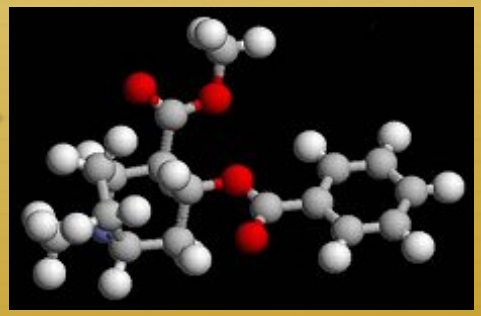
FORENSIC TOXICOLOGY



FORENSIC TOXICOLOGY

Introduction

Forensic Toxicologists:

- detect and identify drugs and poisons in body fluids, tissues, and organs
- work in crime laboratories, medical examiners' offices
- measure the amount of alcohol or other abused drugs in the body for violations of criminal law

Forensic Toxicology

Drugs and Poisons

On the bottom of your sheet, add this definition:

Toxicity - The degree to which a substance (a toxin or poison) can harm humans or animals.

What is Poison?

- Anything can be a poison
- A poison is any substance that, when taken in sufficient quantities, causes a harmful or deadly reaction

In other words…

- A poison is basically a substance that either harms you or kills you
- The key: "Sufficient Quantities"
  - Example: arsenic, *water intoxication,* oxygen doping

Intoxicant vs. Poison

- Intoxicant: requires that you ingest a rather large amount to be lethal
- Poison: only requires you ingest a small amount

Context Clues:

- What does INGEST mean?
- What does LETHAL mean?

Toxicology

- Toxicology deals with drugs, poisons, and other toxic substances, and how these substances alter or harm living organisms (particularly humans)

Forensic Toxicology

- A forensic toxicologist:
  - Finds a toxin and figures out what would happen to a person that ingested/contacted it

Toxicologist Examples

- Assess the state of inebriation of an automobile or industrial accident victim
- Determine whether someone died from a poison or from natural causes
- Assess whether drugs played a role in a criminal's actions

Looking for toxins…

- Most toxins don't change the body
- Therefore, the toxicologist must look for other evidence in body fluids

How Poisons Can Change the Body

In 2004, Viktor Yushchenko announced independent candidate for president of the Ukraine. His major rival was Prime Minister Viktor Yanukovych. The campaign was often bitter, controversial, and violent, with accusations of "dirty tricks" from both sides. Yushchenko became seriously ill in early September 2004. On December 11, Austrian doctors confirmed Yushchenko was poisoned with a poison called Dioxin. He had more than 1,000 times the usual concentration in his body. This is the second highest dioxin level ever measured in a human. No one has ever been tried for this crime.

Looking for Toxins

- Biotransformation
  - When one chemical changes into another in the body
  - Also called metabolism
- Metabolites
  - The new chemicals that happen when the body tries to break down/get rid of a toxin

Metabolite Example:

- Heroin is made from morphine
- When someone ingests heroin, their body turns it into morphine
- What should a toxicologist look for?

Check for Understanding:

- What is the difference between metabolism and metabolite?

A note on metals:

- Metallic elements also cause disease and death
  - Iron, mercury, lead, and copper all lead to serious health problems
  - Mercury, lead, arsenic, antimony, selenium, and other metals can kill

Collecting Samples

- Blood
  - Most useful sample! Modern technology can reveal almost all poisons and their metabolites
- Urine
  - Doesn't show how much or when the toxin/drug was ingested

Collecting Samples

- Stomach Contents
  - Are removed, washed, and tested. Doesn't relate to how much was in the blood
- Liver
  - Location where most drugs are metabolized. Can show level of drugs moments before death

Collecting Samples

- Vitreous Humor
  - Liquid of the eyeball- resistant to decay
- Hair
  - Absorbs heavy metals and provides a time line
- Insects
  - Test insects that feed on dead bodies when the body is very decomposed

Levels of drugs in the body:

- Normal
  - Level expected in the normal population
- Therapeutic
  - Level a doctor wants a patient to reach on prescription medicine

Levels of drugs in the body:

- Toxic
  - A level that may cause harm (nausea, vomiting, etc.)
- Lethal
  - Level that consistently causes death

N-Squad Episode One

- The following slides are from the **N-Squad** Episode 1 game from Rice University.
- There will be a quiz. Use your study guide to fill in the information from the slides.

N-Squad Episode One

- A 12 oz bottle or glass of beer has the same amount of alcohol as one serving of wine (5 oz.) or liquor (1.5 oz.)

N-Squad Episode One

- The only real effective way to sober up after drinking alcohol is to allow time to pass.
- Drinking coffee, taking a cold shower, or switching to another type of alcohol has no real effect.

N-Squad Episode One

- Teens are **TWICE** as likely to be in alcohol related crashes than adults.
- Teens tend not to be as experienced with driving than adults.
- Teens' judgment skills are more harmed by alcohol even if they drink less than adults.

N-Squad Episode One

- Alcoholism is an addiction and can be treated.
- Unfortunately, it cannot be cured at this time.

N-Squad Episode One

- Alcohol is identified as a depressant.
- Depressants slow down thinking ability and reaction time.
- Depressants make you drowsy.

N-Squad Episode One

- The liver filters out toxins from the bloodstream.
- The liver is the largest organ (other than the skin) in the body.

N-Squad Episode One

- The pathway that alcohol moves through the digestive system is:
- From the mouth
- To the esophagus
- To the stomach
- To the small intestine

N-Squad Episode One

- Short term alcohol abuse and obesity are major causes of a fatty liver.
- Liver cirrhosis is caused by hepatitis from long-term alcohol abuse.
- Liver cirrhosis is also called liver "scarring".

N-Squad Episode One

- The large intestine:
  - Eliminates feces (poop)
  - Absorbs water and minerals from the bloodstream.

N-Squad Episode One

- The small intestine:
  - Absorbs about 80% of the alcohol from the bloodstream.

N-Squad Episode One

- The stomach:
  - Absorbs about 20% of the alcohol from the bloodstream.

We will be looking at how Alcohol affects the body

Alcohol Statistics

- Nearly 17,500 automobile deaths in the U.S.
- 40% of all auto deaths are due to alcohol
- Over 2 million people/year injured, requiring hospitalization due to alcohol
- Most abused drug; Must be able to test rapidly/accurately, due to legal needs

FORENSIC TOXICOLOGY

Alcohol Levels

- Is measured as the quantity of alcohol present in the blood (BAC) or the alcohol content in the breath
- The amount of alcohol exhaled in the breath is directly proportional to the alcohol concentration in the blood

Rate of Absorption

Depends on:

- amount of alcohol consumed
- the alcohol content of the beverage
- time taken to consume it
- quantity and type of food present in the stomach

BAC: Effects from Alcohol

0.02 - 0.03 BAC

No loss of coordination, slight euphoria and loss of shyness. Mildly relaxed and maybe a little lightheaded.

0.04 - 0.06 BAC

Feeling of well-being, lower inhibitions, and relaxation. Judgment is slightly impaired. Minor impairment of reasoning and memory, and less cautious. Your behavior can become exaggerated and emotions (ex. happiness or sadness) felt more intensely.

BAC: Effects from Alcohol

0.07 - 0.09 BAC

Impairment present in everyone. Driving skills such as vision, steering, lane changing and reaction time are impaired along with balance, speech, and hearing. Feelings of Euphoria in some. Self-control and caution are reduced. Riskier behaviors displayed. Judgment, reason and memory suffer. You are likely to believe that you are functioning better than you really are.

0.08 BAC is legally impaired and it is illegal to drive at this level.

BAC: Effects from Alcohol

0.10 - 0.12 BAC

Significant impairment to motor coordination and loss of good judgment. Speech may be slurred; balance, vision, reaction time and hearing will be impaired. Probably not thinking straight.

0.13 - 0.15 BAC

Very obviously drunk. Severe impairment to judgment, perception, and major motor skills. Very slow reaction time. Blurred vision, loss of balance and slurred speech. Feelings of well being starting to be replaced by anxiety and restlessness (dysphoria). Vomiting common.

BAC: Effects from Alcohol

At .15 BAC you are 380 times more likely to be in a fatal crash than you are sober.

0.16 - 0.19 BAC
The drinker has the appearance of a "sloppy drunk." At this point, most drinkers begin to feel incapacitated. Many social drinkers will pass out. Nausea begins to set in and the drinker has difficulty focusing on any object.

The average BAC among fatally injured drivers is 0.17, which is also the average BAC nationally for persons arrested for drunk driving.

BAC: Effects from Alcohol

0.20 BAC

Out of it. Confused. Dizzy. Requires help to stand or walk. If injured may not feel the pain. Nausea and vomiting. The gag reflex is impaired and you can choke if you do vomit. Blackouts are likely.

0.25 BAC

All mental, physical and sensory functions are severely impaired. Near total loss of motor function control. Increased risk of asphyxiation from choking on vomit and of seriously injuring yourself by falls or other accidents.

BAC: Effects from Alcohol

0.30 - 0.40 BAC

Extremely life threatening. You have little comprehension of where you are. You may pass out suddenly and be difficult to awaken. Complete unconsciousness. Coma is possible. This is the level of surgical anesthesia. Death may occur.

Over 0.45 BAC death will occur in most people