Training Procedure for Drug Toxicology

1.0 Purpose –This procedure provides a training program for the analysis of drugs and metabolites in biological specimens. This program shall provide analysts with the theoretical background and the working knowledge to conduct independent casework and present competent expert witness testimony in the field of forensic drug toxicology. Quality assurance of all tests performed is a major component of this training program.

2.0 Scope - This procedure applies to Toxicology trainees in the Raleigh, Triad, and Western locations of the State Crime Laboratory (SCL).

3.0 Objectives

3.1 Understand the theory of instrumentation and the procedures used in forensic drug toxicology.

3.2 Perform independent and accurate forensic analysis using the instrumentation and extraction procedures of the SCL.

3.3 Understand the pharmacokinetics and pharmacodynamics of drugs and their metabolites.

3.4 Know and understand Laboratory and Section policies and procedures governing evidence handling, note taking, and report writing.

3.5 Know and understand the toxicological concerns related to storage of blood samples.

3.6 Know and understand NC General Statutes relating to drug toxicology analysis.

3.7 Provide expert witness testimony, which includes the presentation of forensic drug toxicology analysis and the defense of analytical conclusions.

3.8 Successfully complete a competency exam.

3.9 Successfully complete a written exam for each section.

3.10 Successfully complete a round table moot court.

3.11 Obtain a Permit to Perform Chemical Analysis of Blood issued by NCDHHS.

4.0 Procedure

4.1 Training of Experienced Forensic Scientist - In the event a Forensic Scientist with previous training and/or experience in forensic alcohol analysis is hired, the Toxicology Technical Leader shall assess the Forensic Scientist's knowledge, skill, and abilities based on any written training documentation provided by the Forensic Scientist's previous employer. The design of the Forensic Scientist's training program will be based on the Toxicology Technical Leader's assessment.

4.2 Instrumentation- This section is comprised of the following sub-sections: Immunoassay, Liquid Chromatography Tandem Mass Spectrometry (LC-MS/MS), and Gas Chromatography Mass

Spectrometry (GCMS). Each instrument contains a list of assigned readings and a required written examination.

4.2.1 Immunoassay

4.2.1.1 The trainee shall successfully complete all requirements in the Training Procedure for Immunoassays.

4.2.2 Liquid Chromatography Tandem Mass Spectrometry

4.2.2.1 The trainee shall successfully complete all requirements in the Training Procedure for Liquid Chromatography-Tandem Mass Spectrometry.

4.2.3 Gas Chromatography Mass Spectrometry

4.2.3.1 The trainee shall successfully complete all requirements in the Training Procedure for Gas Chromatography- Mass Spectrometry.

4.3 Extraction Chemistry

4.3.1 The trainee shall successfully complete all requirements in the Training Procedure for Extraction Chemistry.

4.4 Drug Pharmacology – This section is comprised of the following sub-sections: Pharmacodynamics and Pharmacokinetics. There is a list of assigned readings and a required written examination.

4.4.1 The trainee shall complete all required reading assignments for this block of training.

4.4.2 Pharmacodynamics and Pharmacokinetics

4.4.2.1 The trainee shall attend lectures, given by the Toxicology Training Coordinator or designee, on Drug Pharmacodynamics and how it relates to driving impairment and the results of the analyses performed at the SCL.

4.4.2.2 The trainee shall attend lectures, given by the Toxicology Training Coordinator or designee, on Drug Pharmacokinetics, that include the following: routes of administration, absorption, distribution, metabolism, and elimination of drugs in the human body.

4.4.2.3 The trainee shall demonstrate understanding of Drug Pharmacodynamics and Pharmacokinetics by giving a ten minute oral presentation on an assigned drug to the Toxicology Training Coordinator.

4.4.3 Required Readings

4.4.3.1 Drummer, O.H. “Benzodiazepines- Effects on Human Performance and Behavior”. *Forensic Science Review*, Vol. 14, January, 2002.

4.4.3.2 Robertson, M.D. and Marinetti, L.J. “Carisoprodol- Effects on Human Performance and Behavior”. *Forensic Science Review*, Vol. 15, January, 2003.

4.4.3.3 Huestis, M.A. "Cannabis (Marijuana) - Effects on Human Performance and Behavior". *Forensic Science Review*, Vol. 14, January, 2002.

4.4.3.4 Isenschmid, D. S. and Levine, Barry "Cocaine" *Therapeutic Drug Monitoring and Toxicology.* AACC Press, 2000.

4.4.3.5 Logan, B.K. "Methamphetamine - Effects on Human Performance and Behavior". *Forensic Science Review*, Vol. 14, January, 2002.

4.4.3.6 Logan, B.K. and Couper, F. J. "3,4-Methylenedioxymethamphetamine - Effects on Human Performance and Behavior". *Forensic Science Review*, Vol. 15, January, 2003

4.4.3.7 Stout, P.R. and Farrell, L. J. "Opioids - Effects on Human Performance and Behavior". *Forensic Science Review*, Vol. 15, January, 2003

4.4.3.8 Mozayani, A. "Phencyclidine - Effects on Human Performance and Behavior". *Forensic Science Review*, Vol. 15, January, 2003

4.4.3.9 Couper, F.J. and Logan, B.K. "National Highway Traffic Safety Administration - Drug and Human Performance Fact Sheets" Retrieved from:http://www.nhtsa.gov/people/injury/research/job185drugs/index.htm

4.4.3.10 Couper, F.J. and Logan, B.K. "Zolpidem and Driving Impairment" *Journal of Forensic Sciences* Vol. 46, 2001, pp. 105-110.

4.5 Written Examination One

4.5.1 The trainee shall complete a written examination covering all material in the Drug Pharmacology Section with a minimum score of 85 %.

4.6 Measurement Uncertainty

4.6.1 The trainee shall attend a lecture, given by the Toxicology Training Coordinator or designee, on uncertainty of measurement. This lecture will include a discussion of the basic concepts of uncertainty of measurement and a review of the current drug toxicology uncertainty budgets.

4.6.2 Required Readings

4.6.2.1 North Carolina State Crime Laboratory Uncertainty Budget for the Quantitation of Cannabinoids in blood using Liquid-Liquid Extraction and LC-MS/MS.

4.6.2.2 Bell, S. "A Beginner's Guide to Uncertainty of Measurement" Measurement Good Practice Guide No 11. 1999.

4.6.2.3 Harvey, D. (2008). "Evaluating Analytical Data" *Analytical Chemistry 2.0* (Chap. 4). Retrieved from: http://www.asdlib.org/onlineArticles/ecourseware/Welcome.html

4.6.2.4 Birch. K. "A Beginner's Guide to Uncertainty of Measurement" Measurement Good Practice Guide No 36. 2003.

4.6.2.5 Gates, K. "The Uncertainty of Reference Standards – A Guide to Understanding Factors Impacting Uncertainty, Uncertainty Calculations, and Vendor Certifications." Journal of Analytical Toxicology. 2009. Vol. 33: pp. 532-539

4.6.2.6 Procedure for Toxicology Measurement Assurance

4.7 Evidence Handling, Notes, and Report Writing

4.7.1 The trainee shall read and understand the SCL Evidence Guide, Procedure for Evidence Management and the Procedure for Toxicology Evidence Handling.

4.7.2 The trainee shall attend a lecture, given by the Toxicology Training Coordinator or designee, on Laboratory and Section Procedures related to evidence entry and handling.

4.7.3 The trainee shall read and understand the following Evidence Control Unit procedures: Data Entry, Evidence Requirements, Evidence Submissions, and Evidence Transfers.

4.7.4 The trainee shall observe the receipt of evidence into the SCL and witness the application of the Evidence Control Unit procedures regarding the submission, receipt, entry, and storage of toxicology evidence.

4.7.5 The trainee shall review and discuss, with the Toxicology Training Coordinator or designee, the proper way to document notes and generate reports in FA for the types of analysis covered in this training procedure.

4.7.6 The trainee shall observe the Toxicology Training Coordinator or designee document notes and generate reports for cases involving drug analysis.

4.8 Quality Assurance/Quality Control

4.8.1 The trainee shall meet with the Quality Manager or designee of the SCL for a session on accreditation, audits, and inspections.

4.8.2 The trainee shall read and understand the SCL Quality Manual.

4.8.3 The trainee shall read and understand the Toxicology Quality Assurance procedure.

4.8.4 The Toxicology Training Coordinator or designee shall review and discuss with the trainee the applicable sections of the Toxicology Quality Assurance procedure.

4.9 Courtroom Testimony

4.9.1 The trainee shall read and understand the SCL Procedure for Court Orders and Discovery Requests and the Policy on Ethics and Conduct.

4.9.2 The trainee shall attend a lecture, provided by SCL Legal Staff, covering the court system, working with attorneys, courtroom demeanor, and ethical practices.

4.9.3 The trainee shall complete all assigned readings.

4.9.4 The trainee shall attend a lecture, given by the Toxicology Training Coordinator or designee, covering common challenges to drug toxicology analysis.

4.9.5 The trainee shall complete a practice moot court to demonstrate knowledge and ability to present casework in a courtroom setting.

4.9.6 Required Readings

4.9.6.1 Uddin, M.H. et al "Stability Study of Sic 1, 4-Benzodiazepines in Bio-fluids Stored at – 20 °C" *Chiang Mai Journal of Science.* Vol. 37: 451-463

4.9.6.2 Logan, B.K. et al. "Recommendations for Toxicological Investigation of Drug-Impaired Driving and Motor Vehicle Fatalities" *Journal of Analytical Toxicology*. 2013. Vol. 37: 552-558.

4.9.6.3 Chapter 20 and 90 of the North Carolina General Statutes.

4.9.6.4 Galloway F.R. and Bellet, N.F. "Methadone Conversion to EDDP during GC-MS Analysis of Urine Samples" *Journal of Analytical Toxicology*. 2009. Vol. 23: 615-619.

4.9.6.5 Rohrig, T.P. and Moore, C. "The Determination of Morphine in Urine and Oral Fluid Following Ingestion of Poppy Seeds" *Journal of Analytical Toxicology*. 2003. Vol. 27: 449-452.

4.9.6.6 Papoutsis, I. et al. "Stability of Morphine, Codeine, and 6-Acetylmorphine in Blood at Different Sampling and Storage Conditions." *Journal of Forensic Sciences."* March 2014, Vol. 59: 550 – 554.

4.9.6.7 Thevis, M. et al. "Urinary Concentrations of Morphine and Codeine after Consumption of Poppy Seeds" *Journal of Analytical Toxicology*. 2007. Vol. 27: 52-56.

4.9.6.8 Christophersen, A. "Tetrahydrocannabinol Stability in Whole Blood: Plastic Versus Glass Containers." *Journal of Analytical Toxicology*. 1986. Vol. 10: 129-131.

4.9.6.9 Johnson, J.R. et al. "Stability of Delta-9-Tetrahydrocannabinol (THC), 11-Hydroxy-THC, and 11-Nor-9-carboxy-THC in Blood and Plasma." *Journal of Analytical Toxicology*. 1984. Vol. 8: 202-204.

4.9.6.10 Odell, M.S. et al. "Residual cannabis levels in blood, urine and oral fluid following heavy cannabis use." *Forensic Science International*. 2015. Vol. 249: 173-180.

4.9.6.11 Karschner, E.L. "Do Delta-9-Tetrahydrocannabinol Concentrations Indicate Recent Use in Chronic Cannabis Users?" *Addiction*. 2009 December Vol. 104: 2041-2048.

4.9.6.12 Rohrich, J. et al. "Concentrations of Delta-9-Tetrahydrocannabinol and 11-Nor-9-Carboxytetrahydrocannabinol in Blood and Urine after Passive Exposure to Cannabis Smoke in a Coffee Shop." *Journal of Analytical Toxicology*. 2010. Vol. 34: 196-203.

4.10 Written Examination Two

4.10.1 The trainee shall complete with a minimum score of 85 % a written examination covering Measurement Uncertainty; Evidence Handling, Notes, Report Writing; Quality Assurance/Quality Control; and Courtroom Testimony.

4.11 Competency Test – The trainee shall successfully analyze and report at least five competency tests. Competency tests may include blood or urine drug toxicology specimens.

4.12 Round Table Mock Court – The trainee shall successfully complete a round table mock court by achieving a satisfactory rating for all categories as documented by the Toxicology Training Coordinator in the SCL Moot Court Evaluation.

5.0 References

5.1 North Carolina State Crime Laboratory Lab-Wide Procedures

5.2 Drug Chemistry-Toxicology Unit Administrative and Technical Procedures

5.3 Baselt, R. C. *Disposition of Toxic Drugs and Chemicals in Man*. 8th Ed. Foster City, California: Biomedical Publications, 2008.

5.4 Baselt, R. C. *Drug Effects on Psychomotor Performance*. 2nd Ed. Foster City, California: Biomedical Publications, 2001.

5.5 Ellenhorn, M. J. *Medical Toxicology Diagnosis and Treatment of Human Poisoning*. New York: Elsevier Science Publishing Co. Inc., 1988.

5.6 Moffat, A. C., Osselton, M. D., Widdop, B. (Eds.). *Clarke's Analysis of Drugs and Poisons*. 3rd ed. London, England: Pharmaceutical Press, 2004.

5.7 Levine, Barry (Ed.). *Principles of Forensic Toxicology*. 3rd ed. Washington DC: AACC Press, 2010.

6.0 Records

Drug Toxicology Training Checklist

Training Section Completion Summary

7.0 Attachments

- Appendix A
- Appendix B
- Appendix C
- Appendix D

Revision History		
Effective Date	Version Number	Reason
02/12/2016	1	Original Document
07/07/2017	2	Added Attachments

Appendix A

Mechanical Pipette Instructions

Traditional Method

1. Firmly attach the pipette tip.
2. Set and lock desired volume to be pipetted.
3. Press plunger to the first stop only.
4. Immerse the pipette tip into sample and slowly return the plunger to its starting position.
5. Remove the pipette from the sample and place in its target container.
6. Press the plunger to the first stop position to dispense the desired volume. Wait one second and then press the plunger to the second stop position.
7. Eject the pipette tip into an appropriate waste container.

Reverse Method

1. Firmly attach the pipette tip.
2. Set and lock desired volume to be pipetted.
3. Press plunger past the first stop to the second stop.
4. Immerse the pipette tip into the sample and slowly return the plunger to its starting position.
5. Remove the pipette from the sample and place in its target container.
6. Press the plunger to the first stop to dispense the desired volume.
7. Eject the pipette tip into an appropriate waste container.

Repeater Pipettes

1. Firmly attach the pipette tip.
2. Set and lock desired volume to be pipetted.
3. Immerse the pipette tip into sample and draw up an appropriate volume.
4. Remove the pipette from the sample and press the plunger to prime the pipette.
5. Place the pipette tip in its target container and press the plunger to the first stop to dispense the desired volume.

6. Repeat step 5 as needed. If the volume is changed, prime the pipette again.

7. Eject the pipette tip into an appropriate waste container.

Appendix B

Liquid Handling System Instructions

1. Ensure that the liquid to be measured is well mixed using shaking and/or vortexing prior to measuring.

2. Refer to the appropriate technical procedure for sample preparation instructions.

3. The liquids being analyzed shall be at room temperature.

4. Liquids containing volatile substances shall be covered or sealed to prevent evaporation of the volatiles.

5. The reservoir containing the diluent (e.g. internal standard solution or water) shall be covered, but not sealed, to prevent a vacuum from forming in the reservoir.

6. Place clean tubing/pipette tip in sample to be aspirated.

7. The tubing/pipette tip shall remain in liquid during entire aspiration.

8. Remove tubing/pipette tip from sample and remove excess sample residue from the tubing/pipette tip.

9. Dispense sample into labeled vial/tube.

10. Remove the disposable tip, if used, and dispense the diluent into the vial/tube.

11. Place cap on collection vial/tube and seal.

12. Wash tubing between sample collections.

Appendix C

pH Meter Calibration Instructions

1. Set the function selector to the pH position.
2. Obtain two buffer solutions with values that bracket the desired measuring range (e.g., pH 4.00 and pH 7.00 for samples that fall between pH 4 and 7).
3. Open the fill hole on the electrode.
4. Place a beaker containing the buffer nearest in value to pH 7 in position and immerse the electrode and thermometer into the solution.
5. Standardize the pH meter to the buffer.
6. Remove the electrode and thermometer from the buffer solution.
7. Rinse the electrode and thermometer with deionized water and dry.
8. Place a beaker containing the second buffer in position, and immerse the electrode and thermometer into the solution.
9. Standardize the pH meter to the buffer.
10. Remove the electrode and thermometer from the buffer and rinse with distilled water and dry.
11. Close the fill hole on the electrode.
12. Record all calibrations in the instrument logbook with the date, operator initials, lot number, expiration date and pH of buffers used and the slope obtained.

Appendix D

pH Meter Use Instructions

1. Set the function selector to pH and open the fill hole on the electrode.
2. Immerse the electrode and thermometer into the sample solution.
3. Read the pH of the sample from the display and record value.
4. Remove the electrode and thermometer from the solution.
5. Rinse the electrode and thermometer with deionized water and dry before proceeding with the next measurement.
6. Close the fill hole on the electrode.