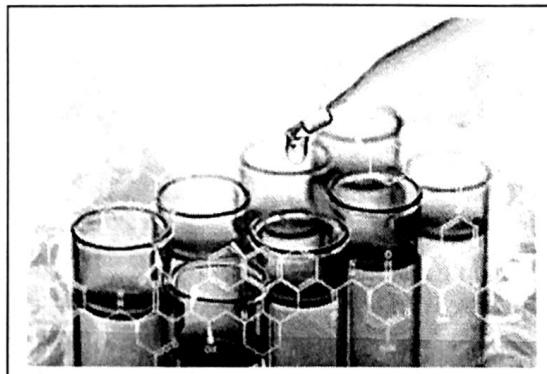


NAME \_\_\_\_\_

## CHEMICAL IDENTIFICATION & TOXICOLOGY

### DIRECTIONS:

- Read/Highlight the information carefully
- Complete the questions and submit your answers



## What is Forensic Toxicology?

The sale and distribution of illegal drugs involves a global black market with an estimated retail value totaling more than \$320 billion in U.S. dollars. Law enforcement agencies have attempted to prevent the distribution and sale of illegal drugs since it was first recognized as a growing problem in the early 1960s. Financial incentives drive the sale of illegal drugs, the result of which often ends in high levels of property crime, murder, and social disorder. Law enforcement agencies work towards reducing the overall size of the drug trade in order to prevent such problems from increasing in magnitude.

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

The ingestion of a poison or toxin can lead to life-threatening injuries and/or death. It may be accidental or deliberate, including cases of suicide and murder. Accidental poisonings and suicidal acts stemming from the consumption of poisons/toxins are considered to be non-criminal matters. The deliberate poisoning of an individual or group of persons is considered to be a criminal matter and will typically result in a police investigation. The science of forensic toxicology plays an important role in the successful investigation and prosecution of such criminal matters.

Toxicology is the science studying the origin, nature, and properties of various drugs and poisons/toxins. Forensic toxicology is the application of toxicology for the purpose of solving criminal cases.

Forensic Toxicology generally concerns the detection and characterization of drugs or poisons/toxins exhibiting adverse physiological effects.

The services of toxicologists are not just required in law enforcement and medical examiner's offices; they work at hospitals where the identification of an overdose can mean the difference between life and death. The work of a forensic toxicologist generally falls into three main categories:

1. Testing for alcohol in urine or blood samples. (i.e.: gas chromatography, breathalyzers).
2. Detection of drugs, poisons and toxins in body fluids, tissues or organs.
3. Identification and quantification of the specific type of drug, poison or toxin in a subject.



*In Canada in 2011, 1.7% of Canadians reported they had used at least one of five illicit drugs: cocaine, crack, speed, ecstasy, hallucinogens & heroin.*

- Statistics Canada website: [www.stat.can.ca](http://www.stat.can.ca)

# What is FORENSIC TOXICOLOGY?

Name : \_\_\_\_\_ Date: \_\_\_\_\_

*Read the related handout in order to fill in the blanks with the appropriate terms.*

The sale and \_\_\_\_\_ of illegal drugs involves a \_\_\_\_\_ with an estimated retail value totaling more than \_\_\_\_\_ in U.S. dollars. \_\_\_\_\_ agencies have engaged in attempts to prevent the distribution and sale of illegal drugs since it was first recognized as a \_\_\_\_\_ problem in the early \_\_\_\_\_. Financial incentives drive the sale of illegal drugs, the result of which often ends in high levels of \_\_\_\_\_ crime, murder, and social disorder. Law enforcement agencies therefore work towards reducing the overall \_\_\_\_\_ of the drug trade in order to prevent such problems from \_\_\_\_\_ in magnitude.

Each year, numerous \_\_\_\_\_ and \_\_\_\_\_ result from the use of illegal drugs. Forensic \_\_\_\_\_ plays an important role in the investigation of such incidents, as well as related crimes.

The ingestion of a \_\_\_\_\_ or \_\_\_\_\_ can lead to life-threatening injuries and/or death. It may be accidental or \_\_\_\_\_ including cases of suicide and murder. \_\_\_\_\_ poisonings and \_\_\_\_\_ acts stemming from the consumption of poisons/toxins are considered to be \_\_\_\_\_ matters. The deliberate \_\_\_\_\_ of an individual or group of persons is considered to be a criminal matter and will typically result in a police investigation. The science of forensic toxicology plays an important role in the successful investigation and \_\_\_\_\_ of such criminal matters.

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2. Detection of \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_ in body fluids, tissues or organs.
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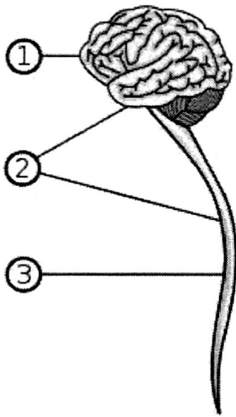
*In 2013 a resurgence in the use of the illegal drug heroin occurred in North America. The death rate for heroin addicts is more than twice the normal rate. The main cause of death of heroin users is overdose. Heroin addicts do not use the drug for pleasure; rather, they use it to prevent severe withdrawal symptoms.*

- Simpson & Connor-Ogorzaly, *Economic Botany – Plants in Our World*. Toronto: McGraw-Hill Publishing Co, 1986. (p. 394)

# Illegal Drugs & the Human Body

Most illegal drugs are psychoactive drugs meaning they alter a person's perception or mood. Some psychoactive drugs are known as depressants because they depress an individual's sense of alertness by causing them to feel relaxed (i.e. marijuana). Other psychoactive drugs are known as stimulants because they stimulate an individual's sense of alertness causing them to feel hyperactive (i.e. cocaine).

Psychoactive drugs can be taken orally, through injection or they may be absorbed into body membranes located in the nose, lungs, rectum or vagina. In order for any type of drug to exert its influence it must be absorbed into the blood stream and transported to its targeted body region. After a drug has been ingested it can be detected both in the region it targets as well as in the bloodstream. Some drugs are broken down in the region they affect, while other drugs are broken down as they pass through the liver. Breakdown products are transported to the kidneys and excreted into the urine. Therefore, forensic toxicologists may look for a drug or the breakdown products of a drug in three areas: the blood, the urine or in the target region.



The majority of psychoactive drugs target the cells of the Central Nervous System (CNS)(2) which consists of the brain (1) and spinal cord (3). 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 this neuron through a space (called the synapse) towards a receptor neuron. Once neurotransmitters come into contact with the receptor neuron a response is triggered. Some examples of responses that may be triggered in neurons with the CNS include muscle contractions, heart rate, the sensation of pain, interpretation of visual images, emotions, and sleep. Once neurotransmitters have triggered a receptor neuron they are quickly broken down so they no longer produce an effect.

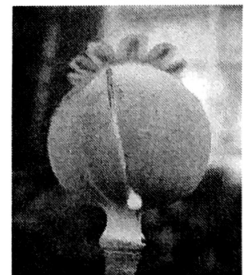
There are many types of psychoactive drugs that exist; some are considered legal, while others are illegal. Psychoactive drugs that are most commonly analyzed by forensic toxicologists are illegal. There are numerous types of illegal psychoactive drugs, each having their own unique effects upon the body. In general, psychoactive drugs fall within two categories: depressants or stimulants.

## DEPRESSANTS

Depressants (also called narcotics) are psychoactive drugs that cause drowsiness, sleep and insensitivity. Depressants prevent the release of neurotransmitters that stop neuron stimulation, producing feelings of relaxation. Other depressants mimic neurotransmitters that prevent the feeling of pain causing a dull, relaxed state to set in. Most depressants are illegal without a prescription, however one of the most powerful and addictive of all depressants, alcohol, is legal. The three most common types of illegal depressants include: *opiates, marijuana and barbiturates*.

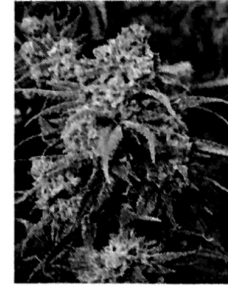
### **Opiates:**

Drugs derived from the milky secretions of the poppy bulb before flowering. 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 chance of infection and addiction. Common types of opiates include: *morphine, codeine, heroin, demerol, and methadone*.



**Marijuana:**

Marijuana is derived from the leaves of the *Cannabis sativa* plant. The active chemical ingredient in marijuana is tetrahydrocannabinol (THC). Only one particular *Cannabis sativa* plant species contains THC. It is thought that THC prevents a neuron's uptake of a common neurotransmitter called acetylcholine, thereby preventing neuron stimulation. Marijuana is also classified as a hallucinogen because it alters normal thoughts and mood. Marijuana intake tends to make one feel relaxed and gives them a sense of well-being. It also impairs a person's coordination and visual acuity. As a result, it impairs one's ability to operate a vehicle. Heavy use of marijuana has been linked to serious lung disorders, addiction, and low sperm counts in males. *Hashish* is an addictive form of marijuana that is derived from pure resin that develops on the leaves and flowers of *Cannabis sativa* plants that have been grown in dry, hot conditions. Hashish causes the same physiological effects as marijuana, however it does so in a quicker and more pronounced way.

**Barbiturates:**

Barbiturates (also called 'downers') are man-made derivatives of barbituric acid. There are 25 known barbiturates, 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 a long period, however these tend to be slow-acting, while other barbiturates are fast-acting. The fast acting barbiturates tend to be the most popular among illegal abusers. Barbiturate abuse 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**

Stimulants are psychoactive drugs that increase alertness and metabolism, cause hyperactivity, stimulate sexual arousal, and prevent hunger. Some stimulants prevent the breakdown of neurotransmitters causing neurons to fire continuously, while other stimulants mimic the effects of neurotransmitters resulting an increase of neuron stimulation in the CNS. Most stimulants are illegal without a prescription. The two most common types of illegal stimulants include cocaine and 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 use can cause a user to feel overly excited, invigorated, reduces appetite and can make one prone to uncontrollable violent behavior. Abuse of cocaine may result in confusion, paranoid psychosis, insomnia, impotence, addiction and fetal deformities in pregnant women. *Crack* is derived from powdered cocaine dissolved in a mixture of water /ammonia or water/sodium bicarbonate and boiled until a solid substance forms. The solid is dried, broken into small rocks and smoked. Crack produces an immediate high and is more addictive than cocaine. Users of crack run the risk of cardiac arrest, seizures, lung trauma, aggressive behavior, and paranoia.

*A deadly cocaine overdose can happen quite easily as a lethal dose of cocaine is only 1.2 grams or ¼ of a teaspoon.*

Simpson & Connor-Ogorzaly, *Economic Botany - Plants in Our World*. Toronto: McGraw-Hill Publishing Co, 1986. (p. 398)

**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 behavior, anxiety, confusion and insomnia. Abuse of amphetamines can cause inflammation of the heart lining, blood vessel damage, skin abscesses and fetal deformities in pregnant women. Common types of amphetamines include: *Speed, Crystal Meth, and Ecstasy.*

*The illegal amphetamine, Ecstasy, is considered to be a type of neurotoxin. A study in primates showed that exposure to Ecstasy for 4 days in a row or longer caused damage to neurons in the brain that was evident 6 to 7 years later.*

- National Institute on Drug Abuse website ([www.nida.nih.gov/Infofacts/ecstasy.html](http://www.nida.nih.gov/Infofacts/ecstasy.html))

**DRUG USE & CRIME**

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

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

Concerns over drug abuse and drug-related criminal activity have been expressed in public and political circles for almost fifty years. In the United States, the *President's Advisory Commission on Narcotic and Drug Abuse* was created in 1963 to take direct action against the growth in drug trafficking and to help develop a host of programs that offered treatment for drug users.

The use of marijuana and heroin increased in North America during the latter half of the 1960's, during which time crime rates increased dramatically. The early 1980's were characterized by the increasing popularity of cocaine, the importation of which led to gang warfare and localized crime and disorder in large cities, fed by an insatiable hunger among their inhabitants for a form of cocaine commonly referred to as 'crack.'

Surprisingly, victimization rates for property crimes have fallen by over 65 per cent between 1976 and 2005. Serious violent crime rates remained relatively high, peaking in 1993, but have fallen over 30 per cent between 1993 and 2005. Interestingly, annual drug-related arrests have more than tripled in the past thirty years, ranging from over 464,000 in 1976 to more than 1,654,000 in 2005.

*In 2004, 17% of U.S. State prisoners and 18% of Federal inmates said they committed their current offense to obtain money for drugs.*

- Wikipedia ([http://en.wikipedia.org/wiki/Drug-related\\_crime](http://en.wikipedia.org/wiki/Drug-related_crime))

# **Worksheet: Illegal Drugs & the Human Body**

Name: \_\_\_\_\_ Date: \_\_\_\_\_

## **Sentence Response Questions**

1. How does forensic toxicology help to solve crime?
2. What are the two general types of illegal psychoactive drugs that exist?
3. What do psychoactive drugs change or mimic in the human body?
4. What are some of the effects that depressants can have upon an individual?
5. What happened to the levels of drug-related arrests in the past thirty years?
6.
  - a) Where are psychoactive drugs broken down in the body?
  - b) Outline where in the body forensic toxicologists will likely find psychoactive drugs or their breakdown products?
7. Compare and contrast illegal depressants & stimulants in the following ways:
  - a) - how they affect neuron activity
  - b) - the general symptoms caused by each type of drug
8. State one possible reason as to why roadside drug-testing devices are not widely used by Canadian law enforcement agencies.

Fill-in-the-blanks

9. In order for any drug to exert its influence, it must first be absorbed into the \_\_\_\_\_.
10. Drugs are either broken down in the region they affect or by the \_\_\_\_\_.
11. Most psychoactive drugs target cells within the \_\_\_\_\_ & \_\_\_\_\_.
12. The two most popular illegal stimulants that exist are \_\_\_\_\_ & \_\_\_\_\_.
13. Illegal drug use has been linked to high levels of \_\_\_\_\_ & \_\_\_\_\_.

**Areas of the Human Body that Psychoactive Drugs Travel Through**

1. CNS
2. Liver
3. Urine
4. Blood
5. Kidneys

14. The correct sequence that psychoactive drugs travel through in the human body, as shown above, would be \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_.

**Some Negative Side Effects of Psychoactive Drugs**

1. Can cause confusion, insomnia and impotence.
  2. Inflammation of heart lining and skin abscesses.
  3. Disrupts blood flow and increased chance of infection.
  4. Severely interferes with one's ability to operate a motor vehicle.
15. Match negative side effect from above with the correct type of psychoactive drug as given below.

Side effects:

Psychoactive drug:      cocaine      opiates      marijuana      amphetamines