STUDY GUIDE: STUDENT PREPARATION FOR CHEM LAB

UC San Diego
CHEMISTRY & BIOCHEMISTRY TEACHING LABORATORIES

FALL 2015

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MISSION STATEMENT

The chemistry laboratory staff collaborates with faculty and teaching assistants to promote UC San Diego's mission of excellence in the areas of education, research and public service. We support the Department of Chemistry & Biochemistry to provide students with safe hands-on practice in experimental chemistry. We organize and prepare experiments so that students may learn the theories, methods, and instrumentation used in chemistry.

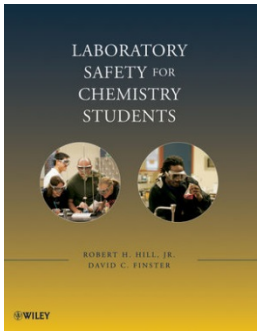
INTRODUCTION

A student planning to work in a chemistry laboratory needs to learn basic safety principles **before** beginning laboratory work. During laboratory work, students and professionals are expected to know:

- General laboratory and life safety principles.
- Specific laboratory policies and procedures for each lab or institution.

General safety practices apply to all laboratories, but procedures and policies vary from one institution (or lab) to another.

For general laboratory safety, read the assigned section in: ***LABORATORY SAFETY FOR CHEMISTRY STUDENTS*** (available to UC San Diego students without extra cost via the University Library).



- **CHEM 7L & 7LM** (General Chemistry Laboratory).
  Students need to be familiar with at least the introductory sections of each chapter in the text.
- **CHEM 43A** (Organic Chemistry Laboratory) **and above.**
  Students need to the study the introductory & intermediate sections of each chapter in the text.

This document outlines the policies of the **UC San Diego Chemistry & Biochemistry Teaching Labs** (the *CHEM Teaching Labs*) and coordinates with *LABORATORY SAFETY FOR CHEMISTRY STUDENTS* (see chapter headings). Follow the LABORATORY RULES and posted procedures. Specific information for instruments and equipment are taught in class as new procedures and instruments are introduced. Rules specific to an individual class are published in the class syllabus.

As you move on to other labs (as either a student or a professional), watch for differences between our procedures and those of your new lab.

LINKS are provided to many published resources, including the Department web pages and the Laboratory RULES.

Throughout the text, **TECHNIQUE** boxes give instructions on basic lab techniques that lab workers need to know. These techniques are reviewed in the last section.

TECHNIQUE – AVOID CONTAMINATION OF REAGENT SUPPLIES. DISPENSE CHEMICALS ONLY FROM BOTTLES. NEVER RETURN CHEMICALS TO SHARED BOTTLES.

STUDY QUESTIONS are provided at the end of each section – both here and in the text book. Use these as a check on your understanding and send us recommendations for improvements.

FEEDBACK. Comments, corrections and suggestion on this publication are welcome and valuable. Please help us improve by sending your comments.

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PRINCIPLES, ETHICS AND PRACTICES

This section supplements Chapter 1 in **LABORATORY SAFETY FOR CHEMISTRY STUDENTS** *by Robert H. Hill, Jr., and David C. Finster. John Wiley & Sons Inc., 2010.*

IN THIS SECTION:

Everyone Goes Home® is a slogan we learn from the US firefighters community, but it's a great motto for lab workers as well – nothing we learn or accomplish matters much if we don't all go home safely at the end of the day.

Our **LAB RULES** and the practices outlined here and in ***LABORATORY SAFETY FOR CHEMISTRY STUDENTS*** have been developed for safety – to assure that you go home safely. Remember that each organization or institution has its own set of rules; many will be the same or similar to ours, but check the local rules wherever you work.

Pay special attention to the rules concerning preparation and appropriate behavior. Arriving prepared allows each student a full benefit of the lab experience. Appropriate clothing (*see* **PERSONAL PROTECTIVE EQUIPMENT**) protects the body & feet from accidental contact with hazardous materials. **Students who arrive unprepared or inappropriately dressed will be dismissed**.

One theme that will recur throughout this text is that the hazardous properties of dangerous materials do not change with location. Strong acids remain corrosive to skin whether purchased at a lab supply company or a pool supply shop. Throughout your life, you will often be the person in a group who is best informed about hazardous materials. Share what you learn and advise your friends, family members and co-workers so that they too go home safely at the end of the day.

BASIC LAB PRACTICES

EATING, DRINKING, GUM CHEWING, AND SMOKING ARE FORBIDDEN in lab (to avoid chemical ingestion, excessive inhalation of harmful vapors and ignition sources). Food, drinks, and smoking materials (including chewing tobacco) are permitted only in securely closed containers well away from lab work areas. As of 2014, UC San Diego (along with all of the UC campuses) is smoke and tobacco-free.

Prudent practice. In any situation not covered by specific guidelines or the **LAB RULES**, the careful worker will ask "What would a prudent person do?" (*i.e.*, what would be the careful and sensible action?). Such "prudent practice" decisions save time, work and lives.

Arrive prepared. Understand the materials and equipment you will use in lab – contact your Instructor or TA for further information if the class materials provided are not clear. Know the hazard(s) of each substance in your work plan – list materials, hazards and the appropriate protection in your lab notebook as part of your pre-lab planning.

On **DAY ONE** and every day, bring to class:

- Chemical splash goggles;
- Long-sleeve, knee-length lab coat;
- Lab notebook & pen;
- Water-proof marker.

A laboratory is a workplace. The list of things not permitted in chemistry labs is long – begin with anything that might increase the chance of ingesting lab chemicals: eating, drinking, cooking, applying makeup, or smoking. Careful workers do not touch hands to their faces while working in lab. You know yourself best; make your own plan to take a break during the work period to remove goggles, get a drink or have a snack, if needed.

Attentive and serious behavior is expected at all times**;** rowdy or boisterous play – or pranks of any kind – will be cause for expulsion from lab.

Housekeeping. Store book bags and other extra materials away from work areas and off floors to protect them and to keep walkways clear. Keep work areas clear; store extra glassware and materials as soon as you finish with them, keeping only essential materials on the workbench.

- Clean your work area every day:
- Clean hood areas and benches at the end of each session.
- Check that all reagents and waste containers are securely closed.
- Clean lab benches with sponges; rinse well and squeeze dry for the next user.
- Except as directed by a supervisor, dry a clean surface or wet hands with cotton towels. Air dry the towel and reuse.
- See **EMERGENCY RESPONSE** for instructions on cleaning hazardous spills.
- Ask for staff advice if you're unsure how to clean something.

Handle hazardous materials with correct techniques. Your TA may instruct you in these techniques as well:

- **Bottles, stoppers and caps.** Keep supply bottles and waste containers tightly capped at all times between uses. After removing material from a container, replace the cap immediately, making sure to use the correct cap. Bottle caps and stoppers can contaminate a workbench or hood surface. Hold the cap while pouring – ask your TA to demonstrate this technique. If the bottle is awkward or too large, place the cap on a watch glass or weighing paper.
- **Never touch** hazardous chemicals with bare hands; use tools such as tongs and scoops.

- **Never remove** chemicals from the laboratories. Do not attach samples to lab reports or notebook pages. In addition to causing disposal problems, taking samples from lab creates the potential for an accidental exposure.
- **Anhydrous materials** (such as NaOH, $CaCl_2$, $MgSO_4$ or $NaSO_4$) absorb water from the air and MUST be kept tightly closed between uses. Left in the air, NaOH or KOH pellets will absorb moisture and produce a puddle of concentrated corrosive liquid on the work bench – a serious skin exposure hazard.
- Spills on inert surfaces (for spills on people, *see* **FIRST AID**). Regardless of how small, spills must be THOROUGHLY CLEANED (*see* **SPILL RESPONSE** for specific instructions).

Record all data immediately in the lab notebook. Any copying from temporary notes risks introducing errors in recorded data. Build this habit from the beginning: in a research lab, the dated and signed laboratory notebook may become evidence of priority in a discovery.

TECHNIQUE – AVOID CONTAMINATION OF REAGENT SUPPLIES. DISPENSE CHEMICALS ONLY FROM BOTTLES. NEVER RETURN CHEMICALS TO SHARED BOTTLES.

For a solid sample.

Pour an approximate amount into a small beaker or watch glass, then use a spatula to transfer what you need to your receiving container; return your container to the balance.

The excess material left can be given to another worker; dispose of any remaining excess in the 'excess reagent' container provided. Do not leave the excess unattended and do not return it to the supply bottle.

Transferring liquids.

- Use a pipette bulb (or other tool) to transfer liquids. If the bulb is contaminated, request assistance – an appropriate response will depend on the nature of the contamination.
- A dedicated dispensing pipette or syringe may be provided. Take care to keep the pipette with its bottle. Don't put any other pipette into a liquid reagent bottle.
- If no dedicated pipette is supplied, pour the approximate amount needed into a graduated cylinder or test tube (in a beaker), then pipette the sample into your flask.
- Never return unused material to a reagent bottle.

If a reagent spills down the outside of a bottle, rinse the bottle, collect the rinse solvent and transfer the rinse solvent immediately to an appropriate waste bottle. Your TA can help you identify the correct one.

- Cap the bottle tightly & hold it over a beaker.
- For inorganics, rinse the bottle with water.
- For organics, rinse the bottle with acetone.

TECHNIQUE – DILUTING CONCENTRATED CORROSIVES: POUR CONCENTRATED ACID (OR BASE) INTO WATER SLOWLY AND STIR WELL; THIS PROCEDURE AVOIDS LOCAL HEATING AND SPLATTERING OF THE CORROSIVE MATERIAL. THE REVERSE PROCEDURE (ADDING WATER) CAN CAUSE SERIOUS INJURY.

REMEMBER: ALWAYS ADD ACID.

Balances.

- Remember to calibrate and tare the balance – ask the TA for instruction for your lab's balances.
- Clean the balance area after each use.
- Never leave any solid or liquid in or around the balance area. Use the brush to clear the balance area.

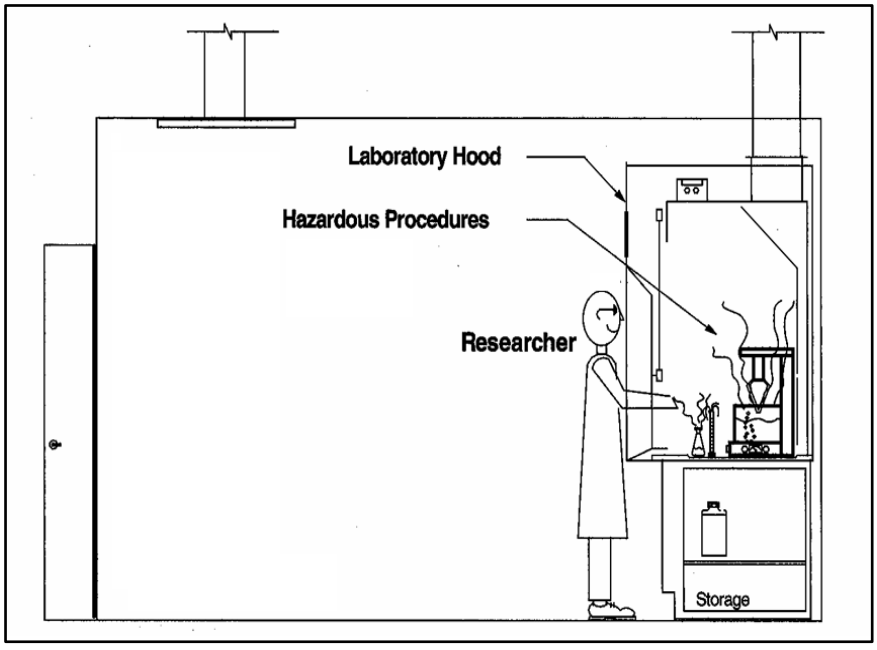
TECHNIQUE – MASSING SOLIDS: PLACE LOOSE MATERIALS (POWDERS & CRYSTALS) IN A CONTAINER - NOT DIRECTLY ON BALANCE PANS. SELECT SMOOTH PAPER OR A SMALL BEAKER, ACCORDING TO THE SIZE OF THE SAMPLE NEEDED. REMOVE THE CONTAINER FROM THE BALANCE TO ADD LOOSE MATERIAL; RETURN IT TO THE BALANCE AND RECORD THE MASS IN YOUR NOTEBOOK.

Waste disposal.

- Each exercise in the Teaching Labs has specific instructions about waste handling and disposal.
- Unless you have specific instructions to "dispose to drains," assume all experimental wastes are hazardous; look for appropriate waste containers.
- Each **hazardous waste container** has a clear description of the material(s) it should contain. Put waste materials in the correct container.
- Note the **maximum fill** line for each container. NEVER FILL THE BOTTLE ABOVE 90% of the container volume.
- For a **full waste bottle**, close it & leave it in its tray.
  Request a replacement waste bottle from the Stockroom (YORK 3150, NSB1104, or TATA 3304).

Laboratory hoods.

The vented laboratory hoods provided in the Teaching Labs are an integral part of the air handling system (see **ENGINEERED CONTROLS**). Hoods provide a safe work area for volatile hazardous materials. Air flows into the hood through and around the face frame and carries vapors and fumes out of the laboratory. Work in a hood when handling volatile materials that are toxic, corrosive, flammable or odorous.



Recommended video instruction: This excellent animated short (about 8 min.) explains the parts and functions of a chemical hood: Chemical Fume Hood: How it Works to Protect You. Available in English, French, Russian, Spanish and German. Another good video, from UC Berkeley Environment Health & Safety, is Proper Use of a Fume Hood.

LABORATORY REGULATIONS (aka THE LAB RULES)

Prepare carefully. Attentive and considerate behavior is expected at all times. Maintain clean laboratory benches and common areas. Clean your own work area and any common areas assigned to you.

EATING, DRINKING, GUM CHEWING, AND SMOKING ARE FORBIDDEN in lab (to avoid chemical ingestion, excessive inhalation of harmful vapors, and ignition sources). Food, drinks, and smoking materials (including chewing tobacco) should be left outside the lab or stored in securely closed containers away from lab work areas.

PREPARE & PROTECT YOURSELF

The minimum level of safety protection needed in the Teaching Labs is safety eyewear, long pants, closed shoes, and long lab coat. Students who arrive unprepared or inappropriately dressed may be dismissed until ready to work.

SAFETY EYE PROTECTION: [Note: this is the Department rule; individual Instructors may use a more restrictive rule (*e.g.,* goggles only).] Safety Eye Protection must be worn by everyone when anyone in the lab works with glassware or chemicals. All students, faculty, staff, and visitors are required to wear approved splash goggles or safety glasses, in addition to any prescription glasses.

Chemical splash goggles are required whenever anyone is transferring more than a small amount (~25 mL) of a hazardous material or when performing any operation involving a splash hazard. Safety glasses are designed for use in normal laboratory operations but offer only minimal splash protection.

Approved goggles and glasses. Chemical splash **goggles** (close fitting & indirectly vented) are required for some classes – check the syllabus. With prescription glasses, choose **safety glasses or goggles** designed to fit over glasses. For goggles from other labs/schools/activities, check with Safety Coordinator or Instructor. The Teaching Labs Stockrooms are not equipped to lend or sell goggles

Additional eye and face protection (*e.g.,* full-face shields) are available and used as directed by the experimental procedure or the lab supervisor. Always be sure to use proper eye protection with ultraviolet (UV) lamps and lasers.

Contact lenses: Worn with **safety eyewear** (required for everyone), contact lens wear is acceptable. The current understanding is that using contact lenses in lab creates no *additional* hazard.

APPROPRIATE CLOTHING: Lab Coats, Long Pants and Closed Shoes are required. Choose sturdy **shoes** that cover the whole foot and protect from spills and broken glass. Wear a **knee-length, long sleeve lab coat** closed to protect skin & clothing. Coat sleeves must cover arms & shirts. Wear **long pants** (or equivalent) that extend to the tops of your shoes to protect from spills & splash. *University policy does not consider leggings, tights or hosiery as pants (or equivalent) for laboratory spill and splash protection purposes.* Furthermore, no skin may be visible between your shoe and pants (or equivalent) either seated or standing – in these cases socks that cover any/all exposed skin are required. Avoid synthetic clothing; remove loose jewelry; secure hair and clothing away from flames, equipment, and chemical contamination.

GLOVES are provided in the labs; they should be worn when working with hazardous chemicals and removed after use. Ask the lab staff if you do not find suitable gloves stocked in your classroom. Remove gloves and wash hands before leaving the lab and entering public areas.

KNOW THE HAZARDS OF MATERIALS before beginning any procedure. Check the appropriate **Safety Data Sheet (SDS);** additional information is available on bottle labels, in your laboratory manuals & textbooks, in the laboratories and in the Chemistry Teaching Lab Stockrooms (YORK 3150 and NSB 1104). The Science & Engineering Library does not hold SDS, but can make computer access available for your search.

KNOW YOUR SAFETY EQUIPMENT: In each lab, learn the exits & evacuation routes, whether a telephone is installed, location of first aid station(s), shower/eyewash stations, spill control materials & fire extinguishers. Learn how to summon assistance from the Stockroom, Campus Police, or EH&S, as appropriate (see below).

KNOW YOUR OWN LIMITS: If you have limited mobility or any condition that may limit your ability to work safely, consult with the Lab Staff, campus EH&S, and your health care provider. If you carry **medication** that might be needed on an emergency basis (*e.g.,* for diabetes or asthma), inform your lab supervisor or a responsible coworker. Work stations for **physically impaired or temporarily disabled students** are available; if you need these facilities, ask your Instructor.

EMERGENCY RESPONSE INFORMATION forms allow students & staff to communicate medical information to emergency responders; blank forms are available in the Teaching Labs Stockrooms.

PREVENT ACCIDENTS AND SPILLS

Attentive and considerate behavior is expected at all times. Maintain clean laboratory benches and common areas. Horseplay and pranks are especially dangerous in a laboratory setting and are forbidden at all times. Distractions (such as music, telephones, headphones and ear buds) are forbidden, as they may distract the user from the task at hand or prevent the user from hearing instructions or warnings.

Keep all lab materials and lab gloves away from the **face & mouth**. Never pipet or start a siphon by mouth; this has been a source of serious laboratory mishaps. **Never work alone** in the laboratory and never perform unauthorized experiments. Students are to be in the Teaching Labs only when attended by an Instructor, TA, or member of the lab staff.

HAZARDOUS MATERIALS HANDLING: Label all containers with contents (material & concentration) and chemical hazards. **Store** hazardous materials in secondary containers (trays or tubs) and segregate materials according to hazard classes. Store hazardous materials **below eye level** and **return** materials to their proper storage locations. Date containers when first opened.

Use the secondary containers provided for carrying hazardous materials outside the lab or between labs. To obtain a refill from the Stockroom, choose the appropriate container to carry the empty bottle. At the Stockroom, request a refill and return to lab with the filled bottle in the secondary container. Return the bottle & the carrier to their storage locations.

HAZARDOUS WASTE MANAGEMENT. Hazardous waste containers are provided; choose the correct container for chemical hazardous waste and for all broken glass (& other sharps). Unless explicitly instructed, do not dispose of any waste to the drains. Read labels and ask the TA, the Instructor, or the lab staff person for your course. The Environment, Health and Safety Specialist at the Teaching Labs (see below) or the lab safety staff at UCSD EH&S (x 43660) can also help you find information.

Use **LABORATORY FUME HOODS** for all work involving (or producing) flammable, corrosive, fuming or noxious chemicals. Any volatile toxic substance should be opened & used only in a laboratory hood. When in doubt, place the work in a hood and read SDS.

RESPOND APPROPRIATELY TO ACCIDENT, SPILL, OR SUDDEN ILLNESS

**** ***TA must not leave students unattended in the classroom.*** ****

SUMMON ASSISTANCE and – if you are trained – **ADMINISTER FIRST AID**. Call the Teaching Lab Stockroom or send an uninjured person with a message. Emergency contact information is posted near each telephone (where available). If you suspect an ambulance is needed, do not hesitate to call for emergency assistance: 858-534-4357.

An **ACCIDENT REPORT** is necessary for any accident or chemical spill, no matter how minor the incident seems. These records are important in identifying recurring injuries, near misses, or problem areas.

PERSONAL EXPOSURE: If **clothing catches fire** or if a hazardous chemical is **spilled on skin or in eyes**, assist the exposed person to the shower/eyewash and rinse the areas of contact with copious amounts of water for 15 minutes or until assistance arrives; remove contaminated clothing. Immediately send an uninjured person to notify the lab staff to ensure injuries receive proper treatment.

SPILL CLEANUP: Do not attempt without proper protective equipment. For large or very hazardous spills, call for assistance. For **small spills**, use the spill cleanup kits and PPE provided; consult your lab supervisor and Material Safety Data Sheets for cleanup precautions. Double bag and label contaminated materials; store in the Hazardous Waste Area of the lab. Notify the lab staff – disposal will be arranged. For a **mercury (Hg) spill** use only mercury collectors provided in spill kits. Never mix mercury with other waste.

BUILDING EVACUATION: Always assure the safety of people before considering any damage to property. When instructed, leave the lab immediately. **Use stairs, never elevators** (power may fail in an emergency). **Pull the fire alarm** as you exit. At a safe location, call **858-534-4357** to report the situation to the UCSD police. Go to the assigned location for your lab or building. Lab supervisor will take attendance (to assure everyone is safe) and provide this information to responding emergency personnel. Do not leave the area or reenter buildings until instructed to do so. Note any injuries to yourself or others and any remaining dangers. Provide assistance to injured persons, as long as you do not place yourself in additional danger.

FIRE: For clothing fire, respond immediately: stop-drop-roll, douse with shower or smother with fire blanket, fire extinguishers, coat, or towels; call for assistance. Do not attempt to fight equipment/property fires in the lab; evacuate the lab quickly (see **BUILDING EVACUATION**); close doors and call for assistance.

EARTHQUAKE: Move away from overhead lights, heavy unsecured objects, and hazardous materials. Choose a sheltered position to wait (under a table, in the frame of a closed door, or against a bearing wall). Once tremors stop, shut down gas lines & heat sources. Exit the building quickly (see **BUILDING EVACUATION**).

STUDY QUESTIONS

- What is the reason for prohibiting ALL food, drink, and smoking materials in the labs?
- What clothing is appropriate for CHEM lab workers?
- What does “prudent practice” mean?
- Why is the practice of using a spatula to scoop powder from a bottle discouraged? Explain a preferred technique.
- What should you do with excess materials you won’t use?
- Check dictionary definitions and distinguish clearly between “volatile” and “hazardous.” Are all volatile materials also hazardous?
- Our LAB RULES are posted in the labs & available on our website. How could you find the RULES for another lab you planned to visit?
- Suggest a rule that might be used to prevent tripping on backpacks in a crowded lab.

EMERGENCY RESPONSE

This section supplements Chapter 2 in **LABORATORY SAFETY FOR CHEMISTRY STUDENTS** *by Robert H. Hill, Jr., and David C. Finster. John Wiley & Sons Inc., 2010.*

IN THIS SECTION:

Who to call for emergency assistance.

Our priority in any emergency: the safety of people.

What emergency equipment is available.

Personal information & emergency contacts in emergency response.

Building evacuation route from your lab building.

Evacuation assembly location for your lab group.

Earthquake response.

Student's role in responding to a lab emergency and incident reporting.

Student response to chemical spills.

Always consider ***people before property.*** No experiment or structure is worth more than a person. Our goal is that all go home safe at the end of the day. Accidents do occur, so learn your likely role and respond appropriately.

With many people present in most student labs, it is far more likely you will witness (and assist in) a lab emergency than that you will be the person most affected. Prepare yourself to respond in aid of another person, as she or he may panic and not remember what to do. If you are involved, do your best to stay calm and ask those around you for the assistance you need.

PREPARE TO RESPOND

Emergency equipment. Begin by studying the equipment provided in your laboratory (and in each new lab you enter). Your TA will introduce:

- Exit doors,
- Telephones (if any),
- Shower/eyewash,
- First aid & spill kits,
- Fire extinguishers,
- Fire blanket.

Call for help. Call when you need help and when you're not sure.
An ambulance is needed for:

- Any unconsciousness or difficult breathing, however brief,
- Sudden illness,
- A head wound or any severe bleeding (doesn't stop with application of pressure).
- 

Take an opportunity to be trained in (at least) **Basic First Aid**. Classes are offered through various community organizations, through the University, and by the American Red Cross.

Call for assistance, respond to injuries, then notify the Lab Staff. Seek medical assistance and give all information (including the nature and concentration of the spilled material) plus the injured person's **EMERGENCY RESPONSE INFORMATION** form (if available) to Emergency Responders. TA and involved persons will complete an **Accident Report.**

INCIDENT REPORTS are available in labs; TA and students injured or involved in an incident will work together to complete the report and return it to the Stockroom. **Request replacement** first aid items and restock the First Aid kit, leaving it ready for another class.

FIRST AID

A lab injury or a sudden illness requires an alert and immediate response from nearest uninjured persons on the scene. With burns and chemical spills, ***minimizing time before aid*** is critical in minimizing injuries. An injured person is unlikely to remember training and may be unable to listen to instructions. Those nearby must respond and give what aid they can whenever doing so does not increase danger to others. Don't do anything that will increase the number of injuries.

Those not directly involved in the response should keep the area clear for responders to work. If your assistance isn't needed at the moment, remain available to give assistance. Wait outside the lab to give privacy. If extra clothing is needed, ask in the Stockroom. If emergency shower is in use, floors will be slippery.

MINOR INJURIES: BURNS & CUTS

Notify your TA without delay, even for very minor injuries. Identify possible chemical contamination or exposure and seek First Aid:

- Cool burns and dilute/remove contaminates with cool running water.
- Continue rinsing for 15 minutes – no soap or scrubbing.
- Wash cuts gently; apply pressure to stop bleeding.
- Apply bandages in First Aid kits.

SUDDEN MAJOR ILLNESS

Major illness may include:

- Serious cuts or burns,
- Difficulty breathing,
- Seizure,
- Loss of consciousness,
- Any head wound.

The persons nearest (student, TA, Instructor or staff) must act as the **first responders**. If you are one of these:

- Call for assistance (**858-534-4357**),
- Prevent further injury/contamination,
- Apply pressure to stop bleeding and,
- If trained, begin CPR where needed,
- Notify Lab Staff.

Identify possible chemical contamination or exposure and give information (including **SDS** and **EMERGENCY RESPONSE INFORMATION** form) to Emergency Responders.

Fire blankets are provided in the labs. Use the blanket to cover a person who is ill or injured to keep them warm & prevent shock. TA/Instructor will complete an Accident Report.

CLOTHING FIRE: STOP! – DROP! – ROLL!

Fire on Clothing or Hair is a serious emergency that requires immediate response from the nearest unaffected person, as the victim will be unlikely to remember previous instructions.

- **STOP:** **Prevent the affected person from running**, as running feeds the flames and makes the fire worse; use any means available to stop him/her.
- **DROP:** Dropping to the floor allows the next step.
- **ROLL:** Roll the affected person to smother flames. Use whatever is at hand to help.
- **Emergency shower/eyewash** is a good response to a fire, if it is nearby. Do not travel more than a few steps to reach it - **STOP! – DROP! – ROLL!**
- **Fire blankets** – or any other available item (coats, blankets, jackets, sweatshirts, *etc*.) can be used to smother a fire once a person has dropped to the floor. Do not wrap a person who is on fire and still standing – forming a chimney will promote the fire.

HAZARDOUS SPLASH ON SKIN OR IN EYES

In the best spill situation, a chemical splashes on clothing that can be quickly removed – lab coats are especially easy to peel away, often before liquids penetrate to clothing. Don't wait to open buttons. Once the contaminated clothing is away from skin surfaces, evaluate whether there is a skin exposure (or just a laundry and disposal problem).

RINSE with **water only** – no soap or scrubbing. Begin immediately and continue rinsing for *15 minutes*. If serious injury is suspected, continue rinsing until paramedics arrive on the scene and begin medical evaluation.

WATCH THE CLOCK. An uninjured person must keep time.

EYEWASH provides direct rinsing for face & eyes:

- Begin rinsing with goggles on,
- Remove goggles and continue rinsing,
- Gently hold eyes open with fingers.

EMERGENCY SHOWER rinses the whole body, cool burns and dilute/remove contaminates. It provides unheated domestic (drinking) water in massive quantities; use it to rinse off contamination on skin or extinguish fires on clothing.

- Use with eyewash, if both are needed.
- Remove contaminated shoes and clothing while rinsing to remove contamination from skin surfaces.
- No drains are provided; expect walkways to be slippery as the water pools in the lab, soaking anything on the floor.
- When you notify the Lab Staff, they will call Facilities Management to deal with the water.

Our emergency response plan includes clothing that we can supply to anyone whose clothing is contaminated & must be removed. If you have such a situation in your lab, please contact your Teaching Labs Stockroom (YORK 3150, YORK 1808 or NSB 1104). Along with other assistance, we will supply scrub-style pants (various sizes) and lab coats to give the decontaminated worker something clean & dry to wear home/to the doctor.

DRENCH HOSE

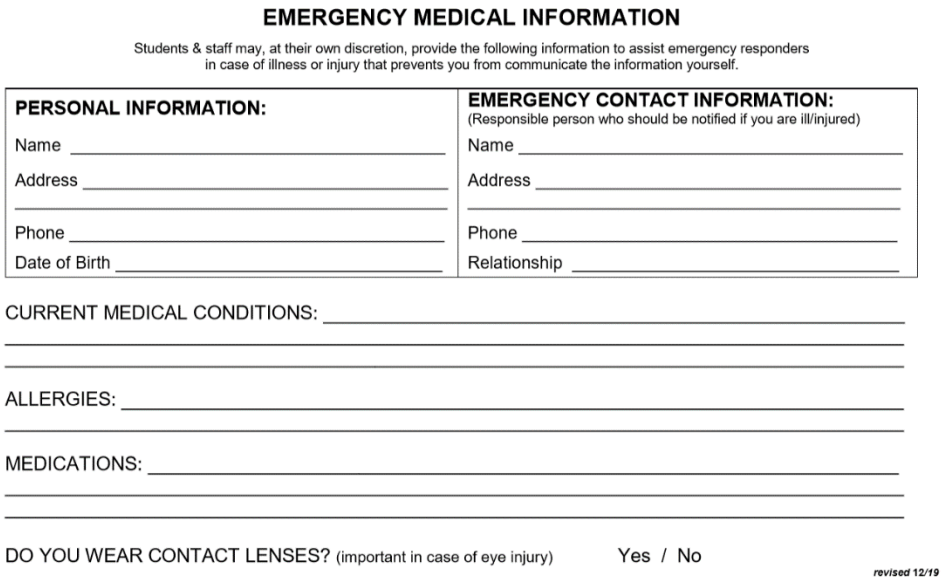
A **sink-mounted DRENCH HOSE** is an extra emergency item – not a substitute for having a laboratory eyewash or emergency shower. Use drench hose as a temporary measure to remove chemicals from eyes or skin**.**

Use the DRENCH HOSE regularly to rinse the sink. Regular use flushes the water through the hose & removes contaminants from the nozzles. Use flowing water to clean sink, rinse glassware, clean sponges, etc. Close covers when not in use.

PERSONAL INFORMATION

You may have personal information that you want to be given to an Emergency Responders (paramedics or emergency room staff) if you are injured or involved in an accident and not able to respond.

To record this information (allergies, medications, *etc.*) use the **EMERGENCY RESPONSE INFORMATION** forms available in Teaching Labs and in the Labs Stockrooms. These forms remain in the control of the student (in the lab notebook), and may be changed or replaced at any time. At UC San Diego, we encourage everyone to complete this form and make it available by securing it inside the back cover of the lab notebook. (Take an extra copy and carry in your wallet or backpack.) If you are injured, the information will be passed **only** to Emergency Responders.



EMERGENCY MEDICAL INFORMATION

Students & staff may, at their own discretion, provide the following information to assist emergency responders in case of illness or injury that prevents you from communicate the information yourself.

PERSONAL INFORMATION:	**EMERGENCY CONTACT INFORMATION:** (Responsible person who should be notified if you are ill/injured)
Name _____	Name _____
Address _____	Address _____
_____	_____
Phone _____	Phone _____
Date of Birth _____	Relationship _____

CURRENT MEDICAL CONDITIONS: _____
_____
_____

ALLERGIES: _____
_____

MEDICATIONS: _____
_____
_____

DO YOU WEAR CONTACT LENSES? (important in case of eye injury) Yes / No

revised 12/19

Anyone carrying **emergency medication** should alert the lab supervisor or another student of its location so they can assist, if needed.

Students are also asked to identify an **emergency contact person**. This information is requested on the first day in lab and stored for one quarter, or until the student requests a change.

In case of an emergency, I give Department of Chemistry and Biochemistry staff permission to notify my EMERGENCY CONTACT.

Student Name: _____ Student Signature: _____

(Please print clearly) **EMERGENCY CONTACT**: _____ relationship: _____
(print full name)

(area code) phone #:(_____)_____ email: _____

BUILDING EVACUATION AT UC SAN DIEGO

A major event, such as a major chemical spill, a fire or an earthquake, may require **BUILDING EVACUATION.** Each University building has an assigned assembly location, chosen to allow groups to gather away from buildings, clear of Emergency Responders' operations, and away from overhanging power lines or tree branches. Follow all instructions of the Emergency Responders. They may ask you to relocate your group Police, Fire Fighters, Paramedics to work.

In the CHEM Teaching Labs, we **do not conduct fire drills.** Always assume an alarm is real. Remember that your first priority is always the safety of people.

- If you can do so without delay, shut down open flames and electric equipment; gather your personal belongings (you may not be able to re-enter the building).
- Use only the stairs – remember that power & elevators may fail.
- Check the intended evacuation route for obstacles, if possible. Remember: smoke, debris, flooding, loss of electricity, or other impediments may be present.
- If you can do so without injuring yourself, assist others, especially those who have trouble with stairs.
- Move people who are unable to leave the building to an area of refuge. Possibilities include:
    - Most enclosed stairwells
    - An adjoining building behind fire doors
    - An office with a closed door, located a safe distance from the hazard
    - Exit balconies and corridors
- Exit the building quickly without running.
- Report to your assembly area (see maps, below).
- TA or Instructor will take roll to assure that everyone is safely evacuated – be sure you are counted.
- Notify emergency responders immediately about the location and condition of any people remaining in the building.
- Do not reenter the building until authorized to do so by an appropriate authority such as police or fire department.

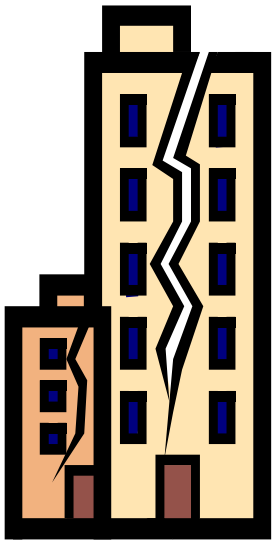
EARTHQUAKE EVACUATION is a special case: ***wait until the shaking stops***.

Duck, Cover and Hold On.

Keep your body low – if the first tremor knocks you down, don't try to get up. Protect your face and neck.

- Get under a desk, table or stairway, if you can.
- If there are no sheltering objects, move against an interior wall & cover your head with your arms.
- Remain under cover until the shaking subsides.
- Watch for unsecured equipment that may be shaken off a table.
- Watch lighting fixtures, which may swing loose.

When the first shaking stops, evacuate the building; pay special attention to reporting damage and unsafe conditions. Move to the Designated Assembly Area (see maps, below).



BUILDING EVACUATION PROCEEDURES & SITES

Shut down open flames & electrical equipment in your work area.

Take personal belongings.

Assist others where possible & report injuries to Emergency Responders.

Close (don't lock) doors as you leave.

Use stairs only – elevators may fail.

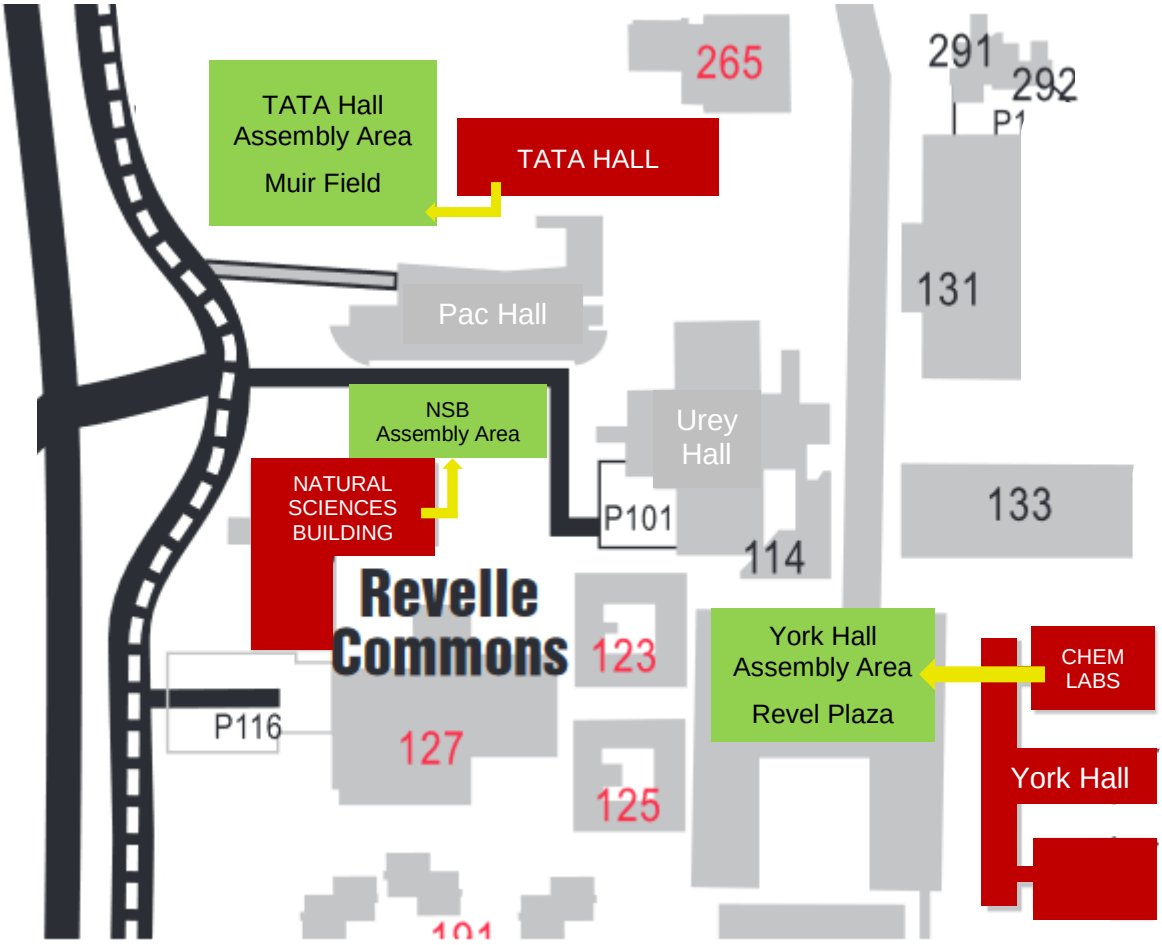
Assemble your group – keep all driveways clear.

Take roll & report missing persons to Emergency Responders.

Follow instructions of Emergency Responders.

Return to building only on instructions of:

- Emergency Responders
- EH&S Staff
- Lab Staff.



PREVENT INJURIES AND SPILLS

Dispose of broken glass and other hazardous items, such as corrosive liquids or flammable products so these items do not cause injury. Dispose of all nonhazardous rubbish in the trash cans and keep floors clear & dry at all times.

Each lab is provided with a storage area for backpacks & other personal items away from work areas and off lab floors. Careful storage protects workers from tripping and protects books and other materials from contamination.

SPILL RESPONSE

Spill response requires an immediate assessment of the hazard presented by the spill. For this reason, ***all spills and accidents must be reported to the lab supervisor (TA or Instructor) and the stockroom staff without delay***. All spills and accidents require Incident Reports. Avoid injury (or further injury) by keeping people out of spill area. Study the **FIRST AID** section carefully.

For spills, as for any accident, consider **life before property**. The first people available must respond on the scene (student, TA, Instructor or staff). Give assistance to any injured persons whenever it is possible to do so without increasing the danger to yourself or others. Do not make a situation worse by involving or contaminating more people.

Notify the Lab Staff and EH&S about the nature and extent of the spill.

Hazardous chemical spills that are **large** or **volatile** (evaporating quickly) require **evacuation** of the lab and professional assistance. If the situation is larger or more hazardous than you are prepared to handle, evacuate the room and call for assistance. Close and lock doors and post signs (stocked in the Spill Kits) on the lab doors to avoid entry by someone unaware of the spill. Call for assistance:

- If you don't have the materials or equipment to clean the spill,
- If other responsibilities (students, children, animals, a partner who needs help) require your attention,
- If the situation is beyond your comfort zone: you don't have training, experience, or capacity to respond
- If you're not sure.

A **mercury (Hg) spill** is a special case. Mercury is a neurotoxin and the primary route of exposure is inhalation of mercury vapor. If mercury is spilled in/on a *hot* environment (sand bath, oven or hot plate), evacuate the lab without delay & call for assistance. The vapor pressure of mercury (and the risk of exposure) rises quickly with rising temperature. If the mercury spill is *cold or room temperature*, the vapor pressure will be low and the risk of exposure smaller. Use the special cleanup equipment provided in the Spill Kits for cold mercury spills.

TECHNIQUE – CALL FOR EMERGENCY ASSISTANCE:

CAMPUS EMERGENCY OPERATOR WILL SEND HELP FOR MEDICAL EMERGENCIES, FIRES, PLUMBING OR ELECTRICAL PROBLEMS. STORE THIS NUMBER FOR EASY ACCESS.

Small hazardous spills may be cleaned using the materials in lab Spill Kits under the direction of the TA or Instructor. Choose appropriate PPE & follow instruction provided in the Spill Kit to absorb/neutralize spilled materials before collecting it for disposal. Complete an Accident Report and turn it in to the Stockroom.

Broken glass contaminated with hazardous or smelly materials can be rinsed with an appropriate solvent before placing glass shards in the **broken glass** container. Collect the solvent rinse for disposal as hazardous waste.

Acid or base spill on inert surface (bench and floor). Regardless of how small, spills of corrosive materials must be THOROUGHLY CLEANED and NEUTRALIZED.

- Dilute the spill with water
- Neutralize acid with solid sodium bicarbonate ($NaHCO_3$).
- Neutralize base spills with solid citric acid ($CO_2CCOCO_2CCO_2$).
- After neutralizing the spill, rinse the surface with water.

When the area appears has been cleaned, test the wet surface with pH test paper and repeat as needed to assure surfaces are neutral. For a spill that drips off a lab bench, be sure to check inside drawers for additional liquids. Sodium bicarbonate and citric acid can be found in the lab Spill Kits.

Dispose of all used waste paper (towels and Kimwipes) in trash receptacles. Paper used to absorb chemicals should be placed in solid hazardous waste containers or in a plastic bag for waste collection – not in the general trash. Place broken glass the broken glass boxes or (if contaminated) in a plastic bag inside a study box. Never leave broken glass in just a bag – serious cuts may result.

Used spill cleanup materials. Seal used/contaminated materials in plastic bags provided in the Spill Kits. Label the bags with contents, hazards, date and your name; leave them in the lab's hazardous waste collection area. Notify staff so they can arrange collection & disposal. Request replacement cleanup materials (at Stockroom Service Window, YORK 3150 or NSB 1104) and replace the used items, leaving the Spill Kit fully stocked.

TECHNIQUE – CHECK FOR ACID/BASE. TO DETERMINE WHETHER A CORROSIVE SPILL HAS BEEN THOROUGHLY CLEANED, MOISTEN THE CLEANED AREA WITH A WET SPONGE AND RUB A pH TEST PAPER (AVAILABLE IN LABS) ACROSS THE WET SURFACE. COMPARE THE RESULTING COLOR OF THE STRIP TO THE GUIDE ON THE PACKAGE LABEL. IF THE SURFACE IS NOT NEUTRAL (pH < 4 OR > 10) , CLEAN IT AGAIN.

STUDY QUESTIONS

- Suppose you carry emergency medication that may be needed on short notice. What are the pros and cons of informing others (roommates, lab partner or lab supervisor) of its use & location?
- How does building evacuation for an earthquake differ from evacuation for a building fire?
- How often does the Chemistry Department typically run fire drills in the Teaching Labs?
- Where does your class assemble in an evacuation? Why?
- If you get a chemical splashed in your eye(s), you should flush your eye(s) with running water for at least how many minutes?
- Where is the First Aid kit in your lab stored?
- Where is the fire blanket? Why was that location chosen?
- What might be your role in an emergency response if you were the nearest uninjured person? If you are at the other end of the room?
- Who should be notified in case of a sudden illness or injury in the lab?
- Suggest situations in which the emergency shower/eyewash would be helpful.
- What is an EMERGENCY RESPONSE INFORMATION form and who should use one? Where can you get a replacement if yours is lost or needs revision?
- How should you dispose of the sludge created when neutralizing a small acid spill with sodium bicarbonate?
    - dump it in the trash bin.
    - collect it in a plastic bag and store in the hazardous waste area of the lab.
    - leave it to dry on the work bench, then dump in trash bin.
    - leave it to dry on the work bench, then store in the hazardous waste area of the lab.
- How can you assure that all acid has been cleaned from a spill on the floor?
- Who is available to assist you in cleaning a spill of hazardous materials in your lab?
- Where is the Spill Kit kept in your lab?
- After cleaning a spill, how should you dispose of the leftover broken glass?
- How can you assure the Spill Kit will have what you need in case of a chemical spill?
- How big a spill is “too big” for a student & TA to clean up?

HAZARD COMMUNICATION

This section supplements Chapter 3 in **LABORATORY SAFETY FOR CHEMISTRY STUDENTS** *by Robert H. Hill, Jr., and David C. Finster. John Wiley & Sons Inc., 2010.*

IN THIS SECTION:

What information is available to users of hazardous chemicals.

Where to find safety data.

How to share safety data with co-workers & classmates.

All who work with hazardous materials need to find hazard information and communicate that hazard information to others.

YOU HAVE A RIGHT TO KNOW. Hazard information allows workers to make informed decisions about the work they plan to do and the materials they will use. Employers are required to make this information available to employees; this is known as the employee's *right to know.* A community surrounding a business that handles hazardous materials also has a *community right to know* about those materials. These regulations are administered by OSHA (the Occupational Safety & Health Administration) and (in California) by CalOSHA.

UC San Diego CHEM lab students are not employees, so OSHA/CalOSHA regulations do not apply to them, although they do apply to anyone employed by the University, including TAs. In this case, we treat everyone working in labs the same; whether you are working or preparing for future work, take your rights and responsibilities seriously. We do.

GHS for Hazard Communication

The **GLOBALLY HARMONIZED SYSTEM (GHS) FOR HAZARD COMMUNICATION**, is a uniform system of labeling hazards (the GHS system) designed by the United Nations. GHS required by federal regulation (HazComm 2012) and is now being implemented by the US chemical enterprises (2012 – 2016).

The Occupational Safety & Health Administration (OSHA) has published information about the system . Those of us who will continue working with hazardous chemicals in the coming years are learning about:

- Hazard Communication Standard Labels
- Hazard Communication Standard Pictograms
- Hazard Communication Safety Data Sheets
- GHS Frequently Asked Questions.

LOCATE SAFETY INFORMATION

Safety Data Sheet (SDS) are one of our principal tools for locating hazard information. Under older regulations, they were called ***Material*** *Safety Data Sheets*, so you may see "MSDS" or "(M)SDS" as well.

SDS are available through multiple sources:

- Many chemical manufacturers provide SDS within their product catalogs. Our primary chemical supplier is Fisher Scientific.
- ChemWatch has been discontinued as the primary search site for the University of California. UC's new vendor is RightAnswer.com.
- Bookmark the University's SDS search or another reliable site on your computer.
- Make an SDS folder and save the safety data sheet.
- Add to your SDS folder as you learn new materials. Build your collection for future review.

In UC San Diego's *Environment, Health & Safety* pages, read:

- SAFETY DATA SHEETS EXPLAINED and
- SAFETY DATA SHEET SOURCES.

UC San Diego Science & Engineering Library provides guest computer access.

When preparing for lab work, make a **table of materials** to use. Include the *quantity needed;* this will help you think about the risks (exposure if spilled).

OTHER SOURCES OF SAFETY INFORMATION

SDS are not available for all chemicals you can expect to use (or produce) in lab exercises; materials that are not sold in interstate commerce are not covered by Federal law and regulations. When seeking either safety information or physical data, also check:

BOTTLE LABELS. Pay careful attention to the labels on **consumer products** available in hardware, grocery & hobby stores. Some of these products can be extremely hazardous.

In the lab, carefully read the original (primary) manufacturer's label (when available) and the labels prepared when transferring materials to smaller bottles.

REFERENCE BOOKS. A number of these are available for student use in the Teaching Labs Stockroom (YORK 3150 or NSB 1104). Examples include

- *Merck Index*.
- *CRC Handbook of Chemistry & Physics*.
- Various manufacturers' catalogs, such as the Aldrich catalog, contain a wealth of information.
- *Dangerous Properties of Industrial Materials* is available on-line via the UC San Diego Library reference collection.

OTHER WEB SITES. UC San Diego *Environment, Health & Safety* has a good list of sites.

For assistance in understanding and interpreting safety data, seek out:

- your TA & Instructor,
- Teaching Labs Safety Coordinator,
- Chemistry Department Safety Director,
- labs staff person assigned to your course, and
- safety professionals in our Department of Environment, Health & Safety.

MATERIAL NAME, concentration	HAZARD	QUANTITY NEEDED	PPE / EQUIPMENT NEEDED
sodium hydroxide (6M NaOH)	CORROSIVE	35mL	goggles, gloves OK on lab bench
ethanol, 100%	FLAMMABLE	50mL	goggles, gloves work in fume hood

A table of materials for a lab notebook.

LABEL EVERYTHING

Hazard communication continues with telling others about the hazards of your materials.

Label all containers <u>before</u> filling. Use a waterproof marker or tape. Name the chemical you intend to put into a beaker, bottle or flask. A graduated cylinder can be marked across the horizontal foot.

Think ahead & plan the labels you will need for your work. A page of labels to use in lab follows. Copy these pages or download the .pdf file.

Always include:

- your name & date
- full chemical name; add (but don't substitute) abbreviations, if desired
- concentration: if you only know approximate concentration, use that. Add more information when available; your Sharpie marker will write on the clear tape.
- hazard information: check the SDS for this information.

Save your labels to a file. It's often easier to revise a sheet of labels (& save to a new file) than to start from scratch.

Cut the labels apart & tape them to your bottles & flasks with clear tape. Remove them when no longer needed.

Chemical name: _____ HAZARD(S): _____ Concentration: _____ Owner: _____ Date:	**HYDROCHLORIC ACID SOLUTION** **CORROSIVE** **3.0 M HCl** **JOHN PALMER** **DEC. 12, 2012**	**SODIUM HYDROXIDE SOLUTION** **CORROSIVE** **~1.5M NaOH** _____ **JOHN PALMER** **DEC. 12, 2012**

Chemical name: ______________________
HAZARD(S): ________________________
Concentration: ______________________
Owner: ___________________________
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STUDY QUESTIONS

- Where can a student locate the SDS on a material needed in lab?
- When is a student permitted to access the UC San Diego Teaching Labs' SDS files?
- Where can you access SDS files on the web?
- When is an employee allowed to use SDS from the employer's files?
- State the responsibilities and rights of a STUDENT under the OSHA Hazardous Communication Standard.
- State the responsibilities and rights of a WORKER under the OSHA Hazardous Communication Standard.
- State the responsibilities and rights of A SUPERVISOR/EMPLOYER under the OSHA Hazardous Communication Standard.
- Who has a *right-to-know*? Know what?
- Choose four of the following substances. For each, locate and read the SDS: find the molecular formula, the hazards to health, the degree of flammability (if any), and the reactivity of the material. Consider whether each one is toxic, reactive, flammable or corrosive.
    - hydrochloric acid
    - sodium hydroxide
    - acetone
    - ethanol
    - potassium permanganate
    - diethyl ether
- For two of the materials given above, write a label for a bottle that will hold 100 mL of a 0.5M solution that you will store for several weeks.
- How can you learn in advance whether a material is *hazardous*?
- What is the best way to warn others in the lab about the hazards of YOUR materials?

LABORATORY HAZARDS AT UC SAN DIEGO

This section supplements Chapters 4 & 5 in **LABORATORY SAFETY FOR CHEMISTRY STUDENTS** *by Robert H. Hill, Jr., and David C. Finster. John Wiley & Sons Inc., 2010.*

IN THIS SECTION:

What makes a chemical hazardous?

How to minimize risk of working with hazardous materials.

What physical hazards are likely to be present in lab?

The US Occupational Safety and Health Administration (OSHA) defines a **hazardous chemical** as any chemical that is a **health hazard** or a **physical hazard**.

One material may fall into a combination of hazard groups. Characteristics which are useful in controlled chemical reactions may become injurious if allowed to proceed in contact with living tissues or if the reaction proceeds more quickly than desired. For example, a reaction of a strong base with a fat (used commercially to form soap) will cause a deep penetrating chemical burn if the fat involved is a part of your skin or eye.

It may also be a ***hazardous material*** if it presents physical or electrical hazards, such as sharp edges, extreme temperature, or electric charge. The location of the material (laboratory, hobby shop, garage, grocery store) does not change the hazard of the material, although commercial names may obscure the actual contents of a product.

A ***hazard*** is an inherent property of the material and not generally something that can be changed. The associated ***risk*** of being injured by a hazardous material is a combination of the inherent hazard and the degree to which a person is **exposed**. Recognize & understand the hazard; assess the risk involved; then minimize the exposure to minimize the risk.
REMEMBER: When there is no exposure, there is no risk of injury.

Hazardous chemicals at home. Remember that the **hazard** of a material (chemical) or operation doesn't change when the operation happens at home. Indeed, many chemical accidents occur at home, when consumers mistakenly assume commercial products are safe, or when commercial products are mixed.

We expect each of our students will become a consumer armed with safety training: a valuable resource to families, friends and co-workers. Check the (M)SDS on your household and hobby chemicals and consider whether they are handled correctly in your home, club or hobby group. Help those around you to appreciate the hazards of their cleaning and hobby materials.

HEALTH HAZARDS

A **health hazard** as a chemical for which there is (in OSHA's definition) "statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees." This definition includes:

- Agents that damage the
  - lungs,
  - skin,
  - eyes, or
  - mucous membranes
- Toxic or highly toxic agents,
- Reproductive toxins,
- Irritants,
- Sensitizers,
- Corrosives,
- Carcinogens
- Hepatotoxins,
- Nephrotoxins,
- Neurotoxins,
- Agents that act on the hematopoietic system

Irritants cause transient effects which may be mild or serious.

Corrosives are materials (solids, liquids or gases) that cause destruction of other materials (including living tissues). These may be acids (such as hydrochloric acid, HCl, or sulfuric acid, H_2SO_4) or bases (such as sodium hydroxide, NaOH, or ammonium hydroxide, NH_4OH). Strong bases are a particular eye hazard (see the reaction between fat & base, above). These materials are very difficult to wash from eyes; never handle them without your splash goggles.

Carcinogens are materials that cause cancer. Special precautions are taken with these, including limiting such works to those who have had specific training.

Reproductive toxins include mutagens (which cause genetic mutation) and teratogens (which cause malformation of an embryo).

Allergens may cause reactions in people who have become sensitized through previous exposure.

Asphyxiants interfere with the supply of oxygen to vital organs:

a *chemical asphyxiant* (such as CO) interferes with the absorption or utilization of oxygen;
a *simple asphyxiant* (such as CO_2) displaces oxygen in the air breathed, starving the body.

PHYSICAL HAZARDS

PHYSICAL AND MECHANICAL HAZARDS are common in labs and other workplaces.

OSHA defines a physical hazard as a chemical for which there is scientifically valid evidence that it is one or more of these:

- A combustible liquid,
- A compressed gas,
- Explosive,
- Flammable,
- An organic peroxide,
- An oxidizer,
- Pyrophoric,
- Unstable (reactive),
- Water-reactive.

Flammable materials are those that readily ignite & burn in air. Many common solvents are highly flammable and require special care.

Unstable (reactive) materials are those likely to react spontaneously under normal or relatively mild conditions. Uncontrolled reactions may cause explosions or start fires. Reactives may include strong ***oxidizers*** (such as nitrates, $-NO_3$) or strong ***reducers*** (such as hydrazine, NH_2NH_2), as well as those that react spontaneously with air (pyrophoric) or water (water reactive).

Chemical Incompatibility. Some materials are stable in themselves, but must be kept apart from materials with which they would react strongly (***incompatible*** materials); careful storage of hazardous materials keeps incompatible materials separated. As an example, acids and bases are stored in such a way that they would not mix, even if the bottles were broken.

Radioactive materials are a special case of reactive materials. Radioactive materials emit ionizing radiation as unstable atomic nuclei decay to form more stable nuclei; the emitted radiation (which may occur in several forms) may damage living tissues or effect changes in nearby materials. Ionizing radiation may also be emitted by machines such as X-ray machines.

The Teaching Laboratories currently use only one sealed source of radioactive materials; everyone who works with such as source is specifically trained. Any workplace in which you will use such materials will be required to provide training in the appropriate use & precautions.

Thermal hazards arise when materials are substantially hotter or colder than ambient (surrounding) temperatures. Use tongs, insulated gloves or other aids to guard hands and other skin surfaces from contact with extreme temperatures. Remember that hot glass looks just like cool glass.

TECHNIQUE – HOT GLASS. PLACE HEATED GLASSWARE IN A LABELED AREA, ON A MAT, OR IN A HEAT-RESISTANT CONTAINER WHILE IT COOLS.

TO DETECT WHETHER A HEATED ITEM (SUCH AS A BEAKER) IS **STILL TOO HOT** TO TOUCH, HOLD A HAND SEVERAL INCHES AWAY AND SLOWLY APPROACH UNTIL YOU FEEL HEAT RADIATING FROM THE SURFACE.

USE SIMILAR PRECAUTIONS TO PROTECT SKIN WHEN WORKING WITH VERY COLD (CRYOGENIC) MATERIALS, SUCH A LIQUID NITROGEN ($N_{2(l)}$) OR DRY ICE ($CO_{2(s)}$).

Mechanical hazards. Injuries from slipping, tripping, falling, crushing and cutting are among the most common in American workplaces.

- Keep walkways clear and keep floors dry.
- Use only approved ladders/steps – never lab stools or chairs – to reach items stored overhead.
- Manage electric cords to keep them clear of walkways, work areas and chemical hoods/sashes.
- Read and understand the instructions for any machine before using it.
- Restrain hair, clothing and jewelry.

A **sharp** is any item that could cut through a plastic trash bag. Sharps include razor blades, needles, fine pipettes, and any broken glass. Single-use pipets and other glassware is also disposed to hese boxes, as it may break and become sharp. **Carefully dispose of sharps in the special containers provided in the labs – never to the ordinary trash.** This practice protects lab workers as well as others who may enter the lab.

TECHNIQUE – COLLECT BROKEN GLASS. USE TONGS TO PLACE PIECES AND SHARDS INTO A CUT-RESISTANT CONTAINER. USE A BRUSH & DUST PAN TO COLLECT SMALL PIECES. CARRY THE SHARPS TO THE **BROKEN GLASS BOX** WITHOUT TOUCHING THE GLASS WITH HANDS.

ELECTRICAL HAZARDS

Risk of electrical shock arises when current runs in unplanned ways. This may result from worn, damaged or improperly grounded instruments.

- Read and understand the instructions for any machine before using it.
- Check all electrical cords and report worn ones for replacement immediately.
- Manage cords to reduce mechanical wear and restrain excess lengths (preventing trip hazards, as well).
- Do not overload circuits.
- Do not operate instruments on extension cords.

STUDY QUESTIONS:

- Why are acids and bases stored separately?
- Does hot glass look hot?
- Why are lab workers directed to restrain long hair and loose clothing
- What is a common hazard of laboratory solvents?

HAZARD CONTROLS

This section supplements Chapter 7 in **LABORATORY SAFETY FOR CHEMISTRY STUDENTS** *by Robert H. Hill, Jr., and David C. Finster. John Wiley & Sons Inc., 2010.*

IN THIS SECTION:

Engineered hazard controls present in our labs.

Student's responsibility for using and maintaining engineered systems.

Administrative controls in effect in our labs.

Personal protective equipment required to work in our labs.

Personal protective equipment available for use in the labs.

Personal protective equipment for using hazardous chemicals at home.

Safety professionals divide hazard controls (methods for minimizing hazards) into a number of categories. Prominent among these are **engineered**, **administrative** and **personal protection** controls.

Engineered controls eliminate or reduce the presence of the hazard, reducing the consequent risk of injury. This is always the preferred control, but elimination of (or substitution for) the hazard may not be possible, or may be effected only partially.

Administrative controls limit the worker's exposure to the hazard, reducing the consequent risk of injury. This is the second line of control.

Personal protective equipment (PPE) protects the worker when engineered and administrative controls fail. PPE forms our last line of defense in the order of controls. If the hazard continues to be present and the worker is in danger of exposure, PPE may prevent or mitigate injury.

ENGINEERED CONTROLS

The built-in protections which distinguish a properly constructed laboratory from an ordinary office space are called **engineered controls**; another good name would be "technological controls." They include chemical hoods, air handling systems, fire sprinklers, and fire walls & doors.

Engineered controls provide passive protection – they protect all workers in an area without action on the worker's part. Because they are passive and always on, engineered controls are the preferred method for controlling laboratory hazards.

When you, as a laboratory manager, researcher or business owner, construct your laboratory, consult with those who specialize in designing such spaces. An ordinary commercial workspace lacks many of the necessary elements of a laboratory.

FIRE PROTECTION

All our labs have fire sprinklers, although not all are obvious; some are recessed into the dropped ceilings. **Sprinklers** are heat activated and respond one at a time – usually one sprinkler will extinguish a lab fire. In a larger fire, **fire walls & closed fire doors** provide a 1-hour *fire envelope,* delaying the spread of a fire and protecting both occupants & Emergency Responders.

Keep all lab doors closed and always close them when leaving. In a fire, the walls and fire doors will contain the fire, allowing evacuation through the adjacent hallway. They also allow fire fighters to approach the room and set up their equipment before they are exposed to the fire.

LABORATORY VENTILATION

Chemical hoods & air handling systems carry fumes and vapors away from a worker's breathing space.

Single-pass air. In contrast to most commercial building systems (see below), our laboratories use 100% fresh air: all the air in the lab is brought in, heated or cooled and exhausted to the atmosphere after only one use. Our lab system supplies enough fresh air to allow the entire volume of air in the lab to be replaced eight to ten times each hour.

Negative pressure. The lab ventilation system is balanced to draw air into the lab at all doors, as well as at air intakes. This inward flow of air protects those in surrounding areas if there is a chemical release.

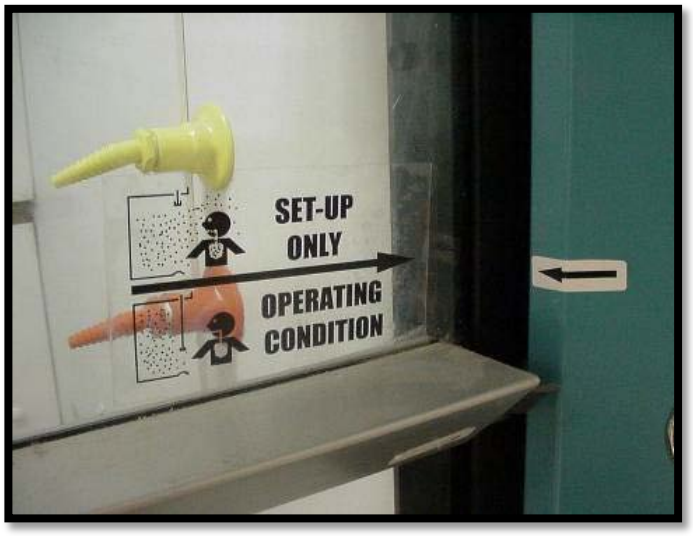
> An office or home ventilation system typically recirculates most of the air (to save energy). A variable portion of fresh 'makeup air' is added in to the recirculating air. The ratio of recirculated to fresh air is managed for heating and energy efficiency, comfort and costs.

CHEMICAL HOODS

The function and role of chemical hoods is well covered in Chapter 7 in ***LABORATORY SAFETY FOR CHEMISTRY STUDENTS***. Study that section carefully.

Excellent video presentations are available about chemical hoods on our Safety Videos page:

- Chemical Fume Hood: How it Works to Protect You (available in English, French, Russian, Spanish and German) is an excellent animated short (about 8 min.); it explains the parts and functions of a chemical hood.
- Basic Fume Hood Air Flow and Operation provides a good working demonstration .
- Proper Use of a Fume Hood, from UC Berkeley Environment Health & Safety.



The **hood sash** is the window unit at the face of the chemical hood. It may have sliding glass panels in it.

At UC San Diego, the highest **operating sash position** is indicated by arrows posted on the frame and the sash of the hood (see photo). Open the sash no further than where the arrows match, for normal operations. Open further to place large equipment into the hood, but close it – at least to the arrows – before beginning work.

A **Hood alarm** indicate a malfunction in this protective air handling system. Never try to silence an alarm without finding and reporting cause of the alarm.

When an alarm sounds, check to make sure the sash is properly positioned – this alone may silence the alarm, indicating that the problem is fixed.

If the alarm continues, notify the Lab Staff so the hood can be repaired. Tape a note on the hood stating when the problem was reported & to whom. Use another hood until the defective one is repaired.

If all alarms in one room are sounding, suspect a system failure. Report the alarms to the Lab Staff and delay any work that needs a hood.

YOUR ROLE

As a student, your responsibility for engineered hazard controls is using them correctly and reporting needed repairs.

- Unless someone is entering or leaving, close lab doors to allow the ventilation system to work smoothly.
- Open volatile hazardous materials (those that vaporize easily) only in the hood.
- Set up equipment at least 6" back from the sash to capture gases, vapors and fumes.
- Closed the sash and windows completely whenever possible.
- Close the hood sash as much as possible, opening the windows just enough to do your work while maintaining proper air flow.

Report problems. If a laboratory hood or other system seems to be malfunctioning or making strange noises, tell your TA or lab supervisor. You may be asked to carry a note to the Lab Staff, to assure that repairs are begun as soon as possible. Be sure the message includes enough information to be useful: the lab room, the location of the problem, and as much information about the problem as possible.

ADMINISTRATIVE CONTROLS

Administrative controls are the rules we work under, whether they are rules agreed by a group of co-workers (*"clean the refrigerator every Friday"*) or those imposed by an employer or teacher (*"everyone wears solid shoes and a knee-length lab coat"*). This document is a summary of the administrative controls that apply to students in the Teaching Labs. Following these procedures keeps things running smoothly.

Signs posted in labs direct (or forbid) particular actions. Notify the Lab Staff if signs become worn or damaged.

NO STORAGE HERE

NOTICE:
Failure to follow procedures may cause supervisor to explode.

OPEN ONLY IN HOOD

Because administrative controls depend on compliance, they are secondary to engineered controls for reducing risks from hazardous materials. If a risk cannot be mitigated by technological means, then work rules may be the answer for reducing exposures.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

When working in lab, remove **loose jewelry**. Restrain **hair** and loose clothing away from flames, contamination, or contact with moving parts of machines.

LAB CLOTHING

Choose lab clothing carefully. Appropriate lab clothing (for students, staff, TA and Instructor) takes into account the chemical and physical hazards of lab work – the presence of corrosive and flammable materials as well as the use of open flames.

Wear **long pants** (or equivalent clothing), to protect legs from spills and splash.

Wear a long-sleeve, knee-length **lab coat** closed to protect skin and clothing. Restrain shirt sleeves so they don't protrude beyond coat sleeves. Labs are cool so long clothing (pants and lab coats) is comfortable. If the lab is too warm, please let the staff know.

Flame retardant natural fibers, such as cotton, wool and linen, are preferred for lab clothing. Synthetics fibers, such as nylon, burn easily or melt onto skin. They are particularly inappropriate for lab. Store lab coats in the lab or carry them folded in plastic bags to contain any contamination. Unless contaminated by hazardous chemicals, lab coats can be washed - separate from other laundry,

Lab coats protect clothing from fine aerosols as well as larger spills. Wear them only for lab work and remove them before leaving the lab area. Wearing a lab coat away from the lab area indicates a disregard for the health and safety of the community.

Shoes must be closed all around to protect the feet from broken glass and chemical spills. Sandals, ballet flats and other open shoes are inappropriate. Choose a closed shoe made of nonabsorbent material with a tread that will not slip on a wet floor. Be aware that boots or safety shoes are standard practice in many workplaces.

***The minimum level of safety protection necessary to work in the Teaching Labs** is safety eye protection, long pants (or equivalent), closed shoes, and long (knee-length) lab coat. Students who arrive unprepared or inappropriately dressed will be dismissed until ready to work.*

LAB GLOVES

The light-weight disposable **gloves** available in the labs can be used to protect hands from *incidental* contact with lab chemicals and to protect from dirt & abrasions. Base a decision to wear gloves (or not) on the hazard of the materials in your plan. Check with your TA until you feel confident in your own decisions.

Keep hands away from your face in lab and **NEVER** touch a lab glove to your face or glasses. If gloves are dirty, worn or contaminated, remove and discard them, wash your hands and get new gloves, if they're still needed.

Always remove gloves & wash hands before leaving the lab or starting a new activity. Lab workers who forget to remove gloves can carry hazardous materials to clean areas and contaminate others. If you see others wearing gloves outside lab, please remind them.

An experimental plan that involves close contact with chemicals needs to be revised. Request assistance if a safer plan doesn't seem feasible. Unusually hazardous materials or extended contact will require greater protection than that offered by disposable gloves; consult with Lab Staff if you suspect this will be necessary.

SAFETY EYEWEAR

DEPARTMENT RULE: Safety eye protection is required for all workers in all labs when anyone is working with glassware or chemicals.

\- Department of Chemistry & Biochemistry, UCSD

This Department Rule allows for the use of a laboratory as a classroom for a lecture or quiz. As long as no one in the room is doing lab work, eye protection is not required; when the first person begins to work with glassware or chemicals, everyone (students, TAs, staff, Instructors, and visitors) must don appropriate eye protection. (Visitors should check in with the Stockroom (YORK 3150 or NSB1104); they will be supplied with goggles, as well as protective clothing.)

The choice of appropriate eye protection (see illustrations) is governed by several factors. The choice of appropriate eye protection (see illustrations) is governed by several factors. **Safety glasses** provide protection from impact (as from broken glass) but little protection from liquids splashed into the face; they are appropriate for dry lab work.

GOGGLES ----------SAFETY GLASSES ---------- Visorgogs®

SAFETY EYE PROTECTION: NOTE that *Visorgogs*® are glasses, not goggles.

Chemical splash goggles (see illustration) fit closely to the face, especially across the forehead, and are vented indirectly to prevent a splash from reaching the eyes. Goggles purchased for other activities may not be appropriate for chemical work. Ask the safety staff to be sure. **Chemical splash goggles** are required when *anyone in a work area* is transferring more than a trivial amount of an eye hazardous substance. Note that everyone who might be affected by a spill in the area wears splash goggles until the procedure is completed, not just the person carrying or pouring the hazardous substance.

In some laboratories, specific procedures with a high level of eye hazard are restricted to "goggles only" areas. There are cases where additional eye and face protection are warranted and face shields are available for these cases, but such cases rarely occur in student laboratories.

GOGGLES ONLY. For simplicity and for the greatest measure of safety, a lab class may (at the option of the Instructor) be designated a "goggles only" class. In recent terms, Chemistry 7L and 143A have been "goggles only" for all students, staff, TAs, Instructors, and visitors in these classroom. Check the class syllabus for current requirements.

More advanced lab students are expected to have both goggles and glasses and to be able to distinguish the situations in which each is appropriate. if unsure about the better option, check your decision with your TA until you feel confident in your own decisions. The lab TA and Instructor will assist in developing judgment about such situations. Goggles are always appropriate.

The UC San Diego Bookstore and carries approved **chemical splash goggles** (*for example,* ENCON series 500) and approved **safety glasses** (*for example,* UVEX brand Ultraspec 2000 & 2001, Astro OTG 3001, and Astrospec 3000 series glasses). The Astro OTG3001 and Ultraspec2001 glasses are designed to fit over prescription glasses. The Teaching Labs Stockroom **does not sell or lend** goggles or glasses to students.

Wash goggles and glasses frequently, as for any other personal item. Anti-fog cleaners (available in the Bookstore and in the Lab Stockrooms) provide some relief from fogging.

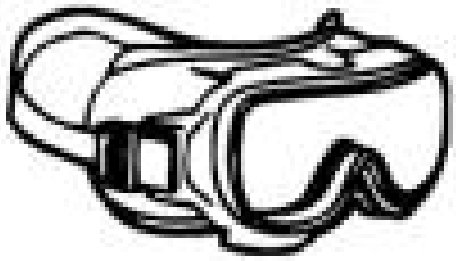
Contact Lenses. When worn with safety eyewear (goggles or safety glasses), contact lens wear is acceptable. Be aware that this is the UC San Diego CHEM Teaching Labs rule; some labs and some employers do not allow contact lenses.

Hearing protection. Excessive noise is not generally a concern in chemistry labs, but occasions arise when protection is necessary.
Be aware that hearing protection is standard PPE in many industrial jobs and for any use of power tools (at home or at work). Hearing protection is rated by the amount of noise reduction (in decibels, dB) provided.

PPE AT HOME

Many household and hobby materials are hazardous. Use – and encourage other to use – protective equipment appropriate to the activity. Examples include:

- gloves and goggles for wet chemicals,
- eye protection and hearing protection for target shooting or power tools, and
- sturdy boots for moving heavy materials.



DOs & DON'Ts of Lab Coats . . .

Properly worn, a lab coat covers your clothes and minimizes the risk of exposure to spills & aerosols. It also provides short-term protection from saturation by harmful substances and temporary protection against fire. Although, most lab coats are not designed to be impermeable to hazardous substances or flameproof, they can be quickly removed, isolating you from harmful exposures or flames.

To minimize exposures to harmful substances in the lab and provide some temporary protection against fire, follow these *DOs* and *DON'Ts*.

DO . . .

Do wear a lab coat at all times when working in a lab.

Do chose a lab coat based on the expected work hazards:

- A lab coats made of cotton fabric is recommended for general lab use.
- Choose a disposable lab coat when using high-hazard materials or when hazard-appropriate decontamination services are not readily available.
- Choose flame resistant fabric (*e.g.*, Nomex) if there is a significant fire potential.
- In high-hazard areas, choose a coat that has no openings for access to pockets; openings can compromise the wearer's safety.

Do choose a lab coat that covers the knees and has full-length sleeves. Ask for assistance if you're hard to fit.

Do wear lab coats completely "buttoned" up. Snap closures are preferred over buttons to allow quick removal in an emergency.

Do immediately remove a lab coat if wet, contaminated or on fire.

Do add an impervious apron (rubber or coated fabric) when there is a significant chance of exposure to corrosive materials or when working from a seated position (as in a wheelchair).

Do keep lab coats clean. If contaminated with hazardous material, coat will be decontaminated on site or disposed as a hazardous waste. Once decontaminated, coats may be laundered, separated from general laundry. For general dirt, separate from general laundry and wash frequently.

DON'T . . .

Don't use a lab coat made of synthetic fabric in a fire hazard area. Synthetic fabrics burn, melt, shrink and stick to skin.

Don't wear lab coats unbuttoned. An open coat is an invitation for hazardous exposures.

Don't roll up the sleeves on lab coats or allow shirt/sweater sleeves to protrude.

Don't wear lab coats outside the lab area or take a contaminated lab coat into a food area. Carry coat in a closed plastic bag.

Adapted from materials produced by: ***Risk Management & Safety*** THE UNIVERSITY OF ARIZONA

STUDY QUESTIONS

- What are fume hoods for and how should they be used?
- Why are lab workers instructed not to prop open lab doors for fresh air?
- Distinguish between safety glasses and splash goggles; give the important similarities and differences. Give an example of an activity where each is appropriate.
- Contact lenses are not recommended for use in the Teaching Laboratories.
    - o True
    - o False
- To protect your eyes when mixing strong caustics or acids, it is recommended you wear:
    - o Safety glasses with side shields
    - o Safety goggles
    - o A face shield with safety glasses or goggles
    - o A face shield
- When are splash goggles required in the Chemistry Teaching Labs?
- Is a Lab Supervisor (Instructor or TA) permitted to make a safety rule which is stricter than the Department Rule?
- What eye protection is required in your lab class?
- Does handling hazardous chemicals at home require protective equipment? Why/why not?
- Describe how you will apply the safety knowledge you learned from this course to your work environment or your teaching environment.
- When should you wear protective gloves in lab?
- What might happen to a students who arrives for a lab class in sandals or shorts?
- What is the minimum appropriate level of personal protection required in the Teaching Labs?
- Does the Teaching Labs Stockroom lend goggles to students who forget? What if it's your birthday?
- When are you REQUIRED to wear your safety glasses (or goggles) by departmental policy?
- What is the minimum eye protection required when you pour 30 mL of a hazardous liquid or are in danger of being splashed?
- What is the appropriate eye protection for a lab worker pouring 2L of boiling water?

HANDLING AND STORAGE:
HAZARDOUS MATERIALS & HAZARDOUS WASTES

This section supplements Chapter 8 in **LABORATORY SAFETY FOR CHEMISTRY STUDENTS** *by Robert H. Hill, Jr., and David C. Finster. John Wiley & Sons Inc., 2010.*

IN THIS SECTION:

Our rules for storing chemicals in lab.

Our rules for carrying chemicals through common areas, such as hallways.

Our system for collection & disposal of hazardous wastes generated in the labs.

Student's responsibility in storing chemicals and managing hazardous wastes.

HAZARDOUS MATERIALS STORAGE

Our plans for storing hazardous chemicals in our labs reflect our understanding that various chemical classes will react with each other, given the chance. We work to reduce the chance of unintended reactions by:

- storing bottles in secondary containers (trays or tubs that will contain spills)
- store *incompatible* items (acids & bases *or* oxidizers & fuels) separately
- Earthquake strips on shelf edges keep things from falling during a tremor.
- Bottle caps and cupboard doors should be closed whenever not in use.
- Flammable materials, which might become involved in a fire, are stored in closed cabinets, except in small quantities needed in the labs.

As a student, observe and respect the ***No Storage*** labels in certain areas in the labs; these areas are either not earthquake safe or materials stored there might interfere with fire sprinklers or other essential systems.

HAZARDOUS MATERIAL HANDLING

- Open & close bottles with care, guarding against spills.
- Keep a cap or lid in your hand while pouring or set it on a clean watch glass; this guards against contamination of the bench top and the reagent.
- Obey signs about designated areas for particular activities, such as flame tests.
- When a procedure generates a hazardous waste, collection the waste in a beaker, rinsing your glassware with an appropriate solvent. Any glassware or stir bars that fall into your beaker can be retrieved before you transfer your waste to the appropriate waste bottle.
- Clean (and report) all spills immediately (*see* **BASIC LAB PRACTICES** and **SPILL RESPONSE**).

TECHNIQUE – DISPENSE LIQUIDS. POUR FROM BEAKERS OR BOTTLES BY HOLDING A CLEAN GLASS ROD TO THE RIM OF THE POURING CONTAINER AND POURING THE LIQUID DOWN THE ROD. THIS TAKES SOME PRACTICE BUT IT ALLOWS YOU TO DIRECT THE FLOW OF LIQUID INTO THE RECEIVING VESSEL. PRACTICE WITH A SMALL BEAKER AND WATER.

REFILLS OF HAZARDOUS CHEMICALS. Despite our best efforts to have materials ready in the lab, your lab may run short of a necessary reagent. Proceed with caution and follow the techniques described below. The secondary containers are stored on a special shelf near the lab door. If your bottle is very small, set it inside a beaker in the covered box to prevent spilling.

Bottle jackets (usually red) for bottles

Boxes with lids (for smaller items).

Secondary containers for carrying hazardous materials outside the labs.

TECHNIQUE – REFILL AN EMPTY REAGENT BOTTLE. CLOSE THE EMPTY CONTAINER AND RINSE/WIPE THE OUTSIDE OF THE BOTTLE TO REMOVE ANY CONTAMINATION. CHOOSE THE APPROPRIATE SECONDARY CONTAINER AND USE IT TO CARRY THE EMPTY BOTTLE TO THE STOCKROOM SERVICE WINDOW ATTENDANT (IN YORK 3150 OR NSB 1104). REQUEST A REFILL AT THE STOCKROOM AND CARRY THE REFILLED CONTAINER BACK TO YOUR LAB IN THE SECONDARY CONTAINER. RETURN THE BOTTLE AND THE CARRIER TO THEIR PROPER STORAGE LOCATIONS.

WASTE MANAGEMENT

Wastes generated in the labs range from nearly innocuous (towels wet with water) to hazardous (flammable or toxic materials). Careful disposal of wastes protects the safety of all workers, including the essential maintenance staffs who support our lab work.

A **sharp** is any item that could cut through a plastic bag. These items include both broken items and those intended to be sharp:

- broken glassware,
- fine glass pipettes,
- needles,
- razor blades and
- any item with a sharp edge or point.

Special containers are provided in the labs for the disposal of sharps. Place broken glass and other sharps in the labeled cardboard containers provided. Capillary tubes and pipettes can be placed in the large broken glass boxes or special disposal containers may be provided. Needles

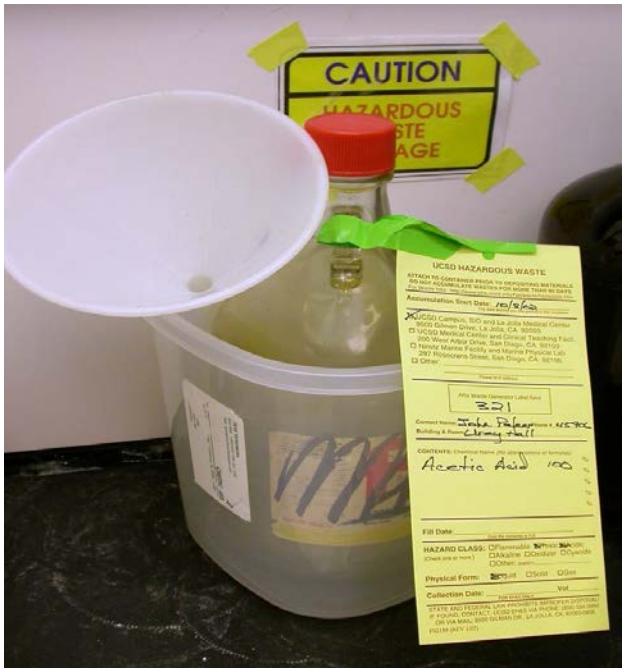
are seldom used in the Teaching Labs, but present a special public health problem in clinical labs. In any lab that uses needles, especially to draw blood, workers receive training in proper disposal.

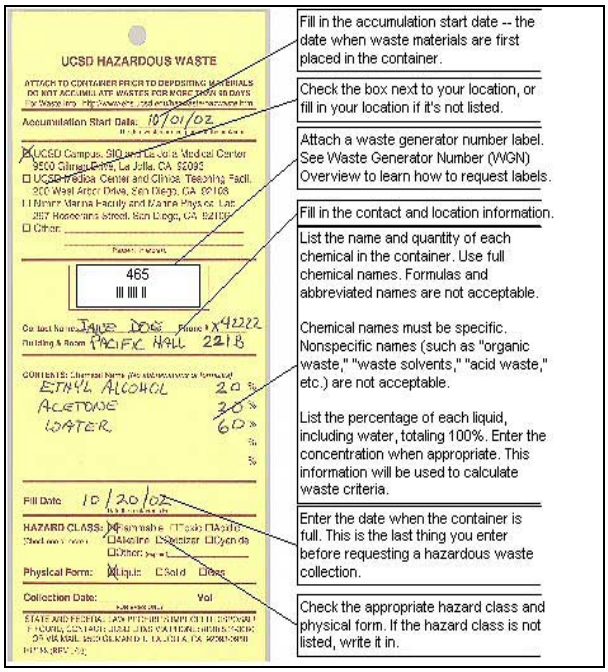
Hazardous chemical wastes. Unless you have specific instructions to “dispose to drains,” assume experimental wastes are hazardous and look for appropriate waste containers. **Chemical waste containers** are provided and labeled by the Lab Staff.

Keep each waste container in a tray (in case of spills or leaks) and keep them closed at all times, except when actually adding waste. Leaving a waste container open in a hood (". . . *because we're all using it . . . "*) does **not meet** this rule; it must be closed by each worker after each addition of waste. This practice minimizes spills, evaporation of volatile wastes, and fines by regulatory agencies.

Waste bottles are typically 4- to 20-liter bottles with descriptive labels. In addition, each will have a campus Hazardous Waste Tag, as required by law. If the tag is missing or defaced, please let the staff know so it can be replaced.

If a waste bottle is full, cap it securely and leave it in its tray; and request another bottle for that waste from the Lab Staff. If you don't see a container appropriate for your waste, ask your TA or the Lab Staff member assigned to your lab.





Excess chemicals which will not be used are ***never*** returned to the stock bottle (due to the chance of contamination); try to find someone who still needs the item, then dispose of any remaining excess in the appropriate waste container.

STUDY QUESTIONS

- In an earthquake, all bottles in a storage container may break and mix. Which of the following is an unsafe group to store together (*hint:* think about what class of chemical represents)?
  - hydrochloric acid, sulfuric acid, phosphoric acid
  - acetone, ethanol, benzene
  - ammonium nitrate, machine oil, and potassium permanganate
  - sodium chloride, calcium sulfate, potassium phosphate
  - tetrahydrocannabinol, opium, sodium barbiturate

- Which of the following factors affects our choices in storing hazardous materials?
  - Chemical compatibility
  - Safety of workers who will handle containers later
  - Earthquake safety
  - Convenience

- How would you carry an empty 1.5L bottle to the Stockroom in order request a refill of 1*M* NaOH solution? Assume NaOH (sodium hydroxide) meets at least one of the criteria for being *hazardous*.

- Why are you instructed to transfer methylene chloride only in the chemical hood?
  (Hint: good reasons would include toxicity, flammability, liquid spills, volatility; check the SDS for methylene chloride (dichloromethane, **CH_2Cl_2**).)

- Is the difference between hot and room-temperature glass visible?

- Suggest a useful strategy for handling broken or chipped glassware.

- What is the best way to deal with broken glass with a hazardous solid residue?

- What should you do with a hazardous waste generated in the Teaching Labs?

- Why are you instructed never to return chemicals to stock bottles?

- What should you do with excess hazardous solid you will not use?

  Devise a disposal strategy: You have your wash bottle of water, your spatula, and two hazardous wastes: **toxic solid** you have synthesized, dried & weighed on filter paper and a **mixture of liquids** including acid, water, and metal ions.
  You also have three hazardous waste containers labeled:
  - "DRY SOLIDS ONLY"
  - "LIQUID WASTE ONLY"
  - "ORGANIC SOLVENTS ONLY".

TECHNIQUES LAB WORKERS NEED TO KNOW

TECHNIQUE – AVOID CONTAMINATION OF REAGENT SUPPLIES. DISPENSE CHEMICALS ONLY FROM BOTTLES. NEVER RETURN CHEMICALS TO SHARED BOTTLES.

TECHNIQUE – DILUTING CONCENTRATED CORROSIVES: POUR CONCENTRATED ACID (OR BASE) INTO WATER SLOWLY AND STIR WELL; THIS PROCEDURE AVOIDS LOCAL HEATING AND SPLATTERING OF THE CORROSIVE MATERIAL. THE REVERSE PROCEDURE (ADDING WATER) CAN CAUSE SERIOUS INJURY.

REMEMBER: ALWAYS ADD ACID.

TECHNIQUE – MASSING SOLIDS: PLACE LOOSE MATERIALS (POWDERS & CRYSTALS) IN A CONTAINER - NOT DIRECTLY ON BALANCE PANS. SELECT SMOOTH PAPER OR A SMALL BEAKER, ACCORDING TO THE SIZE OF THE SAMPLE NEEDED. REMOVE THE CONTAINER FROM THE BALANCE TO ADD LOOSE MATERIAL; RETURN IT TO THE BALANCE AND RECORD THE MASS IN YOUR NOTEBOOK.

TECHNIQUE – CALL FOR EMERGENCY ASSISTANCE:

CAMPUS EMERGENCY OPERATOR WILL SEND HELP FOR MEDICAL EMERGENCIES, FIRES, PLUMBING OR ELECTRICAL PROBLEMS. STORE THIS NUMBER FOR EASY ACCESS.

TECHNIQUE – CHECK FOR ACID/BASE. TO DETERMINE WHETHER A CORROSIVE SPILL HAS BEEN THOROUGHLY CLEANED, MOISTEN THE CLEANED AREA WITH A WET SPONGE AND RUB A *p*H TEST PAPER (AVAILABLE IN LABS) ACROSS THE WET SURFACE. COMPARE THE RESULTING COLOR OF THE STRIP TO THE GUIDE ON THE PACKAGE LABEL. IF THE SURFACE IS NOT NEUTRAL, CLEAN AGAIN.

TECHNIQUE – COLLECT BROKEN GLASS. USE TONGS TO PLACE PIECES AND SHARDS INTO A CUT-PROOF CONTAINER. USE A BRUSH & DUST PAN TO COLLECT SMALL PIECES. CARRY THE SHARPS TO THE **BROKEN GLASS BOX** WITHOUT TOUCHING THE GLASS WITH HANDS.

TECHNIQUE – HOT GLASS. PLACE HEATED GLASSWARE IN A LABELED AREA, ON A MAT, OR IN A HEAT-PROOF CONTAINER WHILE IT COOLS.

TO DETECT WHETHER AN ITEM (SUCH AS A BEAKER) IS **STILL TOO HOT** TO TOUCH, HOLD A HAND SEVERAL INCHES AWAY AND SLOWLY MOVE CLOSER UNTIL YOU FEEL HEAT RADIATING FROM THE SURFACE.

USE SIMILAR PRECAUTIONS TO PROTECT SKIN WHEN WORKING WITH VERY COLD (CRYOGENIC) MATERIALS, SUCH A LIQUID NITROGEN OR DRY ICE ($CO_{2(s)}$).

THE MINIMUM LEVEL OF SAFETY PROTECTION NECESSARY TO WORK IN THE TEACHING LABS IS SAFETY EYE PROTECTION, LONG PANTS (OR EQUIVALENT), CLOSED SHOES, AND LONG (KNEE-LENGTH) LAB COAT. STUDENTS WHO ARRIVE UNPREPARED OR INAPPROPRIATELY DRESSED WILL BE DISMISSED UNTIL READY TO WORK.

TECHNIQUE – DISPENSE LIQUIDS. POUR FROM BEAKERS OR BOTTLES BY HOLDING A CLEAN GLASS ROD TO THE RIM OF THE POURING CONTAINER AND POURING THE LIQUID DOWN THE ROD. THIS TAKES SOME PRACTICE BUT IT ALLOWS YOU TO DIRECT THE FLOW OF LIQUID INTO THE RECEIVING VESSEL. PRACTICE WITH A SMALL BEAKER AND WATER.

TECHNIQUE – REFILL AN EMPTY REAGENT BOTTLE. CLOSE THE EMPTY CONTAINER AND RINSE/WIPE THE OUTSIDE OF THE BOTTLE TO REMOVE ANY CONTAMINATION. CHOOSE THE APPROPRIATE SECONDARY CONTAINER AND USE IT TO CARRY THE EMPTY BOTTLE TO THE STOCKROOM SERVICE WINDOW ATTENDANT (IN YORK 3150 OR NSB 1104). REQUEST A REFILL AT THE STOCKROOM AND CARRY THE REFILLED CONTAINER BACK TO YOUR LAB IN THE SECONDARY CONTAINER. RETURN THE BOTTLE AND THE CARRIER TO THEIR PROPER STORAGE LOCATIONS.

VIDEO RESOURCES

How do you learn? If you're a listener (auditory learner) you many find Lectures helpful, while someone who learns best by doing (a kinesthetic learner) needs hand-on practice.

For those who learn well by watching & listening to video presentations, here's a list that may be helpful.

After the Rainbow - http://www.youtube.com/watch?v=g6vR0BdRCNY&feature=youtu.be

Splash Zone - http://www.youtube.com/watch?v=5TqQT9Pfh_Q&feature=youtu.be

Stay Protected - http://www.youtube.com/watch?v=cJRXyJ9eZnM

PPE - http://www.youtube.com/watch?v=guRkqTPsFEk&feature=youtu.be

Proper lab shoes - https://www.youtube.com/watch?v=Z6mpxE9UKKQ&list=PLNhVwA0XZE27h8uh8ug8kX3362W2CAvai&index=1

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Chemical Fume Hood: How it Works to Protect You. Available in English, French, Russian, Spanish and German.

Another good video, from UC Berkeley Environment Health & Safety, is Proper Use of a Fume Hood.

LAB SAFETY WORKSHOPS. Students who learn best with hands-on activity (doers) should take advantage of the LAB SAFETY WORKSHOPS offered by the Teaching Labs Safety Program.