3

Getting Started and Staying Organized

YOUR LAB BENCH is your home, your real estate, and its setup and maintenance are integral to the reproducibility of your experiments. Whatever your personal sense of style, try to rein it in and keep your lab bench neat. Ignore the machismo that reigns in many labs, the sense that a Real Scientist doesn't worry about cleaning up junk, and stay organized. At the very least, remove the debris of one experiment before you start another.

What will be done on the bench? Will you only prepare samples for gel analysis at your bench, or will you also run the gel —that is, is there a common place in the lab for electrophoresis that you can use? Try to use the common areas as much as possible, and keep your bench space as free as possible: Resist the temptation to do everything on your bench, as it will tend to get fairly messy.

Organization is key. It is no longer possible to incorporate the sheer volume of scientific information available: One can only hope to know how and when to access what you need. Without a system for maintaining references, data, computer files, and journal articles, you will be hopelessly mired in paperwork within weeks. Keeping control of information is as important as IQ in the lab.

SETTING UP A FUNCTIONAL LAB BENCH

To feel as if you have really moved in, set up your lab bench so you can start experiments as soon as possible. It will probably take longer than a week to know exactly what you will be working on and to pinpoint the specific reagents you will need, but there are standard supplies and reagents that everyone needs, and you should set yourself up to do an experiment as soon as possible.

1. **Briefly assess your needs.** Look around the lab, think a bit about the kind of work that goes on, and make a tentative (and perhaps, mental) list of what you think your bench should have.

Don't use opened boxes or bags of supplies. If you find opened pipet tips, pipets, or tubes, use only what can be autoclaved to guarantee cleanliness and sterility.

2. **Find out what is available at the bench.** Often when you move into a lab bench, you will inherit the equipment that the previous bench user had. Check it out. If it works, use it: Later on, if it is inadequate, you can replace it. Even if it is not exactly what you are used to—for example, people tend to be particular about their pipet aids—give the old one a try.

3. **Get rid of what you don't need.** You need to maximize whatever space you have. After you have gone through the drawers and shelves, get rid of things you won't use. Either ask other lab members if they want it, or put it on a cart for a week with a sign that everyone can take what they want, and then discard what is left after a week.

Immediately dump all buffers you may have found on your shelf. It may be tempting to cut down on your work by using that Tris buffer, but you don't really know if the buffer is okay.

4. **Clean.** You won't have a chance ever again to have things as clean as possible. Wipe down the shelves and the lab bench with a mild soap mixture. Rinse well.

While you are setting up, and even more so during your experiments, you will create a lot of debris that you will want to get rid of. *Do not throw anything away until the particular laboratory rules for waste disposal have been explained to you.* A lab can be shut down by the Laboratory Safety Department for infractions of the disposal rules.

Chapter 8 gives the particulars of waste disposal, but you should be aware that the following kinds of trash will each have their own method and place of disposal:

Paper, recycled and waste
Biological waste
Radioactive waste
Broken glass
Syringes, needles, pasteur pipets
Chemical waste
Hazardous chemical waste

Use gloves as you are working, since there may be residual radioactivity or hazardous chemicals.

5. **Order what you need for routine lab work.** *Order conservatively.* (Most supplies and equipment needed to do experiments will be in the lab.) You can order as you go along, so order the minimum now. Ask for guidance from the person responsible for ordering (if there is such a person), or from a lab member. Find out what your budget is and, even if it is limitless, order only what you absolutely need. See below to find out how to order.

Don't order any major pieces of equipment unless you have discussed it with the P.I. Try to borrow any equipment you need.

6. **Do an experiment as soon as possible and reassess your needs.** The setup and actual execution of even a small experiment will point out what you need, what you can borrow, what is wrong. Now order what you need to do a specific series of experiments.

Although you do want to be as prepared as possible for the first experiment, don't wait until you have everything. Do an experiment the first week, even if you have to borrow supplies.

How to Order Supplies and Reagents

1. **Find out how to physically place an order.** The ordering procedure will be institute dependent, and your responsibility can range from merely reporting that something is needed, to calling to place the order yourself. Most places have an in-house store for the most commonly ordered items, and the ordering procedure may be different here than for outside orders. Most places have centralized ordering through a Purchasing Department, and that department is responsible for actually making the call and handling the paperwork for all of the lab personnel. It is also the responsibility of the Purchasing Department to find the best deal among the manufacturers on the item you request: If you need the item from a particular manufacturer, you should note this in the order.

Most standard supplies that you need for your initial experiments will be in stock in the lab.

2. **Be sure the item isn't already in the lab or hasn't been already ordered.** Check behind boxes and bottles for a duplicate item. Ask the purchase person if someone else has ordered the item, or ask other lab personnel.

More and more institutions are switching to on-line ordering: if this is true for your workplace, you will probably need a password as well as an account number (which you need for all orders). This can take several days, so arrange it before you need an order.

3. **If the item is standard in the lab, order the exact specifications and amount usually ordered.** For chemicals, the empty bottle itself is the best source of order information. For other items, consult with the person in charge of ordering, or with another lab member.

4. **If the item is new to the lab's repertoire, follow these steps:**

   - *Check with the person who gave you the protocol* or recipe for which the item is needed. The source of a reagent can be critical, especially if you are trying to replicate a result, and an investigator who has used the reagent can give the best advice for type and manufacturer, as well as storage advice.

   If there is a senior technician, do consult him or her about ordering and setting up: such a person is usually an exceedingly valuable resource.

   - If the protocol has no recommendation for the source of a reagent, *ask someone who has done similar experiments to recommend a manufacturer.* You could also ask the purchasing department, or the person who does the ordering, for a suggestion for a manufacturer, and call the manufacturer. There are several *on-line services* that enable you to look up any item, compare prices and specifications, and request information from the manufacturer. Several of these are listed in the Resources, at the end of the chapter. You could also go to one of the many Biomedical Science bulletin boards on line, and pose a question about the item in question to people who might have used it. You could also ask *sales representatives* for help. Most, if you have a good rapport, will tell you fairly honestly about the appropriateness and limitations of a particular item. Just take all such information with a grain of salt.

   You must decide how you will deal with sales reps. Most researchers consider it to be a real pain to have to talk with one, and many institutions and companies will not let sales reps onto the floors to harass people. Yet a good sales rep can be infinitely helpful. Most are trained in one of the biological sciences, and they can help make decisions and cut costs. Sales reps have a tough time. Be courteous to all, but be selective when deciding with whom you will speak.

   - *Buy the minimum amount.* The price per unit of a reagent often drops dramatically with an increase in the size of the order. But a reagent that will not be soon used can go bad, and becomes a very expensive venture. Resist the temptation to buy a whopping big bottle.

   - *Buy the highest quality you need and can afford*—with the emphasis on need. Some reagents come in grades of purity, with a higher price for the more pure reagent. But the most expensive grade isn't necessarily better, and may give dif-

ferent results. If the grade hasn't been specified, call the manufacturer and explain what you need.

- *Keep a record of what you ordered.* This will make it easier to reorder. It is also a good idea to record order numbers and lot numbers under the appropriate experiments in your research notebook.

For example, bovine serum albumin (BSA) can be used (among other things) to block nonspecific protein binding to a filter, or to stabilize an enzyme reaction. For the latter use, in which any contaminants could inhibit the enzyme activity, the BSA must be much more pure.

5. Have the item shipped in the most inexpensive and safe manner. You may, for example, have a choice between a wet ice and dry ice shipment of enzymes. Take the minimum protection needed, according to the manufacturer's advice. Avoid "Rush" orders.

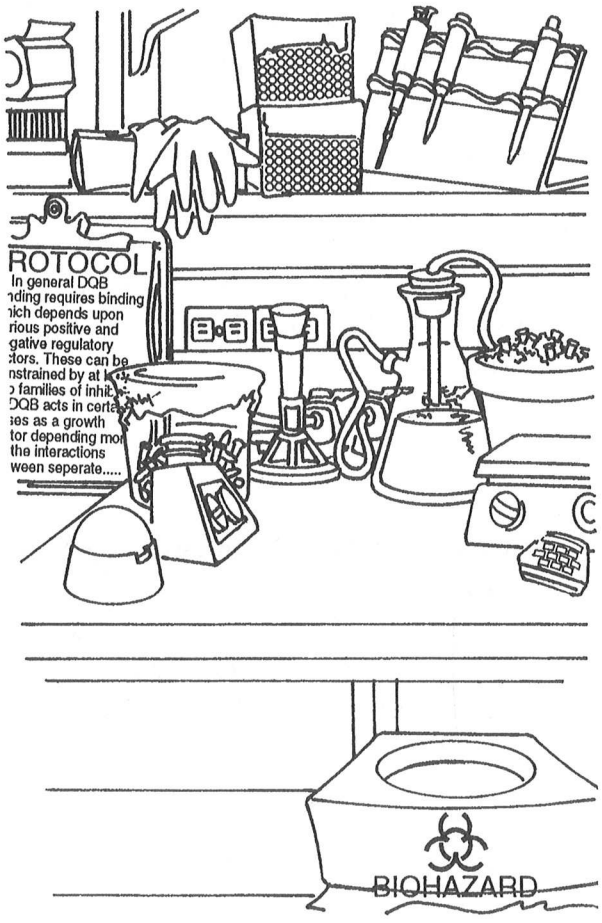

FIGURE 1.

The laboratory bench. The lab bench should have a central area of working space, surrounded by the equipment and supplies you need to set up and perform experiments.

Lab Bench Needs

Space

At least 2 feet should be totally clear lab space for active experiments. Don't store anything here, and clean up the remains of each experiment as it is completed to preserve this area.

You could also put down several layers of bench paper at one time, and just strip off the top layer when it is soiled.

Some people cover the bench with either blue "diapers" or special bench paper which is absorbent on one side, plastic backed on the other side. If you do this, the absorbent side should be up. If you do cover the bench, the paper should be changed frequently, or the entire reason for putting the paper down is nullified.

If you are doing any *radioactive* work on the bench, you must cover the bench with plastic-backed paper. However, this should be done for *each* experiment and the paper should be removed after each experiment (to be disposed of in radioactive waste). Keeping the same paper on after an experiment defeats the whole point of putting it on.

Shelves

Personal room-temperature reagents are stored above the bench. One of the first things a newcomer to the lab needs to do is to make a supply of buffers needed to start doing experiments.

If the shelves divide a bench in two, be sure that you don't nudge a bottle off the shelf onto your backyard neighbor. Never store acids, bases, or other caustic reagents on the shelves.

Reagents typically stored at the bench

10x PBS
Ethidium bromide, 5 mg/ml in water
10x Tris acetate EDTA (TAE) buffer
10x Tris borate EDTA (TBE) buffer
10 % SDS
20x SSC
1 M Tris, pH 7.0, pH 7.5, pH 8.0
0.5 M EDTA, pH 8.0
3.0 M Na acetate, pH 5.2
5 M NaCl
5 or 10 M NaOH
10x Laemmli running buffer

Refrigerated reagents you are likely to need

Chloroform/isoamyl alcohol
Phenol– water saturated
Phenol/chloroform/isoamyl alcohol
Sample buffers for RNA, DNA, and protein gels

Most buffers should be autoclaved before storage at room temperature.

See Chapter 7 for methods of buffer and reagent preparation and recipes for commonly needed reagents.

Bench and drawers: Checklist

Aspirator. A device that uses suction (house vacuum or pump-generated) to remove fluids, usually supernatants.

Biohazard disposal bag. All disposable material in contact with living organisms must be disposed of as biohazard material (Chapter 6). A place next to your bench for a large can or holder for a biohazard disposal bag is essential. A smaller holder for a bag on your bench is not essential, but makes life easier and safer.

Hot plate stirrer. You can boil samples before running them on a gel, stir a hard-to-dissolve reagent to your heart's content, or strip a filter, all at home.

Ice bucket. This is usually a common laboratory item. But since the first thing you will do most mornings is to fill up your ice bucket, be sure you have one always available.

Lab coat. Just about every institution will provide you with one or several lab coats, and most will have them laundered for you. Some labs use only disposable paper coats. Lab coat use is required for certain jobs but you should wear one whenever you are doing lab work, for safety and to prolong the life of your jeans. You need a separate coat for radioactive work.

Latex gloves. Latex gloves come powdered or powder-free. Try several brands of gloves before you order, because many people are sensitive or actually allergic to certain kinds. Make sure you order the right size: Tight gloves hurt, loose gloves get caught in pipettors and make it difficult to manipulate fine items. Used gloves should be disposed of in the biohazard trash.

Microfuge. Okay, this might be more than you should expect. But if you had one, you would use it all the time. You could get a tiny 6-sample personal microfuge, but this doesn't spin fast enough for nucleic acid precipitations.

*Microfuge tube racks.*Three or four racks will enable you to carry on several manipulations at once. Store them in a drawer so that they don't get "lost."

Parafilm. This stretchy plastic will be used often to seal plates and tubes, so keep it on the bench. Either get a dispenser with a cutting edge, or keep a scissors or covered scalpel always close to the box.

Pasteur pipets, sterile, and bulbs. You can also use disposable transfer pipets. These are used for filling and balancing centrifuge tubes, removing supernatants, and any approximate movement of small volumes.

Pipettors: 0–20, 10–100, and 50–250 or a 10–200, 100–1000 µl. If you inherit a set, have them recalibrated. These can be kept neatly in a shallow drawer, but it is better to either purchase the appropriate rack, or rig up holders by attaching 50-ml plastic centrifuge tubes to the shelf.

Pipets. You need a few glass pipets for measuring solvents and other liquids. Keep the pipets in an autoclavable can or canister. Useful pipet sizes are 2, 10, and 25 ml. Especially if you are doing tissue culture work, most of your pipets will be disposable and sterile plastic ones. Buy individually packaged pipets if you will use them infrequently, the more inexpensive bulk packages if you need pipets often.

Pipet aids. Since there is no mouth pipetting allowed, you need a tool to provide suction. A bulb will work fine, but an automatic pipet aid is more dependable and is easier to use.

Sharpie marker. Keep only one on your bench at a time, with your name on a piece of tape around the barrel; otherwise, you'll never find one when you need it.

Squeeze bottles. One should contain distilled water, for filling balance tubes, etc., and one should contain 70% ethanol for disinfecting tubes, spills, and cleaning the bench. Label every squeeze bottle with its contents.

Sterile microfuge tubes in a covered beaker or another autoclavable container. Have at least two containers filled with the size microfuge tube you will most often be using. The 1.5–1.7-ml and 0.5-ml sizes are the most popular.

Sterile tips in boxes for pipet aid. Although you can purchase prepacked tip boxes, many labs fill them manually. Always have three or four boxes of each size. Not all tips fit all pipettors, so check with the manufacturer of the pipettor (or someone in the lab) for the appropriate tips.

Tape for labeling. If you have plenty of bench space, set up a multiple tape dispenser on your bench so you have easy access to colored or white tape (for labeling reagent bottles), scotch tape (for protecting writing on microfuge tubes), autoclave tape (to put on *everything* you autoclave) and Biohazard and Radioactive label tape. If space is limited, keep a single roll of tape in a dispenser in a drawer.

Timer. Whether you are staining slides for 1 minute, or doing a 2-hour enzyme digestion, you should set a timer. Choose one that has multiple channels, so you can time two or three different procedures at once. Many timers have a magnet on the back, so they can attach to metal shelves, or a clip to allow them to be worn on your lab coat.

Tips/sharps disposal box. Pipet tips and pasteur pipets can pierce plastic bags and should be collected separately in another container. You could use a syringe and needle disposal box for all your sharps, or use a small bag in a holder or beaker

to collect them. Check with Laboratory Safety to find out what they recommend (and, perhaps, dispense) for needles and syringes and for other sharps.

Vortex. Usually comes with the bench. An adapter for multiple tubes is available for many models and is very useful.

Pipets, Pipettors, and Pipet Aids

Pipettors

There are dozens of pipettors, so you can find one exactly suited to your particular need. Some have one button for picking up and dispensing samples, and for ejecting tips: Others have separate buttons for each function. Some can be calibrated in the lab, and others must be calibrated professionally. Many can be autoclaved and are ideal for pathogenic organisms.

For most pipettors, the button must be pushed twice to release the contents of the tips. Push until you meet resistance, and then gently push again. This final push expels the last bit of volume, along with some air, and must be done as gently as possible to avoid creating aerosols.

In addition to the specificity offered through the range of pipettors, flexibility is also given through the wide choice of available tips. Tip extenders allow pipettors to be used in tissue culture, giving the sterile tip access into flasks and jars. Long, flattened tips are made for loading sequencing gels. Other tips have filters that prevent carryover from one sample to another, and are excellent for PCR, infectious, and radioactive samples.

Adjustable volume pipettor. Good benchtop pipettors, ideal for a variety of pipetting tasks.

Electronic pipettor. Can be programmed to dispense a set of volumes, and to do dilutions.

Fixed volume pipettor. Fixed pipettors are good as dedicated instruments for particular assays, where the same volume must always be dispensed.

Multichannel pipettor. Constructed to dispense several samples at the same time. They are usually built and used for microplates, with 4, 8, or 12 dispensing outlets. They may be fixed, variable, or repeater dispensers.

Positive displacement pipettor. With a positive displacement mechanism, air space between liquid and plunger is eliminated. These pipettors are extremely accurate, as sample volumes are unaffected by surface tension, viscosity, vapor pressure, or density. Especially coupled with filtered tips, positive displacement pipettors are ideal for PCR, radioactive, and biohazard samples, because there is no aerosol production or sample carryover.

Repeater pipettor. For repetitive dispensing. Dispenses multiple samples without refilling, from an attached reservoir. The reservoir may be an attached syringe or bot-

tle, or may pump from any container through tubing attached to the pipettor. It can be a single-channel or multichannel pipet and may dispense fixed or adjustable volumes.

Pipets

Capillary pipets (also known as micropipets). Small glass tubes that load microliter volumes by capillary action or with bulb suction. Use for samples for thin-layer chromatography, PCR, or electrophoresis.

Measuring pipets. Similar in style and usage to serological pipets, but with a smaller tip opening.

Pasteur pipet. Glass, different kinds and lengths of tips. Good for filling balancing tubes for centrifugation, removing and transferring liquids. Can be plugged with cotton. Often used by being attached to tubing for vacuum aspiration.

Serological pipets. These are your standard, everyday pipets. For most purposes, they are identical to measuring pipets. Glass or plastic, reusable or disposable, plugged or unplugged, single-wrapped, bulk-wrapped, or package-your-own—there are many sizes and options. Glass pipets are needed for organic solvents, and sterile, usually plastic, pipets for tissue culture. Each lab has its own system of choosing and dealing with pipets. Most pipets are made to deliver (marked T.D., to deliver, on the top of the pipet; also marked by double rings) the chosen volume when the fluid is released entirely from the pipet. Other pipets (marked T.C., to contain) are made to release the chosen volume only when the fluid is released to a measured point.

Transfer pipet. Plastic, disposable. With built in pipet bulb. Ideal for filling balancing tubes for centrifugation, or for transferring cells or substances that might stick to glass.

Volumetric pipet. Calibrated to deliver one specified volume. It is not particularly useful in most labs.

Pipet Aids

Pipet aids provide manual suction and are used for ordinary pipets, glass or plastic. They are also used with pasteur pipets, but working with short pipets such as pasteurs may result in fluid uptake into the pipet aid.

Bulb, or pipet filler. Bulbs are chemically resistant, and are a low-tech and useful supply to have around a hood. To pipet, first expel air by squeezing valve "1" (or "A," for aspirate) above the bulb. Then draw liquid up by pressing valve "2" (or "S," for suction) on the stem. To release, press valve "3" ("E," for exhaust) on the side of the stem.

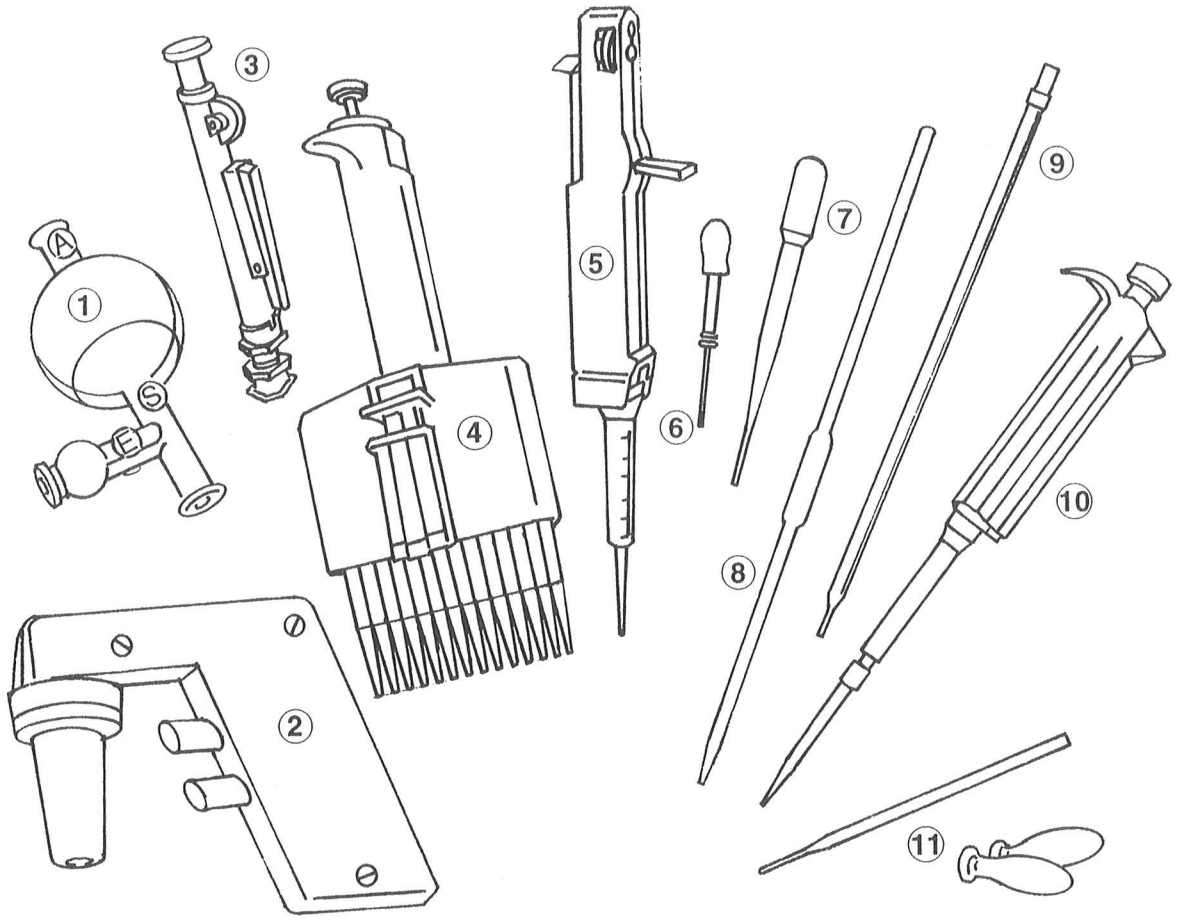

FIGURE 2.

Dozens of pipets, pipettors, and pipet aids are available for benchwork. Only a few examples are shown here. **Key:** (1) *bulb (pipet filler),* (2) *pipet-aid,* (3) *pipet pump,* (4) *multichannel pipettor,* (5) *repeater pipettor,* (6) *capillary pipet with bulb,* (7) *transfer pipet,* (8) *volumetric pipet,* (9) *measuring pipet,* (10) *fixed volume pipet,* (11) *pasteur pipet, bulb for pasteur pipet.*

Pipet-aid. Attaches to glass or plastic pipets of 1 to 100 ml, handles volumes of 0.1 ml to 100 ml. Filter in tissue culture nose provides protection of electronic components and prevents cross-contamination. Comes with attached power supply or with built-in portable rechargeable power supply.

Pipet pump. Manual, safe, and accurate one-handed pipeting done by rotation of the thumb wheel. For rapid release of the pipet's contents, press the plunger or the quick release bar available for many models.

Setting up an aspirator. An aspirator is used for removing supernatants, something routinely done in most laboratories. You should have one dedicated for aqueous, nonradioactive material, and you will probably have to assemble it yourself.

You will need:

House vacuum or pump. House vacuum is preferable, since it doesn't require maintenance.

Two 1- or 2-liter filtration/vacuum flasks. To prevent liquids from being pulled up into a pump or house vacuum line, set up two flasks in tandem: The second flask will take any accidental or careless overflow from the first flask.

Vacuum tubing. Tygon vacuum tubing of I.D. (inner diameter) 1/4″ or 5/16″, O.D. (outer diameter) 1/2″ or 9/16″, and wall measurement 1/16″ or 1/8″.

Rubber stopper, with hole. At least 2 cm of stopper should stick out, so the stopper can easily be removed for frequent cleaning. There is a sizing chart in most catalogs. Stoppers can be purchased with or without a hole already present: Unless you really feel like boring a hole, purchase one already bored.

Most of the components for assembling an aspirator will be available either in the lab itself, or in the institutional store. If not, all of the materials can be purchased from one of the large catalog companies.

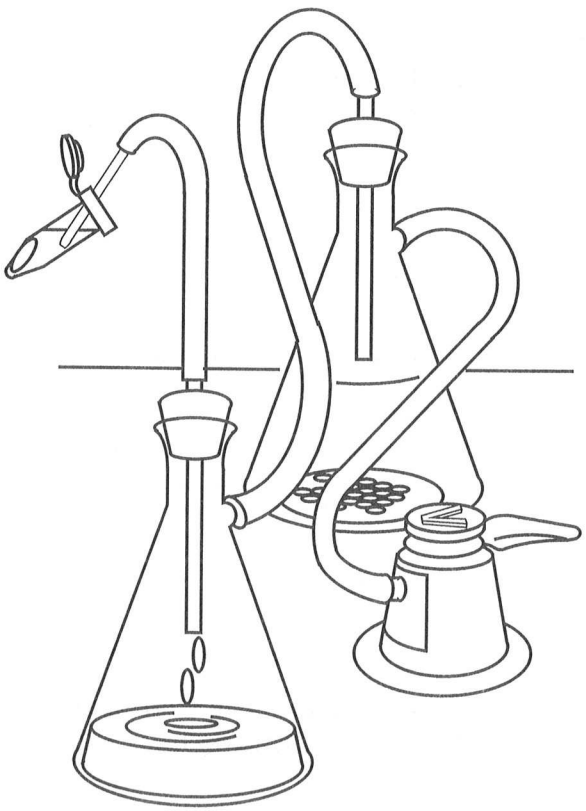

FIGURE 3.

Benchtop aspirator, connected to house vacuum line. (Reprinted, with permission, from Sambrook et al. 1989.)

Glass pipet or hollow glass rod to fit in stopper. Use a thick-walled hollow glass rod. Don't use pipets or pasteur pipets. Pipets are so long that you will not be able to fill the flask as high as you could with a shorter (6–8 inch) glass rod. Pasteur pipets are too short, and are so fragile that they could easily shatter during insertion into the stopper.

0.45-micron filter. In a biosafety cabinet flask setup, this is necessary to prevent aspiration of biohazard material into the vacuum line. If you plan to aspirate bacteria or cells, incorporate one into bench aspiration setup (see Chapter 8).

See "Bench maintenance" for upkeep advice and Chapter 9 for the use of an aspirator to remove supernatants.

Bench maintenance

Daily
Make sure your "experimental space" is completely clear.
Wipe down the bench at the end of each day with a mild detergent or 70% ethanol, or change the bench paper if it is soiled.
Dump your ice and rinse out your ice bucket.

Weekly
Replenish microfuge tubes, tips.
Dump all biohazard waste.

As needed
Get a new sharps disposal box and deal with the old one as the department requests.

Aspirator
Clean the primary flask regularly, even if you use it infrequently: The fluid may evaporate and leave an impossible-to-clean residue. If you use the suction apparatus often, clean it daily. The method of cleaning will depend on the contents.

- Nonhazardous and nonbiological substances, such as buffers, can be dumped down the drain while the water is running. Rinse the flask several times.
- Biohazard fluid (yes, this includes supernatants from *E. coli*) must be disinfected before disposal. Pour a volume of bleach that is approximately 10% of the volume of the flask fluid into the flask. Swirl gently and let the flask sit for 30 minutes, then pour the contents into the sink while the

water is running. Allow the water to run a minute after you have poured the fluid away, and avoid breathing the fumes. Rinse the flask several times.

- Solvents and hazardous substances, including phenol, must be disposed of according to the institution's safety rules. Contact EHS or your laboratory safety officer.

If you are using and cleaning the suction apparatus often, add the bleach to the clean flask before you replace it on the bench.

Biohazard trash disposal

Biohazard waste must usually be double-bagged, and only certain bags are acceptable at each institution. It must be autoclaved before disposal in regular trash, and this may be an individual, lab, or institutional responsibility.

Tip boxes

Tips can be purchased already sterilized, but it is cheaper to buy tips in bulk and load them into tip boxes. Always wear gloves when you do this, to prevent leaving oil from your skin on the tips. After loading, put a piece of autoclave tape on the box and date it. Autoclave the boxes for 15 minutes.

Some boxes come as towers, with one box on top of the other. Do not stab wildly at the box when getting a tip: If you are a little off center, the entire tower can hit the ground and fall apart.

Microfuge tubes

Like tip boxes, microfuge tubes can be purchased as sterile tubes, or can be autoclaved after being placed in a beaker or receptacle. Don't cap the tubes before autoclaving. Remove tubes by gently shaking the container onto the bench or with a forceps: Never use an ungloved hand to prowl around the container.

Pipet aid

Although some pipet aids are connected to a power source or have batteries, most must be recharged by being plugged in several hours to a power source. When you feel the pipet aid becoming less efficient at pulling liquids, first check to see whether there is a cotton plug from a pipet stuck in the nosepiece. If there is, pull it out with a tweezers. A filter inside the pipet aid prevents aspiration of fluid into the body of the pipet aid. The filter may have gotten wet and need to be replaced. Snap open the nosepiece to check the filter and replace it, if necessary. Order a few filters to keep at your bench. If there is no physical blockage, plug the pipet aid in overnight to recharge.

Pipettors
Pipettors need to be calibrated every few months to a year, depending on the usage. Be aware of the amount in the tip when you are working: You may notice a change in the volume or the feel of the pipettor as it is aspirating. Test the accuracy of the pipettor every few weeks by comparing volumes with a new or newly calibrated pipettor. Some pipettors can be calibrated at the bench, others must be sent away for a check-up. The pipettor must be completely clean and free of radioactivity before it is sent.

Water baths
Change the water if it looks discolored or starts to smell. You could add an antibacterial agent to the water, but it isn't necessary. Use only distilled water in the bath. To prevent evaporation, either use a cover or keep the surface covered with ping pong balls.

SETTING UP A COMMAND CENTER

Most of the research you need to do will be accomplished not at the bench, but at the desk and computer, as you organize information, think, read, and analyze data. Your desk should not merely be the place where you keep your lab notebook and phone numbers. It should be a refuge and a resource, and a powerful place from which you control the direction of your research.

The Desk

It is very convenient to have a desk beside your lab bench. You can monitor experiments while you read, and have a clean place to record experiments in your lab book as you go along. The desk is usually small, and it is good to keep most items in drawers and on the shelves, to keep the desk space clear. Good organization may be all the edge you will have over other scientists, and it starts at your desk.

Bookshelves above the desk are good for library and reference books, journals, and for stacks of papers. Do not keep any chemical or lab equipment here.

One of the drawers should be dedicated to storing papers and articles. If there are no suitable drawers, it is often possible to fit a small file cabinet under or next to the desk.

Another drawer should have a lock. Personal valuables and sensitive data could be kept here, locked. Backpacks, purses, and checkbooks can disappear from the most apparently secure laboratory.

If radioactive work is done on the bench right beside the desk, a plastic shield or plate should be set up between the desk and the bench.

Desk essentials

Calculator. You may have a calculator on the computer, but you need an always reachable one. In some labs you must provide your own calculator.
Calendar/memo book (organizer). This could be the secret to your happiness. Choose whatever format works, but you should have room to record seminars, appointments, ideas, and experiment plans. See pages 59 and 63.
Formatted computer disks. You must always be ready to save files onto a disk, sometimes in a terrific hurry.
Lab notebook. Book or sheets, see Chapter 5.
Paper or notebook to record protocols, freezer contents, etc.
Post-Its. Invaluable for marking sections of books or journals, or leaving notes.
Pencils. Useful for writing on microscope slides, because the marks don't wash off with ethanol or methanol.
Pens. Never be lacking a pen within reach. Use a pen, never pencil, for recording of all data.
Ruler. Clear plastic, for measuring bands on gels, and drawing lines on graphs.
Scotch tape. After writing on tubes with marker, cover with a piece of tape to prevent smudging. Also used for attaching data sheets into your notebook.
Trays. You should have two or three trays to use to organize papers.

Dealing with Papers and Other Stuff

- **All the information at your desk should be accessible within 5 minutes.** Time is too precious to spend finding a method you saw in a paper last week, or trying to figure out if this week's or last week's seminar is the one you shouldn't miss.

  If you aren't vigilant, you could quickly have a desk covered with papers that you will not look at and which will eventually become outdated. Then you can rationalize the afternoon it takes to throw them all away, and feel you accomplished something. You haven't.

> Neither neatness nor sloppiness is the key to paper management, nor is quantity the root cause of a paper glut. The real cause of a paperwork crisis is a problem with decision making: picking up the same piece of paper five times and putting it down again because you can't decide what to do with it.
>
> *The Organized Executive*, pp 35–36.

The research business is about information, and you need to keep your information...well, informative. And the only way to do this is to:

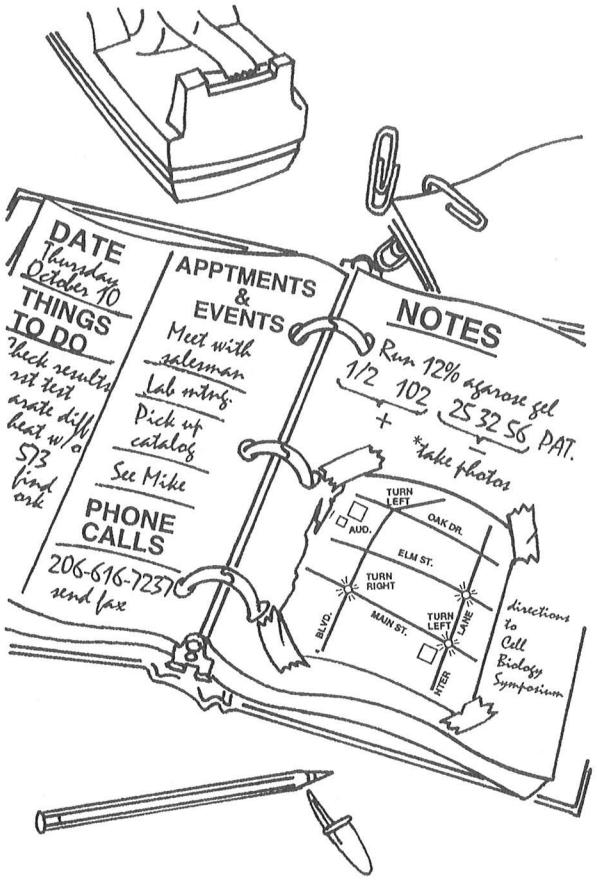

FIGURE 4.

Use the organizer and appointment book to record conversations and planned experiments, as well as seminars and meetings

- **Avoid letting a piece of paper touch your hand more than once.** Deal with each bit of information as soon as you receive it.
- **Establish a filing system.** All the information you have must be either visible or easily found. Some suggested tools are:

  Organizer/appointment book. A large book in which you can record appointments, things-to-do, phone numbers and E-mail addresses, seminar times and meetings. This is vital. You should only have one such book, and put temporary notes in a notebook or a Post-It. You can use a computer program, but only if you have sole use of a computer and only if that is the only organizer you use.

  File cabinet. You will need to have files for journal articles, personal papers (insurance, CV, letters), your reprints, and data (films and sheets that don't fit in your lab book).

The only papers you should keep on file are papers with methods you need, important papers relevant to your project, and papers that are difficult to obtain. Most papers are easily available in a library or on-line. A good solution is a literature management program on the computer: You can record the reference and write a summary of the paper.

Trays for the desktop. Two trays will be fine. One is for incoming papers, yet to be dealt with. The other is for papers that will be handled later. This can be divided by folders into topics—you could have one folder for reprint requests, one for phone calls that must be returned, one for papers you want to read before filing.

- **Set up a regular routine** for dealing with papers and things to do, a routine that is part of a larger routine. (Other tasks that you should set aside time for are reviewing data and keeping up with the scientific literature, both of which are discussed in later chapters.) Consolidate tasks and time as much as possible: Open mail once a day, deal with plasmid requests once a week, look up articles every Wednesday.

- There are only a **few choices** to make for each piece of information. You can: Toss it immediately, file it, act on it, or a combination of the above. Some things cannot be physically dealt with immediately, but should be relegated to a pile to be handled later. For example, you may want to file all the scientific literature you receive daily in a "To read" file. Either set a regular time for your reading, or set a time limit for how long a paper can remain unread. Don't ever let this pile get too big.

Examples of paper triage: Daily mail.

The institution's weekly seminar list. Read the list, decide which seminars you will go to, and write the topic, speaker, and time on your calendar. Don't hang it up, or keep it for reference. Toss it.

An introductory offer for a new journal. Do you want the journal? Will you really read it, can you afford it? Decide now. If you don't want it, toss the paper. (If you change your mind you will always be able to find a phone number for the journal, really.) If you do want it, fill in the form and mail it.

Reprint request. If there are only a few of these trickling in, deal with it immediately. Give it (graciously) to the secretary if it is her job to mail requests, or mail the reprint yourself. If you receive many requests, put the request aside and deal with all requests every 2 weeks.

- **Experiments always take priority,** and there will be times when the most carefully organized system grinds to a halt because there is simply no time to do anything but benchwork. Do the experiments and try to resume control as soon as you can.

Using the Computer

The lab computer is not a luxury, but is indispensable for writing, researching, and communication. You must have access to a computer for (at the very least) word processing and literature searches. Checking out the computer situation should be one of your priorities during your first week in the lab (see Chapter 1).

If you don't know how to use a computer, or are confused about an application, contact the institution's computer service department. Take any available relevant computer courses offered at your institution. It will require what will seem to be an extravagant investment (a day or two) but it will save you hours and hours of time.

Word processing

A word processing program is used for text composition and manipulation. Even if you like to write with a number two pencil on a yellow legal pad, the information will ultimately have to find itself on a disk for editing, printing, sending, and sometimes, journal submission.

If computer access is a terrible problem, composing may have to be done first on paper, but the more you can compose on the keyboard, the more time you will save.

Word processing programs now come with spelling and grammar checks, table-making and graphing capacity. More importantly, these programs can work with bibliographic, spreadsheet, and database software, and information from other applications can be integrated into manuscripts and presentations.

Find out which word processing program is used by the laboratory and the department, and use that program. Don't hang onto your old program: If you ever need help from the secretary on a grant or manuscript, you'd better be using the program he or she is used to. Most programs are similar enough that it should take less than a day to become quite proficient with a new program.

You must be sure your programs will work together: One way to do this is to use a package of related software from the same manufacturer.

Bibliographic management

Especially in your early days in the lab, papers and lists of papers you have read or intend to read will accumulate rapidly. A bibliographic management program will help you control this pile by numbering and organizing your references. You can retrieve references by keyword, author, or journal, making it easy to find a particular paper or to make a list of references about a particular topic. This also means that you don't need to keep as many papers, since you can enter a summary or notes into the reference.

You must be sure that your bibliographic management program can work with your word processing program. Although you can enter all your references manually, it is wonderful to have your reference management program be able to cooperate with reference update programs and all library search programs you use.

The list of references you call up for a manuscript can be formatted in any journal style. And if you redo the paper for another journal, reformatting the references will take a few keystrokes.

References from Medline and other sites, as well as from compatible literature update programs, can be directly downloaded into the bibliographic program.

Internet access

This is not optional. Find out how to get on line from your institution's computer center: There will probably be a form you must fill out, and a password you must apply for. Find out how you can log on at home, using your work account number.

E-mail enables you to keep in contact with colleagues all over the world. You can send manuscripts to collaborators, scan in data and send it to another lab. And yes, you can say hi to your mom. You may need an E-mail password and account, in addition to your on-line account. If you share a computer with other lab members, be sure you have your own password and directory for your own E-mail.

Journals can be found on line. Most free journal web sites only show the Table of Contents and abstracts of the articles, but this is terrific for browsing; the full article is available at some sites.

Literature searches can be done on-line. You can search libraries and databases. Medline, the database of the National Library of Medicine (NLM), is now free, and it is available at any number of sites in addition to the NLM. There are other databases, but Medline will be the most useful

Newsgroups allow you to post questions to technical questions, and to read the answers or participate in a posted "discussion" of the topic on line. If you want ideas on the best electroporator available, or want advice on a particular protocol, ask the question of the appropriate group. You can find a list of groups by searching the Web by key word, or by going to one of the several sites listed at the end of the chapter. Listserv sites also allow you to post questions, but this, and the answers, are sent by E-mail.

Technical literature is available at the Web sites of most companies. This information may not just pertain to the company's products, but also to related basic research.

Literature update programs

Several programs will send you a weekly disk with hundreds of biological journal titles, and sometimes, abstracts, listed. With a saved search strategy, usually by keyword and/or authors, you can search the journals and import the references to your reference management program if the programs are compatible. The alternative to a literature update program is a regular search of the current literature with the same keywords.

Data collection and organization

You can enter your data in a spreadsheet program (for calculations) or in a database (for organization and retrieval). Many instruments, such as beta counters and fraction collectors, are hooked directly to computers with programs that can collect and analyze data. In this case, compatibility with your word processing programs is not likely to be a priority, or even a possibility. However, many programs will be standard and will mesh with your other programs.

Graphics

There are dedicated graphic programs that allow you to enter data and draw a variety of graphs and tables. Data can easily be added or removed, and the graph redrawn. Simple graphics can be done by many word processing, spreadsheet, and data base programs, as well as by drawing and presentation programs.

Presentation programs

Presentation programs are useful for making slides for seminars, but not as useful for illustrations for publications. Text, graphs, and tables are artistically rendered, and can be presented as a slide show on the computer, be printed (and later photographed), or be made directly into slides through a photo or computer department with the appropriate software.

Specialized software

There are software programs that perform a variety of mathematical and theoretical functions, such as designing primers for PCR (see Chapter 12) or modeling protein structure. Unless the lab has a program running, or you are very familiar with a program, don't make a big investment learning a new program now.

Organization and scheduling

Only if you have unlimited access to a computer should you think of using a personal organizer. An organizer and calendar will keep track of and notify you when seminars are and when cells are ready for harvesting: It will keep your phone numbers and dial the phone for you. But you have to use the computer program consistently for it to be worthwhile having it.

You should only have one system of schedule organization. It is almost impossible to use both a computer program and an appointment book to keep track of daily affairs.

Scanner and scanner software

Pictures, text, data, and documents can be scanned into your computer. You can then incorporate the scanned images into your own programs, where you can manipulate them and/or send them by E-mail or over the Internet to other researchers. For example, gels can be scanned in and art or presentation software used to label the lanes and make figures or slides.

Basic Rules for Computer Use

- **Check which computers you can use.** People are very possessive about their computers, and the sight of someone pumping potentially virus-ridden disks into a computer without asking permission can be absolutely infuriating. If there aren't enough computers in the lab, find out if there are departmental computers for you to use. Also check the institutional computing center for available computers.

- **Never use a computer if it is obvious that someone is in the middle of something.** You could lose all of that person's work if they haven't saved it. And the corollary to this, of course, is:

- **Always exit from the program you are working in before you leave the computer.** This makes it clear to other people that the computer is available. It also lessens the chance that someone will (1) read private documents, (2) inadvertently lose your data, or (3) load too many programs and crash the computer.

> *Turning the computer off while it is reading from or writing to a disk may damage the disk, the hard drive, or both. Be sure the drive indicator lights are off.*

- **Save, save, save.** Save into two places: to a floppy disk, and onto a hard drive. If you save onto a shared hard drive, be sure you have a directory set up to receive your files (for example, ... /yourname/manuscript3). If you have a document that is confidential, save it only to a floppy or your removable hard drive.

- **Check all downloaded software and data, and all floppy disks, for viruses.** The computer should have a virus-check program (if it doesn't, you should get one through computing services) that checks the computer upon start-up and can be used to check every disk put in and every downloaded piece of information. Download only into a temporary directory, check for viruses, and only then, transfer the information to where you want it.

- **Exit all programs before turning off the computer.** The computer should be turned off at night, although relatively harmless custom in some labs dictates that the computer is always left on.

- **Turn on the computer before the monitor: Turn off the monitor before the computer.**
- **No game playing or WWW cruising when someone may need the computer.** Work use always comes first.
- **Don't put floppies into the computer until the computer has been turned on and booted.** In some systems the computer will try to boot from the floppy, usually no big deal, but it is delay.
- **Do not erase or delete anything from the computer, unless it is your files or data.** If the hard drive is getting full, make an announcement to everyone to remove unneeded files or to copy them to another venue. Never remove *anything* without checking with everyone and giving plenty of advance warning!
- **A password is needed for Internet access. Apply for one** (check with the departmental office for the procedure) **and never give it to anyone.** Some programs and computers also require passwords, and these are unlikely to be the same as your Internet access number.
- **Don't eat or drink while working at the computer.** At the least, the keyboard will be sticky. Don't forget that there is no food or drink allowed in the lab.
- **Don't expose your disks or the computer to magnetic fields,** such as the field generated by large stereo speakers. Info on disks is stored magnetically and too close proximity to a magnet can erase the disk.

If you spill a drink into the keyboard, turn the computer off immediately and unplug the keyboard. Get as much liquid out as possible and leave the keyboard to dry overnight before you plug it back in.

Before you panic:
Save your work, if you can.
Check all cables.
Make sure there is power.

RESOURCES

Biochemical Resources
Tel (517) 381-8269
http://biores.com (This web site is a database of chemicals, biochemicals, laboratory products, and services that can be searched.)

BioMedNet, "The World Wide Club for the Biological and Medical Community"
http://biomed.net.com (Medline is available through this site, as well as discussion groups, a job exchange, and *HMS Beagle*, a science magazine.)

BioSupplyNet source book, BioSupplyNet, Inc., 10 Skyline Drive, Plainview, New York 11803
Phone: (516) 349-5595
Fax: (516) 349-5598
http://www.biosupplynet.com (The BioSupplyNet Source Book is a comprehensive directory of biomedical research supplies and equipment. The web site allows you to search by key words for product names or categories.)

BioTechniques Home Page
http://www.biotechniques.com (A library of techniques, a buyer's guide, and connections to many biological research sites.)

Glossary of microbiology. 1997. T. Chen.
http://www.hardlink.com/~tsute/glossary/index/html/

Guide to the Internet. Trends. 1997. Elsevier Science, Cambridge, United Kingdom.
http://www.elsevier.com/lcate/trendsguidev (A booklet describing how to use the Internet to find scientific information.)

Hancock, L. 1996. *Physician's guide to the Internet.* Lippincott-Raven Publishers, New York.

Horton, R.M. 1996. Using newsgroups: Virtual conferences on specialized topics. *BioTechniques* **20**: 62–64.

Medsite Navigator, Medsight Navigator and Medsite.
http://www.medsitenavigator.com/ (Tries to integrate and group related medical and science sites together to promote the easy exchange of information. Links to Newsgroups, journals, Internet searches, and Medline.)

National Institutes of Health (NIH)
http://www.nih.gov/science/journals/ (Pointers to on-line journals are available through many web sites. A comprehensive list can be found through the NIH site.)

Newsgroups, Tips and Techniques.
http://genome.eerie.fr/bioscience/services/biolnew.html (An extensive list, with links to many biological newsgroups.)

Sambrook J., Fritsch E.F., and Maniatis T. 1989. *Molecular cloning. A laboratory manual.* 2nd edition. Cold Spring Harbor Laboratory Press, Cold Spring Harbor, New York.

SciQuest, Research Triangle Park, North Carolina 27709-2156
Phone: (919) 786-1770
Fax: (919) 782-3128
http://www.sciquest.com/catalyst/welcome.cgi (This web site also allows searches by key words, and automatic requests of chosen vendors.)

United States National Library of Medicine (NLM)
http://www.nlm.nih.gov

Medline
http://www.nlm.nih.gov/databases/medline.html (Medline can be accessed in several ways at this site. Once found, papers can be ordered through Loansome Doc, a service which can deliver documents to your library.)

Winston, S. 1983. *The organized executive. New ways to manage time, paper, and people.* Warner Books, New York.