# TOXICOLOGY TRAINING MANUAL

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# Revision History

| Revision # | Description of Changes |
|---|---|
| 1 | Original version transferred into Qualtrax |
| 2 | Added more information to background and theory sections, specified the number of supervised cases that must be completed prior to being signed off to do independent casework. Removed the use of the Artel System for intermediate pipette checks in section 6, combined several sections. |
| 3 | Added the types of cases to the supervised cases section. |
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# 1.0 Introduction

## 1.1 Background and Theory

1.1.1 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed as a guide to provide a forensic analyst Trainee with the background necessary to process blood and urine specimens to detect and confirm the presence of drug compounds other than ethanol and other volatiles. Ethanol and other volatiles training is addressed separately. The analyst is first tasked with review of the ISP Employee Handbook, ISP-FS ISO/IEC 17025:2005 Compliant Quality/Procedure Manual and the ISP-FS Health and Safety Manual. The analyst is then responsible to successfully complete the currently approved ethics course.

1.1.2 This training plan addresses each of the various stages of sample processing, from initial sample checkout to the processes involved in screening, confirmation and report generation. To properly analyze and interpret the results of analysis, the Trainee must possess a working knowledge of drug metabolism and a fundamental understanding of the pharmacology of psychoactive compounds. In order to understand agency incident reports, the analyst must have an understanding of the tools used by law enforcement to detect impaired driving. For effective expert witness testimony, the analyst must not only be knowledgeable about the testing processes, the drugs detected, and the pharmacology of the drugs, but should also have a working knowledge of our criminal justice system, including applicable Idaho Code. All of the covered topics are then applied for the proper preparation and presentation of courtroom testimony as demonstrated by mock courtroom testimony. In addition to discipline specific training, the new analyst must obtain a general knowledge of forensic science as a whole. When the Trainee has established competence by successfully completing training plan elements, supervised performance of analysis on case material completes the training process.



## 1.2 Objectives, Principles and Knowledge

1.2.1 In order to address the training plan questions: the Recommended Background Reading cited, or equivalent, must be consulted if the Trainee is not familiar with the subject matter.

1.2.2 For the background reading, the edition listed or a newer version should be consulted.

1.2.3 Both the education and work experience of the Trainee must be considered; however, at least a verbal review of material for the Trainer must be done to the satisfaction of the Trainer.

1.2.4 To establish the competency of the analyst, answers to training plan questions may be provided verbally and/or in written form. This choice is at the discretion of the Trainer. The Trainee must answer all of the questions 100% correct and if any part of the answer is incorrect, the Trainee must revisit the required reading until they can answer the question fully and correctly.

1.2.5 Training does not have to proceed in the order used in this training plan and the order and appropriate sections are at the discretion of the Trainer and/or Technical Lead.

1.2.6 It is not necessary to complete the entire training manual at one time, only the sections that apply to a particular Analytical Method.

1.2.7 Training for all Analytical Methods does not have to be pursued concurrently. Some Analytical Methods are utilized infrequently; therefore training can be completed prior to sign-off on all listed analytical methods. However, the Trainee must complete the training for a particular analytical method before that method can be used for casework by the Trainee.

1.2.8 Additional Training for Experienced/Signed-off Analyst

1.2.8.1 For training of an experienced analyst (Forensic Scientist II or III) in a new or updated technique or instrument, the training is to be commensurate with the magnitude of changes and with consideration of the analyst's existing background. The extent of training to be required will be agreed upon by the discipline leader and quality manager with input from the analyst.

1.3 Health and Safety Hazards

1.3.1 Precautions should be noted and appropriate use of PPE should be followed

1.3.2 Biohazards

1.3.3 Chemical Hazards

1.4 1.4 Reading and Practical Exercises

1.4.1 The new or experienced analyst is reminded that this training plan only addresses the core of training for toxicological analysis. After the completion of training, the analyst is responsible for keeping their knowledge current through continual literature review (relevant journals and textbooks) and by attendance at scientific meetings.

## 2.0 Roles and Responsibilities

2.1 Supervisor

2.1.1 The Supervisor shall be apprised of the training schedule and estimated dates of completion for the individual modules. In addition, the Supervisor will evaluate mock court testimony.

2.2 Technical Lead

2.2.1 The Technical Lead shall assess any prior applicable training, review the current training plan, assign the appropriate modules and organize the training. The Technical Lead should regularly monitor the Trainee's progress and review their training record for completeness and accuracy, procure final competency tests and schedule mock courts. The Technical Lead shall provide input regarding mock court performance to the Supervisor and/or other members of management. At the completion of training plan or appropriate modules, the Technical Lead shall review all documentation regarding training to determine if the Trainee performed all required training and is competent to perform analysis. If the Trainee is competent to perform analysis, the Technical Lead shall forward all required documentation to the Quality Manager. The Technical Lead may act as the Trainer or designate an onsite Trainer.

2.3 Trainer

2.3.1 The Trainer shall provide a copy of the training plan to the Trainee with an anticipated timeline for completion. The Trainer is responsible for coordination of practical exercises, demonstrating techniques, reviewing answers to questions, providing feedback and administration of module tests. The Trainer should monitor for comprehension and competency in theoretical knowledge and basic practical skills. The Trainer shall communicate progress, delays, or the need for supplemental activities to the Technical Lead and/or Supervisor. Deficiencies should be openly discussed among the Trainee, Trainer, Technical Lead and/or Supervisor in an attempt to rectify them.

2.4 Trainee

2.4.1 The Trainee is responsible for completing the background reading for the modules on their own as well as providing written answers to any questions contained in the modules. The Trainee is expected to observe the Trainer whenever possible and take notes while doing so. If the Trainee cannot meet any of the anticipated timelines, the Trainee is responsible for notifying the Trainer. The Trainee should ask questions and ask for explanations whenever something is not clear.

# 3.0 Administrative Issues

3.1 Background and Theory

3.1.1 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to provide a forensic analyst Trainee with the necessary background information regarding employment with the Idaho State Police, other disciplines within the lab system, ethics, the procedures and quality requirements for the laboratory system as a whole, as well as the health and safety requirements for working in the laboratory

3.2 Objectives, Principles, and Knowledge

3.2.1 Complete the reading and practical exercises specified below.

3.3 Health and Safety Hazards

3.3.1 N/A

3.4 Reading and Practical Exercises

3.4.1 Reading

3.4.1.1 Idaho State Police Employee Handbook (http://intranet/ or equivalent)

3.4.1.2 Idaho State Police Forensic Services ISO/IEC 17025:2005 Compliant Quality/Procedure Manual (Documents Section of ILIMS)

3.4.1.3 Idaho State Police Forensic Services Health and Safety Manual. (Documents section of ILIMS)

3.4.2 Exercises

3.4.2.1 The Trainee must be familiar with relevant sections of the Idaho State Police Employee Handbook.

3.4.2.2 The Trainee will complete the Idaho State Police Forensic Services General Training plan. This core training plan covers the Idaho State Police Forensic Services ISO/IEC 17025:2005 Compliant Quality/Procedure Manual, the Idaho State Police Forensic Services Health and Safety Manual, the currently approved ethics course and basic training in other forensic science disciplines.

# 4.0 Evidence Handling

4.1 Background and Theory

4.1.1 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to provide a forensic analyst Trainee with the necessary background information regarding how evidence is packaged, received and tracked.

4.2 Objectives, Principles, and Knowledge

4.2.1 Complete the required reading and exercises specified below.

4.3 Health and Safety Hazards

4.3.1 Gloves and lab coats should be worn when working with evidence.

4.4 Reading and Practical Exercises

4.4.1 Reading

4.4.1.1 Idaho State Police Forensic Services Health and Safety Manual

4.4.2 Exercises

4.4.2.1 Describe the procedures followed for the intake of toxicology specimen collection kits, transfer of samples, required paperwork and subsequent specimen handling considerations.

4.4.2.2 Describe the types and applications of the toxicology collection kits distributed by ISP-FS.

4.4.2.3 Describe the agencies served by their laboratory and the programs involved.

4.4.2.4 Describe the barrier protection measures required when handling biological samples.

# 5.0 Balance Operation and Intermediate Pipette Check

5.1 Background and Theory

5.1.1 Proper use of a balance is important when preparing reagents as well as when doing intermediate pipette checks. Improper use of the balance can lead to issues with extractions, and inconsistencies between sample runs.

5.1.2 Many of the analytical methods require the use of a calibrated pipette for at least the addition of the sample to the internal standard. Use of a pipette that is not functioning properly can lead to accuracy issues. The pipettes are sent out yearly to ensure they are still functioning within tolerances. In between the times that the pipettes are sent out for calibration, intermediate checks must be performed in the laboratory. These intermediate checks must be performed within 45 days prior to the pipette being used for casework.

5.1.3 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to provide a forensic analyst Trainee with the necessary information and skills to properly operate both a balance and a pipette as well as be able to perform intermediate checks on the pipettes.

5.2 Objectives, Principles, and Knowledge

5.2.1 Complete the reading and exercises specified below.

5.3 Health and Safety Hazards

5.3.1 Gloves and lab coats should be worn when working in the laboratory. In addition, if any powders are being weighed, safety glasses or goggles should be worn.

5.4 Reading and Practical Exercises

5.4.1 Reading

5.4.1.1 Manufacturer manual for all balances to be used by the Trainee.

5.4.1.2 Analytical Method #16

5.4.1.3 Analytical Method #17

5.4.1.4 College Chemistry/Biochemistry Text, chapter(s) discussing Absorption Spectrophotometry.

5.4.1.5 Curtis, R.H., Performance Verification of Manual Action Pipets: Part I, Am. Clin. Lab. 12(7):8-9; 1994.

5.4.1.6 Curtis, R.H., Performance Verification of Manual Action Pipets: Part II, Am. Clin. Lab. 12(9):16-17; 1994.

5.4.1.7 ISO 8655-6:2002, Piston-operated volumetric apparatus - Part 6: Gravimetric method for the determination of measurement error.

5.4.2 Exercises

5.4.2.1 Become familiar with the operation of any analytical or top-loading balances used to prepare toxicology solutions and reference material.

5.4.2.2 Describe the basic steps involved in obtaining the weight of a material.

5.4.2.3 Describe the principle, equipment, and calculations involved when using the gravimetric method to perform an intermediate check of a POVA.

5.4.2.4 Demonstrate the ability to perform an intermediate check on a POVA.

# 6.0 Solution Preparation

6.1 Background and Theory

6.1.1 Proper solution preparation is imperative for the analytical methods. Improper or inconsistent solutions can lead to problems with the extraction and/or inconsistencies between analytical runs.

6.1.2 Safety is of the utmost importance when working with solvents/chemicals as many pose potential health hazards.

6.1.3 When preparing a solution that involves concentrated acid, it is very important to add the components in the proper order. Acid should always be added to water. Water should never be added to acid.

6.1.4 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to provide a forensic analyst Trainee with the necessary information and skills to properly prepare any solutions that need to be made for analyzing toxicology samples.

6.2 Objectives, Principles, and Knowledge

6.2.1 Complete the reading and exercises specified below.

6.3 Health and Safety Hazards

6.3.1 Gloves, lab coats, and safety glasses or goggles should be worn when working in the laboratory.

6.4 Reading and Practical Exercises

6.4.1 Reading

6.4.1.1 Analytical Method #23

6.4.1.2 College Chemistry Text, chapter(s) discussing the properties of solutions.

6.4.1.3 Seamonds, B. and Byrne, E.A. Basic Laboratory Principles and Techniques pp. 3 - 43. in: Clinical Chemistry: Theory, Analysis, Correlation. Mosby, 2003.

6.4.1.4 Shugar, G.J., Shugar, R.A. and Bauman, L. Grades of Purity of Chemicals pp. 145-154, pH Measurement. pp. 232-234. in: Chemical Technicians' Ready Reference Handbook, McGraw Hill: New York, 1973.

6.4.1.5 Habben, K.H. Basic Analytical Reference – Chapter 19. pp. 1-9, in: Current Approaches in Forensic Toxicology. Presented by the Forensic Toxicologist Certification Board, Inc. at SOFT meeting, 1994.

6.4.1.6 Operation Manual for pH Meter.

6.4.2 Exercises

6.4.2.1 Basic Chemical Calculations and Nomenclature

6.4.2.2 The analyst must be able to address the questions and define the following terms:

6.4.2.2.1 Solvent

6.4.2.2.2 Molarity (M)

6.4.2.2.3 How moles per liter are in a 2M solution?

6.4.2.2.4 Normality (N)

6.4.2.2.5 How many equivalents in a 2N solution?

6.4.2.2.6 Weight per Volume Percent (%w/v)

6.4.2.2.7 Weight per Weight percent (%w/w)

6.4.2.3 Become familiar with solution preparation and required documentation. This must include the preparation of hydrolysis agents, buffers and extraction solvents used in all stages of specimen preparation for analysis.

6.4.2.4 The Trainee must have a working knowledge of pH meter operation and documentation. The Trainee must standardize a series of pH buffers and perform a pH check during the preparation of a buffer solution for the Trainer.

# 7.0 Enzyme Immunoassays

## 7.1 Background and Theory

7.1.1 An immunoassay is a biochemical test that measures the concentration of a substance in a liquid (in this case, a biological specimen) using the reaction of an antibody or antibodies to its antigen (drug).

7.1.2 Both Enzyme Multiplied Immunoassay Technique (EMIT) and Enzyme-Linked Immunosorbent Assay (ELISA) are used for screening toxicology samples in the laboratories. Which assay is used will depend on which lab the individual is training in. Both EMIT and ELISA are immunoassay techniques that provide a preliminary identification of what drugs or drug classes may be present in the sample.

7.1.3 EMIT is a homogeneous, competitive assay in which glucose-6-phosphate dehydrogenase (G6P-DH) competes with drug present in the sample to bind to the specific antibodies used for that assay. If the drug of interest is present in the sample, it will bind to the antibodies, which leaves the G6P-DH active. The active G6P-DH causes NAD+ to be converted to NADH. This conversion causes a signal that is measured by the instrument. The higher the signal, the more drug present in the sample. The Viva Automatic Chemistry Analyzer operates based on this type of principle.

7.1.4 ELISA is a heterogeneous, competitive assay in which both labeled antigen and the sample are added to wells containing antibodies. After allowing the antigens to bind to the antibodies, the wells are washed and any unbound antigen is removed. A substrate is then added to the wells, which causes a color change. The absorbances for the wells are then measured. The more drug there is the sample, the lower the absorbance will be. The DSX Automatic Chemistry Analyzer operates based on this type of principle.

7.1.5 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to provide a forensic analyst Trainee with the necessary information to be able to explain what enzyme immunoassays are and how they work.

## 7.2 Objectives, Principles, and Knowledge

7.2.1 Complete the reading and exercises specified below.

## 7.3 Health and Safety Hazards

7.3.1 Gloves, lab coats and safety glasses should be worn when working in the laboratory. Universal precautions should be taken when dealing with biological specimens.

7.4 Reading and Practical Exercises

7.4.1 Reading

7.4.1.1 Analytical Methods #1 and #7

7.4.1.2 Thompson, S.G., Principles for Competitive Binding Assays. pp. 246 – 264. in: Clinical Chemistry: Theory, Analysis, Correlation. Mosby, 2003 or more recent version.

7.4.1.3 Sections Covering Immunoassay and EMIT. refer to index for pages, in: Principles of Forensic Toxicology, Second Edition, Levine, B. ed., AACC, 2003 or more recent version.

7.4.1.4 Spiehler, V., Immunoassays in Toxicology. pp. 55-98, in: California Association of Toxicologists (CAT) Manual for Analytical Toxicology, 1994.

7.4.1.5 Liu, R.H., Evaluation of Commercial Immunoassay Kits for Effective Workplace Drug Testing. pg. 67-130, in: Handbook of workplace Drug Testing. Liu, R.H. and Goldberger, B.A. eds., Washington D.C.: AACC Press, 1995.

7.4.1.6 Hearn, W.L. and Walls, H.C., Common Methods in Post-Mortem Toxicology. pp. 995-998, in: Drug Abuse Handbook, Second Edition, Karch, S.B. ed., Boca Raton: CRC Press, 2007 or more recent version.

7.4.1.7 Viva-Jr Operator's Manual, Article No.: 6002-940-410, Version number: 01/04-06.

7.4.1.8 Viva-Jr System Operations Guide, T268, 6/25/07, D01373.

7.4.1.9 DSX Automated ELISA System® User's Manual, REV.04-20-05, 2005

7.4.2 Exercises

7.4.2.1 Describe the competitive binding process as it applies to immunoassay.

7.4.2.2 Define and discuss the following terms as they relate to Enzyme Immunoassay (EIA):

7.4.2.2.1 Enzyme

7.4.2.2.2 Antigen

7.4.2.2.3 Antibody

7.4.2.2.4 Hapten

7.4.2.2.5 Cross-reactivity/analytical specificity

7.4.2.2.6 Antigenic Determinant
7.4.2.2.7 Cutoff
7.4.2.2.8 Drift effect

7.4.2.3 Discuss specificity versus sensitivity as it applies to EIA.

7.4.2.4 Discuss the major differences between homogeneous and heterogeneous enzyme immunoassays.

7.4.2.5 Demonstrate a working knowledge of theory and application of enzyme-multiplied immunoassay technique (EMIT).

7.4.2.5.1 Describe the basic EMIT process.
7.4.2.5.2 Discuss the attributes and limitations of EMIT.
7.4.2.5.3 Describe the basic ELISA process.
7.4.2.5.4 Describe the attributes and limitations of ELISA.

7.4.2.6 Viva Automatic Chemistry Analyzer (if applicable)

7.4.2.6.1 Demonstrate the ability to apply the Viva system software to operate the analyzer.
7.4.2.6.2 Demonstrate a thorough understanding of the required periodic and as needed maintenance for the Viva analyzer.
7.4.2.6.3 Demonstrate a thorough understanding of troubleshooting techniques for the Viva analyzer.

7.4.2.7 DSX Automatic Chemistry Analyzer (if applicable)

7.4.2.7.1 Demonstrate the ability to apply the DSX system software to operate the analyzer.
7.4.2.7.2 Demonstrate a thorough understanding of the required periodic and as needed maintenance for the DSX analyzer.
7.4.2.7.3 Demonstrate a thorough understanding of troubleshooting techniques for the DSX analyzer.

# 8.0 Liquid-Liquid Extraction

8.1 Background and Theory

8.1.1 Liquid-liquid extractions (LLE) are used to separate out drugs in a sample from interfering substances and get the sample in a solvent that can then be injected into an instrument used for confirmation (GC/MS or LC/MS/MS). Typically a protein precipitation is done first to assist in getting the drugs out of the sample. The sample is combined with an immiscible organic solvent and after a pH adjustment, drugs present in the sample will travel into the organic layer, which can then be removed and purified and/or injected into the instrument.

8.1.2 LLE utilizes differences in pH and solubility characteristics of various analytes. At an alkaline pH, a basic compound is in the non-ionized form, and an acidic compound is in the ionized form. The opposite is true for acidic pHs. A compound in its non-ionized form prefers the lipophilic environment of an organic solvent to the aqueous environment of the biologic sample.

8.1.3 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to provide a forensic analyst Trainee with the necessary information to be able to understand and describe in more detail what a liquid-liquid extraction is and how it works.

8.2 Objectives, Principles, and Knowledge

8.2.1 Complete the reading and exercises specified below.

8.3 Health and Safety Hazards

8.3.1 Gloves, lab coats and safety glasses should be worn when working in the laboratory. Universal precautions should be taken when dealing with biological specimens.

8.4 Reading and Practical Exercises

8.4.1 Reading

8.4.1.1 Sections Covering Liquid-liquid Extraction. Refer to index for page numbers, in: Principles of Forensic Toxicology. Second Edition, Levine, B. ed., AACC, 2003 or more recent version.

8.4.1.2 Stafford, David T., Liquid/Liquid Extraction in Toxicology –Chapter 14. pp. 1-13, in: Current Approaches in Forensic Toxicology.

Presented by the Forensic Toxicologist Certification Board, Inc. at SOFT meeting, 1994.

8.4.1.3 Hearn, W.L. and Walls, H.C., Common Methods in Post-Mortem Toxicology. pp. 1005-1007, in: Drug Abuse Handbook. Second Edition, Karch, S.B. ed., Boca Raton: CRC Press, 2007 or more recent version.

8.4.2 Exercises

8.4.2.1 Become well versed in the principals involved with liquid-liquid extraction.

8.4.2.2 Describe the properties that are involved in a solvent's ability to extract a particular analyte.

8.4.2.3 Describe the following processes as they relate to liquid-liquid extraction:

8.4.2.3.1 Basic Extraction

8.4.2.3.2 Acidic Extraction

8.4.2.3.3 Back Extraction

8.4.2.3.4 Buffering – Why are different pHs required for different methods?

8.4.2.4 Explain how the Henderson-Hasselbach equation applies to liquid-liquid extraction.

# 9.0 Solid Phase Extraction (SPE)

9.1 Background and Theory

9.1.1 Solid Phase Extraction (SPE) is a type of extraction method in which a sample is passed through a solid or stationary phase (typically referred to as a column or cartridge) in order to isolate drugs in the sample from interfering substances. There are many different types of extraction columns that can be used depending on what compounds are to be extracted.

9.1.2 There are three major purposes for solid phase extraction. The first is to concentrate the analyte of interest, in order for it to be measured. The second is to remove undesired components (like proteins) that may interfere with the analysis. The third major purpose for using solid phase extraction is to get the analyte into the proper solution for subsequent analysis.

9.1.3 SPE can be either normal or reverse phase. The difference between the two depends on the attributes of the stationary phase (column). In normal phase, a hydrophilic stationary phase is used, while reverse phase the column is hydrophobic.

9.1.4 Both the type of stationary phase and the solvents that you pass through the column are very important. There is a particular order that must be followed in order to successfully extract drugs from the samples. Changing the order of the solvents could result is the drugs coming out of the sample earlier than expected and being lost in the waste. It could also result in the sample being stuck in the column and not eluted.

9.1.5 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to provide a forensic analyst Trainee with the necessary information to be able to understand and describe what a solid phase extraction is and how it works.



9.2 Objectives, Principles, and Knowledge

9.2.1 Complete the reading and exercises specified below.

9.3 Health and Safety Hazards

9.3.1 Gloves, lab coats and safety glasses should be worn when working in the laboratory. Universal precautions should be taken when dealing with biological specimens.

9.4 Reading and Practical Exercises

9.4.1 Reading

9.4.1.1 Sections Covering Solid Phase Extraction. Refer to index for page numbers, in: Principles of Forensic Toxicology. Second Edition, Levine, B. ed., AACC, 2003 or more recent version.

9.4.1.2 Sears, R.M., Liquid/Solid Extraction in Toxicology – Chapter 15. pp. 1-51, in: Current Approaches in Forensic Toxicology. Presented by the Forensic Toxicologist Certification Board, Inc. at SOFT meeting. 1994.

9.4.1.3 Platoff, G.E. and Gere, J.A., Solid Phase Extraction of Abused Drugs from Urine. Forensic Science Review. 3(2):119-132. 1991.

9.4.1.4 Chen, X.H., Franke, J.P. and Zeeuw, R.A., Principles of Solid-Phase Extraction. pp. 1-22, in: Handbook of Workplace Drug Testing. Washington, D.C.: AACC Press, 1995.

9.4.1.5 Gere, J.A. and Platoff, G.E., Solid-Phase Extraction of Abused Drugs in Urine. pp. 23-44, in: Handbook of Workplace Drug Testing. Washington, D.C.: AACC Press, 1995.

9.4.1.6 Hearne, G.M and Hall, D.O., Advances in Solid-Phase Extraction Technology. American Laboratory, January 1993.

9.4.1.7 Hearn, W.L. and Walls, H.C., Common Methods in Post-Mortem Toxicology. pp. 1006-1007, in: Drug Abuse Handbook. Second Edition, Karch, S.B. ed., Boca Raton: CRC Press, 2007 or more recent version.

9.4.2 Exercises

9.4.2.1 Become knowledgeable about the principles involved with solid phase extraction (SPE), by completion of the required reading.

9.4.2.2 Describe the advantages of SPE over liquid-liquid extraction methods.

9.4.2.3 Discuss Van der Waal Forces as they relate to SPE.

9.4.2.4 Discuss the sorbent options for SPE columns in regards to the types available, their target compounds and the interactions which they participate in.

9.4.2.5 Discuss the six typical steps involved in a SPE procedure.

9.4.2.6 Discuss how to prepare the sample for optimum analyte retention on a particular SPE column.

# 10.0 Supported Liquid Extraction (SLE)

10.1 Background and Theory

10.1.1 Supported Liquid Extraction (SLE) is an extraction technique that utilizes the same principles as LLE but the immiscible solvent is supported by solid material (typically silica-based).

10.1.2 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to provide a forensic analyst Trainee with the necessary information to be able to understand and describe what a supported liquid extraction is and how it works.

10.2 Objectives, Principles, and Knowledge

10.2.1 Complete the reading and exercises specified below.

10.3 Health and Safety Hazards

10.3.1 Gloves, lab coats and safety glasses should be worn when working in the laboratory. Universal precautions should be taken when dealing with biological specimens.

10.4 Reading and Practical Exercises

10.4.1 Reading

10.4.1.1 Biotage® Isolute® SLE+ User Guide, 2016.

10.4.2 Exercises

10.4.2.1 Demonstrate a working knowledge of theory and application of SLE extraction.

10.4.2.1.1 What does SLE stand for?

10.4.2.1.2 Describe the basic SLE process.

10.4.2.1.3 How is it similar to LLE and SPE and how does it differ?

10.4.2.1.4 What are some key factors affecting analyte partitioning?

10.4.2.1.5 How can pH be used to enhance extraction efficiency?

10.4.2.1.6 What types of solvents should be used for neutral analytes? What for polar analytes? What for non-polar analytes?

10.4.2.1.7 Why is it important to completely dry down the sample before reconstituting?

# 11.0 Gas Chromatography/Mass Spectrometry

## 11.1 Background and Theory

11.1.1 Gas Chromatography (GC) is a separation technique in which a volatile mixture is distributed (or partitioned) between a stationary phase (or column) and a moving gaseous phase. The sample is injected into the instrument and volatilized. A gas flowing through the column carries the sample through the column. The composition of the column can differ, which will lead to differences in how much time the sample will spend interacting with the column. The time it takes the sample to get through the column is referred to as the retention time. The more time the sample spends interacting with the column, the longer the retention time will be.

11.1.2 Mass Spectrometry (MS) is a highly important analytical technique that allows for the identification of compounds based on their unique mass-to-charge (m/z) ratios. In order to be measured, the sample must first be ionized. There are various ionization techniques that can be used to accomplish this. There are also numerous different types of mass spectrometers. The mass spectrometer is typically joined to another instrument that is first used to separate out the components in a mixture.

11.1.3 The mass spectrometer is comprised of four parts: the inlet (where the sample is introduced), the source (where the sample is ionized), the mass analyzer (where the ions are sorted according to their m/z ratio, and the detector (where the separated ions are measured and the results can be displayed in a chart).

11.1.4 Gas Chromatograph/Mass Spectrometers are widely accepted in the scientific community. The GC or MS alone does not give sufficient information for identification of compounds but when the two are coupled together, the combination of the retention time and mass spectral data does allow for positive identification of compounds.

11.1.5 Use of GC/MS instruments for identification of compounds is widely accepted in the scientific community. Both instruments will be covered in more detail in later sections.

11.1.6 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to provide a forensic analyst Trainee with the necessary information to be able to understand and describe what a gas chromatograph/mass spectrometer is, how it works, as well as be able to operate and troubleshoot the instrument(s).

11.2 Objectives, Principles, and Knowledge

11.2.1 Complete the reading and exercises specified below.

11.3 Health and Safety Hazards

11.3.1 Gloves, lab coats and safety goggles or glasses should be worn when working with chemicals. Gloves should be worn when working with the GC/MS.

11.3.2 Care should be taken when working with the GC/MS as there are parts that are very hot as well as a potential to get shocked if proper care is not taken.

11.4 Reading and Practical Exercises

11.4.1 Reading

11.4.1.1 Sections Covering Gas Chromatography. Refer to index for page numbers, in: Principles of Forensic Toxicology. Second Edition, Levine, B. ed., AACC, 2003 or more recent version.

11.4.1.2 Stafford, David T. Introduction to Chromatography - Chapter 2. pp. 1-39, in: Current Approaches in Forensic Toxicology. Presented by the Forensic Toxicologist Certification Board, Inc. at SOFT meeting, 1994.

11.4.1.3 Dawling, S. Gas Chromatography. pp. 425-499, in: Clarke's Analysis of Drugs and Poisons. Third Ed. Moffat, A.C., Ed, London: The Pharmaceutical Press, 2004 or more recent version.

11.4.1.4 Hearn, W.L. and Walls, H.C. Common Methods in Post-Mortem Toxicology. pp. 1000-1001, in: Drug Abuse Handbook. Second Edition, Karch, S.B. ed., Boca Raton: CRC Press, 2007 or more recent version.

11.4.1.5 Sections Covering Mass Spectrometry. Refer to index for page numbers, in: Principles of Forensic Toxicology. Second Edition, Levine, B. ed., AACC, 2003 or more recent version.

11.4.1.6 Foltz, R.L. Mass Spectrometry. pp. 159-190, in: California Association of Toxicologists (CAT) Manual for Analytical Toxicology Training. 1994.

11.4.1.7 Current instrument manuals (hardcopy and/or electronic) for each GC-MSD in use.



11.4.2 Exercises

11.4.2.1 Describe the influence carrier gas flow has on the efficiency of a GC.

11.4.2.2 Define the following terms as they relate to GC.

11.4.2.2.1 Resolution
11.4.2.2.2 Area under the curve
11.4.2.2.3 HETP
11.4.2.2.4 Signal to noise ratio

11.4.2.3 Discuss which GC parameters affect resolution. Describe how to approach a lack of resolution.

11.4.2.4 Discuss how to alleviate peak tailing.

11.4.2.5 Describe the principles and application of quantitative analysis.

11.4.2.6 Describe the major advantages of using an internal standard.

11.4.2.7 Describe the ionization process.

11.4.2.8 Discuss the differences between SIM and Full-scan acquisition of data.

11.4.2.9 Discuss the advantages of derivatizing drug compounds.

11.4.2.10 Evaluate an Autotune report.

# 12.0 Liquid Chromatography/ Tandem Mass Spectrometry (LC/MS/MS or LCMS-QQQ)

## 12.1 Background and Theory

12.1.1 Liquid Chromatograph/Mass Spectrometers are widely accepted in the scientific community. The LCMS-QQQ utilizes multiple quadrupoles to achieve identification.

12.1.2 The LC portion of the instrument is similar in principle to a gas chromatograph in that there is a partitioning between two different phases. With this instrumentation, the stationary phase is still a solid but instead of the mobile phase being a gas, it is a liquid.

12.1.3 The sample is separated in the LC portion of the instrument, then the sample is introduced into the MS portion of the instrument. The sample is ionized and then passes through the rest of the MS system. There are three different portions of the MS system: Q1, Q2, and Q3.

12.1.4 In Q1, the sample is filtered according to the mass to charge ratio, the quadrupole rods use a combination of radio frequency and DC voltages to only allow specific ions to pass through to the next portion. Those that are not the correct m/z ratio are deflected through the rods.

12.1.5 In Q2 (also known as the collision cell), the fragments that passed through in Q1 are further broken apart into even smaller fragments.

12.1.6 Like Q1, Q3 is another mass filter and those fragments generated in Q2 are then separated according to their m/z ratios.

12.1.7 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to provide a forensic analyst Trainee with the necessary information to be able to describe what an LCMS-QQQ is, how it works, and be able to operate and troubleshoot the instrument(s).



## 12.2 Objectives, Principles, and Knowledge

12.2.1 Complete the reading and exercises specified below.

## 12.3 Health and Safety Hazards

12.3.1 Gloves, lab coats and safety goggles or classes should be worn when working with chemicals.

12.3.2 Care should be taken when working with the LCMS-QQQ so as to avoid shock.

12.4 Reading and Practical Exercises

12.4.1 Reading

12.4.1.1 Agilent 6400 Series QQQ LC/MS Techniques and Operation, Course Number R1893A Volume 1 Student Manual, Agilent 2010

12.4.1.2 Agilent 6400 Series QQQ LC/MS Techniques and Operation, Course Number R1893A Volume 2 Student Manual, Agilent 2010

12.4.1.3 Agilent 1260 Infinity Binary LC Optimization Guide

12.4.2 Exercises

12.4.2.1 Explain how the following terms define or affect the performance of the instrument.

12.4.2.1.1 Resolution

12.4.2.1.2 Eddy diffusion

12.4.2.1.3 Capacity

12.4.2.2 Determine what type of column is currently installed on the LCMS QQQ in your laboratory.

12.4.2.2.1 What is the column packing material?

12.4.2.2.2 What is the total particle size of the packing material?

12.4.2.2.3 What is the inner diameter of the column?

12.4.2.2.4 What is the length of the column?

12.4.2.2.5 What pH range can this column accommodate?

12.4.2.2.6 What is the maximum operating pressure for this column?

12.4.2.3 Describe the difference between a gradient and an isocratic elution.

12.4.2.4 Discuss ways to reduce carryover.

12.4.2.5 What does the term data rate mean and how can that affect resolution and capacity?

12.4.2.6 Describe the difference between electrospray ionization and atmospheric pressure chemical ionization. What are the pros and cons of each ionization technique?

12.4.2.7 What is ion suppression? How is it evaluated and what can be done to reduce it?

12.4.2.8 What occurs in the first quadruple of the instrument, the hexapole, and the final quadrupole?

12.4.2.9 Give a basic explanation of the following acquisition parameters:

12.4.2.9.1 ms2scan

12.4.2.9.2 ms2sim

12.4.2.9.3 MRM

12.4.2.9.4 Dynamic MRM

12.4.2.9.5 Product ion

12.4.2.9.6 Neutral loss

12.4.2.9.7 Neutral gain

12.4.2.10 Evaluate a checktune and an autotune report.

12.4.2.11 Demonstrate the ability to operate an LC equipped with a triple quadrupole Mass Selective Detector.

12.4.2.12 Demonstrate an understanding of the system's software, troubleshooting techniques and the maintenance that is to be performed on the LCMS/QQQ.

12.4.3 The Trainee must demonstrate to the Trainer the ability to pull up the instrument manuals online.

# 13.0 Following Analytical Methods and Preparing Case files

13.1 Background and Theory

13.1.1 There are numerous analytical methods for the toxicology discipline that utilize the various training modules including balance operation, solution preparation, liquid-liquid chromatography, solid phase chromatography, supported liquid chromatography, gas chromatography/mass spectrometry, and liquid chromatography/mass spectrometry. In order to be able to properly follow the analytical methods, the applicable training modules must be completed. The Trainee need not be signed off in all analytical methods but in order to be able to be signed off in the analytical method, the Trainee must first demonstrate an ability to be able to perform the steps associated with the method.

13.1.2 In addition to being familiar with the analytical method, it is vital that the individual is familiar with the requirements for documenting the completed analysis. This includes generation of the analytical reports and supporting documentation needed for both case notes and central data files for the analysis performed. As part of the quality policy, central files, analytical reports and notes are reviewed by another competent analyst before the report is released.

13.1.3 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to provide a forensic analyst Trainee with the necessary information to be able to understand, describe and perform the methods used in the toxicology discipline as well as prepare a case file and central files.



13.2 Objectives, Principles, and Knowledge

13.2.1 Complete the exercises specified below.

13.3 Health and Safety Hazards

13.3.1 Gloves, lab coats and safety glasses or goggles should be worn while working in the laboratory.

13.3.2 Universal precautions should be taken when working with biological samples.

13.4 Reading and Practical Exercises

13.4.1 Exercises

13.4.1.1 To assess the understanding of each method, each of the following must be addressed:

13.4.1.1.1 Fully describe the steps involved in each analysis procedure.

13.4.1.1.2 Describe the quality assurance requirements described in each Analytical Method.

13.4.1.1.3 Describe the acceptance criteria for an analysis run.

13.4.1.1.4 Possess a thorough understanding of the criteria used for the qualitative identification and/or quantitative level of a compound(s) of interest by each analytical method.

13.4.1.1.5 Describe how quality assurance data is monitored and where it must be stored.

13.4.1.1.6 Describe the authentication process for reference material.

13.4.1.2 Describe which documents and data are required to be included in urine or blood toxicology analysis case file/notes packets.

13.4.1.3 List the required documents that are included in the centrally stored QA file/central data packet for each analysis run.

13.4.1.4 Describe the requirements for administrative and technical review of case file/notes packets and analytical reports.

# 14.0 Basic Pharmacology and Drug Metabolism

14.1 Background and Theory

14.1.1 Pharmacology is the study of the use, effects, and modes of action of drugs within a body. It can be broken down into pharmacokinetics and pharmacodynamics. Pharmacokinetics is the study of the absorption, distribution, metabolism, and excretion of drugs within the body. Pharmacodynamics if the study of the effects of drugs on a body including their mechanism of action. In simpler terms, pharmacokinetics is what the body does to a drug while pharmacodynamics is what a drug does to the body.

14.1.2 There are many factors that can influence how long it takes an individual to the break down (or metabolize) a drug. Drugs can produce both active (causes effects) and inactive (does not cause effects) metabolites.

14.1.3 Some drugs are inactive when taken into the body but become active when they are metabolized. These drugs are referred to as prodrugs.

14.1.4 When multiple drugs are confirmed in a sample, it is helpful to be able to identify which ones may be metabolites of other ones. Determining whether or not the drug has metabolized can sometimes help aid in providing a timeframe as to when the drug was taken into the body.

14.1.5 In order to be able to testify regarding what drugs were found in the sample and the effect that these drugs may have had on the individual (possible side effects) it is vital that the analyst have a good understanding of pharmacology.

14.1.6 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to provide a forensic analyst Trainee with the necessary information to be able to understand and explain basic pharmacology and drug metabolism principles as well as be able to identify specific parent drugs and metabolites.



14.2 Objectives, Principles, and Knowledge

14.2.1 Complete the reading and exercises specified below.

14.3 Health and Safety Hazards

14.3.1 N/A

14.4 Reading and Practical Exercises

14.4.1 Reading

14.4.1.1 Spiehler, V. and Levine, B., Pharmacokinetics and Pharmacodynamics. Refer to index for page numbers, in: Principles of Forensic Toxicology, Second Edition, edited by Barry Levine, AACC, 2003 or more recent version.

14.4.1.2 Isenschmid, D.S. Cocaine. Refer to index for page numbers, in: Principles of Forensic Toxicology, Second Edition, Levine, B. ed., AACC, 2003 or more recent version.

14.4.1.3 Huestis, M.A. Marijuana. Refer to index for page numbers, in: Principles of Forensic Toxicology, Second Edition, edited by Barry Levine, AACC, 2003 or more recent version.

14.4.1.4 Moore, Karla. Amphetamine/Sympathomimetic Amines. Refer to index for page numbers, in: Principles of Forensic Toxicology, Second Edition, edited by Barry Levine, AACC, 2003 or more recent version.

14.4.1.5 Kerrigan, S. and Goldberger, B.A. Opioids. Refer to index for page numbers, in: Principles of Forensic Toxicology, Second Edition, edited by Barry Levine, AACC, 2003 or more recent version.

14.4.1.6 Clarke's Analysis of Drugs and Poisons. Third Edition. Moffat, A.C., Ed, London: The Pharmaceutical Press. 2004 or more recent version.

14.4.1.7 Julien, R.M., Principles of Drug Action in: Primer of Drug Action, pp. 1-39, Freeman-New York, 1998 or more recent version.

14.4.1.8 Benet, L.Z., Kroetz, D.L. and Sheiner, L.B.., Pharmacokinetics: The Dynamics of Drug Absorption, Distribution and Elimination. pp. refer to index, in: Goodman and Gilman's The Pharmacological Basis of Therapeutics, New York: McGraw-Hill, Most current edition available.

14.4.1.9 Baselt, R.C., Disposition of Toxic Drugs and Chemicals in Man. Seventh Edition. Foster City: Biomedical Publications, 2004 or more recent version.

14.4.1.10 Baselt, R.C., Drug Effects on Psychomotor Performance. Foster City: Biomedical Publications, 2001 or more recent version.

14.4.2 Exercises

14.4.2.1 Define the following terms:

14.4.2.1.1 Pharmacology

14.4.2.1.2 Pharmacokinetics

14.4.2.1.3 Pharmacodynamics

14.4.2.2 Discuss the factors that influence the metabolism of drugs.

14.4.2.3 List the major metabolites for the following representative compounds. Indicate which metabolites are psychoactive.

14.4.2.3.1 Methamphetamine
14.4.2.3.2 Cocaine alone and in combination with alcohol
14.4.2.3.3 Diazepam
14.4.2.3.4 Clonazepam
14.4.2.3.5 Alprazolam
14.4.2.3.6 Flunitrazepam
14.4.2.3.7 Carisoprodol
14.4.2.3.8 Heroin
14.4.2.3.9 Codeine
14.4.2.3.10 Delta-9-THC
14.4.2.3.11 Imipramine
14.4.2.3.12 Amitriptyline
14.4.2.3.13 Propoxyphene
14.4.2.3.14 Tramadol

14.4.2.4 Characterize phase I and II drug metabolism.

14.4.2.5 The metabolism of the 1,4-Benzodiazepine, Diazepam, yields several metabolites which in turn undergo biotransformation. Indicate which compounds result in each case:

14.4.2.5.1 N-dealkylation (P450 mediated)
14.4.2.5.2 Hydroxylation (P450)
14.4.2.5.3 Glucuronidation

14.4.2.6 The metabolism of codeine yields several metabolites. Indicate which compounds result in each case:

14.4.2.6.1 O-dealkylation (P450 mediated)
14.4.2.6.2 N-dealkylation (P450)
14.4.2.6.3 Glucuronidation

14.4.2.7 The metabolism of methamphetamine yields several metabolites. Indicate which compounds result in each case:

14.4.2.7.1 N-dealkylation (P450)
14.4.2.7.2 Oxidative deamination (P450)
14.4.2.7.3 Aromatic hydroxylation (P450)

14.4.2.8 List compounds that yield methamphetamine as a metabolite.

14.4.2.9 The metabolism of cocaine yields several metabolites. Indicate which compounds result in each case:

14.4.2.9.1 N-dealkylation (P450)
14.4.2.9.2 Transesterification with alcohol (Esterase)
14.4.2.9.3 Ester hydrolysis mediated by esterases (two compounds)

14.4.2.9.4 Aromatic hydroxylation (P450)

14.4.2.10 Define the following terms in regard to drug metabolism:

14.4.2.10.1 First pass effect

14.4.2.10.2 Half-life

14.4.2.10.3 Metabolism

14.4.2.10.4 Zero and first order reactions

14.4.2.11 Give two examples of commonly encountered compounds that form glucuronide conjugates in phase II.

14.4.2.12 Describe the potential modes of excretion for drug compounds.

14.4.2.13 Describe what a prodrug is, why they would be used, and give some examples of prodrugs.

14.4.2.14 Describe how urinary pH will affect urinary methamphetamine concentration.

# 15.0 The Criminal Justice System and Drugged Driving Laws in Idaho

15.1 Background and Theory

15.1.1 In order to be able to testify in a court of law, it is imperative to understand what roles individuals within the court play as well as know basic court terms and how court proceedings work.

15.1.2 In order for expert testimony to be admissible, certain criteria must be evaluated and met. This criteria was outlined in the case of Daubert v. Merrell Dow Pharmaceutical. This case had tremendous implications for science in the courtroom' making judges the "gatekeepers" of the courtroom and what scientific evidence is reliable and relevant.

15.1.3 Before the precedent was set by Daubert v. Merrell Dow Pharmaceutical, admissibility of expert witness testimony had been determined in the case of Frye v. United States. In that case, it was found that expert opinion based on a scientific technique is admissible only when the technique has been "generally accepted" as reliable in the relevant scientific community.

15.1.4 Idaho Code §18-8002, §18-8004 and §18-8006 refer to drinking/drugged driving laws. Since a large amount of cases received in toxicology are related to driving, it is important to understand the applicable Idaho codes and how the testing done fits into those codes.

15.1.5 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to provide a forensic analyst Trainee with the necessary information to be able to understand and explain the principles of Idaho Code §18-8002, §18-8004 and §18-8006 , the criminal justice system and court proceedings and our role within them.



15.2 Objectives, Principles, and Knowledge

15.2.1 Complete the reading and exercises specified below.

15.3 Health and Safety Hazards

15.3.1 N/A

15.4 Reading and Practical Exercises

15.4.1 Reading

15.4.1.1 Schmalleger, F.J., Criminal Justice: A Brief Introduction. Ninth Edition, Prentice Hall:New Jersey, 2011 (paperback).

15.4.1.2 Matson, J.V., Effective Expert Witnessing. Second Edition, Lewis Publishers:Boca Raton, 1994.

15.4.1.3 Kurmack, N.T., Legal Aspects of Forensic Science – Chapter 1, pp. 1-27. in: Forensic Science Handbook, Volume I, Saferstein, R. ed, Prentice-Hall:New Jersey, 1982.

15.4.1.4 Freckelton, I., Legal Aspects of Forensic Science. pp. 1099 – 1102. in: Encyclopedia of Forensic Sciences, Volume 4, Siegel, J.A., Saukko, P.J. and Knupfer, G.C. editors, Academic Press: San Diego, 2000.

15.4.1.5 Idaho Code §18-8002, §18-8004 and §18-8006.

15.4.2 Exercises

15.4.2.1 Through the required reading the trainee should gain a practical understanding of the major branches of US federal and state government.

15.4.2.2 Describe which two branches of the US government have the authority to define what a crime is. Describe how the processes for each branch differ.

15.4.2.3 Be aware of which branch of US government law enforcement falls under.

15.4.2.4 Through the required reading, the trainee should gain a practical understanding of the organizational structure of the criminal justice system.

15.4.2.5 Describe the difference between being charged with an infraction, misdemeanor, or felony type offense.

15.4.2.6 Describe the differences between criminal and civil proceedings, including how the evidence is evaluated.

15.4.2.7 What are the three ways that a person can be charged with a criminal offense? Discuss the differences.

15.4.2.8 Describe the subpoena process. What is the purpose of a subpoena? What do the words “duces tecum” mean when added to the subpoena?

15.4.2.9 Describe the Discovery Process. What does the Discovery Process hope to prevent?

15.4.2.10 Define the following terms:

15.4.2.10.1 Plaintiff

15.4.2.10.2 Defendant

15.4.2.10.3 Counsel

15.4.2.11 Discuss who has the burden of proof: the plaintiff or defendant.

15.4.2.12 Describe the role and functions of the following criminal justice system components:

15.4.2.12.1 Judge

15.4.2.12.2 Prosecutor

15.4.2.12.3 Defense Attorney

15.4.2.12.4 Expert Witness

15.4.2.12.5 Jury

15.4.2.12.6 Bailiff

15.4.2.12.7 Court Reporter

15.4.2.13 Discuss the following questions:

15.4.2.13.1 What is a deposition?

15.4.2.13.2 What are the key differences between a bench trial versus a jury trial?

15.4.2.14 Describe the steps or events that take place in the course of a trial.

15.4.2.15 Discuss the difference between direct, cross and rebuttal testimony.

15.4.2.16 Answer the following questions:

15.4.2.16.1 What does it mean when the analyst's qualifications are stipulated to?

15.4.2.16.2 What objections are made by attorneys during a trial?

15.4.2.16.3 What is the difference between an objection being sustained versus overruled?

15.4.2.16.4 Describe how an analyst is qualified to testify as an expert witness. What is voir dire as it relates to the testimony of an expert witness?

15.4.2.16.5 Describe possible outcomes of the trial process.

15.4.2.16.6 Discuss the ramifications of Daubert v. Merrell Dow Pharmaceutical and Frye v. United States.

15.4.2.16.7 List the factors that help assure a scientific testing procedure is established as reliable.

15.4.2.17 For Idaho Code §18-8002A, Define the following terms and answer the question:

15.4.2.17.1 "Actual physical control"

15.4.2.17.2 "Administrative hearing"

15.4.2.17.3 "Evidentiary testing"

15.4.2.17.4 What happens if evidentiary testing is refused or not properly completed?

15.4.2.17.5 What is the role of the administrative hearing officer?

15.4.2.18 For Idaho Code §18-8004, answer the following:

15.4.2.18.1 Describe what the code defines as unlawful.

15.4.2.18.2 What additional information does the code allow to be considered when a person's ethanol concentration is less than 0.08 (g/100cc blood, g/210L breath or 67mL urine).

15.4.2.19 For Idaho Code §18-8006, what does it describe as "aggravated driving while under the influence of alcohol, drugs or any other intoxicating substances"?

# 16.0 Standardized Field Sobriety Tests (SFST's) and the Drug Evaluation and Classification (DEC) Program

16.1 Background and Theory

16.1.1 The Standardized Field Sobriety Test (SFST) was developed in 1984 after research conducted for the National Highway Traffic Safety Administration found that the validity of the field sobriety testing being administered was very low. It is comprised of three phases and allows officers to assess an individual's degree of impairment.

16.1.2 The Drug Evaluation and Classification Program is a 12-step process that was started in 1979 to assist police officers in determining if a suspect was actually under the influence of something. Before the DEC Program, officers would often pull over a vehicle for suspicious driving, or detain a suspect believing that the suspect was under the influence of alcohol, only to find that there was a very low level or no alcohol detected. Since the development of the DEC Program, trained officers can recognize physical signs of impairment and determine what substance(s) the suspect is under the influence of.

16.1.3 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to provide a forensic analyst Trainee with the necessary information to be able to understand and explain what SFST's and DRE examinations are, which tests are administered and what the results of the testing mean.

16.2 Objectives, Principles, and Knowledge

16.2.1 Complete the exercises specified below.

16.3 Health and Safety Hazards

16.3.1 N/A

16.4 Reading and Practical Exercises

16.4.1.1 Kunsman, G.W. Human Performance Toxicology. pp. 15 - 30, in: Principles of Forensic Toxicology, Second Edition, edited by Barry Levine, AACC, 2003 or more recent version.

16.4.1.2 Page, T.E., The Classification of Drugs by Category. pp. 1 - 12, in: Medical-Legal Aspects of Drugs, Second Edition, Burns, M. ed., Tucson: Lawyers & Judges Publishing Co., Inc., 2007.

16.4.2 Exercises

16.4.2.1 Describe the origins of the Standardized Field Sobriety Testing (SFSTs).

16.4.2.2 What are the phases of Standardized Field Sobriety Tests? What information does each phase provide? Describe what driving behaviors may indicate impaired driving.

16.4.2.3 Describe the process for administering the last phase of SFSTs.

16.4.2.4 Describe the origins of the Drug Evaluation and Classification (DEC) Program.

16.4.2.5 Describe each step of the physiological and psychomotor test protocols that an officer trained in the DEC program administers to a person suspected of driving impaired. What is this officer referred to as?

16.4.2.6 Describe each of the DEC program drug categories. What is the basis of these categories?

16.4.2.7 Provide examples of the major types of drugs that fall under each of the DEC program categories.

16.4.2.8 Describe the physiological responses consistent with each of the drug categories.

16.4.2.9 Describe the psychomotor test performance consistent with each of the drug categories.

16.4.2.10 Can the DEC Program differentiate between methamphetamine and cocaine use? Do methamphetamine and marijuana abuse share any physiological indicators?

16.4.2.11 What is a "Medical Rule Out"? What does it hope to prevent?

16.4.2.12 Describe the four types of poly-drug use considered by the DEC Program.

16.4.2.13 What are the three "S's" used by the DEC program to illustrate how effects of a particular drug category can vary? Describe the factors that influence each "S."

# 17.0 General Preparation and Presentation of Courtroom Testimony

17.1 Background and Theory

17.1.1 Understanding proper court attire and etiquette is vital when preparing to testify in a court of law as a witness.

17.1.2 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to provide a forensic analyst Trainee with the necessary information to be able to understand the proper attire and demeanor for testifying in a courtroom.

17.2 Objectives, Principles, and Knowledge

17.2.1 Complete the reading and exercises specified below.

17.3 Health and Safety Hazards

17.3.1 N/A

17.4 Reading and Practical Exercises

17.4.1 Reading

17.4.1.1 Weingarten, H. The Expert Witness: the Toxicologist in Court. pp. 225- 242, in: California Association of Toxicologists (CAT) Manual for Analytical Toxicology Training, 1994.

17.4.1.2 Sannito, T. Nonverbal Communication in the Courtroom. Champion, Sept.-Oct., 1985.

17.4.2 Exercises

17.4.2.1 Discuss proper demeanor and body language while testifying in court.

17.4.2.2 Describe proper attire for court.

17.4.2.3 Discuss ways to deal with nervousness while testifying.

17.4.2.4 Describe the documents that should be reviewed for a case in preparation for testimony. Consult at least two senior analysts on how they prepare for court.

# 18.0 Mock Courtroom Testimony Requirements

18.1 Background and Theory

18.1.1 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to allow the Trainee to demonstrate their ability to testify in a court proceeding.

18.2 Objectives, Principles, and Knowledge

18.2.1 Complete the exercises specified below.

18.3 Health and Safety Hazards

18.3.1 N/A

18.4 Reading and Practical Exercises

18.4.1 Exercises

18.4.1.1 A mock court will be conducted to provide testimony for a minimum of one DUID case with pharmacology questions.

18.4.1.2 During the mock court, the Trainee may be asked how they would explain the following to a jury (note: not all topics may be covered as some will not pertain):

18.4.1.2.1 Laboratory accreditation
18.4.1.2.2 How samples are received
18.4.1.2.3 How the sample is initially examined
18.4.1.2.4 EIA Screen
18.4.1.2.5 Sample Preparation
18.4.1.2.6 Instrumentation used for confirmatory testing
18.4.1.2.7 The technical and administrative review process
18.4.1.2.8 Quantitation and the uncertainty associated with the values
18.4.1.2.9 The intended use of the drug(s) detected
18.4.1.2.10 Possible side effects of the drug(s) detected
18.4.1.2.11 DEC/DRE categories and Indicators
18.4.1.2.12 Neurotransmission
18.4.1.2.13 Pharmacology
18.4.1.2.14 Pharmacodynamics
18.4.1.2.15 Pharmacokinetics
18.4.1.2.16 Half-life
18.4.1.2.17 Onset of action
18.4.1.2.18 Duration of action

18.4.1.2.19 Types of Tolerance

# 19.0 Analysis of Practice Samples

19.1 Background and Theory

19.1.1 This section of the Idaho State Police Forensic Services (ISP-FS) toxicology training plan is designed to allow the Trainee to demonstrate their ability to perform the analytical methods, data analysis and/or reporting of compounds.

19.2 Objectives, Principles, and Knowledge

19.2.1 The Trainee will demonstrate the ability to do the necessary tasks for the methods they are to be performing.

19.3 Health and Safety Hazards

19.3.1 Gloves, lab coats and safety glasses or goggles should be worn while working in the laboratory.

19.3.2 Universal precautions should be taken when working with biological samples.

19.4 Reading and Practical Exercises

19.4.1 To develop their expertise in using analytical methods, the Trainee will apply them to the analysis of control samples, old proficiency test samples and/or training samples. These training samples may be obtained in the following way: A forensic scientist assigned to a case may take an additional sample from casework that the Trainee may analyze for training purposes. The sample may only be taken if the reserve after removing the training sample is greater than ½ (½ meaning: ½ of the total sample of that type submitted. For example, if two grey top blood tubes are submitted it would be half of the total blood in the two tubes. If a purple and a grey top tube are submitted, it would be the ½ of the volume of the blood in each of the tube types submitted). In addition the Trainee may, under the direct observation of a competent analyst, handle case samples. The Trainer will make all conclusions and must be present and observe all aspects of the work (the Trainee works as the "hands of the Trainer"). All evidence in the "hands of the Trainer" process will be checked out by the Trainer and the chain of custody shall be maintained in the name of the Trainer/trained analyst. Examination reports shall be based solely on examinations performed by or directly observed by approved analysts. The report will be issued by the Trainer/trained analyst. The trainee will document work

performed in the notes section for the case and central data checklist (if applicable). If any evaluations or interpretations for casework are done by the Trainee, the Trainee must initial the examination record for the work performed and the Trainer/trained analyst must confirm observations and conclusions by initialing or signing each page of the examination records. The number and type of practice samples will be at the discretion of the Trainer and the Trainee. A minimum of 2 batches of practice samples will be complete. When both parties are comfortable with the Trainee's proficiency and understanding of the methods, this section can be signed off.

19.4.2 For the purposes of this training module, data analysis may also be considered practice samples.

# 20.0 Competency Testing

20.1 Background and Theory

20.1.1 Upon the completion of training plan sections, the Trainee must complete a competency test consisting of 6 or more specimens. The number of samples will be decided by the Trainer and Technical Lead. The specimens must contain representative commonly encountered parent drug and drug metabolites. Competency tests are logged into ILIMS and handled as a typical case. Reports and applicable restitutions will be prepared, and the case will go through administrative and technical review. The Trainer will evaluate all aspects of how the case is handled and reported, in addition to reporting the appropriate results of testing.

20.2 Objectives, Principles, and Knowledge

20.2.1 The Trainee will demonstrate that they are able to perform all the duties associated with processing case samples.

20.3 Health and Safety Hazards

20.3.1 Gloves, lab coats and safety glasses or goggles should be worn while working in the laboratory.

20.3.2 Universal precautions should be taken when working with biological samples.

20.4 Reading and Practical Exercises

20.4.1 To demonstrate that the Trainee is ready to perform supervised casework, they must complete a competency test. In order for the test to be evaluated as passing, the Trainee must get a 100%, meaning that they correctly identify all compounds that are present and not report any compounds that are not. The Trainer and/or Technical Lead will evaluate the competency test to determine if the results obtained are appropriate. If a drug is not confirmed but is noted and a reason for not confirming given, it will be up to the individual grading the test to determine if the analyst's assessment was correct.

# 21.0 Technical and Administrative Review

21.1 Background and Theory

21.1.1 Upon completion of supervised casework, the analyst will have the opportunity to begin performing case reviews for the methods they are approved in.

21.2 Objectives, Principles, and Knowledge

21.2.1 Complete the exercises below.

21.3 Health and Safety Hazards

21.3.1 N/A

21.4 Reading and Practical Exercises

21.4.1 After the analyst has completed training in blood or urine toxicology they may begin training for technical and administrative review sign off in the appropriate discipline.

21.4.2 The Trainer will demonstrate for the Trainee how the technical and administrative review is done and what documents must be reviewed. It is recommended that the Trainee develop a checklist to use when first starting technical and administrative review.

21.4.3 The Trainee will perform technical and administrative review on a minimum of 50 cases. All aspects of the review (chain of custody, central files, data review, etc.) will be completed. Any errors caught will be recorded and reported to the Trainer. The Trainee will not sign off on the cases but instead the cases will then be reviewed by an approved reviewer.

# 22.0 Supervised Casework

22.1 Background and Theory

22.1.1 After completing the appropriate training modules (including competency testing and mock court) the Trainee will be permitted to do supervised casework.

22.2 Objectives, Principles, and Knowledge

22.2.1 The Trainee will demonstrate that they are able to perform all the duties associated with processing case samples.

22.3 Health and Safety Hazards

22.3.1 Gloves, lab coats and safety glasses or goggles should be worn while working in the laboratory.

22.3.2 Universal precautions should be taken when working with biological samples.

22.4 Reading and Practical Exercises

22.4.1 A minimum of 15 supervised blood toxicology and/or urine toxicology cases will be completed prior to the Trainee being signed off to perform independent casework. The Trainee can be signed off on just blood toxicology, just urine toxicology, or both depending on what the training entailed. If the Trainee is getting signed off on both blood and urine toxicology at the same time, they must complete a minimum of 15 cases total. After completion of the 15 cases, the Trainer and/or Technical Lead will evaluate if the need for additional supervised cases are necessary.

# APPENDIX A

It is expected that analysts will progress at different rates based on past experience; education and that people learn and retain skills differently. The following are general guidelines for the Trainer to consider when assigning, evaluating and signing off on the practice casework section of the toxicology training manual.

The Trainee will practice each extraction method on controls, old proficiency tests and aliquots taken from casework, when feasible.

The Trainee will generally practice with samples to learn the extraction process and then the Trainee will do practice runs that consist of multiple extraction processes. The Trainee will most likely need to run between 50 and 100 samples to demonstrate competence. In addition, the Trainee should perform data analysis on past analytical runs.

The Trainer should observe the Trainee preparing multiple runs. During this observation the Trainer will confirm that the Trainee is:

-Handling the samples with care and in a way that ensures the samples don't get placed in the wrong tube at any time during the examination process.
-Using appropriate techniques to prevent contamination.

The Trainee should act as the hands of the analyst for at least one run and demonstrate that: they are checking the names on the sample container(s) to make sure they match the name entered into the ILIMS system, they are correctly labeling the container(s), they understand how to document the condition of the evidence and describe it in notes, store evidence during the examination process and seal it after analysis.

The Trainee will demonstrate that they store and handle controls and standards appropriately.

The Trainee will be able to perform the routine maintenance and perform and evaluate the quality checks that are required for all of the instrumentation he or she is approved to use.

The Trainee will demonstrate that he or she is comfortable operating the instrumentation and can do basic trouble shooting.

If appropriate for the method(s), the Trainee will demonstrate a solid understanding and comfort level determining when a weak analyte meets the criteria for identification.

The Trainee will demonstrate performance on multiple runs with no need for assistance from the Trainer and with expected efficiencies on the extractions.

If appropriate for the method(s), the Trainee will demonstrate the understanding and the ability to hydrolyze samples, what may prevent this process from working and how to determine this part of the analysis worked.

If appropriate for the method(s), the Trainee will demonstrate the ability to derivatize samples, understand what problems may occur and how to evaluate that in an analysis run.

The Trainee will demonstrate the understanding of which extraction process to run first on samples and which detected analytes should be confirmed.

The Trainee will demonstrate the understanding of when the officer or prosecutor should be consulted on casework decisions.