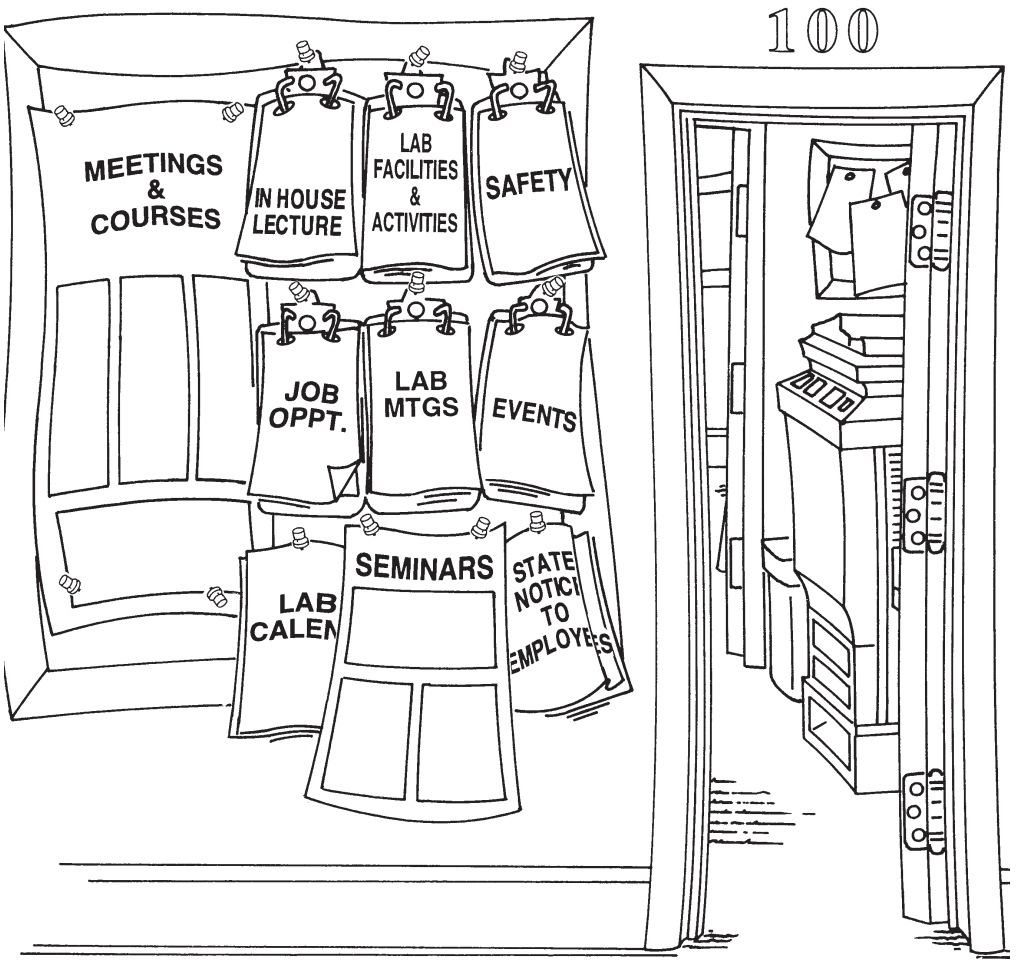
Preface and Excerpt from Chapter 1



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General Lab Organization and Procedures

WELCOME TO ONE of the most exciting and enjoyable workplaces ever evolved, the biomedical research laboratory. There is an amazing concept in operation here: You get paid or get credit for doing experiments, surely an almost scandalously delightful way to make a living. The work is worthwhile. The dress code, if any, is casual. The work hours are often self-determined and based on the needs of the experiment. The lab or department is filled with bright and interesting people with whom you can discuss the salt concentration needed for a kinase assay or the implications of the latest congressional bill. It can come to have all the psychological comforts of home.

Like any complex social organizations, research laboratories have their own customs and rules. The difficulty is that the rules have been unspoken. You are expected to decipher the many obtuse clues and become a law-abiding member of a society in which individualism is highly prized. Although no one is expected to show you how to work the equipment, you will be expected to work it. In a profession in which communication of data is the goal and the reward of the research, not all people can communicate with you clearly and satisfactorily. Don't worry, you will manage! In a short time, the pleasure of working together with colleagues on interesting and similar projects will supplant any initial feelings of unease. But to get your work done well, you must first navigate among sometimes vague and mixed signals and learn how your laboratory beats and hums.

THE BIG PICTURE

A lab is defined by a number of overlapping terms, depending on the audience for whom the lab is being described. A lab may be described in terms of its basic *field*, such as immunology, physiology, or biophysics: This is more of an administrative definition than a functional one. The *experimental model*, the organism used to address the question, is often used to expand the description of the field of research. For example, someone may be a member of a microbial ecology or yeast genetics or a human neuroanatomy laboratory.

The *area of research* is a more practical way to describe a laboratory, since it tells you what the lab actually does: One might say that the lab is a cell cycle lab, or a signal transduction lab. The lab probably has a *focus*, a question that binds all the lab members. The entire lab may be working on the proteins involved in secretion from neurons, or trying to understand why and how a particular transcription protein is involved in development. And individual lab members have their own *questions*, a specific problem that they are trying to solve experimentally.

Another way the laboratory has been defined is by whether it is engaged in *basic* or *applied science*. Basic science was assumed to be pure science, science done only for the sake of knowledge, whereas applied science has been thought of as the use of a basic science idea for the development of a product such as an antibiotic. *Basic science* was considered to be the child of academic research, funded by soft money (research support and/or salary funded by competitive grants). *Applied science* was thought to be performed in companies, funded by hard money (salary and research support are part of the job and are given by the institution or company). These distinctions are not valid. Basic and applied sciences are done in universities and pharmaceutical companies, and research at academic institutions and companies is funded by both hard and soft money. To those who work in labs, the practical similarities are more apparent than the differences.

Some laboratories do *clinical research*, in which human patients or a patient's cells are used to investigate a disease or syndrome, and much of the work is done by medical doctors rather than Ph.Ds. Clinical research labs are usually found only at medical schools or institutions affiliated with a hospital, where there is access to patients.

Each laboratory is usually part of a larger unit, such as a *department* or a *division*, and shares facilities with all department members. Large pieces of equipment such as ultracentrifuges and –70°C freezers are often departmental, even if they are housed within an individual's laboratory. Cold rooms, warm rooms, dark rooms, film developers, autoclaves, and glassware washers may also be shared, unless they belong to a very large and extremely well-funded laboratory. Most departments have a library, where some of the relevant journals of the field are located: Since most journals are on-line, the library more usually serves as a lunchroom or a small seminar room. If not the library, there will be a conference room, used for research presentations and journal clubs. And almost every department has a large bulletin board, near the sec-

retary, library, or main office, upon which are posted seminar times and places, job listings, meeting notices, and departmental happenings.

Use the department—do not hide away in the lab. The department is a resource that can provide ideas, equipment, and connections, and your dealings with the members of the department can greatly influence the happiness and productivity of lab life.

LABORATORY PERSONNEL

Laboratory groups have a dynamic that is fairly unique, in that people work more independently than in other groups, and the organizational structure tends to be rather horizontal. Practically, this means that *everyone is equal*, and it is usually no one's job to show you how to do things. Do not assume that because a person has a "lower" status than you, you can indiscriminately order that person to make a buffer for you: You might get the buffer, but you might also generate a lot of passive aggression. Antagonizing someone may mean that no one will clear out freezer space for you, take your tubes out of the water bath when you have forgotten them, or help you do a calculation until you change your attitude.

Treat all members of the lab with the same respect you give the P.I.

Laboratories have a variety of personnel working in them, with varying levels of commitment and various reasons to be there. The cast of characters commonly includes:

The principal investigator, or P.I. This person may also be known as the head of the lab, the boss, the advisor. The P.I. probably spends more time with administrative tasks such as writing grants or research reports than in doing lab work but is the intellectual guide behind most of the projects in the lab. Directly or indirectly, P.I.s are responsible for funding the laboratory research. The entire atmosphere of the lab—friendliness and camaraderie or vicious competitiveness—will depend on the P.I.'s personality and leadership.

Postdocs. This is short for "postdoctoral" associate, assistant, or fellow (the terms are institution-dependent). Postdocs have received their Ph.D. or, more rarely, M.D., and are doing a 2–5-year training period before looking for a position as a P.I. in a university or in industry. Postdocs usually work quite independently on their own projects, although they will collaborate with other lab members on particular aspects of the project.

Technician or research assistants. A technician can be a college student who wants to gain more experience in the lab before entering graduate or medical school, or a professional with an M.S. and the appropriate pay and title. In academic estab-

lishments, the norm is the new college graduate who will stay only for 2 years. In industry or in some medical centers, longer-term arrangements (with more money and prestige) are found. Technicians do a variety of tasks, including ordering supplies, preparing media, and caring for the lab's cell lines, assisting a particular lab member with their experiments, right up to designing and carrying out their own experiments.

A professional technician is often the most skilled and knowledgeable person in the lab.

Graduate students. Graduate students are doing lab work required for their M.S. or for a Ph.D. Generally, they work long hours and have a lot of time and emotion invested in their projects. Like postdocs, graduate students have their own project or projects and become increasingly independent during their tenure of 4–7 years in the laboratory.

Rotation students. Many graduate schools require their students to work in several labs before they decide on the lab for their thesis work. These brief weeks of research are known as a rotation. Rotation students are in the lab for 6 weeks to 6 months, usually on a short-term project. They may be required to do rotations, or they may want to pick up techniques in a new field, or they may be testing the waters before making a bigger commitment. But the rotation goes two ways: At this time, the P.I. is also deciding whether or not to accept that student into in the lab as a graduate student.

Undergraduate students. Undergraduates are the motor of the lab in many colleges and universities, even at universities with strong graduate programs.. They come to the lab for many reasons: for senior research theses, for independent study, as a work-study job, to get research experience and faculty recommendations for application to graduate and medical school, or just to get a taste of research. Students who have already worked in a lab may be given their own small project, whereas new students might make buffers for the entire lab or, most typically, be assigned to help a particular person.

Summer students. Summer students are usually college students, sometimes high school students. Many universities sponsor high school and college students for summer programs, paying a small stipend and overseeing the general care of the students. Undergraduate students approach the P.I. independently for summer projects, for the same reasons as during the school term.

Residents. Residents are usually found in a medical center lab, researching an aspect of human disease. They may spend several weeks to several months in an area associated with their field, usually doing a short-term project. A resident may be known as a fellow in some institutions.

Visiting faculty. During a sabbatical, a faculty member might go to another lab to learn a new technique, try a new field, or collaborate on a series of experiments.

Secretary or administrative assistants. The secretary may be in charge of ordering supplies for the lab, may help lab members with grant applications, and may organize lab seminars and journal clubs, or may work only to serve the P.I. directly. Be especially considerate of the secretary, who is one of the most important and necessary, but undervalued and rudely treated, people in the laboratory.

Laboratory aides. Some jobs in a department or laboratory are done by a laboratory aide, who is hired to perform a set of specific tasks. This person is usually not trained to be a scientist, but helps the lab greatly by doing tedious and time-consuming jobs. Examples of laboratory aides are *medium preparers* and *glassware cleaners*. The medium preparer makes and distributes cell culture media and bacterial broth and plates. A glassware cleaner—the one who washes the dirty glassware and pipettes and, perhaps, delivers the cleaned and autoclaved things—is a luxury that small labs may not be able to support. This job is likely to be a departmental one, with several labs being serviced by the same person.

Knowing someone's position in the lab can help you understand certain things that appear inexplicable. It can suggest which person might be the best person to consult on a particular scientific or personal problem. But do not define anyone by title alone, or you may pass by a potential fountain of information. You may also be impressed when you should not be!

Laboratory supervisors. The day-to-day operation of the lab may be overseen by a laboratory supervisor. The responsibilities of the laboratory supervisor might range from keeping the lab stocked and organizing journal clubs to suggesting experimental approaches. Whatever the situation, do not let the presence of a supervisor prevent you from ever interacting with the P.I.

Laboratory safety officers. A laboratory member, usually one who has been in the lab for a few years, is usually assigned to act as a liaison between the lab and the Environmental Health and Safety (EHS) department. If you have questions about health, safety, or the appropriateness of lab protocols, speak to the lab safety officer before you speak to someone in the EHS department. This is usually a departmental position.

LAB ROUTINES

Although labs have people coming and going through all hours of the day, certain routines and customs stand firmly in the apparent chaos. It will take a number of weeks before the rhythms of the lab are clear and you can make your place in this

environment. As much as you can without compromising yourself, initially try to work in with the routines of your particular lab.

Hours

Because experiments do not always fit into a 9-to-5 slot, lab workers often have long, unpredictable, and quite eccentric hours. Most people are allowed to regulate their own hours, with the most trust usually associated with academic departments. But even if the lab is an academic lab, and not a word is said or spoken about hours, *there is probably a standard of time commitment that is expected*. Companies and hospital departments tend to have more traditional hours, whereas academic departments may seem more casual, with more late night action. But in both, working less than the deemed and sometimes unspoken expected hours of work can stigmatize the new worker. Find out what hours of work are expected, and try to conform to this. If most people tend to come in late in the morning, and work evenings, try to do the same: Working hours dissimilar to other workers makes it difficult to get to know people and to obtain the help you need.

Position influences hours. Basically, because the lab is dependent on them, technicians and secretaries are expected to work more regular and predictable hours. But if you are expected to stay to finish experiments or projects, it is only fair that you should have more freedom in choosing hours.

Your personal situation may not allow you to work the lab's hours. Children, classes, commutes, and partners are some of the factors that will also influence the hours you can work. *Try to overlap with other lab members as much as you can.* Be up front about your hours, because you certainly do not want to be in a situation where you sneak around and get into weird behaviors such as leaving on lights or pieces of equipment to show that you were there. Hopefully, your work will speak for itself.

Vacation policy also varies from lab to lab and is usually unspoken. In many places, people are discouraged from taking vacations because it always seems as if it is the wrong time to leave a project: Either the project is going well, and you don't want to walk out on a run of good results, or it is not going well, and you feel too guilty to leave before you get it back on track. Take the time you deserve, but don't abuse the privilege of independent decisions.

Dress Code

One of the satisfying benefits of working in the lab is the freedom to wear whatever you like. People in hospitals and companies often dress more formally than do those in academic institutions, since they must interact with non-lab people and patients. People in academic institutions are more likely to be offended at the thought of having their clothing regulated, even by custom. This is a personal issue, but it is most

likely that you can wear whatever you want, and no one will ever question you. There are few rules on dressing for the lab:

- Don't wear good clothes unless you want to spill phenol or bleach on them. Spills only happen to favorite or expensive clothes.
- Don't wear open-toe shoes or shorts. This is a rule in most laboratories, and is obeyed in few. If you are determined to wear shorts or sandals, take great care in doing experiments: Spilling phenol on pants is bothersome, but spilling it on your legs is a real health hazard.
- If you must wear a tie, keep it out of the Bunsen burner.

Laboratory Tasks, Lab Jobs, Assigned Jobs

In many labs, lab personnel *must share common jobs*. Typical jobs include making liters of a commonly used buffer, picking up the dry ice, changing the CO_2 cylinders on the incubators, or packing up the radioactive waste. These jobs may be permanent or may be rotated at regular intervals. Sometimes the job is a particular piece of equipment which the assigned person is responsible for keeping in good running order.

Take your assignment seriously. Do not let your assignments always come second to your own experiments. Other lab members may be dependent on the buffer you keep forgetting to make, and even if you do not absolutely ruin someone's experiment, you will get a reputation as a bad lab citizen. Try to do your jobs with cheer.

Playing the radio. *Most labs have a radio or CD player in the main room, and the debate about the choice of music can quickly escalate into a war. Don't get into it. If you do not like the music, buy earplugs or a personal music player with headphones.*

Laboratory Meetings

Meetings are held in laboratories to discuss the current research of the lab workers, the current research of the field (since recent journal articles are often discussed, these are known as journal clubs), and organizational problems. These may be combined into one or two meetings: Small labs may not have their own meetings but be participants in departmental meetings. Many labs or departments have a *weekly journal club* and a *weekly research meeting*.

In *research meetings*, one or two people present their data. In some places, all lab members briefly talk. These talks may be casual, over lunch and with only a blackboard

Attend all meetings. *Unless you have a desperately pressing experiment, arrange your time so that you can go to all journal clubs and research presentations. Content aside (and you will probably learn a lot), your attendance shows support for your coworkers and is important for departmental cohesiveness.*

or overhead projector, or they may be formal enough to require proper slides and dress. *Journal clubs* are almost always quite casual, although local custom will dictate whether photocopies or the blackboard is used to present the paper. Often, the papers to be presented are listed a few days before the meeting so that everyone can read the papers and have at least a primitive working knowledge of the topic.

Who participates in lab meetings? The backbone of most lab meetings is the students and postdocs, with participation by technicians, faculty, and short-term personnel being dependent on lab policy. Certainly, if you are not required to join in but want to participate, you should ask the head of the lab if it is okay.

If you are expected to participate, you will usually be given a grace period, especially for research seminars. It is common, if you have previously done research, to give your first research seminar on your past research project. The format of lab meetings varies widely: Chapter 6 contains more details about participation in and preparation of lab meetings.

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WHAT TO EXPECT THE FIRST WEEK

You will be assigned a lab bench, or a part of a lab bench. You may also be assigned a *desk*, either in the lab or in a common office area. Don't be offended if the place you have been given is very small—space is at a real premium in most labs and, generally, the more successful the P.I., the more crowded the lab, and the less space each person is given. You may well see that many people have more space, but don't complain yet.

The P.I., or the person responsible for you, will probably sit down with you to discuss the project you will work on. The basics of the project were most likely outlined before you came to the lab, but this is the time you will find out the specifics. *If you are offered the chance to work closely with someone (rather than to work completely independently), grab it!* You will get much more help than if you are patching together instructions on your own, and you can negotiate your autonomy later.

If you can, read literature related to your project or the theme of the work in the lab, before the talk. Don't worry if everything does not make perfect sense, or even if it makes no sense at all—as soon as you do a few experiments, it will all become clearer—it will give you the vocabulary with which to have the conversation.