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1.0 Training Overview

1.1. Training Purpose and Description

1.1.1.Purpose and Goals

The purpose of this training program is to provide a uniform training process for analysts in the Toxicology Section at the Vermont Forensic Laboratory (VFL). This program is designed to ensure and document that those individuals who will be working as analysts are knowledgeable and competent to perform their technical, analytical, and legal duties.

1.1.2.Scope

This program will allow the trainee to familiarize themselves with quality assurance policies and procedures, laboratory set-up, security and safety, evidence handling and chain of custody, the laboratory information management system, sample preparation, testing procedures, report writing, and courtroom testimony.

The VFL Toxicology Section has two disciplines and multiple sub-disciplines. This training manual will cover the general knowledge and responsibilities of an analyst in the Toxicology Section. This manual will typically be completed in conjunction with a sub-discipline-specific training manual(s). A final evaluation, including competency testing, will take place following the completion of sub-discipline-specific training manuals.

This program is designed for new employees or current employees without prior toxicology experience. A trainee with previous experience in forensic or other toxicological analysis may not require all modules or steps; it is the responsibility of the Toxicology Section Supervisor to determine the duration and scope of the training program for a trainee with previous experience. Similarly, the module content may be tailored as applicable to anticipated job responsibilities.

1.1.3.Documentation

The trainee will compile all documentation associated with completed training work. These files may include, but are not limited to, worksheets, reports, and review sheets. The trainer will review these materials and document completion of required training components. Documentation of training will be maintained at the laboratory.

1.2. Trainee Responsibilities

1.2.1. Instructions for Trainee

The length of time needed to complete the training program will vary and is left to the discretion of the trainer and supervisor. The trainee will be provided access to any required or suggested readings and will be exposed to samples and situations expected to be encountered during routine work in the Toxicology Section. The trainee will keep records, where appropriate, of how training tasks were accomplished (e.g. what ethics training was received, who did the trainee observe testify in court, what additional papers not listed in Appendix I did the trainee reference, etc.). At the conclusion of training, the trainee will evaluate the effectiveness of the training program and suggest any improvements to the section supervisor.

1.2.2. Required Training Modules

The trainee, trainer, and section supervisor shall discuss which training manuals, or portions thereof, are to be completed by the trainee based on the trainee's anticipated job responsibilities and the trainee's prior experience. The Toxicology Section has two disciplines and multiple sub-disciplines. An analyst may be trained in any or all sub-disciplines. This document covers the general training required for the Toxicology Section as a whole. Sub-discipline-specific training manuals will be completed in conjunction with this manual as required by job duties. This section may also be used to outline re-training requirements for current employees if needed. The requirements for the trainee are outlined below:

	Required?		Completed?	
	Yes	No	Date	Trainer
1. Training Overview				
2. Laboratory Introduction				
2.1. General Laboratory Requirements				
2.2. Safety				
2.3. Section-Specific Requirements				
3. Sample and Evidence Control				
3.1. Evidence Handling for Casework				
3.2. Laboratory Information Management System				
4. Fundamental Scientific Knowledge				
4.1. Documentation of Education and Experience				
4.2. General Knowledge of Forensic Science				

4.3. General Knowledge of Analytical Methods				
4.4. General Statistics and Data Analysis				
5. Applied Scientific Knowledge				
5.1. Alcohol and Drug Physiology, Pharmacology, and Pharmacokinetics				
5.2. Retrograde Extrapolation				
5.3. Applied Analytical Methods				
5.4. Statistics and Data Analysis				
6. Laboratory Analysis				
6.1. General Equipment Use, QC, and Maintenance				
6.2. Laboratory Maintenance				
7. Reports and Notifications				
7.1. Reporting Requirements				
7.2. Review Process				
8. Legal Knowledge				
8.1. Legal System Fundamental Knowledge				
8.2. General Testimony				
8.3. Document Preparation				
9. Final Evaluation				

1.3. Trainer Responsibilities

The trainer is responsible for instructing the trainee in the operations of the laboratory and the processes and procedures that will ultimately comprise the trainee's job duties. The trainer will ensure that the trainee is exposed to all relevant topics within the training program. The trainer will provide sample sets for the trainee to analyze and/or practice scenarios and will meet with the trainee periodically to monitor progress, review work, and provide feedback. The trainer will assist the trainee in preparing for any assessments, which will include a competency test(s) and may include a mock trial. At the conclusion of training, the trainer will evaluate the effectiveness of the training program and suggest any improvements to the section supervisor.

1.4. Acknowledgement of Training Plan

The signatures of the trainee, trainer(s), and section supervisor below indicate that the expected responsibilities and required training modules have been discussed and agreed upon.

Trainee: _____ Date: _____

Trainer(s): _____ Date: _____

Trainer(s): _____ Date: _____

Section Supervisor: _____ Date: _____

2.0 Laboratory Introduction

2.1. General Laboratory Requirements

The trainee will become familiar with and follow the administrative and quality assurance policies and procedures described in the VFL Quality Assurance Manual and associated documents.

Task	Trainee	Trainer	Date Completed
I have received a tour and have become oriented to the laboratory.			
I have received ethics training and understand that my position carries ethical responsibilities.			
I have read and understand the required readings outlined for this section in Appendix I.			
I have answered the questions outlined for this section in Appendix II and received feedback on my answers.			

2.2. Safety

The trainee will become familiar with and follow the safety policies and procedures described in the VFL Safety Manual.

Task	Trainee	Trainer	Date Completed
I have received a safety tour lead by a safety officer.			
I have read and understand the required readings and training outlined for this section in Appendix I.			
I have answered the questions outlined for this section in Appendix II and received feedback on my answers.			

2.3. Section-Specific Requirements

The trainee will become familiar with and follow requirements and guidelines specific to the Toxicology Section.

Task	Trainee	Trainer	Date Completed
I have read and understand the required readings outlined for this section in Appendix I.			

3.0 Sample and Evidence Control

3.1. Evidence Handling for Casework

The trainee will become familiar with and follow the policies and procedures described in the VFL Evidence Handling Manual. This training will include, but is not limited to, the collection, packaging, storage, and handling of evidence, and requirements for consuming samples.

Task	Trainee	Trainer	Date Completed
I have read and understand the required readings outlined for this section in Appendix I.			
I have answered the questions outlined for this section in Appendix II and received feedback on my answers.			
I have observed the receipt, handling, storage, and return of evidence in the Evidence Section.			
I have observed the receipt, inventory, bench handling, storage, and return of evidence in the Toxicology Section.			

3.2. Laboratory Information Management System

The trainee will become familiar with the laboratory information management system (LIMS) and chain of custody procedures in use at the VFL.

Task	Trainee	Trainer	Date Completed
I have read and understand the required readings outlined for this section in Appendix I.			
I have answered the questions outlined for this section in Appendix II and received feedback on my answers.			
I have observed the use of LIMS by a qualified Toxicology analyst.			
I have been introduced to FA Stage and have had the opportunity to practice in the LIMS.			

4.0 Fundamental Scientific Knowledge

This training module will ensure that the trainee has appropriate formal education and can demonstrate a working knowledge of the fundamental scientific basis of toxicological analysis.

4.1. Documentation of Education and Experience

4.1.1. Education Requirements

The trainee shall meet the educational requirements outlined by the current accreditation requirements. The trainee shall produce pertinent materials, such as transcripts, syllabi, and/or correspondence with instructors, to show that educational requirements are met. These documents will be reviewed and approved by the section supervisor.

4.1.2. Experience Requirements

Prior experience in toxicology may be accepted in lieu of completing portions of this training program. The section supervisor is responsible for determining whether a trainee's prior experience is accepted by the laboratory.

4.1.3. Acknowledgement of Education and Experience

The signatures of the trainee and section supervisor below indicate that the trainee's documentation of education and experience, if applicable, has been reviewed and that the trainee meets the educational requirements to work as an analyst.

Trainee: _____ Date: _____

Section Supervisor: _____ Date: _____

4.2. General Knowledge of Forensic Science

The trainee will become familiar with the various services provided by the VFL. The trainee will develop and demonstrate a general understanding of the scope and breadth of the capabilities of each lab section at the VFL.

Task	Trainee	Trainer	Date Completed
I have read and understand the required readings outlined for this section in Appendix I.			
I have answered the questions outlined for this section in Appendix II and received feedback on my answers.			

4.3. General Knowledge of Analytical Methods

The trainee will develop and demonstrate an understanding of various scientific principles that are foundational to toxicological testing. The trainer will provide feedback based on the answers provided by the trainee. The trainee and trainer will document this by both initialing the boxes below.

Analytical Methods	Completed Required Readings	Answered Required Questions
Analytical Methods		
Spectroscopy		
Immunoassay		
Extraction Techniques		
Chromatography		
Detectors		
Other:		

4.4. General Statistics and Data Analysis

The trainee will develop and demonstrate a foundational knowledge of statistical concepts used in evaluating scientific data. The extent of training required will be determined by the trainer and section supervisor. The trainer will provide feedback based on the answers provided by the trainee. The trainee and trainer will document this by both initialing the boxes below.

Scientific Concepts	Completed Required Readings	Answered Required Questions
Measurement Uncertainty		
Calibration Models		
Regression Analysis		
Statistical Significance		
Microsoft Excel		

Other:		

5.0 Applied Scientific Knowledge

This training module will ensure that the trainee has received the appropriate education and training to apply relevant scientific principles to the testing or calibration performed at the VFL and to demonstrate working knowledge of general toxicology.

5.1. Alcohol and Drug Physiology, Pharmacology, and Pharmacokinetics

The trainee will develop and demonstrate a working knowledge of toxicology basics such as physiology, pharmacology, and impairment.

Task	Trainee	Trainer	Date Completed
I have read and understand the required readings outlined for this section in Appendix I.			
I have answered the questions outlined for this section in Appendix II and received feedback on my answers.			

5.2. Retrograde Extrapolation

The trainee will become familiar with alcohol absorption, distribution, and elimination, as well as the methods for retrograde extrapolation (relation back calculations) in use at the VFL.

Task	Trainee	Trainer	Date Completed
I have read and understand the required readings outlined for this section in Appendix I.			
I have answered the questions outlined for this section in Appendix II and received feedback on my answers.			

5.3. Applied Analytical Methods

The trainee will develop and demonstrate an understanding of how foundational scientific principles are applied to the testing and calibration performed at the VFL. The trainer will provide feedback based on the answers provided by the trainee. The trainee and trainer will document this by both initialing the boxes below.

Analytical Methods	Answered Required Questions
Spectroscopy	

Analytical Methods	Answered Required Questions
Immunoassay	
Extraction Techniques	
Chromatography	
Detectors	
Other:	

5.4. Statistics and Data Analysis

The trainee will develop and demonstrate an understanding of how foundational statistical principles are applied to the testing and calibration performed at the VFL. The trainer will provide feedback based on the answers provided by the trainee. The trainee and trainer will document this by both initialing the boxes below.

Scientific Concepts	Answered Required Questions
Measurement Uncertainty	
Statistical Significance	
Microsoft Excel	
Other:	

6.0 Laboratory Analysis

The trainee will demonstrate the ability to use and maintain general scientific equipment within the laboratory.

6.1. General Equipment Use, QC, and Maintenance

The trainee will develop and demonstrate knowledge of the use of equipment and associated quality control requirements in use at the VFL by observing a qualified analyst use each item. In turn, the trainee will use each item under the direct supervision of a qualified analyst or trainer. The trainee and trainer will document this by both initialing the boxes below.

Equipment	Initials & Date Observed	Initials & Date Performed
Pipettes (including various pipetting techniques such as pre-wetting, rinsing, and reverse pipetting)		
Thermometers		
Positive pressure manifolds		
Centrifuge		
Thermoshaker		
Balance		
Other:		
Other:		
Other:		
I have read and understand the required readings outlined for this section in Appendix I.		
I have answered the questions outlined for this section in Appendix II and received feedback on my answers.		
I have met the outlined requirements in this section and am authorized in the use and basic maintenance of the equipment initialed above.		

6.2. Laboratory Maintenance

The trainee will become familiar with maintenance requirements for the lab space that ensure a clean, effective, and safe working environment. The trainee and trainer will document this by both initialing the boxes below.

Equipment/Procedure	Initials & Date Observed	Initials & Date Performed
Lab maintenance including: eye washes; cleaning of work areas; taking out glass, trash, and biohazardous waste		
I am familiar with the location and expected use of emergency shut down procedures, reagent logs, and maintenance logs.		

I have read and understand the required reading outlined for this section in Appendix I.	

7.0 Reports and Notifications

The trainee will develop and demonstrate knowledge of procedures and documentation for reporting analytical results in accordance with laboratory policy.

7.1. Reporting Requirements

The trainee will review various types of reports. Training will include, but is not limited to, report format, language used, and the use of the LIMS to generate reports.

Task	Trainee	Trainer	Date Completed
I have read and understand the required readings outlined for this section in Appendix I.			
I have answered the questions outlined for this section in Appendix II and received feedback on my answers.			
I am familiar with the various reports generated by the Toxicology Section including certificates of analysis, certificates of calibration, affidavits, and case reports.			

7.2. Review Process

The trainee will become familiar with the policies, procedures, and forms for technical, administrative, and director reviews.

Task	Trainee	Trainer	Date Completed
I am familiar with the review process.			

8.0 Legal Knowledge

The trainee will develop and demonstrate an understanding of the structure and function of the legal system in the state of Vermont as well as the roles and responsibilities of forensic scientists in this system.

8.1. Legal System Fundamental Knowledge

The trainee will develop and demonstrate fundamental knowledge of the legal system. This training will include, but is not limited to, court structure, trial format, discovery and admissibility, courtroom presentation skills, exhibit presentation, and ethical responsibilities of expert witnesses.

Task	Trainee	Trainer	Date Completed
I have read and understand the readings outlined for this section in Appendix I.			
I have answered the questions outlined for this section in Appendix II and received feedback on my answers.			

8.2. General Testimony

The trainee will develop and demonstrate knowledge of the responsibilities of expert witnesses and strategies for effective expert testimony.

Task	Trainee	Trainer	Date Completed
I have read and understand the readings outlined for this section in Appendix I.			
I have answered the questions outlined for this section in Appendix II and received feedback on my answers.			

8.3. Document Preparation

The trainee will practice preparing documents that would be requested from an analyst preparing to appear in court.

Task	Trainee	Trainer	Date Completed
I have prepared my curriculum vitae and had it reviewed by at least one qualified analyst.			
I have been introduced to the discovery process including record retention requirements, documentation, the discovery website, and communication responsibilities.			
I have answered the questions outlined for this section in Appendix II and received feedback on my answers.			

9.0 Final Evaluation

Completion of Training Plan

Completion of training modules will be documented in section 1.2.2. The signatures of the trainee, trainer(s), and section supervisor below indicate that the expected responsibilities and required training modules have been met.

Trainee: _____ Date: _____

Trainer(s): _____ Date: _____

Trainer(s): _____ Date: _____

Section Supervisor: _____ Date: _____

Appendix I: Readings

A: Required Readings

The resources listed below are provided to give the trainee the necessary information to perform their duties. Depending on the trainee's education and experience they may not need to complete every reading in its entirety. The location of various training tools such as readings, videos, or websites are included for convenience. If file locations change or links break, alternative training materials may be used. Supplemental documents are available through the laboratory's shared drive under the training folder, but are not required unless designated as such by the section supervisor.

1.0 Training Overview

- ☐ VFL Intro to Toxicology Training Manual (TOX_P300)

2.0 Laboratory Introduction

2.1. General Laboratory Requirements

- ☐ VFL Quality Assurance Manual and all associated documents (QA_P100)
- ☐ ANAB Guiding Principles of Professional Responsibility for Forensic Service Providers and Forensic Personnel (https://anab.qualtraxcloud.com/ShowDocument.aspx?ID=6732)
- ☐ Boyd, J., "Defensibility and Ethics in the Laboratory" Qual Assur J 2003; 7, 79-83.
- ☐ Ethics and Data Integrity for Environmental Labs, 2004 Webinar Series.
- ☐ Gallo, A., "How To Speak Up About Ethical Issues at Work" Harvard Business Journal June 4, 2015
- ☐ Northrup, T. P., "Ethics and Forensic Science" presentation
- ☐ Rosner, R., "Foundations of Ethical Practices in Forensic Sciences" J. For Sci Vol. 42, Issue 6 (November 1997), pg. 1190-1194)
- ☐ Trevino, L. K., et al. "Managing to be Ethical: Debunking Five Business Ethics Myths" Academy of Management Execution, 2004 Vol. 18, No. 2 (May), pg 69-81.

2.2. Safety

- ☐ VFL Safety Manual (SAF_P100)
- ☐ Most Current Safety Review PowerPoint (Forensic Lab > SECTION FOLDERS > Safety)
- ☐ Meyer, S., "Lead, Noise, Infection Control Training" presentation, 2014.
- ☐ Lab safety videos by BioNetwork (https://www.youtube.com/playlist?list=PL4qaj9envIYnBaQSPpcOMUqWiQUAgPoMq)
- ☐ Blood borne Pathogens (VT DHR CAPS: https://vermont.csod.com/client/vermont/default.aspx)
    - Bloodborne Pathogens (https://vermont.csod.com/ui/lms-learning-details/app/course/5d200e97-0bf9-4536-9141-d76df0f3fbb7)
- ☐ How to Clean a Blood Spill (https://www.youtube.com/watch?v=ztBJ_WpvR6U)

2.3. Section-Specific Requirements

- ☐ Toxicology manuals and associated documents
    - VFL Alcohol Analysis Manual (TOX_P100)

- VFL DMT Manual (TOX_P200)
- VFL Expert Opinions and Affidavits Manual (TOX_P400)
- VFL Certified Reference Manual (TOX_P500)
- VFL Toxicology Screening Manual (TOX_P600)
- VFL Toxicology Confirmation Manual (TOX_P700)

☐ Vermont Department of Public Safety Breath and Blood Alcohol Analysis Rule

☐ VFL Toxicology DUI day at the Vermont Police Academy

- VPA Alcohol Physiology and Pharmacology
- Blood testing
- Evidential Breath Testing Operator Training

☐ Advanced Roadside Impaired Driving Enforcement training

3.0 Sample and Evidence Control

3.1. Evidence Handling for Casework

☐ VFL Evidence Handling Manual (EH_P100)

3.2. Laboratory Information Management System

☐ VFL LIMS How-To Guide (LIMS_P100)

4.0 Fundamental Scientific Knowledge

4.2. General Knowledge of Forensic Science

☐ Explore VFL website (https://vfl.vermont.gov/)

☐ Forensic Lab > Documents > Training > 4.2 General Knowledge of Forensic Science

- A Simplified Guide to DNA Evidence; National Forensic Science Technology Center (NFSTC)
- A Simplified Guide to Fingerprint Analysis; NFSTC
- A Simplified Guide to Firearms Examination; NFSTC
- A Simplified Guide to Forensic Drug Chemistry; NFSTC
- A Simplified Guide to Forensic Toxicology; NFSTC
- A Simplified Guide to Trace Evidence; NFSTC
- Dror, L., et al. “Context Management Toolbox: A Linear Sequential Unmasking (LSU) Approach for Minimizing Cognitive Bias in Forensic Decision Making”. Journal of Forensic Sciences July 2015. Vol. 60, No.4.
- Morris, E. “Cognitive Bias and the Evaluation of Forensic Evidence”. The Champion, May 2012.

4.3. General Knowledge of Analytical Methods

Analytical Methods

☐ ASB Standard 036: Standard Practices for Method Validation in Forensic Toxicology

☐ ASB Standard 017: Standard Practices for Measurement Traceability in Forensic Toxicology

☐ ASB Standard 054: Standard for a Quality Control Program in Forensic Toxicology Laboratories

☐ External Standard, Internal Standard, and Standard Addition | Chemistry with Dr. G (https://www.youtube.com/watch?v=YFPmuS6nm-w)

Spectroscopy

- ☐ Introduction to spectroscopy; Khan Academy (https://www.khanacademy.org/science/ap-chemistry-beta/x2eef969c74e0d802:intermolecular-forces-and-properties/x2eef969c74e0d802:spectroscopy-and-the-electromagnetic-spectrum/v/introduction-to-spectroscopy)
- ☐ Clarke's Analytical Forensic Toxicology: Infrared Spectroscopy (Chapter 18)
- ☐ Clarke's Analytical Forensic Toxicology: Ultraviolet, visible and fluorescence spectrophotometry (Chapter 17)

Immunoassay

- ☐ Levine B., Principles of Forensic Toxicology: Immunoassay
- ☐ Methodology: Immunoassays; AACC (https://www.aacc.org/science-and-research/clinical-chemistry-trainee-council/trainee-council-in-english/pearls-of-laboratory-medicine/2011/methodology-immunoassays)

Extraction Techniques

- ☐ Levine B., Principles of Forensic Toxicology: Specimen Preparation/Extraction
- ☐ VFL Toxicology Digital Library > CHROMacademy PDFs.
    - Sample Preparation: Molecular Properties
    - Sample Preparation: Primary Sample Preparation Techniques
- ☐ Sample Preparation (https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Analytical_Sciences_Digital_Library/Contextual_Modules/Sample_Preparation)

Chromatography

- ☐ Basics of chromatography; Khan Academy (https://www.khanacademy.org/science/class-11-chemistry-india/xfbb6cb8fc2bd00c8:in-in-organic-chemistry-some-basic-principles-and-techniques/xfbb6cb8fc2bd00c8:in-in-methods-of-purification-of-organic-compounds/v/basics-of-chromatography)
- ☐ Chromatography; LibreText (https://chem.libretexts.org/Bookshelves/Analytical_Chemistry/Supplemental_Modules_(Analytical_Chemistry)/Instrumentation_and_Analysis/Chromatography/Chromatography)
- ☐ HPLC or UHPLC? (https://www.thermofisher.com/blog/analyteguru/hplc-or-uhplc/)
- ☐ VFL Toxicology Digital Library > CHROMacademy PDFs.
    - Theory and Instrumentation of GC: Introduction
    - Theory of HPLC: Introduction
    - Mass Spectrometry Fundamental LC-MS: Introduction

Detectors

- ☐ Quadrupole Mass Spectrometer
  - Part 1 (https://www.youtube.com/watch?v=pjCun7QF19U)
  - Part 2 (https://www.youtube.com/watch?v=L_k_AnlLn2s)
  - Fundamentals of MS; Waters Corporation (https://www.youtube.com/playlist?list=PL6yA4jv5tA-k9_2NVxm5jlzpZV_aW59DT)
- ☐ FID
  - GC - Gas Chromatography - FID - Flame Ionization Detector Animation (https://www.youtube.com/watch?v=BJzqdzLY2KU)
- ☐ VFL Toxicology Digital Library > CHROMacademy PDFs.
  - Theory and Instrumentation of GC: GC Detectors
  - Mass Spectrometry Fundamental LC-MS: Mass Analyzers

4.4. General Statistics and Data Analysis

Measurement Uncertainty

- ☐ NIST (https://www.nist.gov/)
  - About Us
  - NIST Policy on Metrological Traceability
- ☐ A Beginner's Guide to Uncertainty of Measurement
- ☐ "MU Guides" Binder
- ☐ Bell S., Measurement Uncertainty in Forensic Science: A Practical Guide.
- ☐ Simplified GUM Document (https://www.bipm.org/documents/20126/2071204/JCGM_101_2008_E.pdf/325dcaad-c15a-407c-1105-8b7f322d651c)
- ☐ ASB Standard 056: Standard for Evaluation of Measurement Uncertainty in Forensic Toxicology
- ☐ How to Find Significant Contributors to Measurement Uncertainty and Automate the Process in 5 Steps (https://www.isobudgets.com/significant-contributors-to-measurement-uncertainty/)
- ☐ VFL Toxicology Digital Library > Calculations & MU
  - Dealing with Uncertainty in Chemical Measurements
  - Forensic Metrology: A Primer for Lawyers, Judges and Forensic Scientists
  - Forensic Metrology: The New Honesty About the Uncertainty of Measurements in Scientific Analysis

Calibration Models

- ☐ Introduction to residuals and least-squares regression; Khan Academy (https://www.khanacademy.org/math/statistics-probability/describing-relationships-quantitative-data/regression-library/v/introduction-to-residuals-and-least-squares-regression)
- ☐ Residual Plots; Khan Academy (https://www.khanacademy.org/math/ap-statistics/bivariate-data-ap/xfb5d8e68:residuals/v/residual-plots)

- ☐ Linear, Quadratic, and Exponential Models; Khan Academy (https://www.youtube.com/watch?v=CxEFOozrMSE)

Regression Analysis

- ☐ Regression Analysis (https://www.youtube.com/watch?v=0m-rs2M7K-Y)
- ☐ Understanding Heteroscedasticity in Regression Analysis (https://www.statology.org/heteroscedasticity-regression/)
- ☐ Polynomial Regression (https://www.youtube.com/watch?v=QptI-vDle8Y)

Statistical Significance

- ☐ Math Skills Review: Significant Figures (https://www.chem.tamu.edu/class/fyp/mathrev/mr-sigfg.html)
- ☐ Tests of Statistical Significance (https://home.csulb.edu/~msaintg/ppa696/696stsig.htm)
- ☐ Statistical Significance: Definition & Meaning (https://statisticsbyjim.com/hypothesis-testing/statistical-significance/)
- ☐ How F-tests work in Analysis of Variance (ANOVA) (https://statisticsbyjim.com/anova/f-tests-anova/)
- ☐ Z Test: Uses, Formula & Examples (https://statisticsbyjim.com/hypothesis-testing/z-test/)
- ☐ Yates, Moore, McCabe. The Practice of Statistics: TI-83 Graphing Calculator Enhanced

Microsoft Excel

- ☐ Paste Options (https://support.microsoft.com/en-us/office/paste-options-8ea795b0-87cd-46af-9b59-ed4d8b1669ad)
- ☐ Microsoft Excel Video Training (https://support.microsoft.com/en-us/office/excel-video-training-9bc05390-e94c-46af-a5b3-d7c22f6990bb)
    - Formulas & functions
    - Other(s): _____
- ☐ Excel training (VT DHR CAPS: https://vermont.csod.com/client/vermont/default.aspx)
    - Mastering Excel 365 – Advanced: Tracing Formulas (https://vermont.csod.com/ui/lms-learning-details/app/course/1ed421f1-cb29-4b7b-a756-d010d9e57e8b)
    - Other(s): _____

5.0 Applied Scientific Knowledge

5.1. Alcohol and Drug Physiology, Pharmacology, and Pharmacokinetics

- ☐ NIH Tox Tutor; (https://www.toxmsdt.com/0-toxtutor-home.html)
- ☐ Levine B., Principles of Forensic Toxicology: Pharmacokinetics
- ☐ Levine B., Principles of Forensic Toxicology: Pharmacodynamics
- ☐ Wigmore, James G. *Wigmore on Alcohol: Courtroom Alcohol Toxicology for the Medicolegal Professional*. Toronto: Irwin Law, 2011. Print.
- ☐ Pharmacokinetics, dynamics, and impairment portions of the VFL Toxicology Reference Library

5.2. Retrograde Extrapolation

- ☐ Extrapolation portion of the VFL Toxicology Reference Library
- ☐ ASB Best Practice Recommendation 122, Performing Alcohol Calculations First Edition 2023

6.0 Laboratory Analysis

6.1. General Equipment Use, QC, and Maintenance

- ☐ Current Pipette COAs
  - ALCOHOL > Traceability Documents > Pipettes
- ☐ Memos regarding pipetting studies
  - ALCOHOL > Memos > QR CTS Information (CAR 22-1 and follow up)
- ☐ ALCOHOL > Reference Library > VFL Toxicology Digital Library
  - Micropipetting Techniques (Pushparaj, P. "Revisiting the Micropipetting Techniques in Biomedical Sciences: A Fundamental Prerequisite in Good Laboratory Practice")

6.2. Laboratory Maintenance

- ☐ Emergency Shutdown procedures for Toxicology
  - ALCOHOL > User Guides

7.0 Reports and Notifications

7.1. Reporting Requirements

- ☐ ASB Standard 053: Standard for Report Content in Forensic Toxicology
- ☐ ALCOHOL > Blood Tox Data > Toxicology Report Language
- ☐ ASB Standard 055: Standard for Breath Alcohol Measuring Instrument Calibration DRAFT 2023. Section 11 Elements of a Calibration Certificate

8.0 Legal Knowledge

8.1. Legal System Fundamental Knowledge

- ☐ Sapir, Gil I., "Legal Aspects of Forensic Science" in Forensic Science Handbook, Vol. 1, ed. Richard Saferstein, Prentice Hall, Inc., Englewood, N.J. 1982, pp1-32 (Chapter 1).
- ☐ Law 101: Legal Guide for the Forensic Expert; National Clearinghouse for Science, Technology and the Law (NCSTL)
- ☐ Vermont DUI Laws: Title 23, Chapter 13
- ☐ Court Divisions of Vermont including the deep dive of the Criminal Division and Supreme Court
  - https://www.vermontjudiciary.org/court-divisions
  - https://www.vermontjudiciary.org/criminal
  - https://www.vermontjudiciary.org/supreme-court

8.2. General Testimony

- ☐ ASB Standard 037: Guidelines for Opinions and Testimony in Forensic Toxicology
- ☐ Daniel Isenschmid, a forensic toxicologist testifies at the Chauvin trial (https://www.youtube.com/watch?v=UgdY4oIJ2jI)
- ☐ Observe VFL Toxicology Section expert testimony (in person or video) or review a court transcript

B: VFL Toxicology Reference Library

Analysts are expected to be familiar with the contents of the VFL Toxicology Reference Library and be alert for articles and/or references that can be added. Updated references should be added to the VFL Toxicology Reference Library during the review period, when they become available, or when new methodologies or technologies are incorporated into the laboratory protocols.
ALCOHOL > Reference Library

Appendix II: Training Questions

Questions listed below are intended to be answered by trainees. Headings are numbered in accordance with the section numbering in the body of this manual.

2.0 Laboratory Introduction

2.1. General Laboratory Requirements

1. Where are the following found?
   a. Mission statement
   b. Documentation/record keeping
   c. Scope of the VFL
   d. Policy on proficiency testing
   e. Audits and casework review
   f. Laboratory objectives
   g. Report writing guidelines
   h. Requests for analysis
2. How often are manuals reviewed? By whom?
3. What type of evidence can be submitted to the lab and by whom?
4. If a key or badge is lost, what must an employee do?
5. Who has access to section areas?
6. Who activates the security alarm? What areas are monitored by the alarm system?
7. What must the employee do if he/she accidentally causes the alarm to go off?
8. Do the lock systems create an audit trail?
9. What is the role of proficiency testing in the laboratory?
10. What purpose do audits serve?
11. Why should a portion of items tested be retained?
12. Can email be used for official business?
13. What is a Quality Review? When are they initiated and by whom?
14. What are the possible outcomes of a Quality Review?
15. What is the name of the system that monitors temperatures in the lab?
16. What temperature are the Tox fridge/freezers set to? What is the tolerance?

2.2. Safety

1. Who is/are the Safety Officer(s) for the laboratory?
2. What is the purpose of the Hazardous Materials Identification System (HMIS) rating?
3. To what do “H”, “F”, and “R” refer?
4. What does GHS stand for?
5. What is the labeling system for GHS?
6. How often are safety inspections conducted?
7. Where are safety records kept for individual laboratory employees?
8. What are “universal precautions” and when should they be applied?
9. What does “PPE” stand for? What PPE is appropriate for use in the Toxicology Section?
10. What is the evacuation plan for the laboratory in case of fire or other emergency?
11. What are SDS’s and where are they kept?

12. What should be done in the event of a chemical spill?
13. How is chemical waste disposed of?
14. What should be done in the event of a blood spill?
15. How is biohazardous waste disposed of?

3.0 Sample and Evidence Control

3.1. Evidence Handling for Casework

1. What elements are required for all proper evidence seals?
2. How should blood kits be sealed?
3. How is incoming toxicological evidence stored?
4. What steps are taken if the evidence submission document does not match the submitted items?
5. How might evidence come into the laboratory?
6. Who is permitted to submit evidence?
7. Under what circumstances can evidence be consumed?
8. What should be documented regarding the blood evidence received?
9. What are the requirements for the destruction of blood evidence?
10. Name two types of evidence contamination and how they might be avoided.

3.2. Laboratory Information Management System

1. What two case numbers are assigned to each case? What is the standard format for each?
2. Which number should be used when communicating with investigators?
3. What is a case record number and how is it generated?
4. Why do some cases have multiple case record numbers?
5. Describe the evidence numbering schematic used by the VFL.
6. What evidence item number or numbers would you assign in the following situations?
   a. Two tubes inside a blood evidence kit numbered A1.
   b. A relation back request received after blood alcohol analysis. The only evidence submitted for this case was one blood evidence kit numbered A1.
7. What is the process for documenting an affidavit request in FA?

4.0 Fundamental Scientific Knowledge

4.2. General Knowledge of Forensic Science

1. What is Forensic Science?
2. What are some disciplines of forensic science-both offered and not offered by the VFL?
3. Generally what types of examinations and/or analyses are performed by the disciplines offered by the VFL?
4. What is a Forensic Analyst?
5. Define cognitive bias and list some ways by which to reduce it.

4.3. General Knowledge of Analytical Methods

Analytical Methods

1. What is a calibration?
2. What is an internal standard and what are some properties of a good internal standard?
3. What is a reference material and how is it different from a certified reference material?

4. What is an external standard and what are some properties of a good external standard?
5. What is a quality control and why are they important?
6. What's the difference between a quality control and an external standard?

Spectroscopy

1. What is spectroscopy?
2. What are some common spectroscopic techniques?
   a) Give some examples of where they are used.

Immunoassay

1. What are antigens and antibodies?
2. What is an immunoassay?
3. Give some real world examples of where an immunoassay technique is employed.
4. Are immunoassay techniques used elsewhere in a forensic lab?
5. What are some immunoassay methods?
   a. How are they different?
   b. How are they similar?
   c. What are some advantages and disadvantages of immunoassay techniques?

Extraction Techniques

1. What is extraction?
2. Why is extraction necessary?
3. What are some matrices where extraction is required?

Chromatography

1. What is chromatography?
2. What are the various types of chromatography?
3. Give some examples of when you might employ various chromatographic methods?
4. Is chromatography used elsewhere in a forensic lab?

Detectors

1. Give some examples of various detector types.
2. What might various detectors be used for?
3. Why is it important to select the right type of detector?
4. How can you determine which detector is appropriate for the testing you are performing?

4.4. General Statistics and Data Analysis

Measurement Uncertainty

1. What is NIST?
   a. Why is it important?
2. What is measurement uncertainty (MU) and what does it mean?
3. What are some real world examples you could use in explaining MU?
4. Define accuracy and precision. How are they related and how are they different?
5. What is bias and how is it calculated?

6. How are bias and accuracy different?
7. What is a % CV and how is it calculated?
8. What is repeatability and reproducibility? How are they similar? Different?
9. What is the difference between error and uncertainty?

Calibration Models

1. Explain the different types of calibration models.
2. How would one determine what type of calibration model is appropriate for their method?

Regression Analysis

1. What is regression analysis?
2. What are some common types of regressions?
3. What is the difference between a linear and polynomial regression?
4. What is an R^2 value?

Statistical Significance

1. What is a significant figure?
2. How many significant figures are in the following:
    a. 0.008
    b. 0.234
    c. 52.10
    d. 5000
3. What is a significance level?
4. What is a null hypothesis?
5. When do you use a Z Test? F Test? T Test?
6. What does p-value mean?
7. Explain 1 tailed versus 2 tailed tests.
8. What does it mean to say a test is statistically significant?
9. What is the difference between equal v. unequal variance and what does this tell you about the data?

Microsoft Excel

1. How can you track cell references?
2. How would you calculate the sum, average, standard deviation, %CV, bias in Excel?
3. What are the various different copy/paste options in Excel?
4. Explain the fundamental difference between “paste by value”, “paste”, and “paste by formula”.
5. What is conditional formatting and what role does it serve?

5.0 Applied Scientific Knowledge

5.1. Alcohol and Drug Physiology, Pharmacology, and Pharmacokinetics

1. What is ADME?
2. Explain impairment vs intoxication.
3. Explain pharmacodynamics vs pharmacokinetics.
4. What is a drug?
5. What are the 7 DRE drug classes?

5.2. Retrograde Extrapolation

1. What is retrograde extrapolation?
2. What information is required to perform a retrograde extrapolation calculation?
3. What is the Widmark equation? What is it used for?

5.3. Applied Analytical Methods

Spectroscopy

1. Explain the principle and operation of infrared spectroscopy.
2. What is Beer's law?
3. What is Henry's law?

Immunoassay

1. What type of immunoassay method is employed at the VFL?
2. What are monoclonal and polyclonal antibodies?
3. What is cross reactivity and how is it relevant to drug screening?

Extraction Techniques

1. What matrices does the VFL test?
2. In the context of blood testing, what is extraction?
3. What are some commonly used extraction methods for blood drug testing?
4. What chemical or physical properties should be considered when choosing an extraction method?

Chromatography

1. Explain the differences in methodologies between GC and LC.
2. What analytes can be analyzed on:
    a. GC?
    b. LC?
3. How does HPLC compare to UPLC?
4. What instrumentation is used in the Toxicology Section at the VFL?

Detectors

1. What are the common detectors paired with:
    a. GC?
    b. LC?
2. What is mass spectrometry?
3. What is flame ionization detection?

5.4. Statistics and Data Analysis

Measurement Uncertainty

1. What is relative standard uncertainty and how is it calculated?
2. What is the difference between type A and type B distribution?
3. What are the differences between major and minor contributors?

4. How does one determine contributors and the level of effect?
5. What approach does the VFL follow to calculate MU? How is MU reported at VFL?
6. What is a confidence interval?
7. What are degrees of freedom and why are they relevant in MU?
    a. How is this different than n?
8. How is standard uncertainty converted to expanded uncertainty?
9. How is the expanded uncertainty rounded?

Statistical Significance

1. What are some examples of type 1 and type 2 errors as they might pertain to toxicology testing performed at the VFL?
2. What is the difference between a normal and rectangular/uniform distribution?

Microsoft Excel

1. What are the following formulae and why might you use them?
    a. INDEX
    b. MATCH
    c. LOOKUP
    d. COUNTIF
    e. COUNTA
    f. IF
2. What is the difference between the TRUNC, ROUNDUP, and ROUND formulas?
3. What does it mean when a spreadsheet is “validated”?
4. When do calculations in a spreadsheet need to be reviewed?

6.0 Laboratory Analysis

6.1. General Equipment Use, QC, and Maintenance

1. What QC checks and maintenance does each of the following require?
    a. Pipettes
    b. Thermometers
    c. Balance
    d. Thermoshaker
    e. Water System
    f. Hood
    g. Refrigerators/temperature monitoring system
2. Explain various pipetting techniques.
3. What are the advantages/disadvantages of pre-wetting and washing your pipette tip?
4. In what circumstances would you reverse pipette a sample?

7.0 Reports and Notifications

7.1. Reporting Requirements

1. What information is typically included in a batch or case file?
2. What information needs to be included on a report?
3. What information needs to be included on a calibration certificate?

4. Is the report you create a final draft? When are reports finalized?
5. Who are reports issued to? Can anyone request a copy of the report?
6. When does technical review begin?
7. What happens if you need to make a correction after technical review is initiated?
8. If we test for a drug, how is that indicated on a report?
9. What if we test a sample using the incorrect method by mistake; would those results be listed on the report?

8.0 Legal Knowledge

8.1. Legal System Fundamental Knowledge

1. What are my responsibilities as an expert witness?
2. Whose "side" am I on? The prosecution? The defense?
3. Describe the Daubert and Frye standards. How do they differ? What standard is used in Vermont?
4. Describe the court structure in the state of Vermont in terms of DUI cases.
5. How do the decisions of the courts impact forensic scientists?
6. What is an "appeal" and why is this process significant for forensic scientists?
7. The state police have submitted evidence in a case. The prosecutor intends to call you as a witness at trial to present your results. The defense attorney calls and asks you a question about your work. What do you do?
8. Describe the difference between a trial and a hearing i.e. an admissibility or motion in limine hearing?
9. What is a deposition? How is it similar to a trial or hearing? How is it different?

8.2. General Testimony

1. May notes (case file, etc.) be referred to during testimony? If so, how must this be done?
2. Describe attributes or qualities of a good expert.
3. Describe some strategies that make expert testimony more effective.
4. While asking you a question a prosecutor makes a statement that is incorrect. What do you do?
5. Define the following terms using language you would use when speaking to a jury.
   a. Forensic science
   b. Chain of custody
   c. Accreditation
   d. Quality assurance
   e. Measurement uncertainty
   f. Validation
   g. Calibration
   h. Drug
   i. Impairment

8.3. Document Preparation

1. What is a curriculum vitae and what type of information should be included on it?
2. If I communicate with an outside party regarding a case, where is this documented?
3. What type of information is routinely shared as part of the discovery process?
4. Do we have to scan and send all requested records for every discovery request regardless of size or perceived applicability to the case?

5. What options does an attorney or other outside party have for reviewing lab records?

DOCUMENT HISTORY			
DATE	**VERSION**	**APPROVED BY**	**ACTIVITY OR REVISION**
2/2/2015	1	Lab Director	Replaces F-ALC 090; training program expanded to cover other Alcohol section functions
6/4/2015	2	Lab Director	Revised Sections 6, 9 and 10 to clearly define milestones, competency testing and authorizations; minor wording & formatting changes throughout document
9/8/2017	3	Lab Director	Revised sections 4 through 9 by separating into subsections for general knowledge, breath, blood, and certified reference materials; added section 4.2; clarified required DMT training in sections 5.2 & 6.2; added required reading for sections 2, 4, 5 & 8 to appendix I; additional training questions added in appendix II
7/18/2024	4	Lab Director	Name of document changed from ALC_P300 to TOX_P300; sub-disciplines removed from this manual and incorporated into separate training manuals - this manual now focuses on general toxicology section training applicable to all sub-disciplines; enhanced pipetting, excel and statistics training sections