Applied Microbiology
&
Biotechnology Laboratory

"sustainable is attainable"

Standard Operating Procedure

AMBL-053-A

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Good Laboratory Work Practice for the Environmental Engineering Laboratory

SOP SUMMARY

This SOP describes how you are expected to conduct work in the environmental engineering laboratory when using equipment and performing laboratory procedures. These expectations are referred to as good laboratory work practice, or GLWP, and are considered an extension to both the laboratory's safety standard (SOP 002A) and the quality assurance plan (SOP 050A).

ENVIRONMENTAL HEALTH AND SAFETY

Hazards Assessment: This procedure does not contain hazards.

Safety Equipment and Engineering Controls: This procedure does not require the use of safety equipment or engineering controls.

Personal Protective Equipment (PPE): This procedure does not require the use of PPE.

Analysis-derived Wastes and Disposal:

Waste Generated	Hazardous (Y / N)	Disposal
This procedure does not generate wastes.	N	None

PROCEDURE DESCRIPTION

1.0 Introduction and Applicability

The proper use of equipment and conduct of laboratory procedures has a direct influence on laboratory safety and the ability to generate quality and usable data. As such, there are a number of work practices common to all laboratory activities that you are expected to follow while working in the laboratory. This SOP describes a number of basic practices that are considered components of overall good laboratory work practice or GLWP. These GLWPs intend to improve safety, minimize cross-contamination of samples, improve quality and usability of data generated, optimize your time conducting analyses, and promote the consideration of others working in the lab.

The GLWPs defined in this SOP are practices applicable to the Environmental Engineering Laboratory and are not considered to fulfill regulated good laboratory practice (GLP) defined and required by the U.S. Food and Drug Administration (FDA), the U.S. Department of Agriculture (USDA), and the Environmental Protection Agency (EPA).

This procedure assumes that all applicable safety training has been completed and that laboratory access has been granted, and applies to all laboratory work that supports generating data. This procedure does not apply to work involving the maintenance or repair of instruments, equipment or laboratory facilities, or work that involves laboratory waste management once the wastes have been properly collected by a class, project, or activity and custody of the wastes is transferred for disposal. This procedure is considered a component of the Laboratory Safety Standard (SOP 002A) and all procedures associated with the use of equipment and conduct of laboratory procedures. Following this procedure is required.

2.0 Definitions for Terms and Abbreviations Used

Previously defined terms and abbreviations used may be found in SOPs that precede this SOP and are not repeated here.

a. Class A Glassware. Glassware that is designated as Class A is manufactured to have the least amount of tolerance in the variance of the volume to be contained or delivered by that glassware – it is the most precise in measuring a specific volume. However, different types of Class A glassware will have a different tolerance. For example, a 250 mL Class A volumetric flask will contain 250 mL ± 0.12 mL (See volumetric glassware), whereas a 250-mL Class A graduated cylinder will contain 250 mL ± 0.65 mL.

b. GLP. Good Laboratory Practice is a quality assurance system defined and regulated by the U.S. Food and Drug Administration (FDA), the

U.S. Department of Agriculture (USDA), and the environmental Protection Agency (EPA) that support non-clinical laboratory studies throughout the planning, conduct, and storage of data generated. The intent is to ensure the quality and integrity of the data submitted to each of these agencies.

c. GLWP. Good Laboratory Work Practice is an extension of the quality and safety assurance systems defined by this laboratory that focuses on how work is planned, conducted, and concluded. The intent is to ensure that work is conducted using practices that promote safety, generation of quality and usable data, and a work environment that considers and respects the work of others in a shared workspace.

d. Unattended. Unattended refers to a sample, solution, chemical, equipment, instrument, or laboratory supplies that are left out or left on when the person responsible has concluded their work in the laboratory and left the lab. Any equipment or instrument that is intentionally left on as part of the experimental plan and may safely be allowed to continue operation while the responsible person is gone, is not considered unattended. Under most circumstances, a person may leave the lab with the intention of returning in a relative short amount of time to continue work without being considered to have left a sample, solution, chemical, laboratory supplies, equipment or instrument unattended during the time they are gone.

e. Volumetric Glassware. Volumetric flask and pipets are marked with a single volume and are typically more accurate for measuring a volume that they contain or deliver than graduated glassware.

3.0 Preparing for Laboratory Work

a. Before work in the laboratory is conducted, a plan for that work is documented. Depending on the scope of the work planned, this may be adequately documented by one of the following.

   1) A class or laboratory activity plan that contains information and includes references to other documents containing information that are necessary for the setup, conduct, and cleanup of that specific activity. This documentation is generally part of the course materials made available to students.

   2) A project plan that that contains information and includes references to other documents containing information that describe the setup, conduct, and cleanup requirements for all of the project's activities. This document is generally submitted when requesting access to the laboratory and is updated throughout the life of the project.

   3) An activity plan that contains information and includes references to other documents containing information that describe the setup,

conduct, and cleanup requirements for a particular short-term activities that is not otherwise associated with a class or project. This document is generally submitted when requesting access to the laboratory.

b. Prior to beginning your work in the laboratory, whether for a class activity or a project, you must prepare yourself to the extent possible for every aspect of the work you expect to complete. This includes conducting some or all of the following activities as may be applicable to your work.

- Verify that all materials, PPE, glassware, chemicals, and reagents needed are available,
- Review all SDS and activity-specific safety protocols, as well as your own risk assessment and incident response procedures,
- Know the locations of first aid kits, fire extinguishers, spill kits, and emergency contact numbers,
- Review and ensure that you are familiar with and can operate the equipment or instrumentation to be used,
- Prepare reagents as needed,
- Have your laboratory notebook or laboratory bench sheets prepared in advance and ready for recording data and observations,
- Ensure your workspace is organized for the work intended with everything you need readily available and in its place,
- Verify the operation of any specialize experimental apparatus that will be used, and
- Review all procedures to be performed.
- Ensure that the time you have scheduled to complete the work planned is realistic and uninterrupted.

b. Know who else will be working in the laboratory at the same time and be aware of the work they will be doing, where they will be conducting their work, and what equipment and other supplies they will be using. In particular, avoid scheduling your work during times when others may be using the same equipment, instrumentation, or materials that you will be using.

4.0 While Conducting Laboratory Work

a. Once you have prepared and begin your laboratory work, there are a few practices that can contribute to the time working in the laboratory being as productive, safe, and optimized as possible, and can support your ability to generate quality and usable data.

- Work at a safe pace.

- Work to minimize the introduction of error, no matter how small.
- Work to economize your time spent in the laboratory.
- Work with respect to others working in the laboratory and their work.

These practices will be outlined in following sections.

b. The more frequently you perform certain procedures, the more familiar you will become with them and the greater will be the tendency to conduct these from memory. This is common and while this is not considered a bad practice, what generally follows is that the procedure's documentation is no longer brought to the laboratory or kept close at hand. It is good work practice to have bench copies of all procedures readily available and that these copies are never taken from the laboratory.

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4.1 Pace Your Work for Safety

Working in the laboratory inherently increases the risk of injury or chemical exposure because of the nature of the work being conducted. However, this risk is significantly reduced not only by following the necessary safety protocols, but also by being familiar with the work and making sure that you never work under conditions where you are rushed or have a limited amount of time to complete the work. Chemical spills or accidents that can result in an injury or broken glassware tend to happen more frequently when you are rushing to finish an analysis.

Although it is expected that you have adequately planned your activity each time before you start working in the laboratory, once you begin your work, follow these practices.

a. Recognize that some lab activities can take up to 1.5 times longer to complete than what you think it will take. Schedule an adequate amount of time for working in the lab.

b. Avoid letting others who are working in the lab from distracting you while you are performing procedures that require your concentration. This can not only cause you to incorrectly perform a procedure and have to redo it, but will also take time away from your work.

c. Perform procedures that involve handling biological, chemical, or physical hazards with caution and at slow enough pace that you can easily control the handling of samples, reagents, and glassware and other apparatus used as part of the procedure.

d. Avoid placing yourself in a position where you end up having to work at a faster and unsafe pace just to be able to finish your work. Be prepared to make the decision to stop work once you recognize that you cannot finish a procedure in the amount of time that you have remaining.

As you become more experienced working in the lab and with the procedures you need to perform, you will have a much better sense of the time you need.

4.2 Minimize Introduction of Errors

Minimizing the introduction of errors in your work is a practice considered essential for producing good quality data. This practice is particularly important for everyone to follow because the poor laboratory work practice of one person can impact the data quality generated by several others. In that regard, your laboratory work practices should also aim to minimize the errors in the work of others as well.

Not surprisingly, many of the practices that help us minimize errors are very simple, common sense things that can be done, and are most beneficial when they become part of our laboratory work routine. Some of the more impactful practices to minimize errors are summarized here.

a. Use Class A volumetric glassware when preparing reagents, standards, and performing dilutions.

b. Perform dilutions so that you are not using less than a 5-mL aliquot of sample or reagent that is being diluted, whenever possible. Consider planning your dilutions with this goal in mind and identify which intermediate dilutions you can use to achieve the lower dilutions while using a larger aliquot volume. Greater error can occur when using smaller volumes.

c. Be meticulous when performing dilutions. Insist that you always measure aliquot volumes as accurately as possible. This includes performing a verification of your ability to measure volumes accurately with the glassware you are using. For instance, if you are using a micropipettor, you should always verify that are consistently dispensing an accurate volume. This should occasionally also be done for a volumetric pipet.

d. Immediately rinse emptied glassware used in preparation of reagents, standards or performing dilutions, or the storage of these solutions, and emptied plasticware used to collect, transfer, or store samples. Do not allow any remnant of a solution or sample to evaporate and leave a residue on the inside or outside of the glassware or plasticware. When practical (*e.g.*, beakers, cylinders, flasks, bottles), a minimal rinse is done by rinsing the container 3 times using tap water, followed by 3 times using deionized water. This will not only minimize cross contamination but significantly simplify subsequent cleaning step that may be required before the glassware or plastic ware is used again.

e. Always replace the deionized or distilled water spigots in their proper location. Never allow either spigot tip to touch any surface that can transfer contaminants to the tip of the spigot thereby becoming a source

of contamination for the next user of the water systems. This is particularly true for the deionized water system for which the spigots are often found in the sink.

f. When practical, select and reuse glassware and plasticware for the same purpose, particularly when used frequently for that same purpose. For example, reuse the same volumetric flask to prepare each calibration check standard that is prepared with each batch of samples being analyzed.

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4.3 Economize Your Time in the Laboratory

When performing certain laboratory procedures, there may be some steps in the overall procedure that require a specific amount of time to wait for a reaction, dissolution of chemical, sample to thaw or reach room temperature. This time waiting, also considered dead time, can add up to s surprising amount of time when nothing is getting done.

During your dead times, look for and determine what small tasks you can complete rather than just waiting and doing nothing. These tasks are typically ones that are nonconsequential to the procedure being performed and that, if necessary, may be stopped before completed. The specific tasks that you can do during dead times that become available will depend on the procedure you are performing, the time it actually takes to perform that task, and your personal work habits.

One of the more practical tasks that can be done instead of waiting is to keep up with rinsing glassware and plasticware. While you may only be able to rinse one or two pieces of glassware, you will have just prevented yourself from having to spend that same amount of time later.

Identifying your usable dead times and the tasks that can be completed during those times is generally only possible after you become very familiar with procedures that are routinely performed. Never attempt to perform such tasks when you have not yet become familiar with the timing of the procedure, or when there is not enough dead time available, or when performing a non-routine procedure or a procedure performed only once. In these cases, your priority must be to completely focus on the procedure.

4.4 Respect Others and Their Work

One of the more significant GLWPs that can be followed is to respect the work of others who are working in the laboratory, regardless of whether they are working at the same time. This not only promotes safety, but also supports efforts to minimize errors and to economize everyone’s time working in the laboratory.

All laboratory activities have at least some work space that is shared with other laboratory users. As a result, work practices that respects others working in the laboratory and their work, these GLWPs are required.

- Cleanup and organize all spaces where you have conducted your work. Decontaminate laboratory bench surfaces that have been contaminated.
- Never leave unlabeled containers with solutions unattended, even if the solution is water. This is an OSHA violation.
- Always leave instruments and equipment in a clean and ready-to-use condition. Decontaminate any equipment or instrument that has been contaminated
- Do not leave equipment or instruments unattended while they are operating or turned on.
- Never move equipment or instrument that have a defined work station, or the supplies that belong with that equipment or instrument, from the designated work station.
- Never borrow supplies from another person's work area unless you have arranged to share the specific item. When finished, return it in the same condition and to the same location where you found it.
- Return equipment, instruments, glassware, chemical, and other laboratory supplies that are shared by others to their proper location when you have finished your schedule work for any given day.

Complete an Incident Reporting Form (SOP 002G) to report instances when any of the above work practices occur.