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| **TEXAS CTE LESSON PLAN**[www.txcte.org](http://www.txcte.org) |
| **Lesson Identification and TEKS Addressed** |
| **Career Cluster** | Law, Public Safety, Corrections, & Security |
| **Course Name** | Forensic Science |
| **Lesson/Unit Title** | Forensic Toxicology |
| **TEKS Student Expectations** | **130.339. (c) Knowledge and Skills**(2) The student, for at least 40 of instructional time, conducts laboratory and/or field investigations using safe, environmentally appropriate, and ethical practices. (A) The student is expected to demonstrate safe practices during laboratory and field investigations(10) The student explores toxicology laboratory procedures in forensic science. The student is expected to: (A) explain the absorption, distribution, and elimination of alcohol through the human body; (B) describe the blood alcohol laboratory procedures as they relate to blood alcohol concentration; (C) explain the levels of tolerance and impairment due to alcohol consumption; and (D) explain the precautions necessary in the forensic laboratory for proper preservation of blood samples. |
| **Basic Direct Teach Lesson**(Includes Special Education Modifications/Accommodations and one English Language Proficiency Standards (ELPS) Strategy) |
| **Instructional Objectives** | The students will be able to:* Analyze physical and chemical properties of evidence collected from a crime scene.
* Identify and explore toxicology lab procedures, such as blood alcohol concentrations.
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| **Rationale** | The role of a forensic toxicologist is extremely important in our society due to the rampant use of drugs, including alcohol. Toxicologists must detect and identify drugs, and even poisons, that are present in bodily fluids, tissues, and organs. Although forensic toxicologists are limited to matters that pertain to violations of criminal law, they may find themselves working in a wide variety of areas such as crime labs, medical examiners’ offices, and hospital labs. |
| **Duration of Lesson** | 3½ Hours |
| **Word Wall/Key Vocabulary***(ELPS c1a,c,f; c2b; c3a,b,d; c4c; c5b) PDAS II(5)* |  |
| **Materials/Specialized Equipment Needed** | * *Chromatography Lab*
* Chromatography Lab handout
* 3 different brands of black marker or pen
* Coffee filters or chromatography paper
* Pencil
* Tape
* Water or acetone
* 1 beaker (200-500 ml)
* Ruler
* Goggles
* Gloves
* Calculator
* Blood Alcohol Determination Worksheet
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| **Anticipatory Set**(May include pre-assessment for prior knowledge) | Do an Internet search for the following article: Coroner Attributes Michael Jackson’s Death to Propofol by Ashley Surdin. Use article and the following questions for a class discussion. Use the Discussion Rubric for assessment.* At age 50, the news of the drug-related death of Michael Jackson rocked the world. Is Dr. Conrad Murray responsible?
* Does the demise of a superstar lie in the hands of his doctor?
* What did the toxicologist(s) find?
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| **Direct Instruction \*** | 1. Role of Forensic Toxicology
	1. Toxicology is the study of drugs and poisons, and their interactions and effects on the body
	2. A drug is a natural or synthetic substance that is used to produce physiological or psychological effects
	3. Forensic Toxicology is the application of toxicology to the law, including
		1. Workplace or forensic drug testing
		2. Postmortem toxicology
		3. Human performance testing
2. Toxicology of Alcohol
	1. Approximately 40% of traffic deaths in the U.S. are alcohol-related (Flinn, 2012)
	2. Toxicologists have had to develop specific procedures for measuring degrees of alcohol intoxication
	3. Methods for diagnosis must be defendable within the framework of the legal system
	4. Metabolism involves the body’s ability to break down chemicals.

There are three steps:* 1. Absorption
		1. Alcohol appears in the blood minutes after consumption
		2. Alcohol slowly enters the body’s bloodstream and is carried to all parts of the body
	2. Distribution
		1. When absorption is complete, alcohol becomes distributed uniformly throughout the “watery” parts of the body
		2. Factors affecting absorption and distribution are
			1. Speed of consumption
			2. Percentage of alcohol content
			3. Quantity of alcohol consumed
			4. Quantity and type of food present in the stomach
	3. Elimination
		1. The body begins to eliminate alcohol as it is circulated through the bloodstream
		2. There are two mechanisms for elimination
			1. Oxidation, which occurs in the liver
			2. Excretion through breath, urine, and perspiration
1. To determine blood alcohol level, analyzing brain tissue would be best. However, brain tissue is not available from a living individual, so blood alcohol concentrations are used. Blood and brain concentrations are directly proportional
2. Measuring the quantity of alcohol consumed can be done by analyzing either blood or breath
3. Testing for Intoxication
	1. Breath testing
		1. The most widespread method
		2. The Breathalyzer measures alcohol content in alveolar breath (deep within the lungs)
		3. It requires no less than 1.1 to 1.5 liters of breath to ensure that “deep-lung” breath is measured
		4. For accuracy, avoid “mouth alcohol” such as from belching, regurgitation, or recent mouthwash
	2. Field Sobriety
		1. The preliminary test performed to ascertain the degree of a suspect’s physical impairment, and whether further tests are justified
		2. Psychophysical tests
			1. Horizontal-gaze nystagmus
			2. Walk and turn
			3. One-leg stand
		3. Preliminary Breath Test
			1. A handheld breath tester that uses a fuel cell to measure alcohol content
			2. Should establish probable cause for requiring more thorough breath or blood tests
4. Blood Analysis
	1. Calculated with a high degree of accuracy by use of gas chromatography which separates alcohol from any other chemicals
	2. Collection and preservation of blood
		1. Before the penetration of the needle, the area must be cleaned with a non-alcoholic disinfectant
		2. Refrigerate the blood until it is delivered to the lab
		3. Effects on collected blood
			1. Storage temperature
			2. Presence of a preservative, such as sodium fluoride
			3. Amount of time in storage
		4. Postmortem blood should be collected from a variety of bodily sites, if it is available at all
5. Blood Alcohol Laws (Morgan, 2012)
	1. The Department of Transportation recommends that states adopt

.08% blood alcohol concentration as the legal measure for drunk driving* 1. This percentage has been adopted by all 50 states

3. .08% only applies to noncommercial drivers; for commercial drivers it is .04%* + 1. An implied consent law is used to prevent a person from refusing to take a blood or breath test based on self-incrimination rights
1. Role of the Toxicologist
	1. Studies bodily fluid, tissue, and organs for drugs and/or poisons
	2. May conduct postmortem pathological examination, or examination of personal effects and empty containers, etc.
	3. May have extremely minute quantities to test
	4. Must detect, identify, quantify, and assess the toxicity

IV. Collecting and Preserving Toxicological Evidence* 1. When possible, collect both blood and urine
		1. Collect two voids (samples) of urine in separate specimen containers
		2. Collect a sample of blood if a physician or registered nurse (RN) is available (the amount depends upon the type of test to be conducted)

V. Techniques in Toxicology* 1. Drugs are chemicals that are categorized as either acids or bases
		1. An acid is a compound that donates hydrogen ions
		2. A base is a compound that accepts hydrogen ions
		3. The pH scale measures the strength of acids and bases
			1. The scale measures from 0 – 14
		4. 7 is neutral; the farther the number is away from 7, the stronger the acid or base
		5. Acids are below 7, and bases are above 7
1. Screening Tests
	1. Thin Layer Chromatography (TLC)
		1. Separates out molecules that move up a thin coated plate
		2. This test has both a solid and a liquid phase
		3. The distance each component travels is based on the characteristics of that substance
		4. It is then compared to known samples
	2. Gas chromatographyuses the same process as TLC except ithas a moving liquid and a moving gas phase
	3. Immunoassay is based upon specific drug-antibody reactions;this is the best method for detecting low drug levels
2. Confirmation Test
	1. Gas chromatography/mass spectrometry
		1. The gas chromatography is completed first
		2. Each separated component then enters the mass spectrometer, where the sample is broken into fragments for identification
3. Detecting Drugs in Hair
	1. Drugs remain in the
		1. Bloodstream up to 24 hours
		2. Urine up to 72 hours
	2. Drugs can become permanently entrapped in a hair’s hardening protein
	3. As hair grows, the drug’s location on the hair shaft becomes a marker for the time of drug intake
	4. Some drugs may enter a hair’s surface from environmental exposure or sweat. This can cause a problem with the accuracy of the test
4. Detecting Non-Drug Poisons
	1. Heavy metals, such as arsenic and mercury, may be detected
	2. Carbon monoxide is one of the most commonly encountered poisons
5. Significance of Toxicological Findings – once a drug is identified, the toxicologist must assess its influence on the behavior of the individual

*Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*NONE |
| **Guided Practice \*** | Chromatography Lab. Have students visualize the process of thin layer chromatography with markers, and calculate Rf values by completing the Chromatography Lab. Use the Chromatography Lab Key and the Individual Work Rubric for assessment.Notes: materials for this lab are for a single group. The number of groups and students per group is to be determined by the instructor.This lab can easily be extended into a forensic mystery activity. To do that, use one of the markers to create enough strips for each group. Label one of the markers “Crime Scene.” Distribute one strip to each lab group at the beginning of the lab. Upon completion of their lab, they will compare the crime scene strip to the ones that they tested.*Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*NONE |
| **Independent Practice/Laboratory Experience/Differentiated Activities \*** | Blood Alcohol Determination. Have students work individually to complete this worksheet. Use the Blood Alcohol Determination Worksheet for the activity and the Blood Alcohol Determination Worksheet Key for assessment.*Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*NONE |
| **Lesson Closure** |  |
| **Summative/End of Lesson Assessment \***  | * Forensic Toxicology Exam and Key
* Chromatography Lab Key
* Blood Alcohol Determination Worksheet Key
* Discussion Rubric
* Individual Work Rubric
* Writing Rubric

*Individualized Education Plan (IEP) for all special education students must be followed. Examples of accommodations may include, but are not limited to:*NONE |
| **References/Resources/****Teacher Preparation** | Saferstein, Richard. *Forensic Science: An Introduction.* New Jersey: Pearson Prentice Hall, 2008Saferstein, Richard. *Forensic Science: An Introduction.* 2nd ed. New Jersey:Pearson Prentice Hall, 2011Saferstein, Richard. *Criminalistics: An Introduction to Forensic Science.* 8th ed. Upper Saddle River, NJ; Pearson Prentice Hall, 2004<http://en.wikipedia.org/wiki/Entomotoxicology><http://www.brad21.org/bac_charts.html>Do an Internet search for the following:* Coroner Attributes Michael Jackson’s Death to Propofol by Ashley Surdin
* Statistics on Alcohol Related Deaths by Mary Flinn
* Alcohol and Driving Laws by Lee Morgan
* drunkdrivingdefense general bac
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| **Additional Required Components** |
| **English Language Proficiency Standards (ELPS) Strategies** |  |
| **College and Career Readiness Connection[[1]](#footnote-1)** |  |
| **Recommended Strategies** |
| **Reading Strategies** |  |
| **Quotes** |  |
| **Multimedia/Visual Strategy****Presentation Slides + One Additional Technology Connection** |  |
| **Graphic Organizers/Handout** |  |
| **Writing Strategies****Journal Entries + 1 Additional Writing Strategy** |  |
| **Communication****90 Second Speech Topics** |  |
| **Other Essential Lesson Components** |
| **Enrichment Activity**(e.g., homework assignment) | For reinforcement, students will compare a specific dosage given to an adult with the same does given to a child. *(Note: all chemicals, natural or man-made, are considered toxic. Paracelsus, considered to be the Father of Modern Toxicology, once said, “The dose makes the poison.”)*Fill a 200ml beaker with water, which will represent the “adult.” Next fill a 100ml beaker with water to represent a “child.” Add 2 drops of a food coloring to each beaker to represent a chemical substance. Stir each beaker.Have the students discuss how, although the beakers have the same “dosage,” the child’s appears to be much more concentrated. This proves an adult dosage can be devastating to a child. Have students hypothesize in a journal entry. Use the Discussion Rubric and/or the Writing Rubric for assessment.For enrichment, students will compare the relationship of Toxicology and Entomology by reading the following article: [http://en.wikipedia.org/wiki/Entomotoxicology.](http://en.wikipedia.org/wiki/Entomotoxicology)After reading, students should write key points about how the toxicology of a decedent can greatly affect the post mortem interval by influencing the life cycles and activities of certain insects. Use the Individual Work Rubric for assessment. |
| **Family/Community Connection** |  |
| **CTSO connection(s)** | SkillsUSA |
| **Service Learning Projects** |  |
| **Lesson Notes** |  |

1. Visit the Texas College and Career Readiness Standards at <http://www.thecb.state.tx.us/collegereadiness/CRS.pdf>, Texas Higher Education Coordinating Board (THECB), 2009. [↑](#footnote-ref-1)