



Figure 9.5. I Know I Left My Experiment Here Somewhere.

The laboratory or a nearby area must be equipped with basic safety items such as fire extinguishers and fire alarms, first aid kits, chemical spill kits, a safety shower, and an eye wash station. Each worker needs to know the evacuation plan for the laboratory and the location of emergency telephone numbers and procedures. Remember that most accidents happen very quickly; there is usually no time for carefully planning a response after the accident occurs. This is the reason that emergency procedures need to be understood and practiced in advance.

Laboratory accidents, no matter how minor, must be reported as soon as possible after the occurrence. There is a natural tendency for many people to cover up minor accidents, such as cuts or spills, either from embarrassment, a dread of paperwork, or concerns about being blamed for the incident; however, these are not adequate excuses for secrecy. Accident reporting is a legal requirement and is also essential in order to prevent repeated problems. There are numerous studies that show that people learn to avoid accidents by being informed about other accidents, as well as near misses. If you are injured on the job and require medical treatment, you need to fill out a workers' compensation form. **Workers' compensation** is a no-fault state insurance system designed to pay for the medical expenses of workers who are injured on the job, or develop work-related medical problems. It provides a mechanism for your employer to pay for your medical treatments without the necessity of a lawsuit.

## D. Personal Responsibility

### i. LABORATORY SAFETY AND COMMON COURTESY

Safety is a matter of personal responsibility for every individual who works in a laboratory. These environments are hazardous by nature, but the actual risk is determined to a large extent by the actions of individuals. It is essential to accept responsibility for yourself and those who work around you. We all have a ten-

Table 9.5. BASIC EMERGENCY PRECAUTIONS FOR THE LABORATORY

The following list provides some of the fundamental preparations that every laboratory should have in place for emergency situations.

- Everyone in the laboratory should be aware of basic emergency procedures.
- There should be at least one person trained in first aid and CPR present at all times.
- The first aid kit must be readily accessible and fully stocked.
- All required protective devices, such as fire extinguishers and eyewash stations, must be well marked and easily accessible.
- Emergency telephone numbers and instructions should be prominently posted by every telephone.
- Evacuation routes should be kept clear of boxes or clutter.

dency to assume that accidents happen to "other people," who are probably not as smart or careful as ourselves. The fact is, accidents are by definition unexpected and sudden, and they are frequently the result of multiple mistakes or oversights. Be aware at all times of situations that could be modified to provide a safer working environment and report any problems to a supervisor immediately. When in doubt about a situation, always ask someone with experience.

Good laboratory technique and consideration for co-workers are essential parts of laboratory safety. Proper labeling of all materials notifies co-workers of hazardous chemicals. Prompt cleanup of spills, reduction of clutter, and the return to storage of unused chemicals and equipment frees working space and reduces accidental spills and mistakes. Although you may deliberately choose to expose yourself to a known risk under some circumstances, it is inexcusable to expose others who have not made that choice.

It is important that you and each of your co-workers know how to respond to an emergency. Be familiar with the emergency procedures established for the laboratory and know what to do if you or a co-worker needs medical assistance. Acquaint yourself with basic first aid and the location of the first aid materials. Know where to find and how (and when) to use the fire extinguishers, and know the evacuation plan for the building in case of fire or other physical emergency (see the Case Study on p. 134).

One of the primary guidelines for behavior in the laboratory is often referred to as the "rule of reason," where an individual asks themselves how reasonable an action is in the current situation, see Figure 9.6 on p 142. Considering whether an action makes sense under the circumstances frequently suggests an appropriate course of action. When tempted to cut corners, think about what your opinion would be of a co-worker who did the same thing.



Figure 9.6. Inappropriate Laboratory Practices.

## ii. PERSONAL HYGIENE

This does not refer to bathing; rather, it refers to personal habits that may increase your risk of hazard exposure. Never eat, drink, smoke, chew gum, or apply cosmetics in a laboratory. Even though you are “not working with anything dangerous,” you can never be sure about other hazards in the immediate area. Never use the laboratory or your pockets to store food, beverages, or anything that will be consumed. If you do smoke (outside the laboratory, of course), be aware that cigarettes in open packs can absorb vapors from volatile chemicals. Develop the habit of washing your hands every time you move away from your lab bench, and at regular intervals while you are working.

Drink only from hall fountains. Water from laboratory faucets may not be **potable** (*suitable for human consumption*), due either to water quality or to contamination of the faucet with hazardous materials. For the same reasons, do not consume ice taken from laboratory machines. Even if you are certain that the ice is made from potable water, it is impossible to know exactly what types of containers may have come into contact with the ice. Avoid storing personal items such as coats in the laboratory, where they may become contaminated with hazardous materials.

Long hair must be tied back in the laboratory to prevent a variety of problems. Hair has an unfortunate tendency to fall forward, which can lead to chemical or biological contamination of the hair, or, even worse, ignition due to contact with an open flame. A greater danger that is not often considered is that most people with long hair frequently push the hair back from their faces without conscious thought, leading to potential skin and hair contamination with hazardous substances from a gloved hand. A related issue is the wearing of beards in laboratories where biological agents are used. Many microbiological standards warn against beards

because of the possibilities of experimental and personal contamination, and laboratory situations that require the use of fitted respirators may preclude beards entirely. This is an issue that is best judged in the individual situation.

Another somewhat controversial issue is the wearing of contact lenses in the laboratory. Many safety guidelines state that contact lenses should never be worn in the laboratory because of the danger of chemical splashes to the eye and an increased potential for eye damage in accidents. The American Chemical Society Committee on Chemical Safety, however, has concluded that contact lenses are suitable for most laboratory situations, as long as standard eye protection is used, and may actually provide some protection against injuries (*Chemical & Engineering News* 76 no. 22 [1998]: 6). The ACS recommendation has been accepted by OSHA. When wearing contact lenses in the lab, always wear eye protection gear, such as safety glasses or goggles. Never insert or remove contact lenses from your eyes in or near the laboratory. Do not adjust an uncomfortable lens with a possibly contaminated finger. Be sure that your co-workers are aware that you wear contact lenses, in case of an emergency. In case of eye contamination, lenses should be left in place and emergency workers notified of their presence.

## iii. WORK HABITS

Many laboratory accidents are the result of simple human carelessness, coupled with the fatigue and distractions that everyone experiences. The obvious prevention measure is to avoid working when tired or distracted, but this of course is not always practical advice. You can address this problem, however, by personally acknowledging your temporarily diminished state of attention, slowing down, and taking extra precautions. Take a few additional moments to plan what you are doing and anticipate any potential problems before they occur.

Do not work alone in the laboratory. Let your co-workers know if you will be in an isolated part of the building, such as a coldroom, for extended periods of time. It is a frequent temptation to finish experiments in the evening or on weekends when the lab is quiet, but this can be a dangerous strategy in the event of a serious accident (see the Case Study below).

### CASE STUDY

#### The Dangers of Working Alone

In 1994, a senior researcher at a major university nearly died while working alone at night. While performing a familiar procedure involving small solvent volumes, a distillation flask exploded, starting a fire. Because he was not wearing a lab coat, his shirt ignited. Even worse, a flying piece of glass severed a major artery in his arm. He collapsed from loss of blood and

shock before reaching the emergency phone. His life was saved because a colleague in a nearby office heard the fire alarm, called 911, and then performed first aid until the ambulance arrived. This university officially prohibited working alone in laboratories, but the prohibition was widely ignored. Following this incident, an enforced policy of using a “buddy system” for work at odd hours was developed. Each worker must have at least one co-worker in the immediate vicinity, in case of emergencies.

Another time for concern about hazards is when passing from the laboratory into public areas and back. Do not wear lab apparel from work, especially lab coat and gloves, into public areas. You may know that your hands and coat are uncontaminated by hazardous materials, but the people you encounter will not. If you do feel a need to wear a lab coat in public, keep a clean coat for this purpose (although this will not reassure the people who see you in the lab coat). Never wear safety gloves outside the laboratory and never handle common use items such as telephones, radios, or light switches while wearing gloves. This is an easy way to spread chemical or biological contamination. In labs where radioactive chemicals are used, radiation inspections specifically include checking door knobs, equipment controls, and laboratory desks for radioactive contamination.

If you must transport hazardous materials through public areas, handle them with one gloved hand, leaving the other hand ungloved for opening doors. Samples should be carried in sealed double containers, to prevent spills. Try not to hurry through halls and around corners, to avoid collisions with co-workers. Many experiments have ended up on the floor (or worse, on a person) because of sudden hallway encounters.

Table 9.6 provides a set of general guidelines for safe laboratory practices for the biotechnology worker.

### III. SAFETY TRAINING

#### A. Importance of a Safety Training Program

It is well documented that most injuries occur to workers with less than 2 years experience on the job. This points to the need for safety training programs aimed at all new employees. It is essential that all laboratory personnel participate in these programs because it is not possible to directly supervise lab work at every step.

Training program requirements originate with government agencies and are then applied throughout institutions. The execution of these programs requires the cooperation of both individual laboratories and the workers within them. The key aims of any safety training program are to allow workers to:

- understand the risks inherent in their jobs
- recognize their personal susceptibility to accidents

**Table 9.6. PERSONAL LABORATORY SAFETY PRACTICES**

- Be sure that you are informed about the hazards that you encounter in the laboratory.
- Be aware of emergency protocols.
- When in doubt about a hazardous material or a procedure, ask.
- Use personal protective wear such as lab coats and safety glasses at all times.
- Do not eat, drink, chew gum, or smoke in the laboratory.
- Avoid practical jokes or horseplay, which can unintentionally create a hazard.
- Use gloves whenever in doubt (see Chapter 10 for guidelines on proper use of gloves).
- Wash your hands regularly, regardless of whether your work requires gloves.
- Always wash your hands thoroughly before leaving the laboratory.
- Read the labels of chemicals and reagents carefully.
- Read procedures before performing them and visualize hazardous steps.
- Minimize use of sharp objects and be sure that you properly dispose of them.
- Clean up spills and pick up any dropped items promptly.
- Label everything clearly.
- Use a fume hood for any chemical or solvent that you can smell, that has known toxic properties, or that is unfamiliar to you.
- Record everything in your lab notebook.
- Always report accidents, however minor, immediately.

- learn about preventive measures that reduce the risk of accidents
- accept personal responsibility for accident prevention

Safety training is not just for new employees. Refresher courses should be available for more-experienced lab workers, allowing them to learn about new policies and resources, and practice safety skills that have not yet been needed.

#### B. Contents of a Training Program

It is important to remember that even though hazards are always present in the laboratory, the risks to human health can be controlled to some extent. A basic safety training program should answer two questions for each worker:

- What are the specific hazards of this job?
- How can I minimize risks to myself and others?