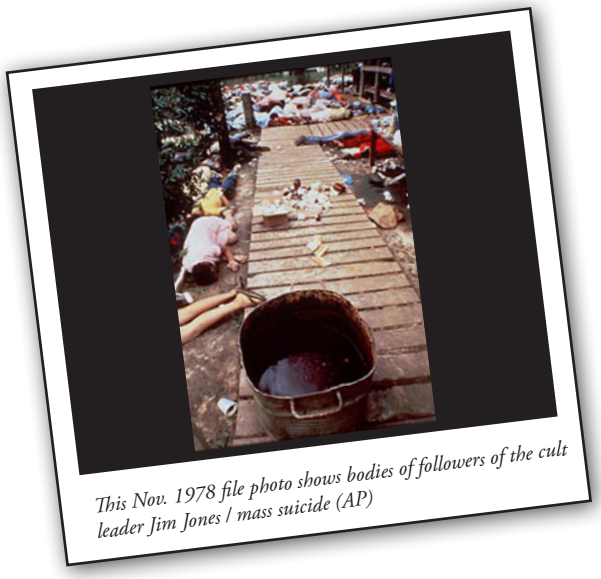
An investigation by the Ukrainian Security Service and the Ukrainian Prosecutor-General's Office has not identified the culprit(s) responsible for the poisoning of Viktor Yushchenko.

Use the above information from this case study to answer the questions in your Assignment Booklet.

Did You Know?

Russian authorities have been criticized for using toxic gases such as those containing sleep-inducing agents. During a 2002 hostage crisis in which Chechen rebels held more that 600 Russian theatregoers, the majority of the deaths from the crisis were due to a toxic gas released by Russian authorities into the theatre.

CRIME CASE STUDY 1.5: The Jonestown Tragedy



This Nov. 1978 file photo shows bodies of followers of the cult leader Jim Jones / mass suicide (AP)

Example

A notorious incident of mass suicide and mass murder involving the use of poison occurred in 1978 in the communal settlement of Jonestown, Guyana, located between Venezuela and Brazil, South America. Founded in the mid-1970s by charismatic cult leader Jim Jones, the commune existed for only a few years. Then, 913 people in the commune died in an act of mass suicide and mass murder on the evening of November 18, 1978.

Take Notes

Background: Jim Jones

James Warren "Jim" Jones was an ordained minister who moved his congregation from Illinois to California in 1965, settling near San Francisco in 1971 where Jones began the People's Temple, a religious cult. In 1974 and for various reasons, Jones decided to build his version of a perfect religious society in Guyana where he would be free from intervention by people who were concerned about family members who had joined his cult.

In 1974, Jones leased about 12 square kilometres of jungle in Guyana and personally oversaw the construction of a small commune that by 1978 became home to more than 1000 followers. Far from the original promise of socialistic paradise, Jonestown became known as a despicable form of indulgence for Jones. He reportedly tortured followers for minor infractions and regulated food supplies as a further means of control.

Jim Jones, the founder of Jonestown
Jim Jones, who founded the Peoples Temple in San Fransisco (RNS)

Various forms of indoctrination were practised including what became known as white nights—tests of loyalty and faith in Jones' leadership that involved drinking Kool-Aid® that followers were tricked into believing contained poison. Everyone who drank the mixture survived and was honoured. Those who refused were shamed into future acts of compliance as signs of their faith in Jones. In effect, Jim Jones was conducting rehearsals for a mass suicide that he referred to as "revolutionary suicide".

Flashpoint

Acting upon allegations of human rights abuses and the possibility that people were being held in Jonestown against their wills, Leo Ryan, a US Congressman, flew to Guyana on November 14, 1978. A contingent of media representatives as well as family members of some of the residents of Jonestown accompanied him to the commune the night of November 17. By the morning of November 18, several people had asked to leave with Ryan and return to the United States. This greatly upset Jones who nevertheless allowed Ryan, his entourage, and several defectors to go to the airport.

Shortly before take-off, a violent ambush occurred. Nine armed men fired numerous rounds, killing Congressman Ryan, three journalists, and a person who was trying to defect. Twelve other people accompanying Ryan, media representatives, and defectors were wounded, several of them seriously. All the injured were left at the airport where they lay until morning when they were rescued by the Guyanese government.

The Mass Poisoning

After the airport ambush, the gunmen returned to Jonestown where, on the evening of November 18, Jim Jones organized another *white night*. This time, however, the grape-flavoured *Kool-Aid*® was actually spiked with poison. Forensic toxicologists determined that the poison was potassium cyanide and that the painkilling drug Valium® was added to the *Kool-Aid*®. Convinced that American-sponsored Guyanese soldiers would soon slaughter them anyway, all the followers loyal to Jones ensured that the entire commune lined up to participate in this mass suicide. Children were forced to go first; grieving parents soon joined them.

The Poison

Potassium cyanide (KCN) is a colourless crystalline compound similar in appearance to sugar and highly soluble in water. KCN smells like bitter almonds and is highly toxic. KCN inhibits the production of ATP in the cells by blocking ***cellular respiration*** in the mitochondria. Cyanide poisoning causes a red facial complexion in the victim because the tissues are unable to use the oxygen in the blood.

More that 200 mg of potassium cyanide ingested results in loss of consciousness in ten seconds to several minutes depending on the body's immune system and the amount of food in the stomach. After about 45 minutes, the body convulses and then goes into a ***coma***. If not treated, the person then has a heart attack and dies within two hours.

The Aftermath

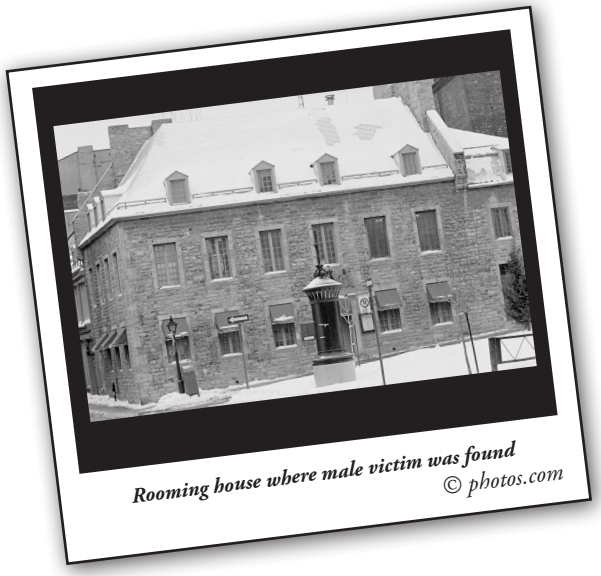
That night in Jonestown, 913 people, including 276 children, died of cyanide poisoning. Loyal followers of Jim Jones murdered perhaps more than 100 who tried to resist. Jones was found dead of a gunshot wound to the head—thought to have been self-inflicted. Only a few autopsies were conducted. Jonestown was abandoned by the few remaining members; it was destroyed by fire in 1983. Today, *Jonestown* is one of the most notorious mass suicides and mass murders in history.

When you are ready, please complete the assignment for Lesson 4 in the Assignment Booklet.

Jonestown, November 1978

Photo courtesy of AP

CRIME CASE STUDY 1.6: Drug Overdose or Intentional Poisoning - That is the Question



Rooming house where male victim was found
© photos.com

Late one evening, a tenant of a three-storey rooming house called police. The tenant had discovered the body of a 26-year-old male when he entered the man's suite to borrow some cigarettes. The male subject, known to police as a low-level drug dealer who frequented the seedier parts of the downtown core, appeared as if he had died of a drug overdose.

After police arrived and sealed off the subject's suite, they noticed that the subject's eyes were wide open and that *rigor mortis* had already set in. The subject's legs and left arm were oriented at strange angles—almost perpendicular to his torso. That the subject had thrashed about the room during his last moments or that he had been involved in a struggle seemed evident.

Police found several marijuana cigarettes, residue from what appeared to be crack cocaine, and two empty bottles of prescription barbiturates scattered around the subject's body.

A suicide note was found nearby (sample evidence #1). Unfortunately, police were unable to find a suitable writing sample from the subject. Consequently, the authorship of the note could not be confirmed. In addition, an empty bottle of rat poison was found in a dumpster outside the rooming house. No fingerprints were found on the bottle.

While canvassing other tenants in the rooming house, police spoke with an acquaintance of the subject who mentioned that two unidentified males who seemed to think that the subject had cheated them in a drug deal had recently threatened him. A thorough search of the subject's one-room suite by police produced a used syringe from a garbage can in the suite.

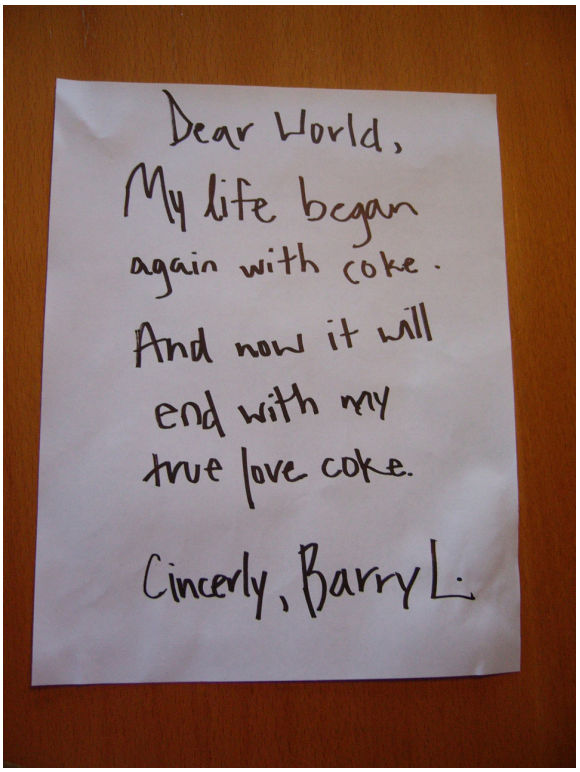
Dumpster outside rooming house

© photos.com

To determine the cause of death, an autopsy was conducted by the medical examiner who noted a small puncture wound in the subject's right upper arm. A forensic toxicologist made a chromatogram (sample evidence #2) from a sample of the victim's blood.

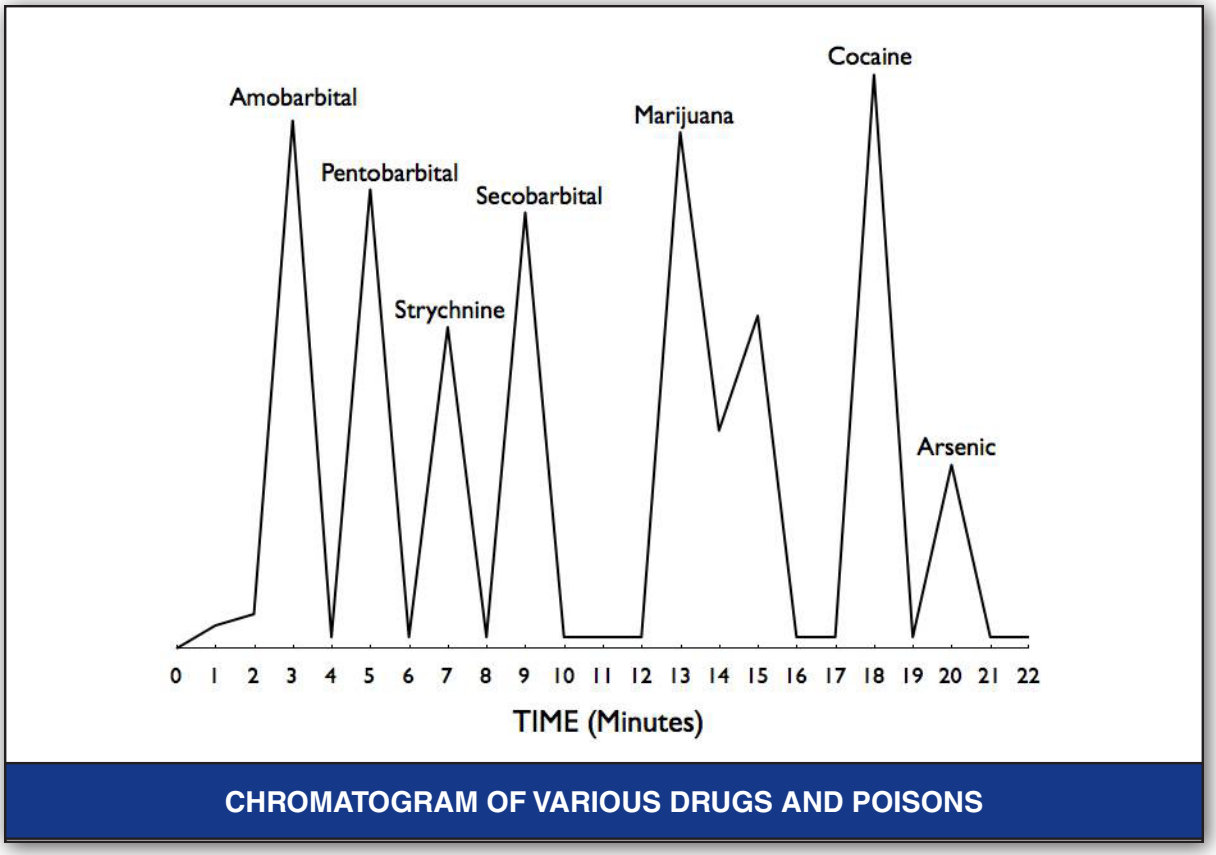
Assignment

Use the above information and the following three images from this case study to answer the questions in your Assignment Booklet.

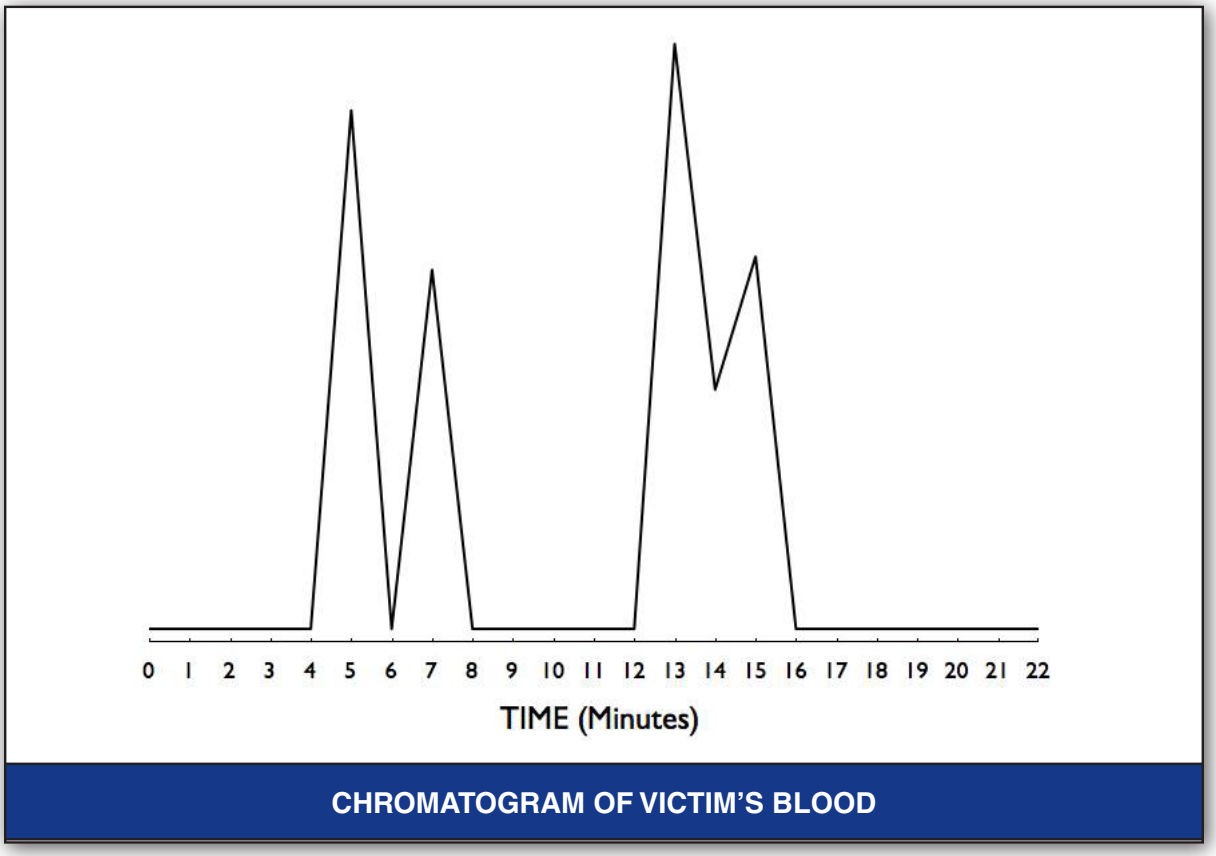


SAMPLE EVIDENCE #1: Suicide Note

Image courtesy of Audri Kowalyk



CHROMATOGRAM OF VARIOUS DRUGS AND POISONS



CHROMATOGRAM OF VICTIM'S BLOOD

Forensic Studies 35

LDC 3569

Module 2

Law Enforcement Protective Equipment and Police Canines

LEARNING ANYTIME ANYWHERE

Alberta Distance Learning Centre

Module 2: Law Enforcement Equipment and Police Canines

A police officer's typical equipment belt
Sergeant A. Kowalyk, Edmonton Police Service

A puppy that will be trained to become a police service dog
Edmonton Police Service

Overview

Catching "bad guys" involves elements of danger and risk. Therefore, police officers carry various equipment to protect themselves and the public. Over the years, science has been involved, both intentionally and unintentionally, in the development of some unique equipment used by law enforcement officers today.

The search for durable fibres to strengthen car tires, an initial goal of chemists, led to the creation of Kevlar. This material was subsequently used in bullet-resistant vests during the Vietnam War, a concept later adopted by police officers, saving many lives in the process.

The Conducted Energy Device (CED), commonly referred to as the *Taser*, is a recent invention that has helped officers apprehend violent and aggressive persons without having to resort to the use of deadly force. Pepper spray and tear gas are also used, both effective in subduing unruly crowds.

Dogs that work in law enforcement are commonly referred to as police canines. The primary function of these specially trained dogs is to provide support to police officers working on the street by tracking and "chasing down" suspected criminals who try to flee police. Police canines and their handlers respond to many types of crimes, often those involving suspects who have fled on foot or who have tried to hide in enclosed spaces such as buildings or containers. Some police departments also use narcotic detection dogs trained to detect the presence of illegal drugs. Also, explosive detection dogs are used to detect explosives hidden from view.

- Lesson 1 examines the properties of bullet-resistant vests and Conducted Energy Devices (CED) and how both have saved the lives of law enforcement officers.
- Lesson 2 discusses the molecular components of pepper spray and tear gas and how each is used by police officers.
- Lesson 3 explains how police canines are trained and used in various areas of law enforcement.
- Lesson 4 examines the details of two historical crimes that involve law enforcement safety equipment and police canines.

Module Learner Objectives

By the end of Module 2, you should be able to…

- understand that bullet-resistant vests are made from the synthetic polymer, Kevlar
- identify five distinct molecular traits of Kevlar, and explain how these traits help to make Kevlar resistant to bullets
- describe how the conducted energy device (also called *CED, taser gun, or electroshock weapon*) functions, and explain the practical use of this device by police officers
- identify the molecular ingredients of pepper spray, and describe the physiological effects of pepper spray upon the human body
- describe the practical use of pepper spray by police officers, and identify any advantages and/or disadvantages of this substance
- identify the molecular ingredients of tear gas, and state the physiological effects of tear gas upon the human body
- describe the practical use of tear gas by police officers and identify any advantages and/or disadvantages of this substance
- discuss a historical crime case(s) that involved the use of law enforcement safety equipment
- appreciate the value of police canines in criminal investigations
- describe the various types of law enforcement canines, such as *tracking, narcotic detection, bomb detection, search and rescue,* and *combat* canines
- identify the most common dog breeds used for law enforcement, and explain the reasons these breeds are used
- describe the training of one type of police canine
- explore a historical crime case(s) that involves the use of police canines

Lesson 1: Bullet-resistant Vests and Conducted Energy Devices

Lesson Objectives: ***The student will...***

- understand that bullet-resistant vests are made from the synthetic polymer, Kevlar
- identify five distinct molecular traits of Kevlar, and explain how these traits help to make Kevlar resistant to bullets
- describe how the conducted energy device (also called CED, taser gun, or electroshock weapon) functions, and explain the practical use of this device by police officers

Sergeant A. Kowalyk, Edmonton Police Service

Did You Know?

Bullet-resistant vests have saved the lives of more than 2000 police officers since the 1970's.

Body Armour

Bullet-resistant vests are a type of body armour. Body armour is of two main categories: hard body armour and soft body armour.

Medeival Knights Wore Hard Body Armour

© *photos.com*

Medieval knights wore hard body armour made of heavy metal chain and steel plates. These suits of armour helped to deflect blows from weapons such as swords, lances, and axes. Current forms of hard body armour include heavy steel or ceramic plates set within bullet-resistant vests. These rigid "trauma plates" deflect edged weapons and many types of bullets that normally pierce soft body armour. Such forms of hard body armour help to absorb and dissipate tremendous amounts of kinetic energy delivered by the impact of a high-power rifle bullet or the focused energy of the tip of a knife. In general, hard body armour offers more protection than soft body armour; however, it is impractical for daily use by police officers because it is heavy and inflexible, restricting movement.

Hard Body Armour Vest Used By Military Personnel

©*Thinkstock*

Bullet-resistant vests, also referred to as soft body armour, are constructed of many layers of bullet-resistant fabric of specialized fibres. Soft body armour absorbs the impact of a bullet, diffusing the force of the impact and thereby preventing penetration. It does not cause bullets to ricochet. Modern bullet-resistant vests are durable, lightweight, and flexible, making them ideal for police officers on the street.

A Single Layer of Kevlar Fabric

Sergeant A. Kowalyk, Edmonton Police Service

Description of the Bullet-resistant Vest

A bullet-resistant vest covers the user's mid-to-upper torso region and provides protection from most common low-velocity and medium-velocity handgun bullets. When a handgun bullet strikes the front or "face" of a bullet-resistant vest, the bullet is caught in a criss-cross 'network' of very strong ***synthetic*** fibres, the first generation of which was developed under the trade name *Kevlar*. These fibres absorb and disperse the kinetic energy of a bullet, which causes the bullet to deform or 'mushroom' as it impacts the multiple layers of resistant material. Some kinetic energy of the bullet is absorbed by each of the many layers of bullet-resistant material in the vest until the bullet has expended all its kinetic energy and comes to rest. Most of the surface area of soft body armour is involved in absorbing the impact of a bullet. Consequently, absorption occurs as an even distribution of energy throughout the "strike face". This helps to reduce blunt force trauma to the user's internal organs, which can result if sufficient kinetic energy is transferred into the soft body armour. The use of trauma plates can further reduce the potential for blunt force trauma.

Did You Know?

The oldest soft body armour was made from 18 to 30 layers of silk and protected users from arrows and spears. A bullet-resistant vest made of silk fabric in the United States in the late 1800s could stop relatively slow-moving bullets fired from black powder handguns. Such vests were very expensive because they were made from silk, approximately US$15 000.

Mushroomed Bullet

Kevlar fibres absorb and disperse the kinetic energy of a bullet, which causes the bullet to deform or 'mushroom' as it contacts multiple layers of resistant material. *Edmonton Police Service*

The Invention of Kevlar

Kevlar was first invented in Wilmington, Delaware in 1964 by a chemist named Stephanie Kwolek. Born in Pennsylvania in 1923, she earned a Bachelor of Science degree in chemistry in 1946. In 1950, she began working at a new *Dupont* research laboratory where she conducted low-temperature experiments in the preparation of polymers for the creation of highly rigid and strong petroleum-based fibres. Kwolek created a solvent that caused unstable intermediates from these experiments to polymerize or bond into long chains or branched structures. When placed under these conditions, Kwolek's polymers formed a cloudy fluid in contrast to the clear and ***viscous*** fluid of most polymers. She was able to spin this cloudy fluid into incredibly strong fibres that were eventually patented and marketed in 1971 under the brand name Kevlar.

Original Bullet

The bullet, prior to being fired into a Kevlar vest, would have looked very similar to the copper bullet at the end of this cartridge. *© photos.com*

Bullet in Bullet-Resistant Vest

Having been fired into a bullet-resistant vest, a bullet is deformed and leaves an impression in the Kevlar. *Sergeant A. Kowalyk, Edmonton Police Service*

Did You Know?

Kevlar's structure consists of relatively rigid molecules, which tend to form sheet-like structures that have similarities to silk proteins.

Molecular Traits of Kevlar

Bullet-resistant vests are made from a ***synthetic*** polymer known as Kevlar. A polymer is a natural or fabricated molecule formed by combining single units, called monomers, into long chains. Other common synthetic polymers include Lycra, nylon, polyester, and Teflon.

Kevlar is so strong because of five distinct molecular traits:

Molecular Trait 1

Much like a long train consists of many individual train cars joined, the polymers that make up Kevlar consist of repeating single units called ***monomers***.

Cross Section of Kevlar Fabric

©*Shutterstock*

Did You Know?

Bullet-resistant vests are legal in most countries; one exception is Australia, where they are prohibited. In the US, federal law restricts the purchase of bullet-resistant vests by convicted violent felons. In Canada, it is legal for any individual to purchase soft body armour. However, proposals are in place to make wearing body armour during the commission of a crime illegal.

© *photos.com*

Take Notes

A single Kevlar polymer chain contains approximately 5 million monomers bonded together. Each monomer in a Kevlar polymer is a chemical unit containing 14 carbon atoms, 2 nitrogen atoms, 2 oxygen atoms, and 10 hydrogen atoms.

Molecular Trait 2

A single Kevlar fibre is an arrangement of molecules oriented parallel to each other like a bundle of sticks. This strong, untangled arrangement of molecules is known as a crystalline structure. A manufacturing process known as spinning is used to create the crystalline structure of Kevlar. This process involves extruding the ***molten*** polymer solution through small holes.

Single Kevlar Fibre

A single Kevlar fibre is an arrangement of molecules parallel to each other like a bundle of sticks.

© *photos.com*

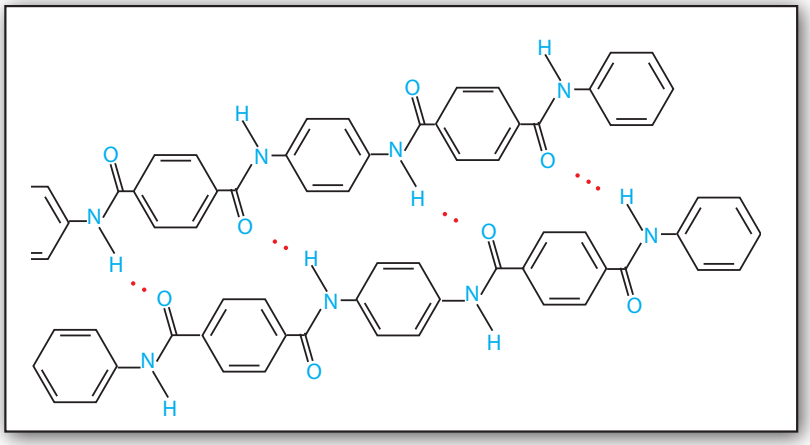
Molecular Trait 3

Kevlar is a polyaromatic amide; that is, it contains many ***aromatic*** and ***amide*** groups. The aromatic groups consist of an arrangement of atoms within one or more rings. The amide groups contain carbon (C), oxygen (O), nitrogen (N), and hydrogen (H) according to the ratio $CONH_2$.

Molecular Trait 4

The individual polymer strands of Kevlar are held together by hydrogen bonds that form between the ***polar*** amide groups. Hydrogen bonds are strong bonds also found in water. These bonds form when a negatively charged oxygen atom from one molecule is attracted to a positively charged hydrogen atom from a nearby molecule.

Hydrogen Bonds



Four hydrogen bonds (shown as red dotted lines) that occur between two strands of Kevlar polymers

© ADLC

Molecular Trait 5

The aromatic components of Kevlar molecules have a ***radial*** composition like the spokes of a bicycle wheel. This spoke-like regularity gives a great deal of symmetry and strength to the internal structure of the Kevlar fibres.

© photos.com

Did You Know?

Kevlar is used in underwater cables, boats, parachutes, and skis.

Properties and Uses of Kevlar

Kevlar is five times stronger than steel, yet it is extremely lightweight. Kevlar does not rust or corrode and it readily absorbs vibrations. Kevlar is expensive because special precautions are necessary to handle the concentrated sulfuric acid used in its manufacture.

Kevlar breaks down when exposed to the ultraviolet rays in sunlight; hence, it is not used unprotected or unsheathed. Dry-cleaning agents, bleach, and repeated washing can also negatively affect Kevlar. To protect against all these problems, the layers of Kevlar in bullet-resistant vests have fabric coverings to prevent exposure to sunlight and moisture.

Kevlar is made in three common grades: *Kevlar*, *Kevlar 29*, and *Kevlar 49*. *Kevlar* is typically used in tires. *Kevlar 29* is used in body armour, industrial cables, ***asbestos*** replacements, and brake linings. *Kevlar 49* is used in applications such as plastic reinforcement for boat hulls, airplanes, and bicycles.

Kevlar Covering

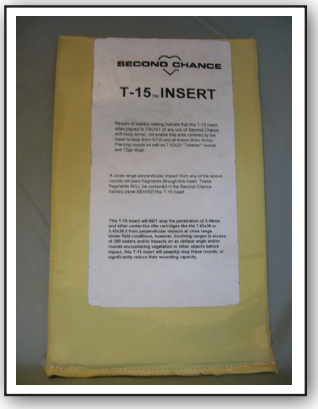
Kevlar in bullet-resistant vests has coverings that prevent exposure to sunlight and moisture.
Sergeant A. Kowalyk, Edmonton Police Service

Did You Know?

Kevlar is also used in parachutes, skis, and space vehicles.

Bullet-Resistant Vests Used in Policing

A Trauma Plate



Trauma plates are often inserted into pockets in the front of bullet-resistant vests.
Sergeant A. Kowalyk, Edmonton Police Service

Most North American police officers engaged in frontline law enforcement now wear bullet-resistant vests. However, as the name implies, bullet-resistant vests do not prevent injury from edged weapons that police officers may encounter, such as knives, arrows, or ice picks. Because the force of a blow from such weapons is focused on a very small area, knives and other pointed objects can penetrate many layers of Kevlar causing injury or death. However, specially designed vests that protect against edged weapons are often worn by correctional officers.

Bullet-resistant vests provide protection from most low and medium-velocity handgun bullets but not high-velocity rifle rounds. Hard body armour consisting of a ceramic or metal plate inserted into a pocket in the front of a bullet-resistant vest greatly increases the protection offered by a bullet-resistant vest. These *trauma plates* are smaller than the front panel of a vest, and they are surrounded by several layers of Kevlar that prevent bullet fragments from ricocheting from the trauma plate after impact. An additional protection helps prevent injury to the heart, lungs, and ribs that may arise from "blunt force trauma", a type of injury sustained by the sudden force of a bullet hitting but not quite penetrating a vest. Blunt force trauma can cause severe bruising, cracked ribs, or even death.

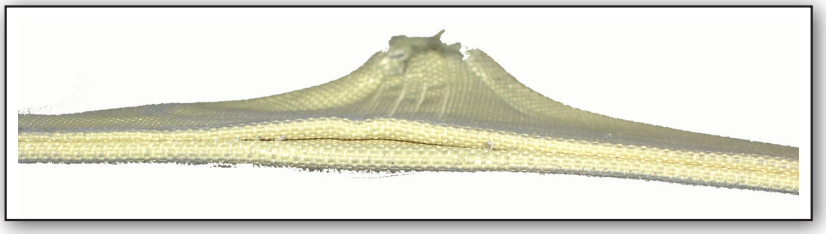
Higher threat protection levels can be achieved with additional layers of Kevlar and heavier trauma plates, but these forms of hard body armour are rigid, heavy, and bulky. They are impractical for routine use by uniformed patrol officers. Tactical team members typically wear such types of body armour for short periods when dealing with high-risk incidents involving the use of firearms.

Did You Know?

Kevlar was originally intended to replace steel belting in vehicle tires.

CASE STUDY: TESTING OF THE FIRST BULLET-RESISTANT VEST

Bullet Impact Site



Side view of bullet impact site in the panel of a Kevlar vest. Image courtesy of Sergeant A. Kowalyk, Edmonton Police Service

One summer night in 1969, the owner of a small pizza restaurant in Detroit was shot during a botched robbery attempt while he was delivering pizzas. While recovering from his wounds, Richard Davis began to research the possibility of developing some concealed personal ballistic protection. While working in his garage, he eventually developed with many layers of nylon fabric a panel thin enough to wear under a shirt. It could stop handgun rounds that were commonly being used by local criminals. The soft protective panels could be worn front and back in a flak jacket design for military personnel.

Davis intended to produce concealable bullet-resistant vests for use by patrol officers, many of whom were being murdered each year by assailants armed with handguns. However, he had first to convince the law enforcement community that a nylon vest would adequately protect a human test subject. Until then, nobody had ever been shot while wearing one of the vests. At that time, nobody knew if blunt force trauma would kill a person even if the bullet did not penetrate the vest.

In a momentous test of nerve in 1972, Richard Davis filmed himself while test firing a .38 calibre revolver into the front panel of a nylon-based protective vest that he wore. As he loaded his revolver, he wondered aloud about the effect of the bullet that he would soon be firing into the vest he was wearing:

"The question is this—will the impact from this .38 create enough hydrostatic shock to stop a person's heart, or kill him, or break his ribs? Any number of things can happen—we've debated this with doctors and everyone else…there's only one way we can find this out, and we can't ask anyone else to do it."

Nervously, Davis spoke about whether he thought his vest would work, and just before pulling the trigger, he uttered these profound words:

"…if it does work, it can save a thousand men in the next ten years. If it doesn't, they're going to die…as I will."

Davis then fired one .38 round into the front panel of his nylon vest, and found that he was able to immediately return fire at an imaginary target. He was later examined at a local hospital. His only injury was a minor abrasion on his chest where the bullet had struck the vest. While wearing a concealable vest, a person could survive a shooting without being incapacitated by the associated blunt force trauma resulting from the bullet's impact. This was extremely significant to police officers, who must be able to return fire at an assailant if they are shot without warning.

Richard Davis went on to form a company called *Second Chance Armour, Inc.*, which soon began using Kevlar for the bullet-resistant vests.

In early sales demonstrations, Davis was so confident in the quality of his company's bullet-resistant vests that he would put on one of his vests and shoot himself, usually with a firearm provided by whatever law enforcement agency to which he was trying to sell the vests. The first police officer whose life was saved by wearing *Second Chance* soft body armour was Detroit police officer, Ron Jagielski, whose vest stopped a .38 round in 1973.

© *photos.com*

Did You Know?

During World War II, the United States tried to create body armour for its army personnel, but the designs were too heavy, restricted movement, and were incompatible with existing equipment. 'Flak jackets' for aircraft crews were developed instead. Made of nylon fabric, these were capable of stopping only flak (bursting shells fired from antiaircraft artillery) and shrapnel (fragments from an exploded artillery shell, bomb, or mine) but not bullets.

Taser Gun

Sergeant A. Kowalyk, Edmonton Police Service

The Conducted Energy Device (CED)

Thousands of police departments worldwide equip their patrol officers with the Conducted Energy Device (CED). The CED is a type of electroshock weapon used to subdue a person by administering an electric shock that disrupts ***superficial*** muscle function. Use of the CED by police has caused the number of officer-involved firearms-related shootings to decrease.

Taser International Inc. developed a CED called the 'taser gun' that is used by more than 2500 law enforcement agencies around the world. However, this is a brand name and not an accurate term for all CEDs. Because of the popularity of the taser gun among law enforcement agencies, CEDs are often called taser guns.

Did You Know?

In 1991, friends of Rick and Tom Smith were brutally murdered by an angry motorist. Concerned about the increasing violence in their neighbourhood, the Smith brothers then purchased a handgun for their mother, but she refused to use it. Hoping to protect people such as their mother who were uncomfortable with guns, the Smith brothers and inventor Jack Cover in 1993 began the American company Taser International Inc. to produce the taser gun.

Model X26 Taser and Cartridge

Sergeant A. Kowalyk, Edmonton Police Service

Description of the CED

Closely resembling a handgun, a CED is an electrical device that works as a contact weapon or as a projectile weapon. When used as a contact weapon, the CED is placed directly upon a body part of a suspect. When used as a projectile weapon, two small weighted barbs attached to lengths of copper wire are propelled from the CED embed in the skin or clothing of a suspect. An electrical charge of approximately 200 000 volts to 300 000 volts is then cycled through the suspect. This sudden charge of electricity immobilizes the suspect through a process commonly referred to as neuromuscular incapacitation, characterized by a sensation of extreme discomfort and immobilization until the electrical current is shut off.

Modern CEDs fire small dart-like electrodes attached to copper wires that connect to a cartridge attached to the front of the device. CED electrodes are propelled by small gas cartridges similar to those in air rifles. The maximum effective range of most CEDs is approximately 6.5 metres (21 feet). Older CED models fire electrodes that embed into the skin and superficial muscle tissues layers, but they have difficulty penetrating thick clothing. Newer CEDs fire similar electrodes; however, these electrodes release a pulse and/or arc of electricity that disrupts nerve and muscle function without penetrating the skin. Consequently, newer CEDs can immobilize a subject wearing many layers of clothing.

Did You Know?

The term TASER is an acronym (Thomas A. Swift's Electric Rifle) created by American Jack Cover in 1969. Mr. Cover named it after a teenage science fiction teenage book character named Tom Swift.

Photo by Flickr user Jason Bain

Principles Behind CED Function

The CED is designed to stimulate both the muscular and nervous systems of the human body. When the CED comes into contact with a body part, a relatively small electrical current sends a high ***frequency*** of electrical impulses into the muscles causing the muscles to spasm inefficiently. The recipient feels great pain and is paralyzed as long as the electrical current is applied. The rapid, inefficient muscular contractions caused by the application of the CED deplete the muscles of oxygen and cause excessive build-up of lactate in seconds. The CED also disables nerve impulses that direct muscle movement, causing disorientation, loss of balance, and confusion for several minutes.

A build-up of lactate causes pain, making movement difficult. Oxygen supplies are low during ***anaerobic respiration***, such as during strenuous exercise when energy demand by the muscles is faster than the body can adequately supply oxygen for ***aerobic respiration***. The build-up of lactate allows energy production to continue despite the lack of oxygen. Therefore, extreme exertion results in the painful, burning sensations often felt in working muscles. It is thought that this painful sensation forces a recovery period to occur that allows the body to break down the excessive lactate.

The main internal components of a CED consist of alkaline batteries, an oscillator, a resonant circuit, and a step-up transformer. When the trigger of the CED is pressed, an oscillator converts the energy from the batteries into a stable resonant electrical circuit. A resonant circuit is an electrical circuit that allows the greatest flow of electricity at a certain frequency. The electricity then flows into a step-up transformer that increases the voltage produced by the CED. In modern CEDs, the electrical current is relatively low because most use commonly available alkaline batteries such as AA or 9 volt.

Did You Know?

Lactic acid is also produced by a type of bacteria (*Lactobacillus bacteria*) found commonly in the mouth, and the acid is responsible for tooth decay.

The output voltages of the CED are in the range of 50 000 volts to 900 000 volts, with the most common being between 200 000 volts and 300 000 volts. However, the actual output current released upon contact with a subject is quite small because of factors such as moisture, body salinity, clothing, the CED's circuitry, battery conditions, and resistance within the subject.

Police Use of the CED

The term "less-lethal" is often used to describe the Conducted Energy Device (CED) by police because no device meant to subdue an aggressive subject is completely safe. Other less-lethal devices used by police include pepper spray, tear gas, and batons.

Conducted Energy Devices are often used by police officers as alternatives to impact weapons or firearms. The availability of a CED is considered advantageous because it can be deployed quickly with great success, often leaving little or no sign of injuries on the subject. This is perhaps preferable to using an impact weapon such as a baton, which can break bones or cause soft tissue damage. A CED can also be used to neutralize an aggressive subject who may be armed with a knife or blunt object without immediately having to resort to the use of a firearm. Most incidents in which a CED is deployed were resolved peacefully without actually resorting to deliberate force. The mere presence of a CED often appears to be enough to gain the cooperation of most belligerent subjects.

Police officers are trained to use their CEDs in accordance with a very limited set of circumstances, typically when a suspect is actively resisting arrest or presents a threat to the officer through overly aggressive behaviour. Police policy on CED deployment varies by jurisdiction. Although the *Alberta Association of Chiefs of Police* recommend that CED deployment occur when a subject is resisting arrest, some police agencies set their standard higher by specifying that other factors must be present, such as the presence of weapons or prior acts of violence.

When the CED is deployed at an incident and is pointed in the direction of a suspect, verbal direction is given in conjunction with its use. The police officer may say, "*Stop resisting or you will be tasered.*" This warning provides a violent or highly agitated subject with the opportunity to reconsider the consequences of his or her actions, and surrender to police without further incident.

A one-second contact with a CED will startle the attacker and cause some pain associated with electro-muscular disruption. This is commonly referred to as a pain compliance technique, involving the use of a CED while in "drive stun" mode. This method of deployment is

Did You Know?

Scrutiny regarding the safety of the CEDs sold by Taser International Inc. has lead to more than 30 wrongful death lawsuits against the company. All the lawsuits to date have been unsuccessful or dismissed.


Take Notes

particularly useful when a subject is under some control but is still uncooperative, such as when police officers are trying to apply handcuffs but cannot gain control of the subject's hands.

This technique can also be used to incapacitate a person by disrupting both the sensory and motor nervous systems, causing temporary involuntary muscle incapacitation. This occurs through the firing of two separate probes that are connected to the CED by thin copper wire approximately 8 metres in length. An electrical charge in cycles of five seconds or longer travels through the wire and into the subject's body. This causes a continuous contraction of muscles throughout the subject's body and results in a loss of balance and muscle control as well as temporary cognitive disorientation. To date, no in-custody deaths have ever been attributed to the use of a CED.

An electrical current of more than 10 amperes is considered potentially lethal to humans. Modern CEDs limit the available current to well below this level. For example, cardiac defibrillators operate in the range of 1.5 to 4.0 amperes, but the *taser* model X26, that almost all police agencies utilize has an average output of 1.8 amperes. Because the current delivered by a CED is low, medical experts generally agree that a CED is not life threatening as long as the subject is not already suffering from a heart condition or what has come to be known as "excited delirium", which is a heightened state of hyperactivity that can result from excessive drug use. Symptoms of this state include aggressive behaviour, paranoia, enhanced physical strength, and the inability to feel pain.

Although all police officers carry handguns, most police departments do not provide a CED to more than a select few of their officers. Because a single *Taser Model X26* costs approximately CDN$2000, the costs involved in equipping and training a large number of officers with CEDs is quite high. It remains to be seen whether this will change in the future.

Patrol officers equipped with CEDs must undergo extensive training. They must first be recommended for training by their respective supervisors. Then, they participate in a one-day course, which consists of learning how to handle the weapon and understanding the mechanics of its basic function. Officers are then tested in various judgment scenarios followed by a written exam. After an officer has successfully completed the course, a coordinator ensures that all policies and procedures are being followed. Additional training is provided annually.


Assignment

When you are ready, please complete the assignment for Lesson 1 in the Assignment Booklet.

Did You Know?

In 2005, *Taser International Inc.* developed a CED integrated with a miniature video camera called the 'Taser Cam'. The Taser Cam is activated anytime an officer is preparing to use his CED. The Taser Cam allows police officers to record the events prior to, during, and after the possible deployment of their CED. *Taser International Inc.* reports that police agencies using their Taser Cam have had a 50% decrease in citizen complaints.

Lesson 2: Pepper Spray and Tear Gas

Lesson Objectives: ***The student will...***

- identify the molecular ingredients of pepper spray, and describe the physiological effects of pepper spray upon the human body
- describe the practical use of pepper spray by police officers, and identify any advantages and or disadvantages of this substance
- identify the molecular ingredients of tear gas, and describe the physiological effects of tear gas upon the human body
- describe the practical use of tear gas by police officers, and identify any advantages and/or disadvantages of this substance

Pepper Spray

To truly appreciate the effects of pepper spray, police officers are sprayed with it during their training.
(AP/Karel Prinsloo)

Pepper spray (also known as *Oleoresin Capsicum spray, OC spray,* or *capsicum spray*) is a chemical compound known as a ***lacrymatory agent*** that irritates the eyes and nose causing tears, pain, and temporary blindness. Pepper spray is a "less-than-lethal" force weapon used by police officers to subdue combative or aggressive suspects.

Did You Know?

"The act of policing is, in order to punish less often, to punish more severely."

- Napoleon Bonaparté

Chilli Peppers

©*Thinkstock*

Capsaicin in Pepper Spray

Bell peppers and chilli peppers are members of the *Capsicum* genus. *Capsaicin* is not found in bell peppers. Chilli peppers contain various amounts of capsaicin. Jalapenos, cayennes, and habaneros are all types of chilli peppers.

The active ingredient in pepper spray is Capsaicin, a tasteless and odourless powdered extract from chilli peppers. The liquid concentrate made from this powder and used in pepper sprays is *Oleoresin Capsaicin* (OC).

Physiological Effects of Pepper Spray

Pepper spray is an inflammatory agent; thus, when sprayed into an individual's face, it causes immediate swelling of the eyes due to ***capillary dilation***. This leads to temporary blindness. OC also causes inflammation of the ***mucous membranes*** lining the nose, mouth, and throat. This may cause a runny nose, uncontrollable coughing, and difficulty with breathing and talking. Some individuals exposed to pepper spray will even experience upper body spasms that force them to bend forward.

Did You Know?

Capsaicin is used in modern Western medicine—mainly in topical creams that help stimulate circulation and relieve pain.

Take Notes

How long an individual is affected by pepper spray depends on the concentration of the OC in the spray. Police officers typically use a pepper spray that contains 10% *Oleoresin Capsaicin* that affects an individual for about 30 to 45 minutes. Because sensitivity to pepper spray varies from person to person, some feel the effects of pepper spray for hours after exposure.

Although pepper spray cannot be completely neutralized, its effects can be minimized. OC is not ***soluble*** in water, so splashing large volumes of water on affected body parts has little to no effect. Because OC is soluble in fats and oils, milk or mild dish detergents can be used to help wash it out.

Interestingly, pepper sprays with higher percentages of OC do not necessarily produce effects that are more dramatic. An effective pepper spray needs to allow a police officer time to disable the suspect and then take control of the situation. As a result, the most effective pepper sprays contain between 2% and 10% OC. Pepper sprays with low OC concentrations are less ***viscous*** or lighter than sprays containing higher concentrations of OC. The lighter the liquid in a spray, the faster it will penetrate the mucous membranes. In addition, the percentage does not correlate to the spray's level of intensity. Pepper sprays with high concentrations of OC may cause more inflammation of the skin surrounding the mucous membranes and may cause the inflammation to last longer.

Pepper Spray

A canister of a patrol officer's pepper spray
Sergeant A. Kowalyk, Edmonton Police Service

Did You Know?

In February 1996, the head of the FBI's less-than-lethal weapons program, Special Agent Thomas Ward, pleaded guilty to taking a bribe of $57 000 from a pepper spray manufacturer, Ward approved of the company's pepper spray product called Cap-stun despite concerns of US military scientists that it was too strong. Ward was sentenced to two months in prison and three months probation for his crime.

Practical Use of Pepper Spray by Police

Pepper spray typically comes in a canister carried in a pouch on a police officer's equipment belt. Most patrol officers in major police departments across North America carry these canisters.

Similar to their use of CEDs, police officers may use pepper spray instead of an impact weapon such as a baton. Pepper spray is considered advantageous because it can be deployed quickly, often with success. It leaves little sign of physical harm after the effects of the spray have worn off in about 30 minutes to an hour. In some circumstances, pepper spray is a preferred weapon in potentially physical confrontations because the use of a baton often causes soft tissue damage. Pepper spray can also be used to neutralize an aggressive subject who may be armed without the officer having to resort to a CED or a firearm.

Police officers are instructed to use their pepper spray only during a limited set of circumstances such as when a suspect is resisting arrest or is openly confrontational and is about to attack an officer. When the pepper spray is pointed in the direction of a suspect, verbal direction is given in conjunction with its use, such as "Stop resisting—put your hands in the air."

Risks Related to Pepper Spray Exposure

When police officers uses pepper spray to subdue suspects, there is a risk that they may be inadvertently exposed to its effects. For this reason, officers are trained to be aware of prevailing winds that might blow the spray in their faces. In addition, officers experience its effects in their classes to help teach them how to react in appropriately should this occur.

People who suffer from severe asthma or who are under the influence of drugs may face some risk of injury or death if they are exposed to pepper spray. This is generally attributed to a potentially fatal condition called "excited delirium" that involves subjects who suffocate or experience heart failure after undergoing tremendous exertion while resisting arrest. Present research indicates that pepper spray is not a direct causal factor in such cases of in-custody death.

The Journal of Investigative Ophthalmology and Visual Science published a study that concluded that one exposure of the eye to OC is harmless but repeated exposure can result in long-lasting changes to the ***cornea***, the outermost thin layer of transparent tissue in the front of the eye. This study concluded that a single exposure to pepper spray causes no lasting negative effects upon visual ***acuity***.

Did You Know?

Most mammals find OC irritating and unpleasant. However, birds are unaffected by OC exposure. The secretion of capsaicin protects peppers from being eaten by mammals, but the bright colours of peppers attract birds that will eventually spread the seeds.

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Tear Gas

Take Notes

Tear gas is a general term for any non-lethal chemical used to cause temporary incapacitation through the irritation of eyes and/or respiratory system. Because tear gas is widely used by police departments to subdue large groups of unruly people in riot situations, it is often referred to as a "riot control agent".

Riot police spray pepper gas at a protestor
AP / Nelson Antoine

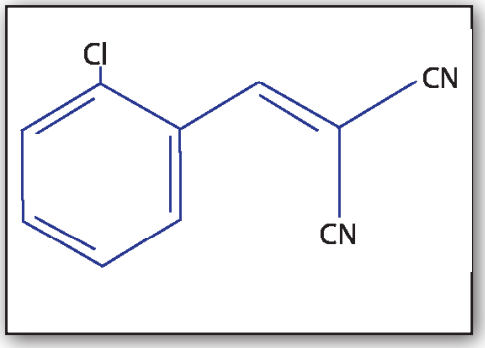
Did You Know?

Capsaicin is so hot that a person's tongue would blister if he or she were to drink a glass containing one drop of capsaicin diluted in 100 000 drops of water.

Properties of Tear Gas (CS)

There are many types of tear gas. The tear gas most widely used by police agencies is 2-chlorobenzalmalononitrile ($C_{10}H_5ClN_2$). Two American scientists, Ben Carson and Roger Staughton, developed $C_{10}H_5ClN_2$, and as a result, the first letters of their surnames, CS, are used as its acronym.

2-chlorobenzalmalononitrile



Unlike the suggestion of the name *tear gas*, at room temperature CS is a white solid and must be released as an ***aerosol*** rather than a true gas. In its aerosol form, CS is dispersed as fine particles, or it is dissolved in a solution.

CS is stable when heated and at room temperature. It has a low solubility in water and a high solubility in basic or alkaline solutions. CS will eventually dissolve in water (15 minutes), but it dissolves very rapidly in an alkaline solution (1 minute). Therefore, CS is easily removed using an ***alkaline*** solution of sodium bicarbonate (baking soda) and water.

Physiological Effects of Tear Gas Exposure

Riot control agents such as CS are lacrymatory agents; that is, they cause severe irritation to the eyes. However, in addition to the eyes, CS causes pain, burning, and irritation to the skin, airways, and any exposed mucous membranes of the nose and mouth.

Did You Know?

"The limitation of riots, moral questions aside, is that they cannot win and their participants know it. Hence, rioting is not revolutionary but reactionary because it invites defeat. It involves an emotional catharsis, but it must be followed by a sense of futility."

- Martin Luther King Jr.

Take Notes

The eyes are the most sensitive organs to tear gas because it causes tearing, burning, and pain. CS exposure also causes the eyelids to close tightly producing temporary blindness. However, if the eyes are opened, vision is nearly normal even if a significant amount of CS residue is present.

Contact of tear gas with the delicate mucous membranes of the nose and mouth produces burning, sneezing, and increased production of mucous and saliva. Inhalation of CS causes burning and irritation of the lining of the ***trachea***, which produces coughing and irregular breathing.

Practical Use of Tear Gas by Police

Tear gas is sometimes used by police to disperse unruly crowds about to riot, or it may be used to clear armed suspects from a house or building. Tear gas is effective in that it produces severe sensory irritation, forcing a person or group of people to flee an area or surrender to police just to escape its noxious effects. Another advantage is that tear gas is non-lethal, and in most cases, its disabling physical effects disappear within minutes.

A Police Officer in Riot Gear

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Tear gas is typically deployed using gas-filled canisters. Tear gas grenades are projected using a grenade launcher, which is useful for propelling canisters of tear gas into a violent mob, for example. A grenade, or metal canister containing tear gas, is loaded into the breech of a grenade launcher prior to being fired from the barrel.

Did You Know?

Police dogs and horses can be used by police for riot control because they have low sensitivity to tear gas. Tear gas has a limited effect on animals because they have underdeveloped tear ducts and their fur provides some protection.

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Effects of Exposure to Tear Gas

Take Notes

One of the greatest advantages to using tear gas is that, in general, it leads to quick submission and its effects are not long lasting. Less than 1% of people exposed to tear gas have effects severe enough to warrant medical care. People who do seek medical help from tear gas exposure usually have eye, airway, or skin complaints. There is no antidote for tear gas; therefore, patients can achieve relief only if their symptoms are treated.

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Assignment

When you are ready, please complete the assignment for Lesson 2 in the Assignment Booklet.

Did You Know?

Use of CS during warfare is prohibited under the terms of the 1997 Chemical Weapons Convention because its use could trigger retaliation with more harmful chemical agents such as nerve gas. Domestic use of CS by police is legal in most countries.

Lesson 3: Police Canines

Lesson Objectives: ***The student will...***

- appreciate the value of police canines in criminal investigations
- describe the various types of law enforcement canines (such as *tracking, narcotic detection, bomb detection, search-and-rescue, combat*)
- identify the most common dog breeds used for law enforcement and explain the reasons these breeds are used
- describe the training of one type of police canine

The primary function of the Police Canine Unit is to provide support to patrol officers on the street. Police canines and their handlers respond to crimes in progress where suspects are fleeing on foot or possibly hiding. Dogs are also used by police to track missing persons or to find hidden drugs or explosives.

Unique Physiological Abilities of Dogs

A Police Canine (Marco) Wearing a Bullet-Resistant Vest

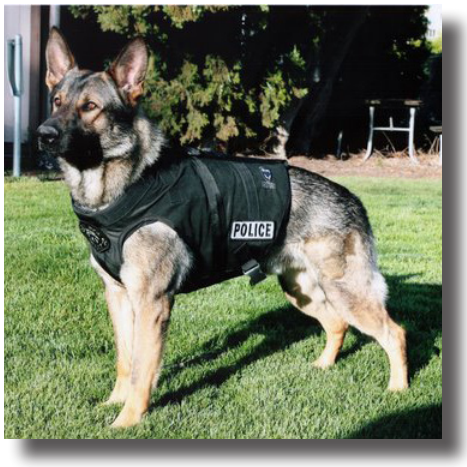


Image courtesy of San José Police Department

Did You Know?

In 1999, a police service dog named Breston, working for the *Cheektowaga Police Department* in Cheektowaga, New York, sniffed out $3.4 million dollars worth of drugs. Breston, a Belgian Malinois, was able to smell the marijuana despite it being heat-sealed in Mylar plastic bags inside plastic-lined crates sealed with foam sealant inside a closed storage garage.

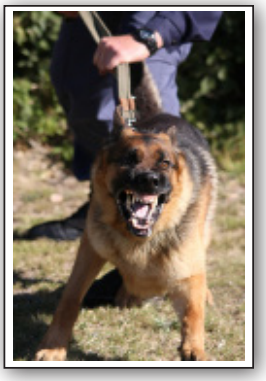
Dogs have several unique physiological qualities that make them valuable assets to police agencies worldwide.

A dog can be trained to use its sense of smell to identify individual people, drugs, explosives, or weapons. In addition, a dog's sense of smell is discriminating in that the dog is able to identify a specific scent even when many other scents are present. Drug smugglers have often tried to fool drug-sniffing dogs by wrapping drugs in materials soaked with perfume or putting the drugs in boxes filled with mothballs. However, well-trained drug detection dogs still find the drugs despite these devious efforts.

A dog's ***olfactory*** system or sense of smell is 50 times more sensitive than a human's is. A dog's nose has approximately 200 million specialized scent-receptor cells called olfactory sensory receptors, but a human's nose has only about 5 million of these. Olfactory receptors are embedded in the special membrane in the nose called the olfactory epithelium. The human nose has an average of 16 cm of olfactory epithelium, but a dog's nose has an average of 150 cm. After molecules of airborne odours dissolve in the ***mucous*** layer covering the olfactory epithelium, they stimulate olfactory sensory receptors that, in turn, trigger an electrical impulse in sensory ***neurons***. These neurons send messages to the ***cerebrum*** for interpretation. The area of a dog's brain that interprets olfaction or smell is 15 times larger than that of a human.

Dogs can run faster and are stronger than most humans; therefore, they can apprehend a criminal suspect who flees or subdue a suspect who is exhibiting violent behaviour. Police service dogs are able to catch a criminal on the run by clamping on them with their powerful jaws.

Another asset of police service dogs is their loud barking, which can be very intimidating to most individuals. Some suspects voluntarily stop running or being aggressive when they see or hear a police service dog.



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Did You Know?

A dog's nose is sensitive enough to detect a single drop of blood in 5 litres of water.

Edmonton Police Service

Historical Use of Canines in Law Enforcement

In 1899, Belgium established the first police dog training program in the world. Success of this program prompted other European countries, such as Germany, France, Hungary, Austria, England, and Italy to train and use dogs formally for police work. In England in 1908, police service dogs were used successfully to subdue crowds of rowdy sailors on shore leave.

In Canada during the late 1800s, the Royal Canadian Mounted Police (RCMP) started using sled dogs to transport officers on their patrol runs. During the early 1900s, the RCMP began using bloodhounds as tracking dogs. By 1935, the RCMP established a formal police service under Captain Harwich, an ex-Prussian military officer, training dogs for searching, tracking, and attacking. The dogs from this program were so successful that additional funding was provided to purchase and train more dogs. As a result, a police dog training school was established in Calgary in 1937.

During World War I (1914-1918) and World War II (1939-1945), dogs were used extensively by the military to guard prisoners, first by Germany and then by other countries. After World War II, the use of dogs in the military lead to more police agencies around the world adopting and/or expanding this method of policing. The use of police dogs continued to grow and became widespread during the 1960s and 1970s in North America. Now, all major North American police department have canine units. Police service dogs are recognized as being a vital part of law enforcement.

Did You Know?

The RCMP has its own Police Dog Breeding Program that produces puppies. Any puppies produced in this program that do not demonstrate the traits required for police work are sold online as pets (www.rcmp.ca/pds/sale/index_e.htm).

Sergeant Colin Quast with Two Police Service Dogs

Left, Xena, a Belgian Malinois; right, Henry, a Labrador Retriever
Edmonton Police Service

Canine Breeds Used for Police Service

Because dogs are various shapes and sizes, not every dog breed is suited for police work. The specific breed used by police departments depends on the specific tasks for which the dogs will be needed. Most police departments use dogs that have been bred and raised specifically for police work. Three popular breeds used for various types of police work are the German Shepherd, the Belgian Malinois, and the Labrador Retriever.

A German Shepherd

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Most dogs working in law enforcement are German Shepherds, which have a long history of use by police and the military. They are suited for police work because they are highly intelligent, agile, and extremely loyal to their handlers. Shepherds have powerful jaws and strong teeth and can be trained to attack and release on command. German Shepherds bred specifically as police service dogs have very high energy and a natural drive for protecting, tracking, and obeying. They are bred primarily for consistent temperament, working drive, and intelligence. When German Shepherds are used as pets, they will often be unhappy and destructive if not exercised frequently or trained to do some job.

A Belgian Malinois

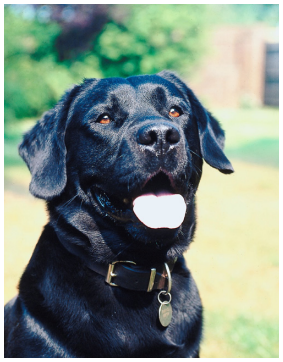
©*Thinkstock*

The Belgian Malinois is another popular breed of dog used for police work. Its looks like a German Shepherd, but it is smaller and has a narrower head and body. Originally, Belgian Malinois were bred as herding dogs. Therefore, they tend to be very loyal to and protective of their handlers. The Malinois is agile and quick, making sharp turns as most herding dogs can. A trained Belgian Malinois is well suited for police work because it is always very alert, watchful, and obedient, attacking only upon command. Belgian Malinois dogs have steady temperament and strong *play drive*, meaning they will perform or work for several hours for a chance to play with their favourite toys.

Did You Know?

More than 3700 dogs were used by the US military during the Vietnam War (1964-1975). Sadly, only 204 of these dogs returned to the US in 1975. The majority of the dogs were simply euthanized, and a small proportion was turned over to the South Vietnamese Army.

A Black Labrador Retriever



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The Labrador Retriever is used commonly by police for detecting concealed illegal drugs or explosives. Because they are very friendly and good-natured, they are unsuitable as attack dogs. However, they can be easily trained for drug detection or explosives detection because they are energetic and respond well to praise and positive attention.

Police Use of Canines

Police service dogs are most commonly used by law enforcement agencies to track and apprehend suspects who run from the scene of a crime. Most major Canadian municipal police agencies have canine units consisting of a supervisor and 5 to 10 canine officers with their police service dogs. Large police agencies have from one to three canine officers on duty at any given time.

Edmonton Police Service

Did You Know?

A black Labrador Retriever named Sadie was awarded the Dickin Medal (the animal equivalent of the Victoria Cross) in 2007. Sadie is an explosives-detection dog working for the British Army. In Kabul, Afghanistan, in 2005, Sadie saved many lives by detecting a powerful bomb hidden under a pile of sandbags outside the United Nations headquarters.

While on duty, a canine officer drives a slightly modified patrol vehicle accommodating the police service dog. Because sometimes a police service dog must remain in a patrol car for lengthy periods (such as while the officer is writing reports), police vehicles used by canine officers have special alarm systems triggered if the ventilation system malfunctions and the interior of the vehicle becomes overheated. The alarm system may automatically lower the vehicle's windows, cause the horn to sound, or notify the officer by cell phone or pager.

Emergency Response

When a situation arises in which a suspect has just fled the scene of a crime, responding patrol officers often call the police dispatcher from their car radio or portable radios to request a canine unit to help them apprehend the suspect(s). The dispatcher then notifies an available canine officer, providing a brief description and location of the event. The canine officer drives quickly to the scene, using the police vehicle's lights and siren in the interest of public safety. A police officer meets the canine officer at the scene and provides a brief description of what occurred, possible suspect description, last known location, and direction of travel. The canine officer considers the time since the suspect left the scene and the presence of pedestrian traffic in the area before beginning a search. If many people are walking in the area, the likelihood of successfully tracking a fleeing suspect diminishes considerably. While the canine officer tracks a suspect, he or she is accompanied by one of the police officers who responded initially to the scene. This promotes officer safety and may assist an arrest if a suspect is apprehended in an isolated area.

If a suspect is apprehended, the police officers who responded initially to the scene will take over custody of the individual and transport him or her to a nearby police station for processing. The canine officer then provides a brief written statement outlining his or her involvement in the apprehension, which forms part of the investigator's case file. The canine officer may complete the required paperwork immediately after the arrest or at the end of his or her shift if other priority calls for service must be handled.

Did You Know?

In August 2003, Constable Darren Leggatt, a 15-year member of the *Calgary Police Service* and 4-year veteran of the Canine Unit, was working with Police Service Dog, Gino, an 11-year-old male German Shepherd and an Explosives Detection Dog, Koko, a 6-year-old female German Shepherd. While Constable Leggatt was doing some administrative paperwork, the dogs were left in a secured Canine Unit police vehicle with the air conditioning on. At some point in the afternoon, the vehicle's air conditioning system failed and began blowing hot air. When Constable Leggatt checked on the dogs, they were both experiencing cardiac arrest. Gino died en route to an Emergency Animal Clinic, but Koko was successfully revived by Constable Leggatt using CPR.

When canine officers are on duty and available, they may patrol high crime areas, look for stolen vehicles, or complete outstanding reports. They are not typically expected to respond to routine calls for service because their primary responsibility is to be available to help other police officers in the apprehension of fleeing suspects.

Detection Dogs

Many law enforcement agencies also use police dogs to "sniff out" narcotics, explosives, or even ***cadavers*** (dead bodies). Drug-detection dogs are able to detect various illegal drugs, including marijuana and methamphetamine, and explosives-detection dogs are used to search places and objects in which bombs or explosive materials may be hidden.

Dogs trained to detect drugs or explosives are not used to track and apprehend suspects fleeing the scenes of crimes. Instead, they are used to assist in the detection of drug shipments or for security purposes by checking for the presence of explosive materials in such places as airports, government buildings, or seaports.

Drug detection dogs are useful in searching difficult-to-reach places in which various quantities of drugs might be hidden. They are also used at traffic stops, in prisons, and even in schools. Their training involves the use of real explosives such as gunpowder, dynamite, and military grade materials such as Semtex. Testing procedures for certification involve identification drills intended to help canine officers distinguish simple unattended items from suspicious packages during searches of luggage, outdoor areas, buildings, vehicles, and aircraft.

Cadaver-detection dogs are trained to detect the scent of decomposing bodies and are used in cases where the objective of an organized search is to find a person's body. Unlike standard Search and Rescue dogs, cadaver dogs are trained to detect the scent of decomposing flesh wafting up from the ground. To train for this purpose, specialized law enforcement training facilities use special chemicals to simulate the scent of decomposing human flesh. Training includes scene and evidence preservation because the discovery of a body (or body part) signals the existence of a crime scene.

An Explosives Detection Dog Searches a Vehicle

©Thinkstock

Edmonton Police Service

Canine Training

The traits of successful police service dogs are intelligence, aggression, strength, and senses of smell. Most police service dogs are male and are often not neutered. An unneutered male dog tends to be naturally more aggressive than a neutered male dog. Aggression in police service dogs is a helpful characteristic in the pursuit of criminals; however, it is kept in check with intense training. Neutering of male dogs involves the surgical removal of both testicles. The testicles produce testosterone that stimulates in dogs secondary sex-related behaviours such as mounting, leg lifting, and aggression. The removal of the testes reduces secondary sexual behaviours due to low levels of testosterone.

Although not very common, some female police service dogs are competent. If a female police service dog is not going to be bred, she is spayed. Spaying of female dogs involves the surgical removal of the dog's ovaries and uterus. This prevents ***secondary sexual characteristics*** from developing, thereby lowering the sexual excitement that male dogs have towards female dogs—especially when they are in ***heat***. Sexual arousal distracts male police service dogs from their important work.

Did You Know?

After the terrorist attacks on September 11, 2001, in New York and Washington, DC, the *U.S. Transportation Security Administration* increased dramatically the number of dogs used to patrol airports and transit systems for drugs and explosives.

Before 2001, only 174 dogs patrolled 39 US airports. As of February 2007 in the US, 420 dogs patrol 75 airports and 13 major transit systems.

To become a part of the Canine Unit in any police department, a constable must have several years experience in policing. For example, in the *Edmonton Police Service,* officers must have a minimum of eight years experience before they can become canine handlers. Often, when officers express interest in becoming members of a Canine Unit, they are expected to help voluntarily in dog training exercises by posing as a *quarry*. A quarry is a police service dog's attack target who hides or flees just as a suspect does. Quarries wear thick, protective clothing that prevents injury from the dog bites they must endure.

When officers have enough years of experience, they then apply to become involved in the "Imprinting Program". During this program, the successful applicants become puppy holders, which means each is responsible for the care and development of a potential police service puppy. Before a puppy becomes a potential canine unit candidate, it is tested at seven weeks of age to determine if it has certain traits needed to become a successful police service dog. The puppy is evaluated several more times during this program. At four, eight, and twelve months, a puppy is put through several obedience and tracking exercises to determine further the suitability for police work. In most cases, police puppies live with their handlers to become socialized and familiar with different environments and situations. This allows for easy transition should the puppy and its handler become chosen for the formal training program. This also ensures the dog remains a social and pleasant animal.

When a potential puppy reaches one year of age, it and its handler enter an extensive training program. A police service dog and handler are trained as a team because they must trust and understand each other completely if they are to function successfully together in stressful, high-risk, and unpredictable situations on the street. A handler must to be able to control the dog completely so that it can be called off instantly when the situation warrants. During police service dog training, both learn to become proficient in tracking, criminal apprehension, searching, obedience, and agility.

The main goals of police service dogs training is to find, chase, intimidate, and hold suspects who are attempting to elude police. Police service dogs are not trained to be vicious; rather, they are trained to enjoy their work. Chasing and grabbing is introduced to them as a game that they play only when their handler gives the appropriate command. Dogs are trained not to bite, but to grab and hold their quarry until their handler gives the release command. When a

Did You Know?

Some police service dogs in North America are trained using commands in German, Hungarian, or Czech. Three advantages to this method include that the dog is less likely to hear inadvertently a command word in everyday conversation, a suspect will likely be unsuccessful if he or she tries to use a stop command, and a suspect will very likely not understand the handler's commands.

police service dog is running at full speed and grabs a fleeing suspect, the person may be bitten especially if he or she attempts to avoid or fight off the dog. Therefore, if possible, the handler will try to give the suspect a verbal warning that the dog will grab them if they do not stop immediately. This verbal warning often causes suspects to give up—leading the handler not to release his dog. If a suspect does not stop and is bitten by a police service dog during the course of a chase, the suspect is given medical attention as soon as possible.

Some police service dogs are trained to use a pursue-and-bark tactic. When a dog finds a suspect, it barks loudly, alerting the handler of the location of the suspect. This loud barking intimidates the suspect and likely prevents him or her from running away. If the suspect does not stop, the dog will hold the suspect until his handler arrives.

Most police service dogs and their handlers remain in a Canine Unit for up to seven years, which is considered the most productive years of a police service dog's life. The dogs are then kept by their handlers as pets.

Edmonton Police Service

Did You Know?

In British Columbia in March 1979, RCMP apprehended a man in connection with detonating explosives in North Vancouver. The man admitted to having hid a large quantity of stolen explosives in a wooded area outside the city. However, the suspect was unable to recall the exact location of the stash. RCMP Constable Spraggs and police service dog Erko were contacted. Despite the rugged and mountainous terrain, Erko located all the stolen explosives, which included 606 sticks of dynamite. The suspect was later found guilty of possession of stolen property and sentenced to 30 days in jail.

CASE STUDY: POLICE SERVICE DOG DIES IN THE LINE OF DUTY

Constable Randy Schreiner and Police Service Dog Titus

Edmonton Police Service

In February 1986, Constable Randy Schreiner of the *Edmonton Police Service* (EPS) was selected to become a puppy handler of a potential police service puppy. The puppy was a male German Shepherd named Titus, a very playful and mischievous young dog nicknamed *Punchout* because he had dark black circles around his eyes. Titus had all the traits needed to become a successful police service dog—intelligence, aggression, strength, good sense of smell, and obedience. In August 1987, Constable Schreiner and Titus began their basic police service dog training.

Titus' first major suspect apprehension occurred in the first month he began working. Police received a *Peeping Tom* complaint by phone involving a suspect trespassing in a person's yard at night and looking in the windows. When Constable Schreiner and Titus arrived at the address of the complainant, Titus picked up the fresh scent of the *Peeping Tom* suspect. Titus followed the scent and lead Constable Schreiner through a rugged embankment into a residential area. As Titus and Constable Schreiner were tracking through the residential area, they came upon two male suspects trying to break into a house by prying open a window. When the suspects saw Constable Schreiner and Titus, they both ran. Titus was then released and easily grabbed the jacket of one of the suspects who was later arrested.

Titus' last apprehension occurred on August 27, 1989. Shortly before midnight, an armed robbery was reported at a convenience store in south Edmonton. Two men with knives had entered, demanded money, and left after tying up the clerk. The two suspects jumped into a waiting Fiero sports car and sped off. Within minutes, several patrol cars spotted the suspect vehicle and began pursuing it. The pursuit concluded with the Fiero hitting a dead end on a service road.

After the car stopped, the driver was apprehended immediately. However, the other two occupants fled on foot. One was apprehended immediately, but the third continued to run. Titus, now four years old and his handler, Constable Schreiner, began pursuing the suspect. Titus followed the suspect as he ran across a busy street. Just as Titus was about to jump to apprehend the suspect, both were struck by an oncoming vehicle.

When Constable Schreiner reached Titus, he was motionless on the ground. He checked Titus' vital signs, but he was not breathing and had only a very faint heartbeat. Another Canine Unit officer arrived on the scene moments later, and Constable Schreiner lifted Titus into the patrol car. As they drove to an Emergency Animal Clinic, Titus' heart stopped. Shortly after they arrived at the clinic, the veterinarian confirmed resuscitation was useless, and Titus was pronounced dead.

The death of Titus was a major loss to the EPS Canine Unit because he was an excellent police service dog in his prime at only 4 years of age. The suspect Titus was pursuing survived and was arrested. Constable Randy Schreiner was obviously very shaken by the incident. After some time off, he returned to the EPS. However, he began working in another unit and did not return to the Canine Unit.

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Related Questions: (Note that this does not have to be submitted for marks.)

1. How long was Constable Schreiner a puppy handler?

2. What type of crime was committed by the first suspect apprehended by Titus

3. At the time of his death, for how many more years was Titus scheduled to serve in the EPS Canine Unit?

4. What did Constable Schreiner do after the death of his partner, Titus?

Check your answers in the Module 2 Appendix in the back of this book.

When you are ready, please complete the assignment for Lesson 3 in the Assignment Booklet.

Lesson 4: Crime Case Studies Involving Law Enforcement – Safety Equipment and Police Canines

Sergeant A. Kowalyk, Edmonton Police Service

The arrest of suspects involves a risk of violence. Police officers must use various pieces of equipment to protect themselves as they try to maintain public safety. Through technology, some unique equipment used by law enforcement officers has been developed.

This lesson focuses upon two historical crime case studies that involve law enforcement safety equipment and police canines. Each case study is based on actual historical events. The first case study is "The North Hollywood Shootout"; the second is "Police Canine Makes the Ultimate Sacrifice".

You are expected to answer the related questions about these case studies in your assignment booklet.

Lesson Objectives: ***The student will...***

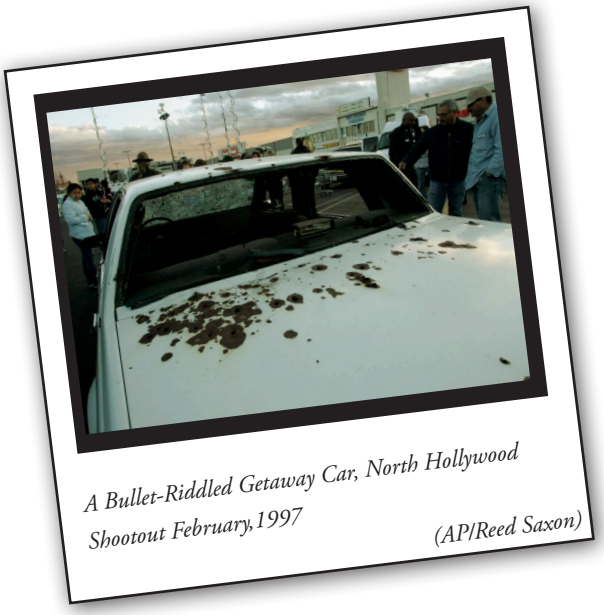
- discuss a historical crime case involving law enforcement safety equipment
- explore a historical crime case involving police canines

Did You Know?

"I know that violent crimes are in the minority, but my concern is that they could become the majority if not addressed."

- Ricardo Gonzalez

HISTORICAL CRIME CASE STUDY 2.1: The North Hollywood Shootout



A Bullet-Riddled Getaway Car, North Hollywood Shootout February, 1997 *(AP/Reed Saxon)*

Example

Take Notes

Background Information

Police body armour and less-lethal weapons such as pepper spray, tear gas, batons, and police service dogs often enable police officers to apprehend aggressive or violent suspects without resorting to firearms. Soft body armour is worn routinely by police officers as a precaution in case an armed suspect shoots at them.

Concealable soft body armour has saved hundreds of officers' lives since it was developed for general duty use in the early 1970s. However, suspected criminals sometimes use it during the commission of crimes. The infamous 1997 North Hollywood Shootout, involving two heavily armed men and hundreds of officers from the Los Angeles Police Department (LAPD), is an example of the effectiveness of soft body armour and the limitations of less-lethal weapons in dynamic situations involving firearms. Although only the suspects were killed in this incident, the high number of injuries made this one of the bloodiest cases of violent crime in the 1990s and one of the most dramatic bank robberies of the 20th century.

Description of the Culprits

The bank robbers were Larry Phillips Jr. and Emil Matasareanu. They were both bodybuilders. Phillips was a 26-year-old unsuccessful real estate salesman with a wife and two children. Matasareanu, an unsuccessful software designer, was raised by his mother who operated a home for several mentally-ill patients. As a result of a blow from one of the patients, Matasareanu suffered from a brain abnormality called epilepsy. Strangely, Matasareanu had brain surgery only a few weeks prior to the North Hollywood Shootout.

The two men had robbed several banks, stealing over $1.6 million in total. Their first three robberies involved stealing cash from armoured cars, and their last two robberies involved holding up banks.

Suspect Body Armor

On February 28, 1997, shortly after 9:00 a.m., Larry Phillips Jr. and Emil Matasareanu entered a *Bank of America* in North Hollywood Los Angeles, California. Phillips was actually covered head-to-toe with soft body armour and bulky clothing as he entered the bank. He had two halves of one bullet-resistant vest wrapped around his legs, four more halves around his thighs and arms, and one vest on his torso. The bullet-resistant vests were not cut up and sewn together because cutting Kevlar breaks the outer seal, which causes it to fray and lose most of its protective quality. The vests were simply held together with the velcro straps that were already on the vests. Emil Matasareanu wore a single bullet-resistant vest with a trauma plate over his torso; he had not covered his arms and legs.

The Robbery

Both suspects were armed with high-powered assault rifles. Before entering the bank, both robbers took some phenobarbitol, a barbiturate prescribed as a anti-seizure medication. The medication likely belonged to Matasareanu for his epileptic seizures. It is thought that both suspects took this drug for its physically calming side-effects.

Thirty-two customers and ten employees were in the bank at the time of the robbery. One customer was injured when he was hit in the head with the end of one suspect's rifle. An individual walking past the bank saw the robbers enter the bank and flagged down an LAPD patrol car.

When the robbers entered the bank, one discharged a full 30-round magazine into the ceiling. The suspects then split up. Phillips kept watch in the lobby while Matasareanu forced the bank manager to open the vault. The bank manager placed US $303 305 in a suitcase, but Phillips and Matasareanu were expecting more. Unknown to them, their previous robberies had led the banks in the area to change their armoured car delivery times to make them less predictable. The bank Phillips and Matasareanu had chosen to rob had not yet received any money from their armoured car delivery service.

When Matasareanu was told that no more money was in the vault, he demanded the manager open the Automated Teller Machines (ATM). However, nobody on-site had access to the ATMs. This infuriated Matasareanu, causing him to try to shoot open the ATM access point. The shots broke the lock, making opening the ATM impossible. Frustrated, the robbers decided to leave with what money they had. They locked all the customers and employees in the bank vault. Larry Phillips left through the north door of the bank, and Matasareanu went through the south door a few seconds later.

The Shootout

Approximately 20 minutes after entry, both suspects exited the bank. They were met by several LAPD police officers armed with handguns as well as a few pump-action shotguns. Standing in the doorway of the bank, Phillips began discharging his rifle at police officers positioned on the north side of the bank. Both gunmen used armour-piercing cartridges in their rifles, capable of penetrating cars, walls, and soft body armour.

A rookie police officer taking cover behind a kiosk across the street from the bank fired at Phillips when his back was turned. The officer struck him in the back with nine buckshot pellets (as determined later). However, because of his body armour, Phillips was left unscathed. Phillips fired back at the kiosk hitting the rookie officer twice in his lower back and buttocks and a detective in the ankle. The two wounded officers entered a dentist's office nearby where the staff treated their injuries.

Meanwhile, Matasareanu had the suitcase of money with him. Three dye packs that had been slipped into the suitcase containing the cash caused a red smoke to begin spewing out. Because the dye destroys the money, Matasareanu abandoned the suitcase and angrily began firing from the south side of the bank. About fifteen minutes into the shootout, Matasareanu received a gunshot wound to his leg. He jumped into a getaway car. As he drove the car, he continued to fire shots through the car's windows.

Phillips continued to fire at officers as he walked away from the north side of the bank. Several officers and detectives fired at Phillips from behind a cement wall at the rear of the bank. Phillips fired back as he calmly walked toward the getaway car. A round from one of the officers behind the wall hit Phillips in the chest, nearly knocking him over. However, his body armour saved him again. At the getaway car, Phillips threw his AK-47 rifle inside and got out a new weapon, an illegally converted automatic HK-91 rifle.

Before he got into the car, Phillips fired randomly at officers just across the street. Officers continued to return fire, one round hitting Phillips' hand. This injury seemed to distract Phillips from getting into the getaway car. He walked away and continued shooting wildly from behind nearby cars. Phillips even began shooting at news helicopters filming the shootout.

The Attempted Getaway

Matasareanu began backing the car out of the parking lot. Phillips hurried to him, firing as he went. As he approached the trunk of the car, a round struck his shoulder, immobilizing the upper left side of his body. Despite this, Phillips continued to shoot his rifle with one-hand. He threw his HK-91 into the trunk and pulled out a Norinco Chinese Type 56 Assault Rifle.

As he tried to load his new weapon, Matasareanu opened the passenger side door. However, Phillips shut the door and began walking beside the car in an apparent attempt to provide cover fire for his partner. The car with Phillips walking beside moved away from the bank to the edge of the parking lot. Phillips ducked behind a tractor trailer on a street near the bank and began firing aggressively again. This allowed Matasareanu to drive past him to the end of the street.

Phillips continued to shoot at officers as he moved. However, his rifle jammed. He then dropped the rifle and pulled a handgun from his jacket. He fired several rounds, but he dropped the handgun after he was shot in the right hand. Phillips then picked up the handgun and shot himself in the throat, dying instantly. It is unclear whether this was deliberate or accidental. A nearby officer thought that Phillips killed himself accidentally as he tried to reload his pistol one-handed.

Matasareanu was further up the street and likely did not know his partner was dead. Police had shot out the tires of his car, so he tried unsuccessfully to car-jack several vehicles one of which was a pick-up truck. He fired several rounds at this truck at which point the

frightened driver disabled his vehicle by shutting off the gas tank pumps and then fled. Matasareanu then pulled out a new weapon from the would-be getaway car, an AR-15 rifle equipped with a 100-round magazine and limped over to the pick-up truck. He fired several times at the officers before getting into the truck. He tried unsuccessfully to start the pick-up and then exited the vehicle. He then ran behind the hood the getaway car and began firing wildly again. The three SWAT officers took cover behind their car and fired at Matasareanu's unprotected feet and legs. Other police officers began firing from the side streets and nearby houses. Finally, after being shot 29 times, Matasareanu collapsed and fell against the hood of his getaway car. When the SWAT moved in to arrest the gunman, he was still alive and yelling obscenities at them. Presumably to ensure the safety of the paramedics and themselves, officers prevented emergency medical staff from approaching Matasareanu. 70 minutes later he died of blood loss due to multiple gunshot wounds having received no medical attention.

The Final Outcome

Approximately 370 LAPD officers were involved in the 40-minute shootout and the investigation afterwards. Twelve police officers, eight civilians, and one civilian dog were wounded. Miraculously, only two people were severely wounded, and they survived their injuries. Larry Phillips was shot 11 times and Matasareanu was shot 29 times. Their Kevlar body armour prevented many of the handgun bullets and shotgun pellets from incapacitating them. As a result, the two men were able to fire hundreds of rounds of high-powered ammunition in their desperate attempt to escape.

Subsequent police investigations into this incident revealed that the LAPD officers were at a significant disadvantage due to a lack of firepower. The multiple layers of body armour worn by Phillips and Matasareanu enabled them to sustain multiple hits from police pistol bullets without being immediately incapacitated.

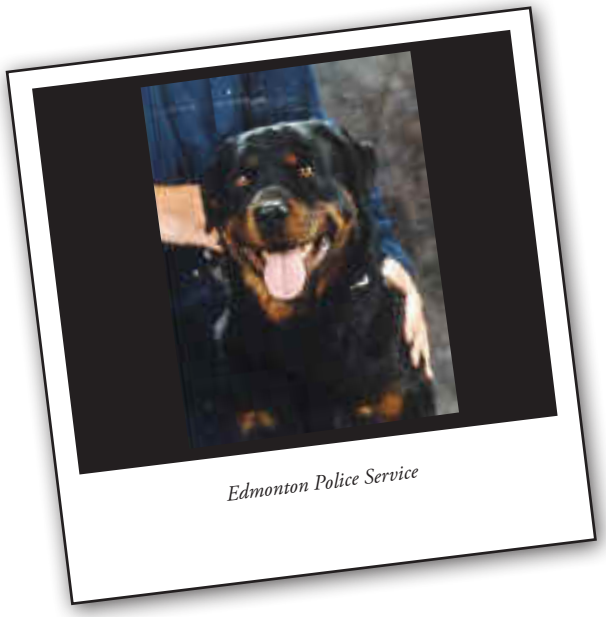
Other less-lethal weapons available at the time, such as tear gas and pepper spray, were not practical due to the dynamic nature of the threat. Had the suspects barricaded themselves in a house, the police could have set up a perimeter and eventually used tear gas to help in their apprehension. Because both suspects were continuously moving and firing automatic weapons throughout the neighbourhood as they attempted to escape, police officers were forced to return fire with their service pistols and shotguns. Tear gas or pepper spray would have had no effect.

Police service dogs were also impractical in this situation because of the extreme nature of the threat. Any police dog that may have attempted to capture the suspects would have likely been shot immediately by the men with their high-powered weapons.

Did You Know?

The family of Emil Matasareanu sued the LAPD for wrongful death because of the LAPD's refusal to allow the ambulances to the scene to treat him. The LAPD stated that ambulance personnel were following standard procedure in hostile situations by not entering "the hot zone" because there were reports of other possible suspects in the area. After a hung jury in the first trial, the Matasareanu family dropped the suit.

HISTORICAL CRIME CASE STUDY 2.2: Police Canine Makes the Ultimate Sacrifice



Example

Take Notes

In June 1998, the *Edmonton Police Service* (EPS) was informed that a suicidal man wearing no shirt, black sweat pants, and running shoes was discharging a shotgun in his backyard. Police determined the man was 20-year-old Chad Yurko. When patrol officers arrived, they confronted Yurko as he was walking on a pathway behind his home. Yurko pointed his shotgun at police, saying he wanted to commit suicide. Officers demanded that he put the gun down, but Yurko continually refused.

Police retreated and called in the EPS Tactical Unit. Patrol officers watched as Yurko began moving toward a large playing field shared by three schools. As Yurko made his way to the field, he began waving his gun and firing rounds aimlessly into the air. When Yurko got to the field, he pointed the gun briefly at several teens and then fired into the air again. Yurko made his way towards Bishop Savaryn elementary school. As he did so, he yelled that he wanted to kill himself and put the gun in his mouth briefly. Fortunately, the playing field was empty because the school's outdoor fun day ended earlier than scheduled. Police notified the school of the situation, telling administration to keep all the children and staff inside.

Patrol officers followed Yurko as closely as they could. This was difficult because the empty field provided officers no cover. Officers had only handguns and one shotgun. They had no long-range weapons with which they could stop Yurko from getting closer to the school. Because Yurko was getting dangerously close to the school, police decided to release a police service dog to subdue the deranged man.

Constable Randy Goss and his canine partner Caesar, a 6 year-old Rottweiller, had arrived at the scene earlier. As Yurko walked towards the school, Constable Goss and Caesar got closer to Yurko while his back was turned. Constable Goss released Caesar. He ran full

Take Notes

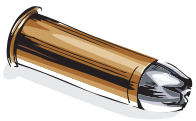
speed towards the gunman. A split second before Caesar would have jumped on Yurko's back, the gunman turned and shot Caesar point blank in the face. Caesar fell to the ground. Three officers moved toward Yurko and began shooting to prevent the man from shooting Constable Goss who was nearby. Yurko was soon subdued after being wounded by shotgun pellets to the head and upper leg. He was taken to hospital where he underwent surgery. Caesar was taken to an emergency veterinary clinic. However, his injuries were fatal. Chad Yurko survived his gunshot injuries. He was charged and later sentenced to 2.5 years in prison.

The entire incident from the time the police arrived on the scene until Yurko was apprehended lasted only 15 minutes. The EPS tactical squad arrived after the suspect had been apprehended. If the EPS tactical squad had arrived earlier, the scenario would have likely played out much differently because they are equipped with high-powered rifles. The tactical squad searched Yurko's house and found a rifle.

Constable Randy Goss was emotionally shaken by the incident because he had raised Caesar since he was 10 weeks old. They had spent every day together. Off duty, Caesar was a friendly family pet who loved to lick the faces of Randy and his family. At work, Caesar was all business. As a result, he was a formidable and successful police service dog. Caesar is viewed as a hero because he gave up his life to protect others.

Assignment

When you are ready, please complete the assignment for Lesson 4 in the Assignment Booklet.



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Did You Know?

Caesar was not afraid of bad guys brandishing guns, but he was afraid of heights. On one occasion, the location of an EPS Canine Unit photo shoot was changed because Caesar refused to go near the location – an overpass bridge.

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Modules 1 and 2

Appendix, Bibliography, and Glossary

Module 1 Appendix

Related Questions - Crime Case Study 1.1: Drug Impaired Driving - A Deadly Mix

1. **Can the Breathalyzer device or Intoxilyzer device detect drugs? If no, state why.**

   No. The Breathalyzer device or Intoxilyzer device cannot detect drugs. These devices test breath samples, but by-products of drug breakdown cannot be found in breath samples.

2. **List four body fluids that contain the by-products of drug breakdown.**

   Blood, saliva, sweat, urine

3. **What body fluids contain the highest concentration of the by-products of drug breakdown?**

   Blood and urine

4. **Explain why the evidence obtained from a roadside drug-testing device cannot be used to convict a suspected drug-impaired driver?**

   Roadside drug-testing devices indicate only if a particular drug is present. They do not indicate the quantity of the drug(s) in the body. They do not provide consistently reliable results. Also, Canadian legislation does not all this evidence to be used in court.

5. **What would the drug-impaired driving legislation allow police officers to demand from a suspected impaired driver?**

   The new laws would allow police to demand the following during drug-impaired driving investigations:

   - *Standardized Field Sobriety Tests administered at the roadside when there is a reasonable suspicion that a driver has taken drugs*
   - *Drug Recognition Expert (DRE) evaluations when a police officer believes a drug-impaired driving offence was committed (This includes a situations where drivers fail the sobriety tests. These evaluations can be administered at a police station and can help police notice the signs and symptoms of drug-impairment in drivers and then testify against them.)*
   - *A sample of body fluid (i.e., blood or urine) should the DRE officer determine that evidence of impairment was caused by a certain class of drugs*

Related Questions - Crime Case Study 1.2: **The Tylenol® Murders**

1. **State the type of poison added to the Extra Strength Tylenol® that killed seven people in the Chicago area in 1982.**

   Cyanide was added to the Extra Strength Tylenol® that killed seven people in the Chicago area in 1982.

2. **Describe how investigators think the killer added the poison to various bottles of Extra Strength Tylenol® in this case.**

   Investigators think that over several weeks the culprit entered various stores in the Chicago area, removed eight bottles of Extra Strength Tylenol®, added solid cyanide to some of the capsules in each bottle, and then placed the bottles back on store shelves. The addition of the cyanide was likely done at another location because no witnesses ever came forward saying they had seen the tampering occur.

3. **Why were police investigators able to rule out the possibility that cyanide was added to the Tylenol® capsules during their production?**

   Police determined that the tampered Tylenol® bottles came from different factories. Therefore, the possibility of sabotage at the production stage in each factory was considered unlikely.

4. **Outline specifically how the poison used in this case causes death in a victim.**

   Cyanide breaks down an important enzyme in the mitochondria of cells and prevents the production of ATP. Without the energy from ATP, body cells die.

   Cyanide tends to target cells in the brain, spinal cord, and heart – thus producing a quick death.

Related Questions - Crime Case Study 1.3: The Poisoning of a Russian Secret Service Ex-Agent

1. **Explain one reason the initial screening of Litvinenko indicated that he had been poisoned with radioactive thallium rather than polonium-210.**

   A substance with a chemical composition similar to thallium may have been present in Litvinenko's body and, therefore, produced a false positive test or a false positive peak in a chromatogram.

2. **What specific poisoning symptom caused Alexander Litvinenko to die?**

   Liver failure. If a person's liver fails, he or she will die within 24 hours because the body is unable to regulate blood sugar, to break down fats or old red blood cells, or to produce blood proteins. Because of a build-up of toxins, death results.

3. **What is the likely source of the unusual poison used to kill Alexander Litvinenko likely?**

   A nuclear reactor in Russia.

Module 2 Appendix

Related Questions - Lesson 3 Case Study: Police Service Dog Dies in the Line of Duty

1. **How long was Constable Schreiner a puppy handler?**

   February 1986 to August 1987 is 18 months.

2. **What type of crime was committed by the first suspect apprehended by Titus?**

   Trespassing in a person's yard at night; looking in the windows of the residence; attempted breaking into a house by prying open a window.

3. **At the time of his death, for how many more years was Titus scheduled to serve in the EPS Canine Unit?**

   He had three more years of service. (Dogs usually stay in the Canine Unit for seven years.)

4. **What did Constable Schreiner do after the death of his partner, Titus?**

   Constable Schreiner took some time off and then returned to the EPS. However, he began working in another unit and did not return to the Canine Unit.

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MODULE 1

Lesson 1

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Modules 1 and 2 Glossary

abscess - a localized collection of pus in part of the body, formed by tissue disintegration and surrounded by an inflamed area

acuity - clearness, or sharpness of vision

aerosol - a suspension of fine solid or liquid particles in a gas, contained under pressure and released as a spray

alkaline - a substance with very few hydrogen ions; basic; having a pH greater than 7

amide - a molecule containing the following functional group: (CO)NR 2 where R = C or H

antibodies - y-shaped proteins on the surface of white blood cells (b cells) that are secreted into the blood or lymph in response to foreign substances and/or antigens

antidotes - remedies or other agents used to neutralize or counteract the effects of poisons

antigen - a foreign substance that when introduced into the body stimulates the production of an antibody (Antigens include toxins, bacteria, foreign blood cells, and the cells of transplanted organs.)

aromatic - in chemistry, a molecule in which the electrons are free to cycle around circular arrangements of atoms that are alternately singly and doubly bonded to one another

asbestos - a strong and incombustible fibre widely used in the past for fireproofing and insulation (Asbestos fibres are easily inhaled or swallowed and can cause numerous serious diseases including asbestosis, a chronic disease of the lungs that makes breathing difficult, and cancer.)

ATP - (adenosine triphosphate) a high-energy phosphate molecule required to provide energy for cellular function; the energy source muscles use for short bursts of power

cadaver - a dead body

capillary dilation - the enlargement of small blood vessels (capillaries) beyond their normal dimensions

cellular respiration - the series of metabolic processes by which living cells produce energy (ATP) through the break down of organic substances

cerebrum - the largest part of the brain consisting of two hemispheres each containing four lobes; controls speech, memory, vision, personality, and muscles in certain parts of the body

coma - a state of deep, often prolonged unconsciousness, usually the result of injury, disease, or poison, in which an individual is incapable of sensing or responding to external stimuli and internal needs

cornea - the transparent layer forming the front of the eye

crystalline - being, relating to, or composed of crystal or crystals

derivative - a compound derived or obtained from another and containing essential elements of the parent substance

enzyme - any of numerous proteins produced by living organisms and functioning as biochemical catalysts necessary to begin internal chemical reactions

euphoric - a feeling of being happy or elated

excrete - the act or process of discharging waste matter (i.e., urine or sweat) from the blood, tissues, or organs

frequency - the number of occurrences within a given time

FSB - a state security organization in Russia; the domestic successor organization to the KGB (The name is an acronym from the Russian federal security service of the Russian federation.)

hemoglobin - the iron-containing respiratory pigment found in red blood cells that carries oxygen and carbon dioxide

impotence - incapability of sexual intercourse, often because of an inability to achieve or sustain an erection

indoctrination - instruction in the rudiments and principles of any science or system of belief or information

insatiable - impossible to satisfy

insomnia - chronic inability to fall asleep or remain asleep for adequate lengths of time

ions - an atom or a group of atoms that has acquired a net electric charge by gaining or losing one or more electrons

isotope - a form of a chemical element distinguished by the varying number of neutrons in its nucleus

KGB - ("Committee for State Security") the intelligence and internal security agency of the former Soviet Union; agency responsible for intelligence, counterintelligence, and internal security (At its peak, the KGB was the world's largest secret police and espionage organization.)

lacrymatory agent - (also lachrymatory) a chemical compound that irritates the eyes to cause pain; may cause temporary blindness

medulla oblongata - part of the brain, especially the base of the brain where the spinal cord connects; controls involuntary activities in the body such as heart rate, breathing rate, and digestive activities

metabolism - the chemical processes occurring within a living cell or organism that are necessary to maintain life

metalloid - a nonmetallic element, such as arsenic, that has some of the chemical properties of a metal

mimic - to copy or imitate closely; to resemble closely; to take on the appearance of

mitochondria - small cell organelles in the form of spherical granules, short rods, or long filaments found in almost all living cells (They produce energy in the form of ATP.)

molten - reduced to liquid form by heating

monomer - a simple molecule that can combine with other molecules to form a polymer

mucous - sticky phlegm or liquid in the respiratory tract

mucous membranes - type of membrane that lines areas of the body such as the mouth, nasal passages, stomach, intestine, vagina, and passages to the lungs

neurons - any of the impulse-conducting cells that constitute the brain, spinal column, and nerves, consisting of a nucleated cell body with one or more dendrites and a single axon

neurotransmitters - chemicals that allow the movement of information from one neuron across the gap between it and the adjacent neuron

neutering - removal of sexual organs in males (castration) or females (spaying) (When a dog is neutered, he is sedated and an elastrator tool secures a band around the testes to stop the blood supply to the testes. A tool called an emasculator is used to crush the spermatic cords to stop blood flow to the testes. Both testes are then surgically removed and the area is sutured.)

olfactory - pertaining to the sense of smell

organic - of, relating to, or derived from living organisms

paranoid - exhibiting or characterized by extreme and irrational fear or distrust of others

physiological - being in accord with or characteristic of the normal functioning of a living organism

polar - carrying a partial positive charge on one side of a molecule and a partial negative charge on the other

precipitate - to cause a solid substance to be separated from a solution

psychosis - a severe mental disorder characterized by derangement of personality and loss of contact with reality and causing deterioration of normal social functioning

radial - arranged as rays from a central point

radioactive - giving off energy because of the breaking up of nuclei of atoms

refute - to deny the accuracy or truth of something

rigor mortis - muscular stiffening following death (The onset may vary from about ten minutes to several hours or more after death, depending on the condition of the body at death and on factors in the atmosphere, particularly temperature. It is caused by chemical changes in the muscle tissue. The state of rigor usually lasts about twenty-four hours or until muscle decomposition occurs by acid formation.)

soluble - capable of being dissolved in a solvent such as water or other liquid

suffocate - to cause discomfort, kill, or destroy by preventing access of air or oxygen; to impair the respiration of; asphyxiate

superficial - close to the surface; shallow

synthetic - not natural or genuine; artificial or contrived; prepared or made artificially

trachea - the airway leading from the larynx (voice box) to the lungs; the windpipe

viscous - thick and resistant to flowing

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