Zaera's Lab Safety Instruction

July 2024 (Last updated by Francisco Zaera)

- ✓ Always Wear Lab Coat in the Labs
- ✓ Wear eye protection when prescribed
- ✓ Do Not Eat in Labs
- ✓ Label All Containers with Chemical Name and Hazard Class

1. Safety Training for New Group Members

New members need to read and follow Lab Safety Manual. Please visit the Zaera group website to download the following documents.

https://zaeralab.ucr.edu/docs-manuals

0. Research Ethics
1. Introduction
2. Injury and Illness Prevention Plan
3. Chemical Hygiene Plan
4. Emergency Action Plan
5. Standard Operation Procedures (only General Lab, Hazard Classes, Processes)
6. Physical Hazards Guide
7. Zaera's Lab Safety Instructions

Once your UCR Net ID becomes available, visit the UC learning center website (http://ucrlearning.ucr.edu). Log in with your Net ID, and search for the course named "Laboratory Safety Orientation (Fundamentals)", which covers the topics listed below. You have to pass the final quiz at the end of each course. Please export your transcript to a PDF file by clicking "Training Transcript", which is under "Learn" of the menu "Learner". Provide a copy to the Lab Safety Officer.

1. Laboratory Safety Orientation (Fundamentals)
2. Chemical Hygiene Plan
3. Hazardous Waste Management
4. Injury & Illness Prevention Plan (IIPP)
5. Personal Protective Equipment (PPE)
6. Fire Extinguishers
7. Emergency Action Plan & Fire Prevention Plan
8. Fume Hood Safety

Afterwards, let the Lab Safety Officer know that you have completed the training, so (s)he can get your signature for the review and training record sheets and show you how to handle the chemical waste in our group. You need to finish all of these steps prior to starting your work in our group.

2. Laboratory Safety Manual

The "Laboratory Safety Manual" is placed, together with a chemical spill kit and a safety face shield, in each room under the "Lab Safety Manual" sign. These items are taped off with yellow caution tape and should never be removed without asking the Lab Safety Officer. "Safety Data Sheets (SDS)" and "Standard Operating Procedures (SOP)" are also available in PDF format in the folders named "SDS" and "SOP", respectively, on the desktop of the office computer in room 141. All lab workers are required to review the manual and to sign off acknowledging that they understand the contents. Also, all members must keep e-file copies of the relevant files and refer to them whenever needed. The manual includes general laboratory safety rules, maintenance, handling of hazardous waste, and general operating procedures for compressed gases, toxic chemicals, and electronic equipment. Additional useful documents for lab safety can be found at https://ehs.ucr.edu/, the web site of the UCR Environmental Health and Safety (EH&S) Department. If you have any question, consult the Lab Safety Officer. Otherwise, please contact EH&S directly (Tel: 951-827-5528). "Annual Lab Safety Self-Audit" from EH&S or Lab Safety Coordinators take place every July, so please do your best to be prepared so that the group do not have any violations to report. It is suggested that the Lab Safety Officer communicate with the group at least one week in advance so that the group can work together to address any obvious violations. This self-auditing is continued to keep the lab clean and safe to prevent any accidents in our lab. You are expected to work safely, keep your working area clean and organized, and handle and dispose of chemicals safely and by following protocol. Also work safely with instrumentation, making sure to follow safe protocol to handle electrical and mechanical objects.

3. Laboratory Hazard Assessment Tool (LHAT)

The Lab Safety Officer, on behalf of Prof. Francisco Zaera, conducts hazard assessments specific to activities in our laboratories, including when new activities are adopted, or if there is a modification to activities. The hazard assessment must occur at least once each calendar year. All the members should evaluate their specific needs, recommendations, and requirements for PPE based on their research activities. The Laboratory Hazard Assessment Tool (LHAT) identifies hazards to personnel and specifies the Personal Protective Equipment (PPE) to be used during work activities. Upon request of recertification, you will receive an email from LHAT. If so, please recertify the updated hazard assessments as soon as possible. New members get vouchers to redeem flame-resistant lab coats at the EH&S building (351-395 W Linden St, Riverside, CA 92507).

4. Purchasing Lab Supplies

If you need to buy an item, search Aldrich, Fisher, VWR, or any other UCR-approved vendor. Contact Natasha Gonzales (natasha.gonzales@ucr.edu, Office Location: 234 Chemical Sciences Bldg.) if you are unsure of which vendor may be UCR-approved. Visit their websites and find a page for the catalog number and price of the item(s) you require. You need to save the page in pdf format and send it to the Lab Purchasing Officer. You may need to get a quote (in writing or over email) if the website doesn't list the prices. We purchase gas cylinders from the campus storehouse, not the stockroom (CS 113), so contact the Lab Purchasing Officer first for the refilling of any of the gas cylinders. You can get some chemicals (not gases) and stuff from the stockroom; please notify the Lab Purchasing Officer by email if you do so.

Once you have obtained the required information on the item that you want to buy, ask the Lab Purchasing Officer to submit a purchase request. The Lab Purchasing Officer can place orders for items below $300 without Francisco's permission. For orders above $300, send the information to Francisco and get his approval first, before asking the Lab Purchasing Officer to place the order.

5. From purchasing to handling chemicals

All the chemicals, even water, have to be labeled indicating their chemical full name and their hazard information (e.g. toxic or flammable), so anyone can identify them in our lab and track them from the time of purchase. To optimize the handling and inventory of chemicals in our lab, the following procedure needs to be followed:

1. If you need to use a new chemical, report this to the Lab Safety Officer first with your own detailed protocols.
2. Read its SDS and SOP provided by the Lab Safety Officer.
3. After reviewing them, sign its acknowledgement page.
4. Check our chemical inventory using the "UC Chemicals" App to see if we already have the chemical that you are looking for and where it is located in the lab. If you don't have the app, you can download it free from your App Store. You need to log in with your UCR NetID.
5. If we already have the chemical, go to the designated place and find it. If a member's name is listed on the tags or bottle's labels, it is because it is reserved for that member. In that case, you need to ask the member first for permission prior to use.
6. Also wear all the PPE required according to its SOPs, and handle the chemical in a fume hood if needed. Make sure that you are familiar with the safety risks of handling the chemical according to its SDS, and follow appropriate procedure for its handling. You need to follow the detailed established protocol whenever you use the chemical. If any changes are required in your protocol, please update the Lab Safety Officer immediately.

Take the quantity required and return the original bottle back to its original place. It is important to replace the bottle back to its original and proper place (in the exact same shelf/row/position that you found it in), otherwise we can lose track of its location in our inventory and unnecessarily purchase additional chemicals thereby wasting money.

7. If unavailable in our lab, ask Pris if there are some in the stockroom (CS 113). When you bring any chemical from there, please notify the Lab Purchasing Officer: provide the chemical name, bottle size, and quantity. Also fill out a form for the Zaera group in the stockroom with the items and quantities you took.
8. Otherwise, ask the Lab Purchasing Officer to submit a purchase request . The Lab Purchasing Officer can place orders for items below $300 without Francisco's permission. Please request the minimum amount of chemical needed.
9. Once the purchased chemicals arrive, update the Lab Safety Officer immediately with the location of where you have store them.
10. Always keep all the chemicals in the designated places and consult with the Lab Safety Officer if there are any issues regarding the storage.
11. If you produce an empty bottle, please take a photo of its barcode and send it to the Lab Safety Officer. Please don't forget this. After that, move the empty bottle to the bottom right cabinet right next to the fume hood in room CS 135.

Usually, there is a **Safety Data Sheets** (SDS) that comes with any purchased chemical. However, this is not the case with common chemicals. Electronic (PDF) versions of the files are usually available from the website of the chemical company, and we have SDS copies for many chemicals in our lab. We don't print all the SDS, but add and keep the SDS files to the office computer and to your laptop. The Lab Safety Officer updates your chemical list, SDS, and SOP. Coordinate with them periodically to keep both your records up to date.

6. Lab Specific Training for Chemical Waste Handling (Online and Offline)

All the members are required to be trained for the handling of any chemical waste produced by their experiments. You must be familiar with the **Waste Accumulation Storage Tracking electronically** (**WASTe**) described at http://ehs.ucop.edu/waste/ during your lab specific training. This program was developed for the labeling and disposal of hazardous waste at all UC campuses. You need to use your UCR NetID to log in. Additional online training is available in UCR learning center (http://ucrlearning.ucr.edu) or at the EH&S website for hazardous waste management (https://ehs.ucr.edu/training/online/hwm/indexlms.html).

1. If you're planning experiments that will produce chemical waste, you need to prepare a proper chemical waste bottle in advance. Please do not begin using your chemicals without having a chemical waste bottle ready. We may use a single bottle for the same or compatible chemicals generated at different times, but must be careful and check for potential incompatibilities. If so, you can add your waste into the waste bottle after updating the chemical waste label with your chemical waste and hazard information. If no appropriate waste disposal bottle is available from our waste list, start one using an empty bottle of a proper size. However, you need to check inside the original bottle carefully, because a small amount of the chemical could remain at its bottom. Please check the partial list of incompatible chemicals posted at the right side of fume hood in room 135 and refer to "**Hazardous Chemical Waste Management"** in the Chemical Hygiene Plan for instructions.
2. Log in to **US Safety** (**http://ehs.ucop.edu/**) and click WASTe (Waste Accumulation Storage Tracking electronically) in the left side menus under Apps.
3. Choose "View My Tags" on Containers menu and click "Chemical".
4. Check if we already have one tag for the same chemical.
5. If so, click the tracking #.
6. See who created the waste bottle and ask (s)he if you can add to it.
7. If not, click "New Tag" and click "Chemical" for type.
8. Fill out all the information according to the hazard class of your chemical waste.
9. Click "Save & Print" to print the tag and put it in the envelope (WASTe sticker) available in the small box right next to the waste storage location in CS 137.
10. After attaching the label onto the chemical waste bottle, place it in the second basket of "flammable" or "corrosive" chemicals if applicable.
11. You may keep using the same waste bottle until reaching 80 vol. % for the same and other comparable chemical waste for 180 days. The waste bottles you create will be your responsibility, so please manage them fully as EH&S keeps monitoring the system.
12. You must move your tracking # to "Containers Ready for Pickup" on the website by clicking the arrows on the left side column if the waste bottle is close to 80% full or older than 180 days (even if it is less than 80% full). The Lab Safety Officer may request the pick-up of old waste bottles without notifying group members if needed, or EH&S may take them when they visit our lab. The tracking items move down automatically to the containers list for pickup, and then EH&S may come to pick them up without notice.

7. Chemicals and Chemical Waste Labels

When a chemical is stored in a new container other than the original bottle, that container must be labeled with the chemical full name and hazard information, even if it is water. Original chemical bottles are to be stored at designated places in rooms 135, 137, 139, 143, and 162 according to their physical phase and chemical hazardous class. Please note that the safety auditors may check any unknown chemical left without a proper label and penalize the lab for it. Therefore, all chemicals (including water) need to be properly labeled. The labeling must include the full name of the chemical and its hazardous information (except in the case of the original bottles, which are already labeled appropriately). Chemical waste containers must be placed right next to the leak detector in room CS 137. Empty bottles for chemical waste and envelopes for waste labels can be found in the bottom-right cabinet, right next to the fume hood in CS 135 and inside the small box near the waste container buckets in CS 137, respectively. Please be fully aware that some chemicals cannot be mixed, or require different solvents. A table of chemicals compatibilities is posted in the chemical waste area. We also have red-labeled plastic containers in CS 135, 139 and 162 for sharps waste such as needles. Besides, each room has a broken glass box.

8. Responsibility for Individual Equipment

All the systems in our laboratory are supervised by the assigned users. If you need to use a system or borrow anything, permission from the responsible person is required in advance. After securing permission, please review the User Guide or Manual from the person in charge or from our group website and become familiar with the system you're going to use. It is better to get the operator's help as well if possible. The responsible user is required to update the Manual of the system under his/her supervision, with proper illustrations, whenever any changes are made.

As of July 2024, the major pieces of equipment have been assigned to the members as follows. The assigned members are responsible for maintenance, repair, and managing use.

Lab Safety Officer: Tharosa Rajaratne
Lab Equipment Manager: Tharosa Rajaratne
Lab Purchasing Officer: Elly Lee

UHV Chamber #1 Victor (CS 135): Ameer Siddique
UHV Chamber #2 RAIRS (CS 135): Ravi Ranjan
UHV Chamber #3 Michelle (CS 143): Leo Winter
UHV Chamber #4 Praxis (CS 137): Tharosa Rajaratne
UHV Chamber #5 UC (CS 143): Tharosa Rajaratne
UHV Chamber #6 Nano-Reactor (CS 137): The Lab Equipment Manager
Reactor #1 ALD Films (CS 137): Elly Lee
Reactor #2 ALD Powder (CS 143): Yihan Zhou
Reactor #3 Silylation/ALD Powder (CS 143): Elly Lee
FT-IR #1 EQUINOX_RAIRS (CS 135): Ravi Ranjan
FT-IR #1 EQUINOX_Transmission (CS 135): Ravi Ranjan
FT-IR #2 TENSOR_Transmission IR Cell (CS 135): Elly Lee/Ravi Ranjan
FT-IR #2 TENSOR_HATR (CS 135): Ravi Ranjan
FT-IR #2 TENSOR_Liquid-Solid Cell (CS 135): Ravi Ranjan
FT-IR #3 TENSOR_DRIFT IR Cell (CS 137): Ravi Ranjan
FT-IR #3 TENSOR_Liquid-Solid Cell (CS 137): Ravi Ranjan
FT-IR #4 TENSOR_ZnSe-ATR (CS 143): Ravi Ranjan
FT-IR #4 TENSOR_RAIRS (CS 143): Ravi Ranjan
GC #1 Agilent-Batch Reactor (CS 135): Ravi Balaga
GC #2 Agilent-Chiral (CS 135): Ravi Balaga
GC #3 HP-UV-Vis Reactor (CS 137): Ravi Balaga
Parr-High Pressure Reactor (CS 135): Ravi Balaga
Glove Box (CS 135): The Lab Equipment Manager
BET (CS 137): Elly Lee
Catalyst Furnaces (CS 135): The Lab Equipment Manager
Centrifuge (CS 139): The Lab Equipment Manager

9. Responsibility for Common Items

Communal equipment also needs to be properly maintained. If broken or in need of service, the person in charge is required to resolve the problems in a timely manner. Users must keep all instrumentations clean and in working conditions.

As of July 2024, responsibilities for the common items are distributed as follows.

Computers & Printer (CS 141): Ameer Sidiqque

Ameer will be the Lab Computer Officer. He can help solve problems with computers, including hardware, software, and interfacing issues, and can help with decisions about the purchasing of new computers. For computers associated with specific instruments, the member responsible for that instrument is still responsible for such computer, but can solicit Ameer's help if needed. Ameer will also provide advice on software operation, compatibility issues, and other IT items.

The office computer will be used for handling all safety issues and for printing chemical waste labels only. Since wireless Internet access is available on campus, the IP addresses assigned to our laboratory should be used only for data transfer from old computers in the lab. Report to Ameer if you run out of paper or ink.

Infrared Spectrometers: Ravi Ranjan

Ravi Ranjan will be in charge of inventorying and administering our FT-IR instruments. You are still responsible for the fixing of your own FT-IR, but can ask for help from Ravi Ranjan. He will be in charge of fixing instruments not currently assigned to anybody in particular, and of coordinating activities such as laser replacement and alignment or software upgrade that may be required for more than one instrument.

Gas Chromatography Instruments: Ravi Balaga

Ravi Balaga will be in charge of inventorying and administering our GC and HPLC instruments. If in need of a GC, make sure that you figure out your needs before using the instruments. Select the appropriate column, detector, and running conditions. If we do not have what you need, develop a plan for acquiring and implementing what you need in conjunction with Ravi Balaga, and get any purchases approved by the Lab Purchasing Officer. Ravi Balaga will be in charge of evaluating the status of the instruments and bringing them up to functioning conditions.

UHV Instruments: Leo Winter

Leo will be the go-to person for all things UHV and Surface Science, with the assistance of Ravi Ranjan. The users of specific assigned UHV instruments will still be the primary caretakers of that instrument, but can consult with Leo and Ravi Ranjan if need. Leo will make sure that basic UHV supplies (gaskets, bolts, etc.) are available, and will manage the

ordering of the liquid nitrogen (together with the Lab Purchasing Officer). Leo may also act as a liaison with the machine shop if you need help with equipment design.

Tool box (CS 139): Leo Winter

Users must always return tools back to their original location/box immediately after use or before going home. Please, out of consideration to other lab members that may need them, do not leave any tools on the bench for long times; return them before the end of the day (especially if you are not using them anymore). If someone from another research groups asks to borrow one of our tools, report the details to Leo, who will keep a record of it. If Leo is not available, write the name of the borrower, the tool he/she borrowed, his/her room number, and how long they may borrow it for on the a sheet of paper and place it on the door of room 139. Users need to clean the area around the bench and floor after using the red vise, and return all wrenches to the original boxes after use. It is suggested that the Lab Equipment Manager or Leo periodically check the lab to see if members have accidentally left tools near their systems or in random locations. If so, they should kindly remind the members to follow these rules. Useful tools have gone missing in the past because of this, resulting in a waste of money and time.

Hardware Parts in drawers (CS 139): Leo Winter

Hardware parts include copper gaskets, flanges, bolts, clamps, O-rings, tubes, and feedthroughs. Consult with Leo if you need any of those. Report to Leo once their stocks are low. These should be purchased in one big order rather than individually when possible.

Mechanical Pumps: Tharosa Rajaratne

Tharosa will be in charge of inventorying, maintaining and administering our mechanical pumps. If you need a pump, check with him about availability. You are still responsible for the fixing of your own pumps. You can borrow another pump while yours is being fixed, but you need to make sure that it gets fixed in a timely manner. Tharosa will also be responsible for the oil-replacing cart (CS 135), but users need to keep the space clean to avoid making it slippery. Make sure to keep the cart clean and oil free after you are finished with it. This prevents any accidents due to slippery surfaces.

Broken Glass box 1 (CS 135): The Lab Equipment Manager,
Broken Glass box 2 (CS 137): The Lab Equipment Manager**,**
Broken Glass box 3 (CS 139): Junghyun Hong,
Broken Glass box 4 (CS 143): The Lab Equipment Manager

If the box becomes full, seal it with tape and put it next to a trash box in the hall.

Fume Hood #1 (135): The Lab Equipment Manager,
Fume Hood #2 (139): Junghyun Hong,

A user needs to stand by the fume hood while working with chemicals in it. No one should leave chemicals unattended in fume hoods or elsewhere. In case of temporarily absences, a warning message needs to be left with sufficient information about the chemicals for the benefit of other members. Clean the space after use and put the chemical bottles back in their original storage places after finishing. Don't leave any stuff in the hood for long-term storage. Keep the 6" zone clear at all times.

Oven (CS 143): The Lab Equipment Manager

Users need to keep both inside and outside clean. Report any issue to The Lab Equipment Manager.

Evaporator #1 (CS 135): The Lab Equipment Manager, **Evaporator #2 (CS 139)**: Junghyun Hong

Re-trapped solvents need to be treated as chemical waste immediately. Users are required to wash the adapter after use.

Balances (CS 137/139): Elly Lee

Review the manual if it is the first time you use them. Do not tune the balance manually as it does it automatically.

For all of you assigned to equipment, please update the manuals when any changes occur. The manuals need to be detailed, describing how to power the instrument up, turning it off, and operating it under normal circumstances. They need to describe any required maintenance and list any possible hazards, with what to watch out for and how to handle any possible problems you can foresee. The manuals must be revised at least every six months or every time you make a major change to the equipment.

It is worth reminding you that you all need to contribute to the smooth functioning of the lab as much as you can. The assignments of tasks to specific members do not release any of you from your own responsibilities to operate, maintain, and repair your own equipment. You also need to be particularly vigilant to work safely, follow the proper safety protocols, keep your working space clean, and store and dispose of chemicals appropriately. In addition to wearing flame-resistant lab coats at all times while in the lab, always wear safety glasses/goggles and nitrile gloves when handling liquid chemicals. This is especially important with regard to EH&S visits, which may be unannounced. Make sure to always keep a second pair of goggles on your desk. It is encouraged that you frequently communicate with each other about any safety concerns and correct each other if you notice any unsafe practices being carried out.