1 INTRODUCTION

1.1 Purpose

1.1.1 The purpose of this training manual is to familiarize the trainee with the policies and procedures of the Chemistry (CHEM) Unit and to prepare the trainee to function as a Forensic Science Examiner within the unit.

1.1.1.1 The term trainee refers to analysts (however titled) that is expected to show technical competency within their given disciple and is separate from the Connecticut Career Trainee title.

1.1.1.2 This training procedure will be used in conjunction with a personal training plan which outlines specific tasks and goals per module.

1.1.2 After a trainee's successful completion of each training element, individuals gain confidence in the high standards of testing conducted at the laboratory.

1.1.3 Modules below are not all inclusive and additional training may be required at the discretion of the FSE2 or above.

1.1.4 Not all modules will be completed and are dependent on the position of the trainee within the unit. A training plan will be established detailing the exact modules to be completed.

1.1.5 The sequence in which the training is presented in this manual shall not be considered the mandatory order of instruction and will be dependent on the needs of the unit.

1.1.6 Exposure to legal aspects and testimony will be continuous throughout the individual's training.

1.1.7 For the purposes of this procedure, an analyst is defined as a Forensic Science Examiner, Connecticut Career Trainee, Laboratory Assistant, or other applicable position.

1.2 Training and Learning Objectives

1.2.1 CHEM analysts acquire knowledge from many different mediums such as on-

the- job training, seminars/lectures, workshops, scientific literature, online learning and professional conferences.

1.2.1.1 On-the-job training: There will be various components to the training including theoretical, practical, and competency testing.

1.2.1.2 Seminars, lectures, and workshops: Material from lectures, seminars, and workshops will be made available to all CHEM analysts.

1.2.1.3 Scientific literature: The analysts should keep current with advances in the field of chemistry and new procedures outlined in scientific literature. New reading materials will be made available to all CHEM analysts.

1.2.1.4 Online learning: The analysts will be made aware of online opportunities for training such as webinars or online classes and are encouraged to participate.

1.2.1.5 Professional conferences: Each analyst should attempt to attend conferences related to the field of chemistry when possible.

1.3 Coordination of the Training Program

1.3.1 The training mentor will be a FSE2 or above.

1.3.2 The training mentor will be responsible for the overall training of the analyst, but may delegate specific training responsibilities.

1.4 Training Documentation

1.4.1 During the employee's training, the trainee is responsible for maintaining all documentation regarding the analyst's progress.

1.4.2 At the successful conclusion of each training module, the training records (to include but not limited to training checklist, practical exam, written exam, training log and authorization documents) shall be scanned into the QMS.

1.4.3 Analysts may not perform casework on a specific module until an authorization notification has been received.

1.5 Training Period

1.5.1 It is expected that the training period (including modules 1-8) of an analyst should not exceed one year.

2 COMPETENCY EVALUATION

2.1 Observations of Laboratory Exercises and Activities

2.1.1 Trainees are required to observe authorized analysts, at minimum twice, completing applicable tasks.

2.1.1.1 It is preferred that the trainee observes the training mentor at least once.

2.2 Practical Competency Tests

2.2.1 Practical exercises shall contain spiked samples (of known identity to the training mentor) and will be administered toward the end of each applicable module.

2.2.2 Practical competency tests are deemed successful when the analyte of interest is correctly identified.

2.2.2.1 For quality control practical exercises, the achieved result shall demonstrate conformance with the quality control acceptability criteria as stated in applicable unit protocol.

2.2.3 Unsuccessful practical competency tests shall be reviewed by the training mentor or above to determine if additional training or if a review of subject material by the trainee is warranted.

2.2.4 If the review of the practical competency test warrants additional training, the Unit Manager(s) will be notified and additional training shall be administered. The trainee shall successfully complete another practical exercise to demonstrate their ability to perform the task.

2.2.5 If the expected result is not achieved on the second practical competency test, the Unit Manager(s) will be notified.

2.3 Written Practical Examinations

2.3.1 A written practical examination is completed as part of the competency

evaluation for all modules.

2.3.2 Examinations shall be distributed at the time of evaluation and shall be completed at the laboratory.

2.3.3 Written practical examinations administered as part of the CHEM competency will be given in a "closed book" format, unless directed otherwise.

2.3.4 Examinations will be graded by the training mentor or above.

2.3.4.1 Written practical examinations require a grade of 80% or better to qualify as successful completion.

2.3.4.2 If 80% or better is not achieved or if there is demonstrated lack of understanding of key concepts, the trainee will be given the opportunity to expand upon their responses verbally (as documented by the training mentor) or in written form.

2.3.4.3 If the explanation or further written form does not satisfactorily resolve the deficiencies identified in the written exam, the Unit Manager(s) will be notified and additional training will be undertaken.

2.3.4.4 Upon completion of additional training, a supplemental exam will be administered.

2.3.4.5 If a score of 80% or better is not achieved on the second written exam, the Unit Manager(s) will be notified.

3 MODULE 1: INTRODUCTION

3.1 Upon completion of this unit, the trainee shall be familiar with:

3.1.1 The purpose of the training program including the proposed timeline of training and defined expectations.

3.1.2 Expectations of the duties as an analyst within the CHEM Unit and as an employee within the laboratory.

3.1.3 The laboratory organization, services and personnel (e.g. Unit, Sections within Laboratory).

3.1.4 Other units and their functions within Division of Scientific Services.

3.1.5 Laboratory Security, Safety and Quality Assurance Manuals, Evidence Control Unit manuals, including those applicable to LIMS.

3.1.6 The process the laboratory undergoes to achieve/maintain accreditation.

3.1.7 Procedures used in the CHEM Unit, including CHEM protocols and CHEM QC procedures.

3.2 Required Readings

3.2.1 GL-3 Security Manual

3.2.2 GL-2 Safety Manual

3.2.3 GL-1 Quality Manual

3.2.4 ECU - Evidence Handling and Submission Manual

3.2.5 General Laboratory – LIMS Protocol and User Manual

3.2.6 CHEM Unit General SOP (CHEM-01)

3.2.7 ANAB Guiding Principles of Professional Responsibility for Forensic Service Providers and Forensic Personnel

3.2.8 Other readings as deemed necessary by Training mentor or Quality Manager

3.3 Optional Reading

3.3.1 ISO/IEC 17025:2017 Standards

3.3.2 AR 3125 ISO/IEC 17025: 2017 Forensic Testing and Calibration Laboratories Accreditation Requirements

4 MODULE 2: HISTORICAL OVERVIEW/UNIT OVERVIEW

4.1 Training Objectives:

4.1.1 Upon completion of this unit, a trainee shall:

4.1.1.1 Know the evolution of modern forensic science. This shall include an introduction to general forensic science through a web-based module, assigned reading, or a presentation by a supervisor. NOTE: This training is to be provided if the trainee has not previously received this introduction during his/her undergraduate or graduate curriculum.

4.1.1.2 Understand the role of the analyst in a criminal case or investigation.

4.1.1.3 Be introduced to the application of ethical practices in forensic science and criminal, civil law and testimony

4.1.1.4 Be able to describe the functions and responsibilities of the CHEM Unit within the laboratory.

4.1.1.5 Be familiar with the Evidence Control Unit's (ECU) policies and procedures and the role of ECU within the laboratory.

4.1.1.6 Be familiar with literature references available to the CHEM Unit.

5 MODULE 3: QUALITY CONTROL / EVIDENCE HANDLING

5.1 Training Objectives

5.1.1 To familiarize the trainee with the following:

5.1.1.1 Inventory and ordering supplies

5.1.1.2 Refrigerators and freezers (temperature logs)

5.1.1.3 Reference standards

5.1.1.4 Preparation and verification of standards, controls and reagents

5.1.1.5 Inventory of evidence

5.1.1.6 Handling discrepancies

5.1.1.7 Evidence itemization

6 MODULE 4: SAMPLE PREPARATIONS (FIRE DEBRIS)

6.1 Training Objectives

6.1.1 For the trainee to understand the use of the various sample preparation techniques to include passive headspace concentration, dynamic headspace concentration, static headspace sampling, solvent extraction, and liquids.

6.2 Readings

6.2.1 CHEM-05 Examination of Fire Debris Evidence

6.2.2 ASTM E1386, E1388, E1412, E1413, E2451, and E3245

7 MODULE 5: GAS CHROMATOGRAPHY/MASS SPECTROMETRY (GC/MS)

7.1 Training Objectives

7.1.1 To familiarize the trainee with the following:

7.1.1.1 The GC/MS instrument(s) in the CHEM unit and how they are used.

7.1.1.2 Make and model of the instrumentation used in the CHEM unit.

7.1.1.3 Use and operation of the instrumentation that is used in the CHEM unit.

7.1.2 Upon completion of this module the trainee shall have an understanding of the following:

7.1.2.1 Have an understanding of the theory and operation of the GC-MS.

7.1.2.2 Know the basic components of an GC instrument and the function of each, including:

- Injection port (split vs splitless for capillary GC)
- Columns (packed and capillary columns, general properties, and type of stationary phases)
- Carrier gas consideration (helium vs hydrogen vs nitrogen)

7.1.2.3 Describe the function and theory of operation of the following components of the MS instrument:

- Interfaces
- Ionization methods
- Mass analyzers
- Detector
- Vacuum systems
- Data system

7.1.2.4 Know what the QC procedures are and when they should be performed.

7.1.2.5 Know how to and be able to perform QC.

7.1.2.6 Basic maintenance/troubleshooting (trainee shall also observe routine maintenance whenever possible)

7.1.2.7 Evaluation of fire debris data and appropriate documentation

7.1.3 Required Readings

7.1.3.1 CHEM-03 QA/QC for the GC/MS Instrument
7.1.3.2 QR CHEM-12 GC/MS QA/QC Worksheet
7.1.3.3 ASTM E1618

7.1.4 Optional Readings

7.1.4.1 Instrument operating manuals

8 MODULE 6 : SCANNING ELECTRON MICROSCOPE/ENERGY DISPERSIVE X-RAY ANALYZER (SEM/EDS) AND GSR SAMPLE COLLECTION

8.1 Training Objectives

8.1.1 To familiarize the trainee with the following:

8.1.1.1 The SEM/EDS instrument(s) in the CHEM unit and how they are used.

8.1.1.2 Make and model of the instrumentation used in the CHEM unit.

8.1.1.3 Use and operation of the instrumentation that is used in the CHEM unit.

8.1.2 Upon completion of this module the trainee shall have an understanding of the following:

8.1.2.1 Have an understanding of the theory and operation of the SEM/EDS.

8.1.2.2 Know the basic components of an SEM/EDS instrument and the function of each, including:

- SEM column (e.g., electron gun, condenser and objective lenses, and aperture)
- Detectors (e.g., EDS, BSE, and SE)
- SEM specimen chamber, stage, and sample holders

8.1.2.3 Describe the function and theory of operation of the following components and features of the SEM/EDS instrument:

- Imaging methods
- Brightness/contrast and thresholds
- Backscattered and secondary electrons
- Characteristic X-Rays and associated spectra
- Vacuum systems (e.g., full vs variable pressure modes)
- Data system

8.1.3 Theory of GSR/pGSR formation and principles behind collection.

8.1.4 For the trainee to understand the fundaments and operation of the SEM/EDS.

8.1.5 Evaluation of data.

8.1.6 SEM sample collection from clothing and other items for GSR analysis.

8.2 Readings

8.2.1 CHEM-04 QA/QC for the SEM/EDS Instrument

8.2.2 CHEM-02 Examination of Primer Gunshot Residue Evidence

8.2.3 CHEM-06 SEM Sample Collection from Evidence for Gunshot Residue Analysis

8.2.4 ASTM E1588 and E3309

9 MODULE 7: FOURIER TRANSFORM INFRARED SPECTROSCOPY (FTIR)

9.1 Training Objectives

9.1.1 For the trainee to understand the fundamentals and operation of the FTIR.

9.1.1.1 Know what the QC procedures are and when they should be performed.

9.1.1.2 Know how to and be able to perform QC.

9.1.1.3 Basic maintenance/troubleshooting (trainee shall also observe routine maintenance whenever possible).

9.2 Readings

9.2.1 CS-8 FTIR

10 MODULE 8: MOOT COURT

10.1 Training Objectives

10.1.1 Analysts will train to provide testimony and will understand the standard of care when expressing and conveying opinions and conclusions.

10.1.2 To understand the role of the expert witness if court testimony is needed.

10.2 Case Testimony

10.2.1 Provide moot-court experience, using a CHEM case to prepare for case testimony.

10.2.2 Laboratory personnel may serve as both prosecution and defense attorneys.

10.2.3 Experience may include voir dire, direct testimony, cross, re-direct and re-cross.

10.2.4 Review and documentation of outcome by Unit Section Supervisor with analyst.

11 MODULE 9: EXAMPLE TRAINING PLAN

11.1 See CHEM-07.1