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Standard Guide for Preparing a Training Program for Environmental Analytical Laboratories[1]

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1. Scope

1.1 This guide is intended to assist the laboratories that analyze environmental samples with the development of a documented training program. The training program should develop and increase the competence of analysts and provide a means of recording the results of all proficiency testing.

1.2 Some of the functions within a laboratory that can be addressed using this guide are as follows:

1.2.1 Analysts,
1.2.2 Technicians,
1.2.3 Quality assurance (QA),
1.2.4 Sample receiving and control, and
1.2.5 Sample procurement (sampling).

2. Referenced Documents

2.1 *EPA Standards:*
EPA Method 150.1[2]
SW 846 USEPA Test Methods for Evaluating Solid Waste—Physical/Chemical Methods, 9040 and 9045[2]

3. Summary of Guide

3.1 This guide is summarized in the following steps:

3.1.1 Define the training needs;
3.1.2 Prepare training materials;
3.1.2.1 Develop training objectives;
3.1.2.2 Develop performance evaluation materials;
3.1.2.3 Develop a detailed training outline; and,
3.1.2.4 Develop a documentation form;
3.1.3 Identify trainers competent in the areas defined in 3.1.1;
3.1.4 Determine need and frequency for retraining;
3.1.5 Assemble and store training materials; and,
3.1.6 Assign responsibility for training program.

4. Significance and Use

4.1 Training is a key component in the development of a competent staff in the environmental laboratory.

4.2 This guide will assist in providing both the organizational structure and the direction for a laboratory training program.

4.3 This guide will result in a documentation effort that will satisfy the requirements of environmental auditing groups.

5. Defining the Need for Training

5.1 Each individual who handles or analyzes environmental samples must be knowledgeable in the proper procedures for performing one's job function. Any deficiencies must be corrected by training. Training also may be extended to include those individuals who accept and record information prior to receipt of a sample or who are responsible for generating a report detailing the results of the analyses. Those involved with quality assurance functions need specialized training as well.

5.2 The first step in developing a training program is to identify the procedures or methods within the laboratory for which an individual is responsible. These may range from basic activities to very complex manipulations or interpretations.

5.2.1 Basic activities might include: pH measurement, pipetting, titrating, unloading sample shippers, or data entry.

5.2.2 Complex activities might include: operating an inductively coupled plasma (ICP), cleaning the source of a mass spectrometer, or data validation.

5.2.3 Within each activity certain tasks will have to be learned. A detailed analysis of these tasks must be performed before specific training courses can be developed.

5.2.4 Before beginning actual training, the level of training should be determined using the task analysis.

5.3 Before starting a training program, an approved Standard Operating Procedure (SOP) must be available for each method or activity.

5.3.1 A detailed manual or training video may serve as an SOP.

5.3.2 Published or externally prepared materials must be followed explicitly or an in-house document should be prepared. It is often difficult to follow commercially prepared

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[2] Available from the National Technical Information Service (NTIS) at 5285 Port Royal Road, Springfield, VA 22161 (www.ntis.gov). SW-846 is additionally available on-line at http://www.epa.gov/epaoswer/hazwate/test/sw846.htm.

materials due to differences in the equipment, work areas, sample type, or even level of training of the analyst. For this reason, it is advisable to prepare SOPs that detail the actual situation that will be encountered by the trainee.

6. Preparation of Training Materials

6.1 An effective training program for environmental laboratories should use training courses that include, as a minimum, the following components. See Appendix X1 for an example of a training course employing these elements.

6.2 *Training Objectives*:

6.2.1 Each method or procedure for which training will be conducted must have a set of objectives;

6.2.2 Each objective should deal with specific aspects of the training process that require a demonstrated response; and,

6.2.3 An objective should be written to include the following components:

6.2.3.1 A statement of the desired result of the training. This statement will often take the following form: "After completing this training course on (specific topic), the trainee will be able to (specify result)." The specified result may be as simple as a new appreciation for the topic or the more difficult development of a specialized skill or the complex ability to perform problem solving activities.

6.2.3.2 A statement of the way in which the expected result will be demonstrated needs to be made. This might include discussion with a trainer, completing a written exercise, demonstrating a skill, or performing an operation without assistance. This statement should be very specific both for the trainee and the trainer. Ambiguity may lead to significantly different expectations and make the training process less effective.

6.2.3.3 A statement of the expected level of performance of the result detailed in 6.2.3.2. For discussions this may be more subjective and left up to the discretion of the trainer. For written exercises this can often be stated as the number of correct responses (7 out of 10) or as percentage of an expected score (80 %). For demonstration of skills it may be the performance on a sample of known composition within specified limits (80 to 120 % of true value).

6.3 *Performance Evaluation Tools*:

6.3.1 After a set of objectives has been formulated that clearly defines the goals of the training exercises, the tools necessary to measure the success of the training must be prepared. Often the development of these performance evaluation tools will aid in refining the objectives formulated in 6.2.

6.3.2 These tools should be carefully designed to measure exactly what has been defined in the objectives. For example, if the training objectives require the trainee to have a general knowledge of a process, a written exercise should not include a detailed discussion of that process. If the objective requires a complicated skill to be mastered, anything less than having the trainee perform that skill successfully will demonstrate inadequately the trainee's competence.

6.3.3 Performance evaluation tools must be prepared so that the trainee can use them for demonstrating competence without ambiguity or confusion.

6.3.3.1 Written exercises must be clear in their direction. Any questions must be worded in such a way that the desired response will be easily recognized by a properly trained individual.

6.3.3.2 Exercises requiring the demonstration of skills must be explicit in their directions. Any supplies or equipment called for must be readily available. Any hazards associated with the procedure must be clearly stated.

6.4 *Detailed Outline*:

6.4.1 Once objectives and performance evaluation tools have been selected, a detailed outline of each aspect of the process being trained must be developed. The development of this outline will help refine the performance evaluation tools indicated in 6.3. Much of this outline will be based on the task analysis (see 5.3). In all cases this outline must focus on accomplishing the stated objectives and providing a result that can be measured.

6.4.2 This outline should contain the general topics of:

6.4.2.1 Overview of task to be accomplished,

6.4.2.2 Definitions and terminology,

6.4.2.3 Theoretical considerations,

6.4.2.4 Safety issues,

6.4.2.5 Operational details,

6.4.2.6 Quality assurance,

6.4.2.7 Reference materials,

6.4.2.8 Documentation requirements,

6.4.2.9 Maintenance procedures, and,

6.4.2.10 Troubleshooting.

6.4.3 The amount of detail included with each of these topics will depend on the complexity of the procedure identified in the task analysis. Some topics may have only one or two items requiring training. Others may have much longer lists with several subheadings. Procedures involving modern computer driven equipment may require more detailed outlines than those processes involving only manual operations. Explicit SOPs in these areas can also reduce the amount of detail necessary in the outline.

6.5 *Documentation Form or Checklist*:

6.5.1 Following the completion of a detailed outline, develop a form to document the completion of items listed on the outline and to record the results of the performance evaluation.

6.5.2 A straightforward way of preparing this form is to use the major headings from the outline. Since this form also could be used as a training checklist, one may want to go into more detail. Space for recording the scores of oral or written examinations, or both, and performance on skills-based exercises should be customized to each task.

6.5.3 This form should have spaces to be initialed by both the trainer and the trainee and dated to show that both parties involved are in agreement as to the status of the training process. Following the completion of each item on the form or checklist and the performance evaluation, a formal statement describing the level of competency should be signed and dated by both the trainer and trainee.

6.5.4 Failure to reach agreement on the successful completion of a training element may require the intervention of a supervisor. Not everyone being trained for a particular process may be able to meet all the criteria successfully and should be

considered for alternate job assignments. The standard of success should not be set at a level exceeding that necessary for the job in question.

6.5.5 All forms and scores should be placed in the individual's training or personnel file.

6.6 *Supplementary Material*:

6.6.1 Whenever a method or procedure requires information not readily available in SOPs, method manuals, or instrument operational materials, supplementary materials should be supplied.

6.6.2 These materials may consist of published textbooks, journals, etc., or information prepared specially for this training exercise. Enough information should be provided to allow the trainee to understand the method or procedure being taught. One should resist the temptation, however, to make the training course an end in itself, losing sight of the ultimate goal of an analyst performing competently.

6.6.3 These materials also may include regulatory information that gives a background for the use of an analytical method. Knowing how the results are going to be used can often emphasize the importance of performing an analysis properly.

7. Trainers

7.1 *Identification of Trainers*:

7.1.1 Trainers should meet the minimum qualifications as follows:

7.1.1.1 Demonstrated competence in method or process to be trained;

7.1.1.2 Education necessary to understand and explain the concepts involved in the method or procedure;

7.1.1.3 Ability to communicate effectively. Depending on the training needs this may require writing skills, speaking skills, or the use of other creative means to communicate concepts and activities to the trainee;

7.1.1.4 Ability to be objective;

7.1.1.5 Understanding of the training program may require training sessions for the trainers in the philosophy, goals, and practices of the training program. Trainers who are able to perform the activities outlined in this guide become more useful in assisting the ongoing development of a successful program;

7.1.1.6 Willingness to put forth the effort necessary to see that the trainee follows through to the completion of the training; and,

7.1.1.7 Sensitivity to the needs of the trainee and a willingness to adapt to meet those needs. Many of those needs will depend on a trainee's learning style.

7.1.2 In addition to those items listed in 7.1.1, effective trainers should also exhibit the following general characteristics:

7.1.2.1 Interest in training,

7.1.2.2 Be a positive role model,

7.1.2.3 Be considerate of others,

7.1.2.4 Be comfortable with people,

7.1.2.5 Be willing to listen, and,

7.1.2.6 Be a problem solver.

7.2 *Training of Trainers*:

7.2.1 If available, effective trainers should be aware of and use the following:

7.2.1.1 Leadership techniques,

7.2.1.2 Proper training techniques,

7.2.1.3 Learning styles and evaluation techniques, and,

7.2.1.4 Concepts of interpersonal relationships.

7.2.2 Effective trainers should be familiar with resources that can aid in the training process. These may include:

7.2.2.1 Standard operating procedures (SOPs),

7.2.2.2 Published methods,

7.2.2.3 Instrument manuals,

7.2.2.4 Reference materials, including books and audio or video tapes, and,

7.2.2.5 Training courses and seminars.

7.2.3 Trainers should be committed to the concepts of training and regularly participate in classes, workshops, seminars, or trade journals to improve their own effectiveness.

7.2.3.1 Many of the concepts listed in 7.2.1 may be unfamiliar to technically trained individuals. Each trainer should become familiar with these concepts through organized sessions designed to develop these skills relative to the specific training needs of the laboratory.

7.2.3.2 Technical improvement also should be encouraged among trainers. As they become more comfortable with new concepts, it will give them more confidence with the trainee.

8. Retraining

8.1 Once an individual has completed a training course and has demonstrated competency, one should be certified to perform that job for a specified period of time. Periodic review of the individual's performance should indicate the need for any additional or remedial training. If a deficiency exists, immediate action should be taken to retrain in the areas of the deficiency.

8.2 If no deficiencies are noticed over an extended period of time, for example, one year, a formal process should be in place that requires an updated set of performance data be placed in the individual's training personnel file.

8.2.1 These data may be from routine performance evaluation samples run by the laboratory.

8.2.2 If a specific set of performance evaluation tools is used to determine continued competency, the individual must be notified of the need to complete it and the required proficiency and time frame.

8.2.3 If a deficiency is noted based on any of the tools specified in 6.3, retraining should be instituted until competency can again be demonstrated.

9. Storage of Training Materials

9.1 It is recommended that the master copy of all training materials be stored in a central location. It should be available for copying and distribution at all times, but it should not be used for routine training purposes. This master file may be electronically maintained.

9.2 As new materials are prepared, they should be distributed to the appropriate trainers and the master copy placed in the central storage location.