CHAPTER 9

Drug Identification and Toxicology

AN ACCIDENTAL OVERDOSE

Within weeks of her death on February 9, 2007, it was determined that model and tabloid celebrity Anna Nicole Smith had died from an accidental overdose of prescription drugs, rather than as the result of foul play or illegal drug use. But how did the medical examiner know which drugs Smith had taken? And how was it determined that the overdose was accidental rather than intentional? Specific forensic analyses by toxicologists helped determine the drugs Smith used and how they caused her death.

The Broward County Medical Examiner in Florida reported that nine drugs and a few drug metabolites were found in Smith’s blood. The drugs included antianxiety and anti-depression prescriptions, such as Valium, pain and allergy medications, such as Benadryl, the antibiotic Ciprofloxacin, as well as human growth hormones. All drugs were found at therapeutic levels. Tests also found the presence of chloral hydrate, a sedative and sleeping medication.

Specialists determined that when this sedative combined with the other drugs in her system, it led to Smith’s accidental death. The combined drug effect acted on her respiratory and circulatory systems, causing them to stop working. The medical examiner ruled out that this was a suicide, as some suggested, because of the large amount of chloral hydrate remaining in the bottle and the normal levels of the other medications in her system.

Drug interactions can cause death in even small doses. Anna Nicole Smith’s 20-year-old son Daniel also appears to have died from a lethal combination of drugs. In Daniel’s case, it was a lethal combination of antidepressants Lexapro and Zoloft, and the drug methadone. This drug cocktail appears to have affected his central nervous system and heart, leading to his sudden death. Forensic investigations of both tragic deaths found no evidence to indicate foul play. Both overdoses were accidental.
OBJECTIVES
By the end of this chapter, you will be able to
✓ Identify the five types of controlled substances.
✓ Relate signs and symptoms of overdose with a specific class of drugs or toxins.
✓ Describe the role of various types of toxins in causing death.
✓ Discuss agents that may be used in bioterrorism.
✓ Define and describe the goals and practice of toxicology.

VOCABULARY
controlled substance a drug or other chemical compound whose manufacture, distribution, possession, and use is regulated by the legal system
drug a chemical substance that affects the processes of the mind or body; a substance used in the diagnosis, treatment, or prevention of a disease; a substance used recreationally for its effects on the mind or body, such as a narcotic or hallucinogen
narcotic an addictive drug, such as opium, that relieves pain, alters mood and behavior, and causes sleep or feelings of mental numbness

poison a naturally occurring or manufactured substance that can cause severe harm or death if ingested, inhaled, or absorbed through the skin
toxicity the degree to which a substance is poisonous or can cause injury
toxin a poisonous substance naturally produced by certain plants, animals, and bacteria that is capable of causing disease or death in humans; a subgroup of poisons
Saliva-based drug tests are as accurate as urine-based tests. The saliva test can generally detect illegal drugs immediately on use for up to about 72 hours.
forensic toxicologists to popularize these new methods were physicians Mathieu Orfila (1787–1853) and Robert Christison (1797–1882).

**MURDER BY POISON**

Although poisoning is popular in murder mysteries and detective stories, in reality, it is not a common form of murder. Less than one-half of 1 percent of all homicides result from poisoning. Throughout history, some notable individuals have died from poisoning: Nazi leaders Heinrich Himmler and Hermann Goering ingested cyanide capsules in 1945; Jonestown cult members consumed cyanide-laced punch in 1978, killing approximately 900 people; Bulgarian dissident Georgi Markov was killed by ricin in 1978; and most recently, Russian ex-spy Alexander Litvinenko was exposed to radiation in 2006. Today, the commonly used poisons include arsenic, cyanide, and strychnine, as well as an assortment of industrial chemicals that were created for other uses, such as fertilizers.

Testing for a vast array of possible toxins can be a challenge to the toxicologist. Toxicologists must distinguish between acute poisoning and chronic poisoning. *Acute poisoning* is caused by a high dose over a short period of time, such as cyanide ingestion or inhalation, which immediately produces symptoms. *Chronic poisoning* is caused by lower doses over long periods of time, which produces symptoms gradually. Mercury and lead poisoning are examples of chronic poisoning in which symptoms develop as the metal concentrations slowly rise and accumulate to toxic levels in the victims’ bodies over a long period of exposure.

**ACCIDENTAL DRUG OVERDOSES**

Accidental deaths from drug overdoses are more common than deaths from poisoning. The deaths of comedians John Belushi and Chris Farley, actor River Phoenix, and musicians Steve Clark, Janis Joplin, Jim Morrison, and Jimi Hendrix were all linked to lethal drug combinations or overdoses.

**DRUGS AND CRIME**

Illegal drugs, such as heroin and lysergic acid diethylamide (LSD), are drugs with no currently accepted medical use in the United States. **Controlled substances** are defined as legal drugs whose sale, possession, and use are restricted because of the effect of the drugs and the potential for abuse. These drugs are medications, such as certain *narcotics*, depressants, and stimulants, that physicians prescribe for various conditions.

Arrests for drug abuse violations have increased steadily since the early 1990s. Drug abuse violations topped the list of the seven leading arrest offenses in
the United States in 2005. Drug offenders make up more than half of the federal prison system population and about 20 percent of the state prison population.

**CONTROLLED SUBSTANCES**

There are five classes of controlled substances: (1) hallucinogens, (2) narcotics, (3) stimulants, (4) anabolic steroids, and (5) depressants.

**Hallucinogens**

Hallucinogens are often derived from plants and affect the user’s perceptions, thinking, self-awareness, and emotions. Hallucinogens derived from plants include mescaline from a cactus (peyote), marijuana, and extracts from certain mushrooms. Hallucinogens, such as LSD, MDMA (the amphetamine ecstasy), and PCP (angel dust), are chemically manufactured. The effect and intensity of response to the drug varies from person to person.

LSD was originally found in 1938 in a fungus that grows on rye and other grains and is one of the most potent mood-changing chemicals. It is odorless, colorless, and tasteless and is sold in tablets or on absorbent paper divided into small decorative squares. PCP was first developed as an anesthetic, but it is no longer used because it induces hallucinations. In the illicit drug market, PCP is available in a number of forms. It may be a pure, white, crystal-like powder, a tablet, or a capsule. It can be sniffed, swallowed, smoked, or injected. Mescaline is smoked or swallowed in the form of capsules or tablets. Marijuana leaves (cannabis) may be smoked or refined, concentrated, and sold as hashish. Hashish is made from resin found on ripe flowers, which are rolled into balls and smoked. Figure 9-1 shows hallucinogenic drugs and the characteristic symptoms of an overdose.

**Figure 9-1.** Table of hallucinogenic drugs and the characteristic symptoms of an overdose.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Characteristics of Drug Overdose</th>
</tr>
</thead>
<tbody>
<tr>
<td>MDMA (ecstasy)</td>
<td>Increased heart rate and blood pressure, muscle cramps, panic attacks, seizures, loss of consciousness, stroke, kidney failure, death</td>
</tr>
<tr>
<td>Mescaline</td>
<td>Hallucinations, euphoria, dizziness, vomiting, increased heart rate, dilated pupils, diarrhea, headaches, anxiety, irrationality of thoughts</td>
</tr>
<tr>
<td>LSD</td>
<td>Dilated pupils, loss of appetite, sleeplessness, increase in body temperature, increased heart rate and blood pressure, sweating, dry mouth, tremors, confusion, distortion of reality, and hallucinations</td>
</tr>
<tr>
<td>PCP</td>
<td>Increased heart rate and blood pressure, convulsions, sweating, dizziness, numbness, and possibly death from heart failure. Drowsiness, which can lead to accidents. Users sometimes exhibit psychosis (completely losing touch with reality) that can last for weeks.</td>
</tr>
</tbody>
</table>
Narcotics

Narcotics act to reduce pain by suppressing the central nervous system’s ability to relay pain messages to the brain. Narcotics include opium and its derivatives—heroin and codeine. These painkillers are very habit forming. Hydrocodone (Vicodin, Lortab), methadone (Dolophine), morphine (MS Contin), oxycodone (Percocet, OxyContin), and codeine-containing pain relievers, such as Tylenol 3 (acetaminophen and codeine), are man-made narcotic painkillers that are often abused. See Figure 9-2 for a summary of narcotic drugs and the characteristic symptoms of an overdose.

**Figure 9-2. Table of narcotic drugs and the characteristic symptoms of an overdose.**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Characteristics of Drug Overdose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opium</td>
<td>Difficulty breathing, low blood pressure, weakness, dizziness, confusion, loss of consciousness, coma, cold clammy skin, small pupils</td>
</tr>
<tr>
<td>Heroin</td>
<td>Difficulty breathing, low blood pressure, coma, spasms of the stomach or intestines, constipation, nausea, vomiting, sleepiness, blue fingernails and lips, death</td>
</tr>
<tr>
<td>Codeine</td>
<td>Difficulty breathing, drowsiness, coma, low blood pressure, muscle twitches, blue fingernails and lips</td>
</tr>
<tr>
<td>Morphine</td>
<td>Difficulty breathing, drowsiness, coma, low blood pressure, muscle twitches, blue fingernails and lips</td>
</tr>
<tr>
<td>Methadone</td>
<td>Difficulty breathing, drowsiness, coma, low blood pressure, muscle twitches, blue fingernails and lips</td>
</tr>
<tr>
<td>Oxycodone</td>
<td>Slow, difficult breathing, seizures, dizziness, weakness, loss of consciousness, coma, confusion, tiredness, cold clammy skin, and small pupils</td>
</tr>
</tbody>
</table>

**Stimulants**

Stimulants increase feelings of energy and alertness while suppressing appetite. Depression often results as the effect of the drug wears off. They are also used and sometimes abused to boost endurance and productivity. Examples of stimulants include amphetamines, methamphetamines, and cocaine (including crack), and are highly addictive. The key difference between methamphetamines and amphetamines is that methamphetamines are more potent than amphetamines. Figure 9-3 shows characteristic symptoms of an overdose with stimulant drugs.

**Figure 9-3. Table of stimulant drugs and characteristic symptoms of an overdose.**

<table>
<thead>
<tr>
<th>Drug</th>
<th>Characteristics of Drug Overdose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphetamines (Speed)</td>
<td>High blood pressure, rapid heart rate, agitation, irregular heartbeats, stroke, seizures, coma, death</td>
</tr>
<tr>
<td>Cocaine/crack cocaine</td>
<td>Dangerous rise in body temperature, sweating, tremors, seizures, irregular heartbeats, stroke, confusion, heart attack, bleeding in the brain, death</td>
</tr>
<tr>
<td>Methamphetamines</td>
<td>Dangerous rise in body temperature, profuse sweating, confusion, rapid breathing, increased heart rate, dilated pupils, high blood pressure, kidney failure, bleeding in the brain, death</td>
</tr>
</tbody>
</table>
Anabolic Steroids

Anabolic steroids promote cell and tissue growth and division. These drugs are produced in the laboratory and have a chemical structure similar to testosterone, the male sex hormone. Anabolic steroids were originally used to treat hypogonadism, a condition in which the testes produce abnormally low levels of testosterone. Today, they are used to treat some cases of delayed puberty, impotence, and muscle wasting caused by HIV infection. In the 1950s, they gained popularity with weightlifters and bodybuilders because they act to increase body muscle and bone mass. The negative side effects of anabolic steroids range from mild side effects, such as acne, increased body hair, and baldness, to severe side effects, such as high blood pressure and cholesterol levels, impaired fertility in males, blood clotting, kidney and liver cancers, and heart attacks.

Depressants

Depressants are drugs, such as barbiturates and benzodiazepines, that relieve anxiety and produce sleep. Depressants reduce body functions, such as heart rate, by acting on the central nervous system and increasing the activity of a neurotransmitter called GABA. The result of increased GABA production is drowsiness and slowed brain activity. The user becomes very calm, which is why these drugs are used to relieve tension and promote sleep. Side effects of depressants include slurred speech, loss of coordination, and a state of intoxication similar to that of alcohol. An overdose may slow heart rate and breathing and cause coma and death. Mixing depressants with alcohol and other drugs increases their effects and health risks.

OTHER ORGANIC TOXINS

Organic toxins are poisonous substances produced by living organisms. They are usually proteins that can be absorbed by another living creature and interfere with that organism’s metabolism. Poisons are generally absorbed into an organism through the intestine or the skin. A bee sting or snakebite is an example of venom, a toxin secreted by an animal that can be transferred to a human (Figure 9-4).

ALCOHOLS

All alcohols are toxic to the body. Methanol is not directly poisonous, but when it is converted by the liver to formaldehyde, it becomes very toxic. Ethanol, the alcohol found in many beverages, is called grain alcohol. It is produced by the fermentation of sugar in fruits, grains, and vegetables. Pure ethanol is tasteless, but it can damage human tissue.

The body converts ethanol to acetaldehyde and then acetic acid. When too much acetaldehyde accumulates in the blood, it may produce dehydration and the classic symptoms of a hangover, headache, nausea, and weakness. Chronic abuse of alcohol can cause liver damage as well as disturbed, dangerous behavior. Consumption of alcohol can depress the central nervous system as well.

BACTERIAL TOXINS

Botulism is the most poisonous biological substance known to humans. It is produced by the bacterium Clostridium botulinum and acts as a neurotoxin,
paralyzing muscles by blocking the release of the neurotransmitter acetylcholine. If the condition is diagnosed early, then an antitoxin made from horse serum may be given. Because damage caused by the toxin is irreversable, acetylcholine release and muscle strength may take months to return, and recovery depends on how quickly the nerves sprout new endings.

This bacterial toxin is extremely deadly in very small amounts and causes painful spasms before death. The toxin may be ingested from contaminated food, such as canned vegetables, cured pork and ham, smoked or raw fish, and honey or corn syrup. People also become infected with bacterial spores that produce and release the toxin in the body. The spores that contain the toxin are sensitive to heat and may be destroyed by cooking and heating thoroughly at 80 degrees Celsius (176 degrees Fahrenheit) for 10 minutes or longer. Purified botulinum toxin (sometimes called “botox”) has been safely used in medicine to treat muscle spasms, eye conditions, excessive sweating, and headaches, as well as to stimulate wound healing and as a cosmetic treatment.

Clostridium tetani is the bacteria that produce tetanus, a potentially deadly nervous system disease (Figure 9-5). The bacteria release tetanospasmin, a poison that blocks nerve signals from the spinal cord to the muscles, causing muscle spasms so severe that they can tear muscles and fracture bones. Tetanus is sometimes called “lockjaw” because spasms often begin in the jaw and may interfere with breathing. Worldwide, tetanus causes approximately 1 million deaths per year. In the United States, tetanus accounts for about five deaths per year, primarily in persons who have not been vaccinated against the disease.

HEAVY METALS AND PESTICIDES

Applications of pesticides have been used primarily for controlling insects, mice, weeds, fungi, bacteria, and viruses that threaten plants or food crops. Pesticides are, by definition, toxic and can cause severe illness and death. Because one of the measures of toxicity of an exposure is its duration, time is of the essence in recognizing pesticide poisoning.

Metal compounds, such as arsenic, lead, and mercury, are very poisonous and have also been used for suicide and homicide. Metals may enter the body by ingestion and inhalation or by absorption through the skin or mucous membranes. Metals are stored in the soft tissues of the body and can damage many organs throughout the body. Figure 9-6 on the next page lists heavy metals and pesticides with characteristic symptoms of an overdose.

Other lethal agents include gases, such as hydrogen cyanide (used in gas chambers), carbon monoxide (non-ventilated car exhausts), and potassium chloride...
Figure 9-6. Table of heavy metals and pesticides, with characteristic symptoms of an overdose.

<table>
<thead>
<tr>
<th>Drug</th>
<th>Characteristics of Drug Overdose</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pesticides (e.g., DDT, aldrin, dieldrin)</td>
<td>Phosphate-containing pesticides that accumulate in fatty tissue inhibit cholinesterase, leading to excess acetylcholine, which interferes with the movement of nerve impulses and muscular contractions. Anxiety, seizures, twitching, rapid heartbeat, muscle weakness, sweating, salivation, diarrhea, tearing, coma, and death</td>
</tr>
<tr>
<td>Lead</td>
<td>Nausea, abdominal pain, insomnia, headache, weight loss, constipation, anemia, kidney problem, vomiting, seizure, coma, and death. Blue discoloration appears along the gumline in the mouth.</td>
</tr>
<tr>
<td>Mercury</td>
<td>The Mad Hatter’s Disease (hat-makers in England used a mercury compound) is a progressive disorder as mercury is absorbed into the skin or lungs. Acute poisoning from inhalation causes flu-like symptoms such as muscle aches and stomach upset. Chronic poisoning causes irritability, personality changes, headache, memory and balance problems, abdominal pain, nausea, and vomiting, as well as excessive salivation and damage to the gums, mouth, and teeth. Long-term exposure can cause death.</td>
</tr>
<tr>
<td>Arsenic</td>
<td>Within 30 minutes of ingestion it produces abdominal pain, severe nausea, vomiting and diarrhea, dryness of the throat, difficulty speaking, muscle cramps, convulsions, kidney failure, delirium, and death. Chronic exposure produces skin lesions and changes in pigment, headache, personality changes, nausea, vomiting, diarrhea, convulsions, and coma.</td>
</tr>
<tr>
<td>Cyanide</td>
<td>Cyanide overdose can be fatal six to eight minutes after ingestion. Rapidly causes weakness, confusion, coma, and pink skin from high blood oxygen saturation. Produces an almond-like odor.</td>
</tr>
<tr>
<td>Strychnine</td>
<td>Enters the body by inhalation or absorption through eyes or mouth. Body spasms, temperature rises, violent convulsions, and rigor mortis (stiffness after death) occurs within minutes.</td>
</tr>
</tbody>
</table>

or sodium pentothal (used in lethal injections). These poisons produce death by inhibiting enzyme activity, interfering with production of adenosine triphosphate (ATP), which is required to provide energy for cellular function, or, in the case of lethal injections, stopping the heart by destroying the cell’s potential for transmitting electrical impulses.
**BIOTERRORISM AGENTS**

*Ricin* is a component of the waste product of the manufacture of castor oil from castor beans. It is lethal in humans in quantities as small as 500 micrograms—a dose the size of the head of a pin! Ricin poisoning can be induced in various forms. It can be inhaled as a mist or a powder, ingested in food or drink, or even injected into the body. It acts by entering the cells of the body and preventing them from making necessary proteins, causing cell death. When enough cells die, death may occur. See Figure 9-7 for methods of ricin poisoning and the characteristic symptoms.

**Figure 9-7. Table of methods of ricin poisoning and the characteristic symptoms.**

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhalation</td>
<td>Within eight hours of exposure, difficulty breathing.</td>
</tr>
<tr>
<td></td>
<td>Within a few hours, fever, cough, nausea, sweating, tightness in the chest,</td>
</tr>
<tr>
<td></td>
<td>low blood pressure, excess fluid in lungs, and death</td>
</tr>
<tr>
<td>Ingestion</td>
<td>Within six hours of exposure, vomiting, diarrhea, bloody urine, dehydration,</td>
</tr>
<tr>
<td></td>
<td>low blood pressure, hallucinations, seizures, and death</td>
</tr>
<tr>
<td>Skin and eye</td>
<td>Redness and pain</td>
</tr>
</tbody>
</table>

Anthrax is caused by a bacterium, *Bacillus anthracis*, that forms endospores (Figure 9-8). A spore is a thick-walled inactive cell that can later grow under favorable conditions. Infected animals can transmit the disease through spores to humans, but human-to-human transmission has not been reported. Anthrax can enter the body by inhalation, ingestion, or skin absorption. Figure 9-9 shows characteristic symptoms of anthrax exposure.

**Figure 9-9. Table of methods of anthrax exposure and characteristic symptoms.**

<table>
<thead>
<tr>
<th>Exposure</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inhalation</td>
<td>Initially produces flu-like symptoms, such as sore throat, cough, fever, and muscle aches.</td>
</tr>
<tr>
<td></td>
<td>Symptoms become progressively worse to include breathing problems and usually results in death.</td>
</tr>
<tr>
<td>Ingestion</td>
<td>Nausea, vomiting, fever, abdominal pain, and severe diarrhea. Intestinal anthrax is fatal in 25 to 60 percent of cases.</td>
</tr>
<tr>
<td>Skin absorption</td>
<td>Raised, itchy bumps that resemble an insect bite develop into a painless sore with a black area in the center. About 20 percent of untreated cases of cutaneous anthrax result in death. Deaths are rare with appropriate treatment.</td>
</tr>
</tbody>
</table>

In 2001, anthrax spread through the U.S. postal system in letter-sized envelopes caused 22 cases of anthrax infection, half of which resulted in death.
SUMMARY

- Forensic toxicology seeks to identify poisons or drugs in criminals and victims and their likely effects on those people.
- The history of intentional poisoning goes back to ancient Greece. The chemical analysis of poisons in the body began in the 19th century.
- Poisoning is rare as a form of murder, but toxicology is important in studying cases of drug overdoses and sporting violations.
- Controlled substances fall into five groups: hallucinogens, narcotics, stimulants, steroids, and depressants.
- Poisons produced by living organisms include alcohol and bacterial toxins.
- Heavy metals and pesticides are also common poisons found in humans.
- Bioterrorism agents include ricin, a poisonous compound produced by the castor bean plant, and anthrax, a bacterium that produces potent toxins.

CASE STUDIES

Mary Ansell (1899)
Mary Ansell, an English housemaid, poisoned her sister Caroline to obtain an insurance settlement. Mary sent Caroline a cake tainted with phosphorous. Caroline died after eating the poisoned cake. Evidence of Mary’s recent purchases of phosphorus and a life insurance policy in her sister’s name was provided at her trial. Based on this evidence, Mary was quickly convicted and executed.

Eva Rablen (1929)
Eva Rablen loved to dance. On several occasions, her husband Carroll drove her to the schoolhouse, where weekly dances were held. The First World War had left Carroll wounded and deaf. He often remained in the car while his wife danced in the schoolhouse. Eva would frequently bring Carroll coffee and sandwiches while he waited in the car. On one such evening, Carroll was found dead after consuming his food and coffee. Initially, the death was attributed to natural causes, but later a bottle of strychnine was found below the floorboards of the schoolhouse. Eva was identified by a druggist as the person who purchased the poison a few days before the death of her husband.

When Dr. Edward Heinrich examined Carroll’s body, traces of strychnine were found in his stomach, in the coffee cup, and on the seat of the car. On the way to the car, Eva bumped into a woman and spilled some of the poi-
seasoned coffee on the woman's dress. Dr. Heinrich examined several drops of coffee left on that woman's dress and found strychnine. In the face of the mounting evidence, Eva changed her plea from not guilty to guilty to avoid the death penalty.

The Death of Georgi Markov (1978) and the Attack on Vladimir Kostov (1978)

After defecting from Bulgaria, Georgi Markov moved to London. While walking one day, he was injected in the leg with ricin. The delivery method used a specially constructed umbrella with a modified tip for injection. He became gravely ill, and on the third day after the attack was vomiting blood. He suffered a complete heart blockage and died. The autopsy revealed a platinum-iridium pellet the size of the head of a pin in his leg. It had been cross-drilled with 0.016-inch holes to contain the toxin. The amount of ricin in the pellet, only two milligrams of the poison, was sufficient to cause his death.

Ten days earlier, a similar assassination attempt was made against Vladimir Kostov in Paris. Kostov's heavy clothing prevented an identical projectile from entering a major blood vessel. Instead, the pellet lodged in muscle tissue, preventing the poison from circulating as it had in Markov's body. This saved Kostov's life. On hearing of Markov's death, Kostov underwent a surgical examination, and the pellet was found before sufficient toxin could be absorbed to cause his death.

Tylenol Tampering (1982)

Extra Strength Tylenol tablets dosed with cyanide claimed seven lives. The person(s) responsible have never been caught. It is believed that cyanide was added to the Tylenol and that the tainted bottles were placed on the shelves of several supermarkets and pharmacies in the Chicago area. In addition to the five bottles responsible for the seven deaths, three poisoned bottles were found on the shelves. Because they were from different production locations, investigators believed the tampering occurred after the product was shipped, rather than in the factory. This was the first documented example of random drug poisoning. The $100,000 reward posted by the drug manufacturer, Johnson and Johnson, has never been claimed. This incident led to the development of tamper-resistant packaging and caplets designed to protect the public.

In 1986, Stella Nickell, a Seattle woman, laced some Excedrin with cyanide and killed her husband for his life insurance. She placed three other poisoned bottles of Excedrin in the store to make it look like a random killing and killed another woman, Susan Snow, in the process. In 1988, Stella was sentenced to 99 years in prison.

Think Critically  You are an advertising executive. Select a category of controlled substance. Using your expertise, create a message to communicate the dangers of that substance to the public.
Dr. Don Catlin, Pharmacologist and Drug Testing Expert

Dr. Don Catlin recently left his position as head of the UCLA School of Medicine laboratory for a new research position. The UCLA laboratory, with more than 40 researchers, helped expose many drug-related sports scandals, by identifying players who were using performance-enhancing drugs. Catlin is one of the most respected sports and antidoping drug testers in the world, and he plans to remain active in the field of research.

Catlin became a professor in the Department of Pharmacology of the UCLA School of Medicine in 1972. In 1982, his interest in substance abuse led him to found the UCLA Olympic Laboratory to do the drug tests for the 1984 Los Angeles Summer Olympics. He also ran the drug testing for the 1996 Atlanta Summer Olympics and the 2002 Salt Lake Winter Games. His job has included testifying and defending his drug-testing methods in court.

The UCLA laboratory has provided drug education and urine tests to a growing number of sports organizations, including the U.S. Olympic Committee, NCAA, NFL, and Minor League Baseball. The lab has developed novel drug tests, such as the one used to distinguish between naturally produced and artificially taken testosterone. The laboratory is one of the world’s premier places for analyzing samples from athletes to detect the use of illegal substances such as anabolic steroids, the blood-oxygen booster erythropoetin, and many other performance-enhancing drugs. It is the busiest lab of its kind in the world, with about 40,000 samples analyzed each year.

What kept Don Catlin so dedicated to the field of sports drug testing? Catlin says, “You should care about preserving something natural and beautiful. I can’t think of anything more exciting than the Olympic model, where 220 countries in the world participate, and every four years they send their best to compete against the best from other countries and the best man or woman wins.”

To be in the field of pharmacology, one needs a science education with graduate studies that include courses in analytical chemistry, drug metabolism, and drug pharmacokinetics. The drug-testing field requires special knowledge of legal and ethical issues. Pharmacologists can work in universities, hospitals, governmental organizations, nonprofit organizations, or pharmaceutical or related industries.

Learn More About It
To learn more about the work of a pharmacologist, go to school.cengage.com/forensicsscience.
True or False

1. Toxins are poisons manufactured in laboratories.
2. The major ways people are exposed to toxins are by ingesting them, inhaling them, injecting them, or absorbing them through the skin.
3. Today, poisoning is a very common form of murder.
4. There are six basic types of controlled substances.
5. Accidental deaths from drug overdoses are more common than deaths from poisoning.
6. Anabolic steroids increase muscle mass and have no harmful effects.
7. *Clostridium botulinum* causes lockjaw.
8. All alcohols are toxic to the body.
9. Mercury can cause the symptoms of acute poisoning.
10. Some poisons, like potassium chloride, interfere with enzyme activity.

Short Answer

Choose a part of the body or a product from the body and describe what type of drug testing could be performed on that part of the body.

- Urine: testing for steroid, narcotics
- Hair: testing for alcohol and drug use
- Breath: testing for alcohol
- Muscle: testing for anabolic steroids

11. How is the test performed?

12. How expensive is the testing?
13. Is the test invasive?

14. Can the test be easily performed on a living person?

15. Is a skilled technician required to perform the test and to read the results?

16. Will the test demonstrate drug usage or toxin exposure:
   a. During the past hour?
   b. During the past several hours?
   c. During the past 24 hours?
   d. During the past few months?

17. How reliable is the drug testing? What variables may affect the results?

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