**Administrative Information**

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| --- | --- | --- | --- |
| School |  | Department |  |
| PI name |  | PI email |  |
| Lab manager name (if applicable) |  | Lab manager email (if applicable) |  |
| Locations covered by this SOP (buildings/rooms) |  |
| SOP version number |  | SOP approval date |  |
| Reviewed and approved by (name) |  | Reviewed and approved by (initials) |  |
| **Emergency contact name** |  | **Emergency contact phone\*** |  |
| Secondary emergency contact name |  | Secondary emergency contact phone\* |  |
| \* Provide emergency contact phone numbers that will be active both during normal work hours and after hours, e.g., personal mobile phone. Alternatively, give separate daytime and after-hours numbers for both contacts. |

SOP Requirements

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| **Instructions Document** | You are responsible for reading the [SOP Instructions](https://tiny.cc/usc-sop-instructions) outlining roles, responsibilities, and other important safety information. In addition, you must include that document as part of your records. |
| **Recordkeeping** | Acknowledgement forms for this SOP and any associated training are included at the end of this document. Additional copies of the forms are available online ([SOP Acknowledgement](https://tiny.cc/usc-sop-acknowledgement), [Internal Training Record](https://tiny.cc/usc-sop-training)). |
| **Customization** | It is intended that personnel add lab-specific information to the SOP template to produce a finished and functional SOP. Suggested places to add customization are highlighted in yellow throughout the document. |

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| Standard (Safe) Operating Procedure: CRYOGENS & dRY ICE |
| **Cryogens & Dry Ice** | Cryogens are substances of low boiling point, below −150 °C, −153 °C, or −180 °C (123 K, 120 K, or 93 K, respectively) depending on the definition chosen, and which are liquid by virtue of being at low temperature. In a laboratory setting, cryogenic liquids are commonly held in insulated containers and kept cold only by their heat of evaporation, which means they continually boil away at a rate proportional to the heat flux flowing into the container. Dry ice is frozen carbon dioxide. At atmospheric pressure, it sublimes to gas at −78.5 °C (194.7 K); it does not pass through the liquid phase unless the pressure is much higher. Although the temperature of dry ice is considerably above the range commonly considered cryogenic, the hazards are similar to other cryogens.Liquid [cryogen boiling points](https://gaslab.com/blogs/articles/cryogenic-safety#Cryogenic%20Gas%20Pressure,%20Density%20and%20Boiling%20Points%20Chart) at atmospheric pressure are as follows: Helium 4.2 K; neon 27.1 K; nitrogen 77.3 K; air 79-82 K (boiling range, since it is a mixture); argon 87.3 K; oxygen 90.2 K.Vacuum-insulated Dewar vessels are usually used for storage. Open-neck Dewars store liquid at atmospheric pressure; the opening is usually covered by a loose-fitting cap which excludes contaminants, but allows free escape of gas. Pressurized Dewars are closed vessels fitted with a pressure-relief valve which controls the level of pressure maintained by liquid boil-off.In some advanced cryogenic setups, active refrigeration may be used to prevent boil-off, or the boil-off gas may be re-liquefied by a mechanical system. |
| **Hazard Classification** | Refer to Section 6 (and Appendix G) of the [Chemical Hygiene Plan (CHP)](http://tiny.cc/chem-hygiene-plan) for details of the OSHA/GHS hazard classification system. **All personnel who agree to abide by this SOP are required to familiarize themselves with the contents of Section 6 of the CHP.** |
| **SDS** | Download, read, and retain Safety Data Sheets (SDSs) for the cryogens and dry ice used. SDSs from reputable cryogen/dry ice supply companies may be found online. |
| **Common Uses at USC** | (1) Liquid nitrogen (LN2 or LN) for cold traps/distillation/sublimation, tissue preparation, LN2 freezers, and miscellaneous cooling purposes in the lab; (2) Liquid helium for superconducting magnet cooling/NMR machine, and ultra-low temperature research; (3) Dry ice (often combined with acetone. ethanol, or isopropanol to increase the rate of heat transfer) for cold traps/distillation/sublimation, tissue preparation, and miscellaneous cooling purposes. |
| **Volumetric Expansion** | Cryogens expand immensely on boiling, with the gas further expanding on warming to room temperature. One liter of cryogenic liquid (or solid for dry ice) will produce the following approximate number of liters of gas on warming to room temperature at ambient pressure: Helium 700; neon 1300; nitrogen 700; argon 800; carbon dioxide 750; oxygen 800. |
| **Hazards** | Physical/exposure hazards associated with cryogens and their storage include:(1) **Explosion**: Evaporation of cryogens in closed systems can produce pressure rises of thousands of pounds per square inch (psi), and even tens of thousands of psi if the free volume is small. Trapped cryogens are easily capable of explosively bursting all common containers and pipework. (2) **Asphyxiation**: The boil-off gas may displace sufficient air to cause a hazardous, or even lethal, reduced oxygen atmosphere. Low oxygen levels are exceptionally hazardous and may cause rapid unconsciousness with no prior warning. Cold dense gas may persist in confined, ill ventilated, or low-lying spaces. Chests used to store dry ice are filled with cold carbon dioxide gas — DO NOT allow your head to enter when reaching for the last blocks of dry ice.(3) **Tissue damage**: Cryogens and dry ice are extremely cold. Contact with skin can lead to cold burns (frostbite), a painful condition caused by damage or death of frozen tissue.Brief contact with droplets of liquid nitrogen usually results in no injury as a layer of gas caused by rapid boiling prevents the liquid from directly contacting skin and limits the rate of heat transfer. Liquid nitrogen held in contact with skin (e.g. by being soaked into porous gloves or getting into open-toed shoes) may cause severe injury. Surfaces cooled by cryogens may instantly freeze to skin if touched. Dry ice pressed against skin may cause rapid cold-burn. Mixing organic liquids with dry ice allows rapid heat transfer on contact with skin and can cause severe burns.(4) **Inadvertent air liquefaction**: LN2-cooled surfaces (e.g., metal filling hose, a trap on a Schlenk line) may condense oxygen-enriched air. Liquefied air presents a fire or explosion hazard if it contacts combustible materials in the presence of an ignition source. Air inadvertently liquefied in vessels may cause pressure rise and physical explosion as the liquid evaporates. |
| **Glass Dewars: Eye Hazard** | Dewar vessels are vacuum insulated. Thus, glass Dewars are under stress due to the external pressure of the atmosphere and may implode without warning with the ejection of shards of broken glass. **Impact resistant eye protection (safety glasses or goggles) shall be worn when in the vicinity of glass Dewars.** It is recommended that glass Dewars be externally protected by a plastic or metal case, or by being wrapped in tough tape (e.g. electrical insulating tape). |
| **Open-Neck Storage Dewars** | Small (~5-20 L) open-neck metal Dewars are commonly used for storing liquid nitrogen in labs. Please refer to the [Cryogens and Dry Ice Fact Sheet](https://tiny.cc/usc-ehs-cryo-fs) for guidance on safe filling of these Dewars. Open-neck Dewars must NOT be sealed in any way or they may overpressurize and burst. If a cap is used, it must be loose fitting with adequate passage for gas release. |
| **Pressurized Dewars** | Pressurized Dewars should be operated and maintained strictly in accordance with manufacturers’ instructions and safety guidance. Safety checks, maintenance, and filling of pressurized Dewars should be done by authorized personnel who are appropriately trained and experienced. Manufacturer’s instructions and equipment operating manuals may be used as the basis of SOPs for pressurized Dewars. Pressurized Dewars are required to be seismically restrained (see below).It is essential that pressurized Dewars are not overfilled, that the pressure release valve is not iced or blocked, and that emergency overpressure relief valves or bursting disks are in good condition.Take precautions against the freezing-open of manually-operated valves. When closing cold valves, do not overtighten or thermal expansion may cause seizure after warming to room temperature. |
| **Storage and Seismic Restraint** | Cryogenic liquids shall be stored in dry areas with adequate ventilation ([CHP](http://tiny.cc/chem-hygiene-plan) Section 7). **Storage of cryogens or dry ice in non-ventilated areas (e.g. cold rooms) is not permitted.**Large open-neck Dewars\* and pressurized Dewars of any size must be seismically restrained. Liquid nitrogen freezers and cryogenic magnets should also be seismically restrained. Consult the [CHP](http://tiny.cc/chem-hygiene-plan) (Section 4) and [EH&S Compressed Gas Cylinder Storage Fact Sheet](https://tiny.cc/usc-ehs-gasCyl-fs) for more information. Email labsafety@usc.edu if there are questions about specific cases.\* In general, any open-neck Dewar too large to be easily lifted and carried by hand should be seismically restrained. |
| **Low Oxygen Alarms** | Low oxygen alarms may be required in cryogen storage and use areas, depending on quantity of cryogen, room size, local ventilation, and other considerations. If a low oxygen alarm is needed, it must be accompanied by appropriate signage inside and outside the room. A member of staff must be assigned to manage maintenance and testing of the alarm system in accordance with manufacturer’s recommendations. Email labsafety@usc.edu for more information. |
| **Transportation** | Personnel shall follow the directions given in the [Cryogens and Dry Ice Fact Sheet](https://tiny.cc/usc-ehs-cryo-fs). **Cryogens shall NOT be transported within any enclosed space in a vehicle (e.g. passenger compartment or trunk), or in elevators with occupants.**The larger sizes of handheld Dewars are heavy. Personnel should not attempt to lift or carry Dewars beyond their comfortable physical capability. To avoid back injury, follow safe lifting practice, see [Lifting and Back Safety Fact Sheet](http://tiny.cc/usc-liftsafe-fs) for guidance. Use a wheeled cart whenever possible. |
| **Other Requirements** | All persons using cryogens or dry ice shall download and read the [Cryogens and Dry Ice Fact Sheet](https://tiny.cc/usc-ehs-cryo-fs), [EH&S Compressed Gas Cylinder Storage Fact Sheet](https://tiny.cc/usc-ehs-gasCyl-fs), and [CHP](http://tiny.cc/chem-hygiene-plan) Section 4 (seismic safety requirements), Section 6 (simple asphyxiants, GHS hazard classification), Section 7 (storage of cryogens), Section 8 (PPE and attire). |
| **Special Hazards: Helium** | [Note – If you do not use liquid helium, you may customize by deleting this section]Liquid helium possesses special hazards on account of its exceptionally low temperature. Liquid helium is cold enough to freeze air to a solid, which can block pressure relief systems. Gaseous helium, close to the boiling temperature, is very dense and it expands immensely on warming to room temperature. Thus, vessels filled with cold helium gas must be vented against overpressure just the same as if they contained liquid helium.Liquid helium at USC should be confined to equipment and storage vessels specifically designed for this material. Equipment should be operated and maintained strictly in accordance with manufacturers’ instructions and safety guidance. Operations with liquid helium (e.g. transfer of liquid), safety checks, and equipment maintenance should be done by authorized personnel who are appropriately trained and experienced. Manufacturer’s instructions and equipment operating manuals may be used as the basis of SOPs for liquid helium use. |
| **Special Hazards: Liquid Air/O2** | Liquid air and especially liquid oxygen are potent oxidants that have the ability to greatly increase ferocity of combustion. Porous combustible materials soaked in liquid oxygen or air can violently explode on ignition. Materials which are very poorly combustible under normal conditions can become violently combustible or explosive if soaked in liquid air/O2. Since oxygen is less volatile than nitrogen, liquid air becomes progressively more enriched with oxygen as it evaporates. Liquid oxygen and oxygen-enriched liquid air also raise fire risk by creating an oxygen-enriched atmosphere. Note that **liquid air may be inadvertently condensed on surfaces or in vessels cooled by liquid nitrogen.**Liquid air and liquid oxygen are not normally used at USC. Before commencing work with liquid air/O2, PIs should customize this SOP with liquid oxygen/air-specific safety information and work practices. They should also provide adequate safety training and safety controls, and follow all safety recommendations provided by the supplier. If you wish to use liquid air or liquid oxygen, please contact labsafety@usc.edu for further guidance. |
| **Dry Ice Cold Baths** | Dry ice is often mixed with acetone, ethanol, or isopropanol to make slush and enable much faster heat transfer than using dry ice alone. These liquids are volatile and highly flammable and adequate precautions against fire must be taken. Acetone is significantly more volatile and has a much lower flash point (f.p. −17 °C) than ethanol (f.p. 14 °C) or isopropanol (f.p. 12 °C); therefore, avoid using acetone for this application.Dry ice slush splashed on skin may cause very rapid cooling since, unlike liquid N2, it is not effectively prevented from skin contact by a layer of gas. Serious cold burns are possible.Dry ice is very soluble in organic solvents. After all the solid dry ice has evaporated, the solvent will continue to evolve gas. Gas evolution may continue for some time even after the liquid has reached room temperature. A “classic” incident is for the liquid contents of a dry ice slush bath to be transferred to a capped bottle which subsequently explodes. Therefore, **liquid from dry ice slush baths shall be allowed to outgas in an open-neck vessel at least overnight before transfer to a capped storage bottle or a chemical waste container.** The outgassing liquid shall be appropriately labelled, for example, “Isopropanol. Flammable. Outgassing — Do not cap”. |
| **LN2 and Glass Vessels/ Traps** | Vessels cooled in liquid nitrogen may get liquid cryogen inside in one of three ways: (1) If the vessel is open to the atmosphere (intentionally, or via a crack or leak) then liquid air may condense; (2) If the vessel is connected to an argon source, or to a nitrogen source even slightly above atmospheric pressure (e.g. a Schlenk line) then liquid argon or nitrogen may condense; (3) If the vessel is closed but has a leak or crack below the level of the liquid nitrogen then liquid may directly enter.To avoid the hazards of condensed cryogen, and potential pressure rise and explosion on warming, follow the steps below:1. Before use, check vessels and pipework for cracks, leaks, and defects, and ensure valves have been properly closed or opened, as appropriate.
2. Vessels cooled in liquid nitrogen should be maintained under dynamic vacuum whenever possible.
3. Sealed vessels should be cooled with liquid nitrogen for the minimum possible time before doing one of the following:
	1. Apply dynamic vacuum if cooling needs to be continued, OR
	2. Open to the air or to a nitrogen line with bubbler, then immediately withdraw the vessel from the LN2 cooling bath and allow to warm with free escape of gas.

If neither (a) nor (b) can be done, there is always a possibility liquid cryogen has entered the sealed vessel and that it may explode on warming. In such cases, use safety glasses/goggles plus faceshield and heavy gloves. Handle vessel with tongs, if possible, and allow to warm behind a blast shield.1. At the end of use, cold traps should be backfilled with either air or nitrogen. To avoid cryogenic liquid condensation, the LN2 cooling bath should be removed as soon as possible after starting the backfilling. The trap should be allowed to warm to room temperature with provision for free escape of gas (direct vent to atmosphere if backfilled with air; bubbler of adequate capacity if backfilled with nitrogen).
2. Substitute dry ice for liquid nitrogen when possible.

**Always use impact resistant eye protection when in the vicinity of vessels cooled in liquid nitrogen.**[If you use cold-traps or other vessels cooled in liquid nitrogen you should customize this SOP with specific instructions for safe use of the apparatus, including safe backfilling and warming.] |
| **Liquid Nitrogen Freezers** | [Note – If you do not use liquid nitrogen freezers, you may customize by deleting this section.]**Storage vials in liquid nitrogen freezers may explode on warming if liquid nitrogen has entered.** Only use vials certified by the manufacturer as suitable for liquid nitrogen freezer use. Always store vials in the gas phase and never under the surface of liquid nitrogen. Use appropriate PPE (safety glasses/goggles plus face shield, lab coat, low temperature gloves) when removing vials from the freezer. Handle cold vials with tongs and keep the caps pointed away from the face and body. Place vials behind a blast shield or in a shatterproof box immediately after removing from freezer and keep in place until warmed. Follow all safety instructions provided by the freezer manufacturer and vial manufacturer [add details here].Note that depending on the contents of the vials, a vial explosion may pose a biohazard in addition to the direct physical hazard. |
| **Specific Substances** | [Add details of specific substances you will be using in the lab under this SOP] |
| **Designated Work Areas/ Signage** | For most work with cryogens and dry ice, the lab may be considered the designated working area. More hazardous work using cryogens/dry ice (e.g., work which poses risk of over-pressurization of containers) should be done at designated areas within the lab which should be signed to warn of the hazard. Appropriate engineering safety controls (e.g., blast shields) should be employed. If highly hazardous work is being performed, additional signage giving the name of the responsible individual and contact number is also recommended.Dry ice slush baths using flammable organic liquids should be used only in areas where flammable liquid use is appropriate, e.g., a chemical fume hood. See SOP for flammable liquids for more information.[Add lab-specific work area and signage information here, if needed.] |
| **Labeling** | Place appropriate internal and external signage where cryogens are being used and stored. Identify containers with the name of the cryogenic liquid (e.g., liquid nitrogen). Label templates are available at the [Chemical Labeling and Signage](http://tiny.cc/usc-chm-lbl-sign) web page. Refer to [CHP](http://tiny.cc/chem-hygiene-plan) (Section 5) for detailed requirements on hazardous materials labeling. [Add lab-specific work area and signage information here, if needed.] |
| **Unattended Experiments** | Unattended hazardous experiments should be signed according to the requirements of the [Unattended Experiments Fact Sheet](https://tiny.cc/usc-unattended-operations). |
| **Personal Protective Equipment** | Appropriate PPE shall be worn for all work with hazardous materials, in accordance with the USC [Minimum Standard](https://tiny.cc/usc-ppe-standard), [CHP](http://tiny.cc/chem-hygiene-plan), and [fact sheets](https://tiny.cc/usc-ehs-fact-sheets). Most commonly, research lab PPE consists of a lab coat, eye protection (safety glasses; goggles required if there is a splash hazard) and chemical protective gloves. A face shield may be needed in addition to goggles for severe splash hazards. Note that for reasons of safety and regulatory compliance, respirator usage is NOT permitted outside of the [USC Respiratory Protection Program](https://tiny.cc/usc-ehs-RPP-fs). Refer to the [CHP](http://tiny.cc/chem-hygiene-plan) (Section 8) and [EH&S Fact Sheets](https://tiny.cc/usc-ehs-fact-sheets) for additional information about PPE requirements.In accordance with the [Cryogens and Dry Ice Fact Sheet](https://tiny.cc/usc-ehs-cryo-fs), splash goggles are sufficient eye protection for lower hazard operations (e.g. pouring liquid N2 from an open-neck Dewar), but a face shield should be worn in conjunction with additional eye protection for higher hazard activities (e.g. dispensing liquid N2 from a pressurized Dewar).Impact resistant goggles or safety glasses shall be used when smashing dry ice into smaller pieces.Cryogenic gloves should be used to protect against contact with cold surfaces. They are NOT liquid tight and DO NOT protect against immersion in liquid nitrogen. Remove immediately if they become soaked. Nitrile gloves may be used if dexterity is needed and cold surfaces are not to be directly handled. Please refer to the [Cryogens and Dry Ice Fact Sheet](https://tiny.cc/usc-ehs-cryo-fs) and [CHP](http://tiny.cc/chem-hygiene-plan) Section 8 for more information.Refer to the [Cryogens and Dry Ice Fact Sheet](https://tiny.cc/usc-ehs-cryo-fs) for required attire and body protection.Hearing protection shall be worn for operations which create intense sound due to escaping gas (e.g. filling of pressurized Dewars). [Add details of any lab- or procedure-specific PPE rules/requirements.] |
| **Decontamination** | Cryogens evaporate cleanly leaving no residual contamination. If harmful materials are used in conjunction with cryogens, all work areas and equipment are to be cleaned and decontaminated after use. [Add details of specific decontamination/cleaning procedures, if needed.] |
| **Work Practices** | (1) Never allow any unprotected part of the body to touch exposed pipes/vessels containing cryogenic liquids. Skin that comes in contact with the cold metal may adhere to it and tear when attempting to withdraw. Handle cold objects with proper gloves; (2) Exercise caution when adding a cryogenic liquid to a Dewar at room temperature or when placing an object at room temperature into a cryogenic liquid. Either will cause the liquid to boil and splash vigorously; (3) Keep ignition sources away when handling cryogenic liquids especially liquid oxygen. Combustible materials (including the users’ clothing) may become oxygen-enriched or saturated through exposure and in the presence of an ignition source, may ignite rapidly and burn fiercely or explode; (4) Only use containers or equipment specified for cryogenic use. Containers should be filled no more than 80% capacity to protect against thermal expansion; (5) Never seal vents on containers holding cryogens/dry ice; (6) Inspect pressure relief valves on equipment (e.g., 150 L Dewar) for ice build-up. [Add details of specific work practices you will be using in the lab under this SOP. Work practices are rules which personnel are required to follow to be safe, for example, that certain procedures may not be done out-of-hours or alone. Work practices can also be a defined way of doing things, for example, diluting concentrated acids by pouring the acid slowly into water while stirring, with a prohibition on pouring water into the acid.] |
| **Experimental Procedures** | [Add details of specific experimental procedures/protocols you will be using in the lab under this SOP] |
| **Waste Disposal** | Cryogens may be safety disposed by allowing to evaporate in a fume hood. Slow evaporation in a well-ventilated room is permissible if the quantities are small.Contaminated materials shall be disposed as hazardous chemical waste. Follow all EH&S directions ([hazmat webpages](http://tiny.cc/usc-hazmat), [fact sheets](https://tiny.cc/usc-ehs-fact-sheets), [CHP](http://tiny.cc/chem-hygiene-plan)) when disposing of hazardous chemical waste. Email hazmat@usc.edu if you have questions that are not answered by EH&S online resources.[Add details of any lab-specific waste disposal rules.] |
| **Cryogen Spill Response** | A small cryogen liquid spill (e.g., one liter of liquid nitrogen in a large room) should simply be allowed to evaporate. If the liquid pools in one place it may freeze the floor and damage it — move the liquid around with a brush if this appears to be happening.Spilled dry ice should be picked up with dustpan and brush, DO NOT pick up with hands.**A large cryogen spill (e.g., a burst Dewar, NMR magnet quench, or pressurized Dewar with the outlet valve frozen open) may rapidly create a harmful or fatal low oxygen atmosphere. A small spill in a confined area may do the same. IMMEDIATE evacuation of the affected area is critical. Close all doors behind you. If any personnel become unconscious DO NOT attempt rescue as you will likely become another victim.** Remember, oxygen deficiency is not clearly sensed by humans and may cause loss of consciousness suddenly with no prior symptoms or warning. Call DPS and state the nature of the emergency. Hazmat will be dispatched with oxygen monitors and self-contained breathing equipment. |
| **Low Oxygen Alarm Response** | **If a low oxygen alarm sounds, IMMEDIATELY evacuate the area and close all doors behind you. If any personnel become unconscious DO NOT attempt rescue as you will likely become another victim.** Remember, oxygen deficiency is not clearly sensed by humans and may cause loss of consciousness suddenly with no prior symptoms or warning. Call DPS stating the nature of the emergency. Hazmat will be dispatched with oxygen monitors and self-contained breathing equipment.**If you are outside a room in which a low oxygen alarm is sounding, do NOT open the door and DO NOT ENTER, even if you think there may be a casualty in the room.** Call DPS. |
| **Cold Burn (Frostbite) First Aid** | Frostbitten areas should be gently rewarmed using warm water (37-40 °C; 99-104 °F); NEVER use hot water.* The water should feel very warm but NOT hot to uninjured areas.
* A hand or elbow can be used to test the temperature if a thermometer is not available.
* Do NOT attempt to rewarm using concentrated heat sources such as heat lamps or hot air blowers.
* Do NOT rub or massage affected areas as this may cause tissue damage.

Rewarming can take up to 30 minutes if freezing is extensive. Signs of satisfactory rewarming include skin becoming a normal color or turning red due to blood flow returning, and numbness giving way to tingling/burning/painful sensations as nerve function returns.It is recommended to always seek medical attention. Medical attention is especially important if there is persistent numbness or pain, blisters develop, the skin is broken, the cold burn is deep or extensive, or blood flow does not return after warming.For more information, see <https://www.mayoclinic.org/first-aid/first-aid-frostbite/basics/art-20056653> and <https://my.clevelandclinic.org/health/diseases/15439-frostbite>.  |
| **Emergency Response** | **Before starting work, review the** [**EH&S emergency webpage**](https://tiny.cc/usc-injury) **and the** [**1-2-3 poster**](https://tiny.cc/usc-123)**. Ensure that the 1-2-3 poster is posted in the lab.** **All personnel operating under this SOP shall familiarize themselves with these documents and webpage.****All personnel operating under this SOP shall have downloaded and read Section 10 of the** [**CHP**](http://tiny.cc/chem-hygiene-plan) (“*Emergency Response / Injury and Illness Reporting*”). This section provides information on chemical exposure response, spill response, and injury reporting.**The 1-2-3 poster, CHP Section 10, and the EH&S emergency webpage are hereby incorporated into this SOP by reference.****All personnel operating under this SOP shall have the DPS emergency number programed into their phone** (UPC 213-740-4321; HSC 323-442-1000).**Phone the DPS emergency line in an emergency!!** DPS have 24 h/day immediate communication access to primary and backup personnel on the EH&S and Hazmat on-call rota. **Do NOT call the EH&S general phone line or individual EH&S personnel in an emergency as access is not guaranteed.** |

SOP Acknowledgement

The undersigned acknowledge by their signature that they:

1. Have read, understood, have access to, and agree to abide by this SOP, AND;
2. Have read and understood the emergency response resources incorporated into this SOP by reference (“[**1-2-3 poster**](https://tiny.cc/usc-123)”, [**CHP Chapters 6 and 10**](http://tiny.cc/chem-hygiene-plan), and [**EH&S emergency webpage**](https://tiny.cc/usc-injury)), AND;
3. Will download, store, read, and thoroughly familiarize themselves with safety data sheets (SDSs) for all the hazardous materials they intend to use within the scope of this SOP.

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| **Name** | **USC ID** | **Email** | **Signature** | **Date** |
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Internal Training Record

If hazards are high or complex, or personnel have limited prior experience or training, then hands-on training should be provided on the contents of this SOP. For convenience, the training may be documented using this form, although PIs are free to keep internal training records in other formats if desired. Training may be conducted by the PI, or the PI may delegate a suitably experienced and knowledgeable lab member (e.g. lab manager or senior postdoc) as the trainer. If delegated, the PI still retains management responsibility for the quality and adequacy of the safety training.

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| Trainer name |  | Trainer position |  |
| Trainer USC ID |  | Trainer email |  |
| Trainee #1 name  |  | Trainee #1 USC ID |  |
| Trainee #1 email |  | Trainee #1 signature |  |
| Trainee #2 name |  | Trainee #2 USC ID |  |
| Trainee #2 email |  | Trainee #2 signature |  |
| Trainee #3 name |  | Trainee #3 USC ID |  |
| Trainee #3 email |  | Trainee #3 signature |  |
| Trainee #4 name\* |  | Trainee #4 signature |  |
| Trainee #4 email |  | Trainee #4 USC ID |  |
| Date training started |  | Date training completed |  |
| Type of training (delete as appropriate) | **Initial training****Refresher training** | Type of training (delete as appropriate) | **Classroom training****Hands-on laboratory training** |
| If refresher training, provide date of initial training |  | If refresher training, was the initial training hands-on in the lab? | **YES 🞏 NO 🞏** |
| Signature of trainer confirming the above named trainees have successfully completed safety training on the contents of this SOP (and any additional subjects listed below) |  |
| Date of signing by trainer |  |
| Additional subjects covered by safety training |  |
| \* If there are more than four trainees, please append an additional sign-in sheet. |