

# Conducting a Laboratory

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The laboratory experience is a vital part of the learning process. Students learn and retain information more effectively after the hands-on experience. Your responsibility as the laboratory instructor is to assist students in achieving the objectives, which are to:

1. Give the student the opportunity to carry out experiments.
2. Make careful observations and record information accurately.
3. Become proficient in laboratory techniques and the use of instruments.
4. Collect data, and analyze it in a scientific manner.
5. Learn to interpret results and draw valid conclusions.
6. Provide applications of concepts and principles discussed in lecture.
7. Learn to work independently and make decisions.
8. Develop the ability to plan and carry out lab tests.
9. Cultivate a team spirit when experiments call for students to work in pairs or groups.
10. Gain respect for the difficulties involved in performing some types of experiments.
11. Acquire skills in using the scientific method.
12. Stimulate interest, enthusiasm and appreciation for science and its impact on everyday life and living.

## **Preparation**

Read over the experiment very carefully and plan to give a short recitation that outlines the experiment and its objectives, covers sample calculations and any changes in procedure, and emphasizes safety precautions. To help students complete the experiment within the allotted time, it is highly recommended that the instructor provides guidelines to use time effectively and minimize errors. If you are not familiar with the experiment, you should plan to run through it yourself, as you will be in a better position to offer constructive suggestions to your students.

If required to administer quizzes in lab, plan a fair quiz that tests understanding of underlying principles, procedures, and techniques, rather than rote memorization. Check to see that all copies of the quiz are legible and complete.

If graded material is to be returned to the students, make sure that you have recorded the scores in your gradebook, and remember to take them to the laboratory with you.

### **In the Laboratory**

Arrive early and check the laboratory for cleanliness, safety features, and necessary materials. If there are any problems, report them immediately to personnel in the stockroom or other authority. When instruments are involved, make sure that you are familiar with operating procedures, and if a warm-up period is required, turn them on so that they will be ready for use by the students.

It is advisable to take 10-20 minutes at the start of the lab period to briefly discuss the activity for the day. Getting the students actively involved in this discussion provides a clear picture of how well each student has prepared for the laboratory session. This information will be very useful in evaluating the student. Emphasize safety precautions, and use demonstrations, as necessary, to introduce new techniques or to illustrate set up of apparatus. Start the class on time and take attendance. Except in unusual situations, punctuality is a fairly reliable indicator of the student's attitude.

Both state law and university chemistry departments require that safety goggles be worn by all persons at all times in the chemical laboratory when the experiments are in progress. The instructor is responsible for enforcing this policy and could be liable in the event of an accident leading to eye injury. Practice what you preach; by setting a good example and monitoring the situation very closely, taking action when necessary, during the first two weeks, you will find fewer abuses of this policy.

Effective teaching in the laboratory requires that you circulate among the students and interact with them by checking their notebooks, asking questions about the experiment, offering suggestions and helping out if necessary. You should not sit at your desk the entire period and expect students to go to you with questions or for assistance. Be prepared to deal with students who are slow in lab, or intimidated and insecure, or anxious to finish quickly and leave early. To ascertain that the student actually performs the experiment and collects his/her own data, you should sign the lab notebook before the student departs the lab. Insist that all entries be made IN INK!

Return graded lab reports promptly, and whenever possible offer suggestions that could help the student to improve his/her lab write-up and earn higher scores. Be prepared to handle accidents. Remember that you are not alone in this situation and seek help from authorities. Presence of mind and being calm are assets in such an event. Familiarity with the use of fire extinguishers is a must when flammables are being used. Also, be aware of students who wear contact lenses, emphasizing the need for clean hands when touching their eyes. When accidents occur, you must complete an accident report and submit it to the proper authorities.

Allow some time for cleanup procedures at the end of the period, but stress the need to complete experiments on time by careful planning and working efficiently. Never make the mistake of letting students work overtime as they would acquire a bad habit. Bad habits are difficult to break and you will pay dearly for your action. Remind students to submit laboratory reports in keeping with lab policies. Individual work stations should be clean, and common work areas and reagent shelves should be cleaned by assigned students on a rotation basis. Before leaving the room, you should check utilities such as gas, water and air outlets, electrical appliances, and any other potential hazard sources.

### **Special situations**

The first and last lab periods may have to be conducted differently depending on the nature of the lab course. The first meeting should be used as a getting-to-know-you session: introduce yourself to the students and give them some useful information, such as your name, lab section number, office location, office hours, and a telephone number where you can be reached. Collect information on 3 x 5 cards about your students that would facilitate efficient and effective interaction.

Some departments require check-in and check-out procedures for students. During check-in, students are assigned lockers containing supplies necessary to conduct experiments. They are responsible for carefully checking all items listed on the check-in sheet and are required to sign this sheet in acknowledgment. During the semester, the student is expected to keep track of his/her supplies and replace any missing or broken items in keeping with the departmental policy. Check-out is scheduled for the last week of classes, and the instructor thoroughly checks each locker to ascertain that all items listed on the sheet at check-in are clean and in good condition. An inefficient check-out by the instructor leads to financial losses for the department, and with tight budgets this would affect the quality and successful operation of the lab program.

### **Laboratory Notebooks, Reports, and Grading Policy**

The lab notebook is a valuable record of work performed in the laboratory. Students should be instructed on departmental policies regarding the maintenance of lab notebooks. Requiring a pre-lab write-up ensures that the student has read the experiment, improves efficiency in time management, increases safety awareness, and reduces the potential for accidents. Grading the prelab write-up during the laboratory session, if possible, is advantageous both to the student and the TA. The student will be encouraged to complete the write-up, and the TA could reduce time spent on grading outside the lab. This does not imply that the TA should sit at his/her desk and grade student write-ups, but rather initiate a prelab format that is brief and organized and can be graded as the TA circulates among the students. All information obtained in the lab should be entered in the lab notebook and not on scraps of paper. It is the responsibility of the instructor to see that students develop good skills in documenting their observations and data. Remember to check and sign the student's notebook before he/she leaves the lab.

In addition to maintaining a lab notebook, students are expected to submit a report on completion of the experiment. Encourage students to turn in their reports in keeping with departmental policy, and do not accept late reports (except for genuine reasons). Some departments provide TAs with grading keys in an attempt to maintain some uniformity in grading. Be prepared to explain your grading scheme if a dissatisfied student approaches you, or if there is an inadvertent error in grading. Students tend to compare grades and you should always be aware of this.

Keep a gradebook and enter all scores faithfully. You will be required to turn in a cumulative lab score for each student at the end of each semester. Besides, you may be required to assign points for subjective evaluation of each student by the TA. Some things to consider for this purpose are the preparedness of the student in lab, correct use of lab techniques, safety consciousness, cleanliness in lab, efficiency in completing experiments, quality of lab notebook and reports, interest and attitude, and experimental aptitude.

### **Conclusion**

The laboratory experience is a wonderful learning opportunity for both the student and the instructor. Do not get alarmed if the unexpected happens--students may not have followed instructions correctly, there

may be an error in the solutions provided, or some impurity could foul the expected result. Be calm and try to provide a logical explanation, and if you are unable to identify the source of the problem, consider alternate solutions such as having the student start anew (if time permits) or team up with another student.

You may encounter difficult situations in dealing with students who are incompetent in the laboratory, refuse to wear safety goggles at all times, or constantly complain about their grades. Patience and perseverance are virtues that will lead you to success under these trying circumstances. Consult the professor for advice as you see fit.

Some of the information in this article is taken from the Handbook for Teaching Assistants published by the Division of Chemical Education of the American Chemical Society.