### TABLE OF CONTENTS

**CONTACT INFORMATION** .................................................................................................................................................. III

1.0 INTRODUCTION ............................................................................................................................................................ 1

1.1 PURPOSE ........................................................................................................................................................................ 1

1.2 SCOPE ........................................................................................................................................................................... 1

1.3 AVAILABILITY OF DOCUMENTS ................................................................................................................................... 1

1.4 GENERAL PRINCIPLES .................................................................................................................................................. 2

2.0 ROLES AND RESPONSIBILITIES .................................................................................................................................... 3

2.1 CHEMICAL HYGIENE OFFICER (CHO) .......................................................................................................................... 3

2.2 PRINCIPAL INVESTIGATORS AND WYSS ADVANCED TECHNOLOGY TEAM ................................................................. 3

2.3 WYSS LAB PERSONNEL ............................................................................................................................................ 4

2.4 WYSS ENVIRONMENTAL HEALTH AND SAFETY (EH&S) STAFF .............................................................................. 5

3.0 CHEMICAL HAZARD COMMUNICATION AND TRAINING .............................................................................................. 5

3.1 TRAINING ........................................................................................................................................................................ 5

3.2 SAFETY DATA SHEETS (SDS) ....................................................................................................................................... 6

3.3 LAB DOOR SIGNAGE AND CHEMICAL INVENTORY ....................................................................................................... 7

3.4 CONTAINER LABELING .................................................................................................................................................. 8

3.5 GLOBALLY HARMONIZED SYSTEM OF CLASSIFICATION AND LABELING CHEMICALS (GHS) ........................... 9

3.6 SAFETY BULLETINS .................................................................................................................................................. 10

4.0 SIGNS AND SYMPTOMS OF CHEMICAL EXPOSURE .................................................................................................. 11

5.0 MEDICAL EXAMINATION AND CONSULTATION ....................................................................................................... 11

6.0 EXPOSURE MONITORING .................................................................................................................................................. 11

7.0 RECORDKEEPING ............................................................................................................................................................ 12

8.0 LAB INSPECTIONS AND PLAN REVIEW ....................................................................................................................... 12

8.1 LAB INSPECTIONS .................................................................................................................................................. 12

8.2 PLAN REVIEW AND UPDATE .................................................................................................................................... 12

9.0 HIERARCHY OF CONTROLS ............................................................................................................................................ 13

9.1 ROUTES OF EXPOSURE ................................................................................................................................................ 13

9.2 ENGINEERING CONTROLS ....................................................................................................................................... 13

9.3 ADMINISTRATIVE CONTROLS .................................................................................................................................. 15

9.4 PERSONAL PROTECTIVE EQUIPMENT (PPE) ............................................................................................................... 16

10.0 PRIOR APPROVALS AND PROCUREMENT .................................................................................................................. 18

10.1 PRIOR APPROVALS .................................................................................................................................................. 18

10.2 PROCUREMENT .................................................................................................................................................. 19

10.3 LIST OF FLAGGED CHEMICALS .................................................................................................................................. 19

11.0 CHEMICAL STORAGE AND HANDLING ....................................................................................................................... 20

11.1 GENERAL SAFE STORAGE REQUIREMENTS OF HAZARDOUS CHEMICALS .......................................................... 20

11.2 FLAMMABLE LIQUIDS .................................................................................................................................................. 21

11.3 CORROSIVES .............................................................................................................................................................. 22

11.4 OXIDIZERS .................................................................................................................................................................... 23

11.5 PEROXIDE FORMING CHEMICALS .................................................................................................................................. 23

11.6 PIRANHA ETCH .................................................................................................................................................. 24

11.7 COMPRESSED GASES ............................................................................................................................................. 24

11.8 LIQUID NITROGEN .................................................................................................................................................. 25
11.9 DEA CONTROLLED SUBSTANCES ........................................................................................................... 25
11.10 TRANSPORTING HAZARDOUS CHEMICALS .................................................................................. 25
12.0 SAFETY PROCEDURES FOR PARTICULARLY HAZARDOUS SUBSTANCES ........................................... 26
13.0 HOUSEKEEPING ......................................................................................................................................... 27
14.0 HAZARDOUS WASTE .................................................................................................................................. 28
  14.1 WASTE IDENTIFICATION ...................................................................................................................... 28
  14.2 STORAGE AND DISPOSAL ....................................................................................................................... 28
15.0 EMERGENCY RESPONSE .......................................................................................................................... 30
  15.1 EMERGENCY EQUIPMENT ....................................................................................................................... 30
  15.2 CHEMICAL SPILL .................................................................................................................................... 30
  15.3 CHEMICAL EXPOSURES .......................................................................................................................... 31

LIST OF APPENDICES
Appendix A  Chemical Information Resources
Appendix B  Liquid Nitrogen SOP
Appendix C  Osmium Tetroxide SOP
Appendix D  Effective Use of Gloves
Appendix E  Particularly Hazardous Substances
Appendix F  Piranha Etch SOP

CONTACT INFORMATION

<table>
<thead>
<tr>
<th>Name/Title</th>
<th>Phone Number</th>
<th>E-mail</th>
</tr>
</thead>
<tbody>
<tr>
<td>University Operations 24/7 (chemical spills, releases, exposures)</td>
<td>617-495-5560</td>
<td></td>
</tr>
<tr>
<td>Mike Carr, Lab Manager</td>
<td>203-710-4224</td>
<td><a href="mailto:Michael.Carr@wyss.harvard.edu">Michael.Carr@wyss.harvard.edu</a></td>
</tr>
<tr>
<td>Simonetta Piergentili, Operations</td>
<td>617-852-1578</td>
<td><a href="mailto:sim.piergentili@wyss.harvard.edu">sim.piergentili@wyss.harvard.edu</a></td>
</tr>
<tr>
<td>Mike Lewandowski, Research Assistant</td>
<td>413-575-2805</td>
<td><a href="mailto:Michael.Lewandowski@wyss.harvard.edu">Michael.Lewandowski@wyss.harvard.edu</a></td>
</tr>
<tr>
<td>Bob Rasmussen, Director of Research Operations and the Biosafety Officer</td>
<td>617-935-9188</td>
<td><a href="mailto:Robert.rasmussen@wyss.harvard.edu">Robert.rasmussen@wyss.harvard.edu</a></td>
</tr>
<tr>
<td>Wyss EH&amp;S</td>
<td>617-432-8234</td>
<td><a href="mailto:Wyss_EHS@wyss.harvard.edu">Wyss_EHS@wyss.harvard.edu</a></td>
</tr>
<tr>
<td>Harvard EH&amp;S</td>
<td>617-496-3797</td>
<td><a href="mailto:lab_safety@harvard.edu">lab_safety@harvard.edu</a></td>
</tr>
<tr>
<td>Occupational Health Departments:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harvard University Health Services: Longwood</td>
<td>617-432-1370</td>
<td></td>
</tr>
<tr>
<td>Harvard University Health Services: Cambridge Children's Hospital Boston</td>
<td>617-495-5711</td>
<td></td>
</tr>
<tr>
<td>Children's Hospital Boston (CHB)</td>
<td>617-632-0710</td>
<td></td>
</tr>
<tr>
<td>Beth Israel Deaconess Medical Center (BIDMC)</td>
<td>617-632-3016</td>
<td></td>
</tr>
<tr>
<td>Dana-Farber Cancer Institute (DFCI)</td>
<td>617-353-6630</td>
<td></td>
</tr>
<tr>
<td>Boston University (BU)</td>
<td>617-253-8552</td>
<td></td>
</tr>
<tr>
<td>Massachusetts Institute of Technology (MIT)</td>
<td>617-726-2217</td>
<td></td>
</tr>
<tr>
<td>Massachusetts General Hospital (MGH)</td>
<td>617-732-6034* or 617-732-8501</td>
<td></td>
</tr>
<tr>
<td>Brigham and Women's Hospital (BWH)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>University of Massachusetts Medical School:</td>
<td>774-441-6263</td>
<td></td>
</tr>
<tr>
<td>Employee Health University Campus</td>
<td>508-334-6238</td>
<td></td>
</tr>
<tr>
<td>Employee Health Memorial Campus</td>
<td>508-793-6400</td>
<td></td>
</tr>
<tr>
<td>Employee Health 210 Lincoln Street</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harvard University Police Department (HUPD)</td>
<td>617-432-1212</td>
<td></td>
</tr>
<tr>
<td>Lockouts/Escort Service</td>
<td>617-432-1379</td>
<td></td>
</tr>
<tr>
<td>Facility Emergency (flood, leak, building, damage, etc.)</td>
<td>908-334-0753</td>
<td></td>
</tr>
</tbody>
</table>
Poison Control | 1-800-682-9211
---|---
BioMed Realty Trust, Inc. (BMR) Security | 617-232-0102 or 617-202-8957
Hazardous Material Emergency Response Contractor: Triumvirate Environmental. | 800-966-9282
Janitronics – Custodial Services | 781-647-5570
Able Engineering Services (Building Maintenance) | 617-735-4399

EMERGENCY HOSPITALS

**Longwood:** Brigham and Women's Hospital (BWH), Beth Israel Deaconess Medical Center (BIDMC), Boston Medical Center, Mass General Hospital (MGH)

**Cambridge:** Mount Auburn Emergency Hospital, Cambridge Health Alliance (CHA), MGH, MIT Medical, Harvard University Health Services – Pound Hall (24/7 Urgent Care)

**Note:** For University of Massachusetts Medical School, MGH and BU affiliated personnel, patients should be taken to the nearest available hospital if necessary.
1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this Chemical Hygiene Plan (CHP) is to comply with the State Occupational Safety and Health Administration (OSHA) 1910.1450 *Occupational Exposure to Hazardous Chemicals in Laboratories*, Harvard’s CHP, and provide Wyss researchers with a Wyss-specific guide to chemical hygiene in the lab.

There are instances, however, when the physical and chemical properties, the proposed use, the quantity used or the toxicity of a substance will be such that these controls may need to be modified. Professional judgment is essential in the interpretation and application of these procedures, and labs may modify or enhance these procedures to meet their specific uses and operational needs when approved by the PI or Lab Manager.

The Wyss culture is based on the premise that every member of the research community shares the responsibility for safety. As part of the community, it is important for lab personnel to be familiar with the EH&S guidelines that apply to their work and to conduct that work in the safest possible manner. The CHP is a resource to assist lab personnel in fulfilling these responsibilities.

1.2 SCOPE

The policies and procedures set forth in this CHP are applicable to all Wyss lab operations and personnel at CLS at 3 Blackfan Circle (2nd and 5th floor) in Boston and 58 and 60 Oxford Street in Cambridge.

*Lab operations:* Storage, handling or manipulation of hazardous chemicals in reactions, transfers, etc. in small quantities on a non-production basis.

*Hazardous chemicals:* Any chemical or mixture of chemicals which is classified as a physical hazard or health hazard, simple asphyxiant, combustible dust, pyrophoric gas, or hazard not otherwise as specified in Appendix A & Appendix B of the OSHA Hazard Communication Standard.

*Lab personnel:* Faculty, staff, research associates and assistants, technicians, teaching assistants, post-doctoral fellows, graduate and undergraduate students.

1.3 AVAILIBILITY OF DOCUMENTS

This document is available at the following locations:

- Wyss External Website
- Wyss Internal SharePoint
Entrance to the main labs

This OSHA factsheet covers the key elements of the Lab Standard.

1.4 GENERAL PRINCIPLES

To provide a safe environment for the Wyss community and protect surrounding property from damage, the following general principles apply to all lab personnel performing work in labs:

1. **Perform Hazard Assessment:** Prior to initiation of new experiments or procedures, an assessment of potential hazards must be performed. Appropriate protective measures, including engineering controls personal protective equipment (PPE), must be identified and implemented. Labs should develop process- or experiment-specific guidelines and protective procedures.

2. **Minimize Chemical Exposures:** Since few lab chemicals are without hazards, general precautions for chemical handling, storage and disposal should be implemented in all labs. Use of less hazardous materials, implementation of engineering controls whenever feasible, and use of PPE to avoid skin contact with or inhalation of chemicals is encouraged.

3. **Avoid Underestimation of Risk:** Even for substances with no known significant hazard, exposure should be minimized. When working with particularly hazardous substances, avoid underestimation of risk. All substances of unknown toxicity should be considered toxic.

4. **Provide Adequate Ventilation:** The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by using chemical fume hoods or other ventilation devices.

5. **Observe Established Standards:** The Permissible Exposure Limit (PEL) and Threshold Limit Value (TLV) established by OSHA and other organizations for each chemical should be observed. Where a regulatory standard does not exist, other recognized exposure limits should be followed.

6. **Follow the CHP:** Procedures described in this CHP are designed to minimize or prevent exposure to hazardous chemicals. Implementation of the CHP should be a regular, ongoing effort.
2.0 Roles and responsibilities

2.1 CHEMICAL HYGIENE OFFICER (CHO)

Harvard EH&S staff are the designated CHO who work hand-in-hand with Wyss EH&S staff. Responsibilities include:

- Provide general lab safety training and annual refreshers via the Harvard Training Portal (HTP).
- Review accidents and other potential exposure conditions reported for further investigation, exposure monitoring or input regarding appropriate corrective action after collaborating with the lab.
- Provide access to and training for the Assessment & Inspection Management System (AIMS) which tracks the following:
  - PPE Assessments
  - Lab Inspection findings and corrective actions
- Provide access to the LabPoint Placarding and Inventory system (door placards and hazardous materials inventory).
- Review procedures developed by PIs/Wyss Advanced Technology Team (ATT) members for new or particularly hazardous substances or hazardous operations.
- Provide technical expertise on subjects where Wyss EH&S and/or the Lab Safety Officer are unable to find a safe solution or procedure to the proposed work.
- Perform annual fume hood certifications
- Provide 24/7 Emergency Response: 617-495-5560 (University Operations).

2.2 PRINCIPAL INVESTIGATORS AND WYSS ADVANCED TECHNOLOGY TEAM

Each Enabling Technology Platform at the Wyss has a lead Core Faculty member, a lead senior member of the Wyss Advanced Technology Team (ATT), and additional ATT members. Working with Wyss EH&S personnel, this group is ultimately responsible for the adaptation and implementation of the CHP for each Platform and/or project, thus maintaining a safe work environment and ensuring compliance with regulatory requirements. These responsibilities include ensuring that:

- Training (section 3.1) is provided to new and current laboratory personnel and is properly documented.
- Lab personnel have adequate knowledge and information to recognize and control chemical hazards in the laboratory.
• Hazardous operations are defined and safe practices and PPE are clearly defined and provided.
• Engineering controls, safe work practices, and PPE are used to reduce the potential for exposure to hazardous chemicals.
• Lab personnel are informed of the potential hazards of the chemicals they use and are trained in safe lab practices, controls and emergency procedures.
• Lab personnel are informed of the signs and symptoms associated with exposures to hazardous chemicals used in their lab.
• Chemical waste is managed properly.
• Action is taken to correct work practices and conditions that may result in the release of hazardous chemicals.
• The PI and/or ATT members grant approval, where required, prior to the use of particularly hazardous substances in the lab.
• Lab operations are supervised to ensure that the CHP is being followed.
• Lab personnel know and follow emergency procedures.

2.3 WYSS LAB PERSONNEL

Lab personnel are those who have received a Wyss access card after completing the required training through the Harvard Training Portal and are permitted to handle chemicals in the lab following this CHP. Responsibilities of all scientists and lab personnel:
• Respect coworkers by following this CHP starting from purchasing the proper amount of chemicals, labeling, storing, and disposing of all hazardous chemicals safely.
• Understand and apply all training received.
• Understand the function and proper use of all PPE. Wear PPE when necessary.
• Develop an SOP detailing hazards, controls, and waste procedures for all experiments. This must be documented in the lab notebook.
• Report, any significant problems arising from the implementation of the SOPs.
• Report all facts pertaining to every accident that results in the exposure to toxic chemicals and any action or condition that may exist that could result in any accident.
• Report accidents to your supervisor and Lab Manager, then fill out an accident reporting form. Accidents are defined as an unplanned event that results in personal injury or property damage that could not have been prevented.
• Contact the PI, ATT staff, Wyss EH&S, or the CHO if any of the above procedures is not clearly understood.

Lab personnel and PIs share responsibility for chemical safety in their lab, including informing visitors entering their lab of the potential hazards and safety precautions to be taken.
2.4 WYSS ENVIRONMENTAL HEALTH AND SAFETY (EH&S) STAFF

The primary responsibility of Wyss EH&S staff is to provide technical support and guidance to lab personnel for the development and management of EH&S programs. EH&S staff are responsible for reviewing and updating this CHP on an annual basis and distributing any required changes to appropriate Wyss personnel. The EH&S staff offer the following services related to chemical hygiene:

- Lab safety practices and control equipment inspections are routinely conducted and properly documented.
- Copies of the up-to-date CHP and chemical hazard reference material (e.g., SDS, door placarding) are available to lab personnel.
- Review procedures developed by PI/ATTs for new or particularly hazardous substances or hazardous operations.
- Development and evaluation of SOPs.
- Laboratory inspection and audits.
- Training and information dissemination.
- Hazard and exposure assessments.
- Hazardous waste disposal.
- Accident reporting and investigation documentation.
- Emergency response:
  - Normal business hours: (c) 203-710-4224 (o) 617-732-8234; or
  - 24/7 Emergency Response: 617-495-5560.

3.0 CHEMICAL HAZARD COMMUNICATION AND TRAINING

The Wyss Institute provides lab personnel with information and training regarding chemical hazards; the purpose is to ensure that all personnel are adequately informed about the work being performed in the lab, associated hazards and actions to be taken to protect themselves during normal operations, as well as during emergencies.

3.1 TRAINING

All Wyss personnel are required to take the following trainings initially, and on an annual basis via the Harvard Training Portal (HTP):

- General Laboratory Safety: This training covers how to safely use, store, and dispose of hazardous chemicals and respond to emergencies in accordance with the regulatory requirements outlined in 29 CFR 1910.1450. It also covers an awareness of additional laboratory-based hazards that may be seen the labs and the following:
  - The Harvard CHP
  - Chemical hazard information (including container labeling and SDSs)
Hazardous waste classification and management
- Research material shipping awareness
- Wyss Emergency Evacuation (covers the Wyss Emergency Action Plan)

Lab Specific Trainings:
- Hands on training is required for high hazard chemical procedures, including Osmium tetroxide and piranha etch handling (see Appendices).
- ESL labs: new researchers working with hazardous chemicals receive a lab safety walkthrough of the ESL labs from Mike Lewandowski, Jack Alvarenga, or Scott Slimmer.
- The undergraduate and interns working in the lab receive an additional classroom training provided by Wyss EH&S.

Additionally, all new personnel receive a New Hire packet that includes the Lab Safety Checklist, which encourages lab personnel to identify all safety controls prior to working in the lab.

3.2 SAFETY DATA SHEETS (SDS)

Safety Data Sheets (SDS) are bulletins prepared by manufacturers to summarize the health and safety information associated with their products. All lab personnel who order hazardous chemicals will receive a SDS from the manufacturer. All SDSs are also made available to lab personnel here. The SDS provide basic, valuable information and should always be read prior to handling a hazardous chemical. SDS may also be obtained online from manufacturer websites. For additional resources to obtain chemical information, see Appendix A.

The following information is required by OSHA for all SDS:

1. **Identification** includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use.
2. **Hazard(s) identification** includes all hazards regarding the chemical; required label elements.
3. **Composition/information** on ingredients includes information on chemical ingredients.
4. **First-aid** measures includes important symptoms/effects, acute, delayed; required treatment.
5. **Fire-fighting** measures lists suitable extinguishing techniques, equipment; chemical hazards from fire.
6. **Accidental release** measures lists emergency procedures; protective equipment; proper methods of containment and cleanup.
7. **Handling and storage** lists precautions for safe handling and storage, including incompatibilities.
8. **Exposure controls/personal protection**
9. **Physical and chemical properties** lists the chemical's characteristics.
10. **Stability and reactivity** lists chemical stability and possibility of hazardous reactions.
11. **Toxicological information** includes routes of exposure; related symptoms, acute and chronic effects; numerical measures of toxicity.
12. **Ecological** information
13. **Disposal** considerations
14. **Transport** information
15. **Regulatory** information
16. **Other information**

Consult with the [Wyss EH&S](#) to apply this general information to the experiment.

### 3.3 LAB DOOR SIGNAGE AND CHEMICAL INVENTORY

All rooms containing hazardous chemicals are labeled with a National Fire Protection Association (NFPA) diamond that gives an overview of key chemical hazards contained within that space. These postings have four chemical hazard types indicated by colors:

- Red: Flammability Hazard
- Blue: Health Hazard
- Yellow: Reactivity Hazard
- White is reserved for special hazards

The rating is on a scale from 0-4, where zero indicates no hazard and four indicates a high hazard.

The Lab Manager updates these placards with information provided during the biannual chemical inventory that is conducted by a third party vendor.
3.4 CONTAINER LABELING

Container labeling is essential for basic hazard communication, determining substances that no longer have a use, or identifying substances in the event of a lab spill or incident. Chemical labels must remain on containers at all times and be written legibly in English.

3.4.1 Stock Solutions and Mixtures

The Wyss requires all stock solutions or chemical mixtures (i.e. mobiles phase solutions, spray bottles, and chemical mixtures) to be labeled:

- Full chemical name.
- Hazard class or concentration.

3.4.2 Chemicals Ordered from a Vendor

Although chemicals ordered from a vendor will have pertinent information on the labels, when the chemical is received in the Wyss laboratories, it should be labeled with the lab members name and date for best practice. All chemicals supplied by a chemical manufacturer, contract research organizations (CRO), or vendor will include the following information and are in accordance with the GHS standard:

- Full chemical name.
• Name and address of the chemical manufacturer or other responsible party.
• Signal Word.
• Pictogram.
• Hazard and precautionary statement for each hazard class and category.

3.5 GLOBALLY HARMONIZED SYSTEM OF CLASSIFICATION AND LABELING CHEMICALS (GHS)

The GHS is an international approach to hazard communication, providing agreed criteria for classification of chemical hazards, and a standardized approach to label elements and SDS. The GHS was negotiated over a multi-year process by hazard communication experts from many different countries, international organizations, and stakeholder groups. It is based on major existing systems around the world, including OSHA’s Hazard Communication Standard (HCS) and the chemical classification and labeling systems of other U.S. agencies. Three changes that apply to Wyss Institute personnel are:

- Material Safety Data Sheets (MSDS) are now Safety Data Sheets (SDS) with 16 standardized sections and terminology (see SDS section for these sections).
- The GHS hazard classification in Section 2 of SDS are in reverse order of the NFPA diamond hazards (found in Section 16):

<table>
<thead>
<tr>
<th>NFPA Hazard Ratings</th>
<th>GHS Hazard Classifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>Severe Hazard</td>
</tr>
<tr>
<td>3</td>
<td>Serious Hazard</td>
</tr>
<tr>
<td>2</td>
<td>Moderate Hazard</td>
</tr>
<tr>
<td>1</td>
<td>Slight Hazard</td>
</tr>
<tr>
<td>0</td>
<td>Minimal Hazard</td>
</tr>
</tbody>
</table>

- There are nine standard pictograms under the GHS to convey the health, physical and environmental hazards:

<table>
<thead>
<tr>
<th>HCS Pictograms and Hazards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Health Hazard</strong></td>
</tr>
<tr>
<td>• Carcinogen</td>
</tr>
<tr>
<td>• Mutagenicity</td>
</tr>
<tr>
<td>• Reproductive Toxicity</td>
</tr>
<tr>
<td>• Respiratory Sensitizer</td>
</tr>
<tr>
<td>• Target Organ Toxicity</td>
</tr>
<tr>
<td>• Aspiration Toxicity</td>
</tr>
<tr>
<td><strong>Flame</strong></td>
</tr>
<tr>
<td>• Flammables</td>
</tr>
<tr>
<td>• Pyrophorics</td>
</tr>
<tr>
<td>• Self-Heating</td>
</tr>
<tr>
<td>• Emits Flammable Gas</td>
</tr>
<tr>
<td>• Self-Reactives</td>
</tr>
<tr>
<td>• Organic Peroxides</td>
</tr>
<tr>
<td><strong>Exclamation Mark</strong></td>
</tr>
<tr>
<td>• Irritant (skin and eye)</td>
</tr>
<tr>
<td>• Skin Sensitizer</td>
</tr>
<tr>
<td>• Acute Toxicity (harmful)</td>
</tr>
<tr>
<td>• Narcotic Effects</td>
</tr>
<tr>
<td>• Respiratory Tract Irritant</td>
</tr>
</tbody>
</table>

Wyss Chemical Hygiene Plan – July, 2018
### 3.6 SAFETY BULLETINS

To bring awareness to safety and recent incidents, Wyss EH&S staff create safety bulletins that are posted on LCD screens, in common areas, and in labs that share recent Wyss lab incidents or near misses. See example below.

**Sulfuric Acid Spill at the Wyss?**

Sulfuric acid, stored and hidden above eye level, was pulled down when reaching for a piece of equipment. The glass bottle shattered and acid spilled on the floor. Researcher did not expect acid to be stored here and had no PPE on – luckily, the researcher was in long pants and not wearing shorts or open top shoes!

**Acid Storage and Handling:**
1. Store segregated from incompatibles in acid cabinet
   - Small amounts on a bench? Store clearly labeled within secondary containment!
2. Always handle within a fume hood with PPE!

**Chemical Labeling:**
1) Full chemical name 2) concentration 3) your name

**Your Responsibility During a Spill:**
1. Can you identify what spilled?
2. Does it present an immediate hazard to yourself or coworkers?
3. Notify coworkers and clear the immediate area
4. Contact anyone from Operations or use the 24/7 number posted in labs: 617-495-5560

<table>
<thead>
<tr>
<th>Hazardous to Ozone Layer (Non Mandatory)</th>
<th>Exploding Bomb</th>
<th>Corrosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Gases under Pressure</td>
<td>• Explosives</td>
<td>• Skin Corrosion/Burns</td>
</tr>
<tr>
<td>• Corrosive to Metals</td>
<td>• Self-Reactives</td>
<td>• Eye Damage</td>
</tr>
<tr>
<td>• Organic Peroxides</td>
<td>• Organic Peroxides</td>
<td>• Corrosive to Metals</td>
</tr>
<tr>
<td>Flame over Circle</td>
<td>Skull and Crossbones</td>
<td>Environment (Non Mandatory)</td>
</tr>
<tr>
<td>• Oxidizers</td>
<td>• Acute Toxicity (fatal or toxic)</td>
<td>• Aquatic Toxicity</td>
</tr>
</tbody>
</table>

An in-depth guide to GHS pictograms and label elements can be found [here](#).

---

Wyss Chemical Hygiene Plan – July, 2018
4.0 SIGNS AND SYMPTOMS OF CHEMICAL EXPOSURE

Lab personnel must be aware of the signs and symptoms of exposure to the chemicals they use. The hazards of lab chemicals can be ascertained by referring to labels and chemical hazard reference material such as SDS. In addition, the ability to recognize the signs and symptoms of chemical exposure is critical, so if adverse effects do arise despite all precautions taken to avoid exposure, those effects can be recognized early and appropriate action can be taken.

If chemical exposure has occurred:
- Seek prompt medical attention at University Health Services or a local hospital.
- Contact the PI, ATT staff, Wyss EH&S staff, or the CHO.

Some signs and symptoms of chemical exposure include:
- Skin that has become dried, whitened, reddened, swelled, blistered, and itchy or exhibits a rash.
- A chemical odor. Many chemicals can be smelled at concentrations well below harmful levels. On the other hand, a chemical may be present without a detectable odor.
- A chemical taste. Some chemicals have characteristic tastes.
- Tearing or burning of the eyes.
- Burning sensations of the skin, nose or throat.
- Cough.
- Headache or dizziness.

5.0 MEDICAL EXAMINATION AND CONSULTATION

The Wyss Institute complies with all policies and procedures regarding medical examination and consultation when necessary as detailed in Section 4.0 of the Harvard CHP. For questions or more details, please contact the CHO or Wyss EH&S.

6.0 EXPOSURE MONITORING

The Wyss Institute complies with all policies and procedures regarding exposure monitoring as detailed in Section 5.0 of the Harvard CHP. For questions or more details, please contact the CHO or Wyss EH&S.
7.0 RECORDKEEPING

The Wyss complies will all policies and procedures regarding recordkeeping as detailed in Section 6.0 of the Harvard CHP. For questions or more details, please contact the CHO or Wyss EH&S.

8.0 LAB INSPECTIONS AND PLAN REVIEW

8.1 LAB INPSECTIONS

8.1.1 Harvard EH&S Inspections

In order to evaluate the implementation and effectiveness of the CHP, Wyss Institute lab personnel, lab supervisors, the CHO, or Wyss EH&S staff will conduct inspections at least annually to review lab safety practices. Lab inspection checklists are available here.

8.1.2 Wyss EH&S Inspections

Periodic, random safety inspections are conducted in cold rooms, wet benches, tissue culture rooms, fume hoods etc. by Wyss EH&S staff or the Wyss Biosafety Officer (BSO) when walking through the labs. Typically, the inspection findings and notifications to lab personnel are conducted via email with a follow-up in person. Minor infractions (such as improper container labeling, flammables in a cold room, improper PPE when handling LN₂ etc.) are addressed immediately in person. This technique of intervening during an unsafe act, is one of the most efficient ways to promote best laboratory practices, and a team-driven safety culture.

8.2 PLAN REVIEW AND UPDATE

The PI, ATT, CHO or Wyss EH&S staff must review the CHP annually and, if necessary, update lab-specific SOPs when particularly hazardous substances are introduced into or removed from the lab or when experimental procedures involving particularly hazardous substances change. Changes to the CHP will be based on regulatory changes, changes in Wyss Institute or University-wide safety policies and practices, as well as from feedback from lab personnel and lab inspection results.
9.0 HIERARCHY OF CONTROLS

9.1 ROUTES OF EXPOSURE

Handling of hazardous chemicals requires a multi-tiered approach to create a safe working environment. When controlling physical and health hazards it is important to identify all possible ways a hazardous chemical can affect the body. There are four primary routes of exposure. Many hazardous chemicals may affect people through more than one of these routes of exposure:

- Inhalation
- Absorption through the skin or eyes
- Ingestion
- Injection: e.g., skin punctured by a contaminated sharp object or uptake through an existing wound.

In research and development, occupational exposure most often occurs by absorption or inhalation. The Wyss Institute mitigates employee risk by instituting the use of engineering controls in combination with administrative controls, and the use of PPE. When these controls are properly followed in the lab, occupational exposure to potentially hazardous substances should not occur.

9.2 ENGINEERING CONTROLS

Engineering controls include “built-in” systems. These controls offer the first line of protection and are highly effective controls to reduce occupational exposure. When properly using the following engineering controls, minimal special procedures or actions on the part of the user are needed.

9.2.1 General Laboratory Ventilation

All labs in which hazardous materials are used must have fresh air ventilation with multiple amount of air turn overs per minute (typically 6-10). Labs are kept under negative pressure compared to public areas (i.e., hallways and office areas to prevent the spread of hazardous vapors and particulates). Notify the Wyss Lab Manager or Associate Director of Facilities if the Heating, Ventilation, and Air Conditioning (HVAC) system is not properly working within the lab.

9.2.2 Substitution

Substitution of currently-used materials with less hazardous materials is one of the most effective ways of eliminating materials that are toxic or pose other hazards. This process must be conducted with the PI, ATT, Wyss EH&S staff or the CHO. Careful considerations must be made when deciding what chemical substitutes may be useful:
• Effectiveness: Will the chemical meet the technical requirements (e.g., solubility, drying time) for the job or process?
• Compatibility: The substitute must not interfere or react with the process, the other materials or the equipment.
• Existing Control Measures: Existing control methods may not adequately control the substitute (e.g., a less toxic substitute may evaporate more rapidly and the existing ventilation system may not adequately capture the vapors).
• Economic Viability: Is the investment worth the reward as it pertains to level of employee protection, and can it fit in the department’s current and future budget.
• Waste Disposal: Will the current waste disposal system meet technical and regulatory requirements when dealing with any new waste created by using the substitute?
• Hazard Assessment: A hazard assessment should be done to decide whether to substitute a different chemical or material.

9.2.3 Chemical Fume Hoods

Chemical fume hoods are designed to exhaust 100% air from the workers breathing zone when used properly. A properly functioning fume hood that is being used correctly will eliminate volatile liquids, dusts and mists. Fume hoods are evaluated and certified by Harvard EH&S at the time of installation and on an annual basis thereafter. Each fume hood should have a current calibration sticker that indicates the hood has been inspected within one year (365 days) of the certification date. The fume hoods also have a marker that indicates the highest point to which the sash can be raised and still maintain proper hood functioning.

To reduce occupational exposure, the following rules must be followed when working at a fume hood:
• Always wear a lab coat, safety glasses, and appropriate gloves.
• Fume hoods must not be used for chemical storage;
• Always keep hazardous chemicals > 6 inches behind the plane of the hood sash;
• Never put your head inside an operating fume hood. The plane of the sash is the barrier between contaminated and uncontaminated air;
• Work with the hood sash in the lowest or narrowest position. The sash acts as a physical barrier in the event of an accident.
• Only use material and equipment actively in use;
• Whenever possible, keep equipment i.e. stirrers, scales, etc. raised off the service of the hood. This will allow for proper air circulation.
• Do not use large equipment in the hood, unless the hood is specifically designated for this purpose. Large obstructions can change the airflow pattern.
• Always shut the sash when not actively working in the hood to conserve energy.
9.2.4 Other Ventilation Devices

In addition to fume hoods, some labs utilize snorkel ventilation ducts to exhaust contaminants at the point of generation. Snorkel ducts do not provide the same level of protection as chemical fume hoods and must only be used for specific processes. Certain labs also utilize contained glove box units for working under an inert environment, working with very toxic substances in a completely closed system or for creating a stable, breeze free environment.

The PI/ATT and Wyss EH&S staff must conduct hazard assessments to determine if additional ventilation devices should be implemented with any new work processes.

9.3 ADMINISTRATIVE CONTROLS

The next level of defense for health and safety are the administrative controls. These controls consist of training, policies, and procedures. They are not generally as reliable as engineering controls since the user has to carefully follow the appropriate procedures and must be fully trained and aware in order to do so.

While general guidelines are detailed in this plan, there are specific SOPs developed that provide written instructions that detail steps that must be performed during a given procedure. Any chemicals listed in section 10.3 must be approved by Wyss EH&S and develop an SOP using the template ‘Lab SOP Template’ here.

When handling any substances that fall under the scope of the SOPs listed below, the researcher must review and read the SOP prior to conducting an experiment. SOPs are developed and approved by the PI, ATT staff, and Wyss EH&S staff.

- Peroxidizable Materials
- Liquid Nitrogen Handling – Appendix B
- Osmium Tetroxide – Appendix C
Additional SOPs provided by Harvard EH&S that Wyss Institute personnel must follow are located [here](#).

### 9.4 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The use of PPE is necessary when feasible engineering and administrative controls are unavailable or if there is a need to supplement those controls. The Wyss Institute provides proper PPE for all lab personnel.

#### 9.4.1 General Lab Attire

To enter the lab, all personnel must have their feet covered, coverage down to the knees. Shirts that expose midriff or sleeveless shirts are prohibited. In addition:

- Contaminated protective clothing must be disposed of properly (contact Wyss EH&S).
- Long hair must be tied back, and loose clothing and jewelry must be confined.

#### 9.4.2 PPE Assessments

PPE assessments are conducted by PIs, ATT staff (or designee), and required PPE is posted at the entrance to each lab. The Harvard University Personal Protective Equipment Policy should be referenced and includes a selection guide for appropriate PPE required by task.

#### 9.4.3 Use and Maintenance

PPE must be kept clean and stored in an area where it will not become contaminated. PPE must be inspected prior to use to ensure it is in good condition. It should fit properly and be worn properly. If it becomes contaminated or damaged, it should be cleaned or repaired when possible, or discarded and replaced.

#### 9.4.4 Lab Coats

Lab coats are provided in the main hallways of the Wyss Institute’s facilities outside the labs. A third party vendor provides clean lab coats and removes the soiled lab coats on a weekly basis. Typically, lab personnel write their name on tape attached the neck of their lab coat. Fire proof blue lab coats are also available on the 5th floor of CLS for work involving open flames or flammable material. Additional lab coat requirements:

- Lab coats must be worn at all times when working at a fume hood or on equipment within a fume hood alcove to be protected from work hazards in the surrounding environment.
• Lab coats must not be worn in common areas: e.g., cafeterias, bathrooms, kitchen areas, outside, conference rooms, break rooms, and carpeted surfaces.
• Do not bring lab coats home. The risk is contaminating someone outside of the lab and creating a liability issue.

9.4.5 Eye Protection
Eye protection must be worn in the lab whenever there is a potential for eye contact with liquids and/or particulates (e.g., when working in a chemical fume hood). Safety glasses are provided at every entrance to the main labs.

• Prescription Glasses If a person wears prescription glasses, they must wear prescription safety glasses or safety glasses or goggles that fit over the prescription glasses.
• Goggles are recommended when working with volatile substances that irritate the eyes, as well as for protection against irritating dusts or spattering or splashing of hazardous materials.
• Safety glasses and goggles have only a limited application and do not offer full protection against all hazards.

For particularly dangerous operations such as distilling at high temperatures, under reduced pressures, or when distilling corrosive liquids, full-face shields of an approved type are to be worn in addition to the eye protection discussed above.

9.4.6 Protective Gloves
The Wyss Institute provides various sizes of nitrile gloves in the general stock room on the 5th floor of CLS. These will provide protection from most hazards in Wyss labs. To protect against exposure to specific reagents, researchers should refer to the glove manufacturer’s glove charts and the NIOSH database to select a glove appropriate for use with the reagent in question (see Appendix E for helpful tips regarding glove selection and the Ansell glove compatibility chart). There is no glove currently available that will protect against all chemicals for all types of tasks.

Note the following:
• Check gloves for leaks before/during use.
• Change gloves frequently.
• Double glove if necessary.
• Be alert to unusual sensations in the hands.
• Follow the “one glove rule” and do not touch lab door handles, light switches, sink handles, and telephones with gloves. Even if they are clean, the perception from others is that they are contaminated.
• Cryo gloves are available at all liquid nitrogen dispensing areas to protect against burns.

**Glove Disposal:** Gloves that have not been contaminated can be disposed of in the regular trash. Gloves contaminated with a hazardous chemical must be collected and disposed of as hazardous waste.

**Latex Alert:** Latex (i.e., several protein antigens) has been shown to be a sensitizer. In order to best protect workers from becoming sensitized, powdered latex exam gloves are PROHIBITED in the Wyss labs. Powder-free latex gloves may be used where appropriate.

### 9.4.7 Respirators

The Wyss Institute does not conduct work where respirators are necessary. Required use of a respirator is the responsibility of the PI, ATT staff and/or Wyss EH&S staff. There are many regulatory requirements surrounding respiratory protection to ensure they are worn safely and properly. Contact **Wyss EH&S** for further instruction. N95 respirators (commonly referred to as dust masks) fall under the Respirator class, as defined by OSHA:

![N95 Respirator](image)

### 9.4.8 Other Personal Protective Equipment

Other PPE must be used as needed. Safety shields are recommended for use whenever solvent or vacuum distillations are being run in glass equipment or whenever large glass vessels are subjected to a vacuum. Safety shields should also be used during reactions involving unknown characteristics or that contain toxic materials.

### 10.0 PRIOR APPROVALS AND PROCUREMENT

#### 10.1 PRIOR APPROVALS

Lab personnel must obtain prior approval from the PI or ATT staff to proceed with purchasing a hazardous chemical they have not handled previously or performing a lab procedure when:

• Working with Particularly Hazardous Substances (PHS), see **Appendix E** for details.
• Working alone with PHS or hazardous procedures.
• Performing particularly hazardous procedures (i.e., piranha etch, potential for violent reactions).

The CHO and Wyss EH&S staff are available to assist researchers in reviewing hazards associated with any procedure, equipment or chemical to be used in the lab to ensure that appropriate safety procedures are established.

10.2 PROCUREMENT

Lab personnel are permitted to purchase chemicals through HCOM. The smallest amount needed should be purchased for the experiment. Never purchase a bulk order just because it is discounted, since in most cases, those chemicals are never used and must be discarded as hazardous waste. When the chemical is received, it should be labeled with the researcher’s name and date, this provides very useful information when organizing chemical storage cabinets.

10.3 LIST OF FLAGGED CHEMICALS

Wyss EH&S staff provide a list of chemicals that require approval via from Wyss EH&S prior to ordering:

- Ammonium vanadate [or Ammonium metavanadate or Vanadic acid]
- Butadiene
- Butyl lithium
- n-butyl lithium
- t-butyl lithium
- Chloroprene
- Divinyl acetylene
- Divinyl Ether
- Hydrofluoric Acid
- Isopropyl Ether
- Methacrylate
- Perchloric Acid
- Picric Acid
- Phosgenes
- Potassium Cyanide
- Potassium Amide
- Potassium Cyanide
- Potassium Metal
- Sodium Amide
• Sodium Azide
• Sodium Cyanide
• Sodium Hydride
• Sodium Sulfide
• Tetrafluoroethylene
• Vinylidene chloride
• Ammonium vanadate [or Ammonium metavanadate or Vanadic acid]

11.0 CHEMICAL STORAGE AND HANDLING

Storage guidelines are included for materials that are flammable, oxidizer, corrosive, reactive, explosive, and highly toxic. The SDS should always be consulted when doubts arise concerning chemical properties and associated hazards.

Keep in mind that most chemicals have multiple hazards and a decision must be made as to which storage area is most appropriate for each specific chemical.

Determine the appropriate storage area using the following priorities:

• **Flammability.** When establishing a storage scheme, the number one consideration should be the flammability characteristics of the material. If the material is flammable, it should be stored in a flammable cabinet.
• **Isolate.** If the material will contribute significantly to a fire (e.g., oxidizers), it should be isolated from the flammables. If there were a fire in the lab, response to the fire with water would exaggerate the situation, so the water reactive material must be isolated from water.
• **Corrosivity.** Next, determine the corrosivity of the material, and store accordingly.
• **Toxicity.** Determine the toxicity of the material, with particular attention paid to all regulated materials. In some cases, this may mean that certain chemicals must be isolated within a storage area.

For example, a material that is an extreme poison but is also flammable, should be locked away in the flammable storage cabinet to protect it against accidental release. There will always be some chemicals that will not fit neatly in one category or another, but with careful consideration of the hazards involved, most of these cases can be handled in a reasonable fashion. Contact Wyss EH&S for help.

11.1 GENERAL SAFE STORAGE REQUIREMENTS OF HAZARDOUS CHEMICALS

• Chemical fume hoods should not be used as a general storage area for chemicals, as this may seriously impair the ventilating capacity of the hood.
• Prohibited to routinely store chemicals on bench tops.
• Prohibited to store chemicals above eye level.
• Prohibited to store chemicals on the floor.
• Highly toxic chemicals or corrosives should be stored in unbreakable secondary containers.
• Chemicals must be stored at an appropriate temperature and humidity level and should never be stored in direct sunlight or near heat sources, such as lab ovens.
• Incompatible materials should be stored in separate cabinets or segregated using secondary containment (e.g., nitric acid and sulfuric acid can be stored together in an acid cabinet, but they must be segregated).
• All stored containers and research samples must be appropriately labeled and tightly capped to prevent vapor interactions and to alleviate nuisance odors.
• Flasks with cork, rubber or glass stoppers must not be used because of the potential for leaking.

11.2 FLAMMABLE LIQUIDS

Flammable liquids are defined as those liquids with a flash point of 140 °F (60 °C) or less and having an absolute vapor pressure of not more than 40 psi at 100 °F (37.8 °C). Common examples include acetone, ethanol, isopropyl alcohol, and acetonitrile.

11.2.1 Storage

Flammable storage cabinets are located under every fume hood and various standalone cabinets throughout the labs. These are mainly shared cabinets, make sure to label the chemicals with name and date.

• All flammable materials must be stored within flammable storage cabinets. This is to eliminate a source for fire and minimize the spreading in the event of a fire.
  o One exception is storing 70% ethanol under sinks in tissue culture rooms and in spray bottles.
• Only the amounts needed for the current procedure should be kept on bench tops and the remainder should be kept in flammable storage cabinets, refrigerators, or freezers that are approved for the storage of flammable substances, or “intrinsically safe”.
  ▪ Wyss facilities at both Boston and Cambridge sites provide intrinsically safe refrigerators.
• Flammables or combustibles must be segregated from oxidizing acids and oxidizers.
11.2.2 Handling

- Always handle within a fume hood. This will contain a spill if it occurs, compared to an open lab bench.
- Flammable substances must be handled only in areas free of ignition sources (e.g., away from open flames and static charge).
- Flammable substances should never be heated using an open flame. Heating mantles, oil baths, safety hot plates, and steam baths should be used. When heating either by steam bath or hot plate, use a filter or distilling flask as a receiver. Such distillations must be carried out in a fume hood.
- Boiling chips or glass beads are helpful in distilling or evaporating flammable substances to prevent superheating and bumping.

Note: Contact CHO or Wyss EH&S about storage and handling of flammable solids.

11.3 CORROSIVES

11.3.1 Storage

There are various corrosive, acid, and base cabinets in the Wyss Institute labs. In labs where cabinets are labeled corrosive, acids and bases can be stored within secondary containment and segregated from incompatibles. These cabinets are mainly shared, so containers must be labeled with full name of the chemical, chemical concentration, researcher’s name, and the date received.

- Corrosives should not be stored above laboratory bench level. Small amounts of corrosives can be on a bench, but they must be stored below eye level in secondary containment and segregated from incompatibles.
- Acids must always be segregated from bases and active metals (e.g., sodium, potassium, magnesium) must be segregated from chemicals that could generate toxic gases upon contact (e.g., sodium cyanide, iron sulfide).
- Specific types of acids require additional segregation. Mineral acids must be segregated from organic acids and oxidizing acids must be segregated from flammable and combustible substances.
11.3.2 Handling

- Wear safety glasses and nitrile gloves. Rare circumstances occur where additional hand protection is necessary. Always consult the SDS or with Wyss EH&S when handling a chemical for the first time for information about additional PPE.
- Always handle within a fume hood
- Do not mix with incompatibles.
- Corrosive materials should not be heated or handled in large, fragile containers (e.g., four-liter beakers) without providing a secondary containment to catch the contents in case of breakage.
- Porcelain dishes should not be used as cleaning baths.

11.4 OXIDIZERS

Store oxidizers (e.g., hydrogen peroxide, ferric chloride, potassium dichromate, sodium nitrate) in a cool, dry place and kept away from flammable and combustible materials, such as wood, paper, Styrofoam, plastics, flammable organic chemicals, and away from reducing agents, such as zinc, alkaline metals, and formic acid.

11.5 PEROXIDE FORMING CHEMICALS

Peroxide-forming compounds are examples of chemicals that present special problems in the lab because they can be violently reactive or explosive. They are generally low-power explosives that are sensitive to shock, sparks, or other accidental ignition. Each Wyss researcher is responsible for managing peroxides they order by following the Harvard Peroxide Lab Safety Guideline. Peroxide tags are located on every flammable storage cabinet, as shown below.

Key guidelines:

- Containers must be dated when received using the provided peroxide tags as shown in the image below. Dispose of the substance after 1 year if never opened.
- Containers must be dated when first opened on the peroxide tag. Once opened, dispose after 6 months.
- If users want to keep their peroxidizable material after disposal recommended date, the chemical must be tested weekly for peroxide formation.
- If an old container of peroxide-forming material is found, if there is excessive buildup, or the container is bulging or rusty, DO NOT open it, but contact Wyss EH&S immediately.
- Must be stored in airtight bottles, away from heat and light
- Must be stored away from acids, bases and oxidizers.
11.6 PIRANHA ETCH

Piranha etch is a mixture of sulfuric acid and hydrogen peroxide, both liquids and vapor are extremely corrosive to skin and respiratory tract. Direct contact will create skin burns and will be extremely destructive to mucous membranes, upper respiratory tract and eyes. Piranha solution is very energetic, exothermic, and potentially explosive. Mixing the solution is exothermic, the resultant heat can bring solution temperatures up to 120°C. It is required to contact the Lab Manager to determine the required precautions and safest fume hood to carry out this work.

11.7 COMPRESSED GASES

Compressed gas cylinders present an important hazard because they have the potential for both mechanical and chemical hazards. The danger of fire or explosion is acute with a high rate of diffusion. Additional hazards arise from the reactivity and toxicity of the gas. Asphyxiation can be caused by high concentrations of even “harmless” gases such as nitrogen. Finally, the large amount of potential energy resulting from the compression of the gas makes a compressed gas cylinder a potential rocket.

Wyss Institute researchers who need gases for a new project should consult Wyss EH&S staff to ensure it is set up properly. Toxic gases must have a hazard assessment conducted by Wyss EH&S and Facilities staff prior to ordering. Personnel are responsible for ordering compressed gases through HCOM under the AirGas vendor and charge to their platform. Contact purchasing@wyss.harvard.edu for assistance.

11.7.1 Labeling

- The contents of the cylinder should be clearly marked (vendor delivers labeled cylinders).
• A tag must be attached to the cylinder to indicate whether the cylinder is full, in use, or empty.

11.7.2 Storage
• Regardless of whether tanks are full or empty, they must have three points of contact at all times: 1) against a wall or bench 2) secured with a bracket, chain or strap, and 3) with the base even on the floor (there are alternatives if this does not work in a specific lab).
• Chemical oxidizers must be stored at least 20 feet away from flammable gas cylinders.
• A cylinder cap or regulator valve must always be in place.
• CLS: Room 5M3 is the storage area for compressed gas cylinders.
• ESL: The tank storage room is located at the exterior loading dock behind the building. Badge access is required.

11.7.3 Handling
• A tank dolly is provided in the storage rooms and must always be used to transfer gases.
• Highly toxic gases should not be moved through corridors in areas where occupants not knowledgeable in the hazards of the gases may be present.
• Cylinder valves should be opened slowly, using a hand wheel or wrench while standing away from the valve opening.

11.8 LIQUID NITROGEN
See Appendix B for information on liquid nitrogen dispensing and handling.

11.9 DEA CONTROLLED SUBSTANCES
The Wyss Institute holds a permit for the use of DEA Controlled Substances and has implemented a Wyss-specific plan. To use controlled substances and for more information, contact Wyss EH&S.

11.10 TRANSPORTING HAZARDOUS CHEMICALS

11.10.1 Transporting Lab to Lab
Chemicals must be transported from lab to lab within secondary containers that are in good condition and protect the bottle from breaking. Carts that have a lip to control any potential spill are also acceptable, and they are readily available throughout the labs.
11.10.2 Shipping and Receiving Hazardous Chemicals

All shipping and receiving of hazardous chemicals go through shipping and receiving:

- CLS loading dock receives all chemical shipments, Janitronics delivers the packages to individual benches.
- Harvard staff receives chemical shipments at 7 Divinity Avenue in Cambridge, they are prepped for transport and transported to ESL and 60 Oxford Street.

All personnel in this department are DOT and International Air Transport Association (IATA) trained. They have the authorization to reject any package that is not in good condition. Researchers are prohibited from shipping hazardous chemicals unless they are properly trained by EH&S staff. If special packaging requirements are not followed, potential fines can be incurred by the Institute.

**Wyss Institute researchers/staff are prohibited from transporting hazardous chemicals out of CLS or ESL to other buildings. This is strictly against DOT regulations.** Chemicals should be ordered and delivered directly to where they will be used. If assistance is needed, contact **Wyss EH&S**.

12.0 SAFETY PROCEDURES FOR PARTICULARLY HAZARDOUS SUBSTANCES

Substances that pose such significant threats to human health are classified as "Particularly Hazardous Substances" (PHS). The use of PHS must be limited by seeking alternatives whenever possible. If these materials must be used, additional caution must be taken. PHS consist of carcinogens, reproductive toxins, biotoxins, and acutely toxic chemicals. Labs that use PHS must document specific SOPs for these materials.

In addition to the following list of general procedures, **Appendix F** contains additional requirements.

- Obtain approval from the PI or his or her designee (i.e., senior member of the lab staff, lab supervisor, and/or CHO) to use these PHS.
• Order the smallest quantity of the chemical necessary to perform the procedure or experiment.
• Wear appropriate PPE, paying close attention to permeation resistance of gloves or protective clothing to be used.
• Work only in a properly functioning, uncluttered chemical fume hood or tissue culture hood.
• This area should be posted or labeled as a “Designated Area” for the use of particularly hazardous materials. Permit only authorized personnel to use any Designated Area.
• Determine, in consultation with the PI or his or her designee (i.e., senior member of the lab staff, lab supervisor and/or CHO) and EH&S, whether fume hood exhaust air should be filtered prior to discharge.
• Consult the SDS for exposure and emergency information before beginning work with these materials.
• Label ALL containers with the contents, date, manufacturer’s name and hazardous properties of the material(s) in the containers.
• Transfer particularly hazardous chemicals in tightly closed containers placed within a durable outer container.
• Limit traffic through the immediate area.
• Decontaminate the work surface immediately after working with these materials. To facilitate decontamination, work surfaces may be covered with stainless steel or plastic trays, absorbent paper with moisture-proof lining or other impervious material, which may be cleaned or disposed of as hazardous waste or biological waste after completing the procedure.
• Securely store these materials immediately after use.
• Label all waste materials with the corresponding chemical classification (e.g. Toxic) or as biological waste.

13.0 HOUSEKEEPING

Housekeeping is critical to maintain efficiency and flow for a busy lab environment like the Wyss where hazardous materials are constantly being transferred and handled. The following housekeeping and hygiene practices should be implemented at all times to reduce the likelihood of accident or chemical exposure:
• Work areas should be kept clean and free from obstructions.
• Hands should be washed after every experiment, before touching any non-contaminated area or object, and before leaving the laboratory area.
• Access to exits, emergency exits, aisles, hallways, stairways, stairwells and controls must never be blocked.
• Hallways must not be used as storage areas.
• Work areas should be cleaned at the end of the experiment and at the end of the day.

### 14.0 HAZARDOUS WASTE

Disposal of hazardous waste at the Wyss Institute is regulated by the Massachusetts Department of Environmental Protection (DEP). This section outlines the key elements to comply with the DEP and the Wyss Lab Hazardous Waste Program. Additional information is available by contacting Wyss EH&S or: ehs.harvard.edu/programs/lab-waste-management.

#### 14.1 WASTE IDENTIFICATION

Common lab wastes include:
- Spent solvents, acids, bases and oxidizers used in extractions, cleaning or other processes;
- Unused reagents and other chemicals that are no longer needed, do not meet specifications, are contaminated, have exceeded their storage life or are otherwise unusable in the lab;
- Waste oils; and
- Other miscellaneous materials, including broken thermometers, heavy metal salts, poisons, etc.

These wastes may be identified as either “listed wastes” (appear on lists of specific chemicals defined as hazardous waste issued by the DEP or “characteristic wastes” (exhibit certain characteristics: ignitability, corrosivity, oxidizer, and toxicity). EH&S staff are available to assist with waste identification.

#### 14.2 STORAGE AND DISPOSAL

Regulations require that hazardous wastes be accumulated and stored in properly managed containers on sufficiently impervious surfaces (free of cracks, gaps, etc.). To request a waste pick up or special container, submit a ticket to waste pick up services.

**Storage:** Hazardous waste in labs is stored in Satellite Accumulation Areas (SAA). SAA can be found in most fume hoods or under HPLCs.
- Containers must be closed at all times, unless waste is being added. Open-top funnels may not be left in open containers, as they are an emission source to the environment.
- Containers must be compatible with the hazardous waste stored within them. When in doubt, use the original shipping container.
Labeling: Containers that accumulate and store hazardous waste must be labeled with a hazardous waste tag (provided in all SAA, see picture below):

- The words “Hazardous Waste” (already provided on the waste tag);
- List the waste constituents and approximate percentage, full chemical name written out;
  - For example, “aptes” must be labeled as 3-Aminopropyltriethoxysilane.
- Check off the associated hazard (i.e. ignitable, toxic, etc.); and
- Include the date upon which the container became filled. Triumvirate Environmental staff will transfer all dated waste containers to the Main Accumulation Area (MAA).
- Containers must be situated so that the labels are clearly visible.

Sink Disposal: Hazardous wastes in lab sinks are prohibited by regulation. All sinks have this sign posted in the vicinity:

Inspections:

- CLS: SAAs are inspected and documented weekly by Triumvirate Environmental, our third party vendor.
- ESL: SAAs are inspected weekly by Wyss researchers who generate the waste.
15.0  EMERGENCY RESPONSE

15.1  EMERGENCY EQUIPMENT

Chemical spill kits (absorbents), universal spill kits, eye wash stations, drench hoses (at some sinks), and safety showers are distributed throughout all of the Wyss labs where chemicals are stored. Operations is responsible for inspections and periodic flushing. They must be unobstructed at all times.

15.2  CHEMICAL SPILL

Chemical spills can result in chemical exposures and contaminations. Chemical spills become emergencies when:

- The spill results in a release to the environment (e.g., sink or floor drain),
- The material or its hazards are unknown, or
- Lab personnel cannot safely manage the hazard because the material is too hazardous or the quantity is too large.

15.2.1  Small Spill

Generally defined as < 1 liter of a known chemical that is not toxic, does not present a significant fire or environmental hazard, and is not in a public area such as a common hallway. Procedure:

- Notify personnel in the immediate area and request assistance to block off the area.
- Contain the spill from the outside with the appropriate absorbent.
- Evenly pour the absorbent over the spill and follow the specific directions on the back of the absorbent bottle (i.e. will turn different color when acid is neutralized).
- Collect the waste and discard properly (most likely solid hazardous waste). Contact Wyss EH&S if unsure of the waste characteristics.
- Notify your supervisor and Wyss EH&S immediately regarding the incident.
The emergency button on the fume hood increases the air flow in the event of a spill. See image above.

15.2.2 Large Spill

Large chemical spills include spills of any quantity of toxic chemicals, large quantities, or chemicals in public areas or adjacent to drains.

- Alert and evacuate everyone in the immediate area. When evacuating the lab, close the door to minimize the amount of smoke spreading to evacuation routes.
- These spills require emergency response which is available 24/7: 617-495-5560.
- Stay outside of the lab and prevent anyone from entering. Wait until the spill team arrives and provide details about the spill.

If the spill presents a situation that is immediately dangerous to life or health, or presents a significant fire risk, activate a fire alarm and evacuate the building.

15.3 CHEMICAL EXPOSURES

Wyss EH&S staff must review all exposure situations, ensure that affected personnel receive appropriate medical treatment and/or assessment, and arrange for the containment and clean-up of the chemical as appropriate.

15.3.1 Skin Exposure

- If the exposure is too large to be rinsed off in a lab sink:
- Activate the nearest safety shower and remove all affected clothing
- Rinse for a minimum of 15 minutes
- A coworker should call 24/7 emergency response at 617-495-5560 or 911 and provide as many details as possible: what chemical, how much, and the location of the spill (building and lab number).
15.3.2 Eye Exposure
- Activate the nearest eye wash station and rinse for a minimum of 15 minutes.
- A coworker should call 24/7 emergency response at 617-495-5560 or 911 and provide as many details as possible: what chemical, how much, and the location of the spill (building and lab number).

15.3.3 Inhalation
- Evacuate the area and get to fresh air.
- Immediately refer to the SDS next steps.
- A coworker should call 24/7 emergency response at 617-495-5560 and provide as many details as possible: what chemical, how much, and the location of the spill (building and lab number).

15.3.4 Ingestion
- If a chemical is ingested, immediately refer to the SDS, since not all chemicals will require the same procedure.
- Obtain medical assistance as indicated.
Laboratory workers requiring health and safety information regarding substances they plan to use or are using, may obtain this information from the following sources:

- Container label
- Wyss EH&S or PI
- SDS
- Manufacturer's technical service department
- Harvard EH&S SDS Database
- American Chemical Society  (800)227-5558
  1155 Sixteenth Street NW
  Washington, DC 20036
  [http://www.acs.org](http://www.acs.org)
- American Petroleum Institute  (202) 682-8000
  1220 L Street, NW
  Washington, DC 20005-4070
  [http://www.api.org](http://www.api.org)
- American Chemistry Council  (202)249-7000
  700 Second Street NE
  Washington, DC 20002
- Compressed Gas Association, Inc.  (703) 412-0900
  14501 George Carter Way, Suite 103
  Chantilly, VA 20151
- U.S. Department of Labor  
  Occupational Safety and Health Administration (OSHA)  (800)321-6742
  200 Constitution Avenue
  Washington, DC 20210
- Region I OSHA Department  (617) 565-9860
  JFK Federal Building, Room E340
  Boston, MA 02203
- Massachusetts Department of Labor and Workforce Development  
  Department of Labor Standards  
  19 Staniford Street, Second Floor
  Boston, MA 02114
  (617) 626-6975
• Massachusetts Department of Public Health (617) 624-5757
  Bureau of Environmental Health
  250 Washington Street, Seventh Floor
  Boston, MA 02108
• Massachusetts Department of Environmental Protection (617) 292-5568
  One Winter Street
  Boston, MA 02108
  http://www.mass.gov/dep/
APPENDIX C

OSMIUM TETROXIDE SOP
APPENDIX D

EFFECTIVE USE OF GLOVES

REASONS FOR WEARING GLOVES

The hands are the part of the body that will most likely to come into contact with chemicals. Skin contact can result in dermatitis that is caused by a chemical or allergic irritation of the skin. In addition, some chemicals penetrate the skin and can cause illness in other parts of the body. Wearing gloves protects workers from skin irritation and other effects of chemical exposure.

CHOOSING THE RIGHT GLOVES

SDS detail appropriate gloves for use with each chemical. In addition, chemical compatibility charts for specific glove materials can be obtained from the glove manufacturer. Also, refer to the Ansell glove compatibility chart or Harvard EH&S Lab Glove Selection Guide.

EFFECTIVE USE OF GLOVES

Improper removal of gloves can be a source of contamination. The procedure, which works for thin gloves that may have to be changed often, is as follows:

- Using the fingers of one gloved hand, pinch the material of the other glove at the base of the palm and peel off the glove.
- With the ungloved hand, reach about an inch under the other glove on the palm side of the wrist, pinch, and peel off the other glove.
- Both gloves have now been removed without skin contact and the contaminated sides of the gloves are facing in.
- Gloves used with highly toxic materials should be disposed as hazardous waste before leaving the work area.

Studies have shown that up to 5% of new gloves have holes in them. Substances leaking through gloves are held in contact with skin, increasing absorption into the body.

Gloves that have been improperly selected or have holes in them can sometimes be worse than no gloves at all. Gloves used for dangerous chemicals can be tested for leaks by filling them with air and immersing them in water. This should not be done with PVA laminated gloves, since they may not be water resistant. If certain types of gloves consistently leak, the manufacturer should be notified.
PARTICULAR HAZARDOUS SUBSTANCES

A partial list of Particularly Hazardous Chemicals is available [here](#).

**Select Carcinogens**

Select carcinogens are substances that meet any of the following criteria:

1. Regulated by OSHA as a carcinogen. Guidance on these regulated carcinogens can be found at the OSHA website.
2. Listed under the category 1. “Known to be carcinogens” in the Annual Report on Carcinogens published by the National Toxicological Program (NTP).
3. Listed under Group 1 (“Carcinogenic to humans”) by the International Agency for Research on Cancer (IARC) Monographs.
   a. IARC Monographs can be found [here](#).
   b. The current IARC carcinogen listing by group can be found [here](#).
4. Listed in either Group 2A or 2B by IARC or under the category “reasonably anticipated to be carcinogens” by the NTP, and cause statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
   - Inhalation exposure of 6-7 hours/day, 5 days/week, for significant portion of a lifetime to airborne concentrations of less than 10 milligrams per cubic meter of air (mg/m3); or
   - Repeated skin application of less than 300 mg/kg body weight per week; or
   - Oral doses less than 50 mg/kg body weight per day.

**Reproductive Toxins**

Reproductive toxins are chemicals that adversely affect the reproductive process. These toxins include mutagens that can cause chromosomal damage and teratogens, the effects of which include retarded fetal growth, birth defects, fetal malformations, and fetal death.

Knowledge of how chemicals affect reproductive health is in its preliminary stage. It has been only since 1973 that manufacturers were required by the Toxic Substances Control Act (TSCA) to test chemicals other than drugs for their effects on reproductive health.

Although a few well-controlled studies have been conducted, the evidence for most chemicals is limited to case reports or to studies done on a small group of exposed people after a problem emerged. Of approximately 55,000 chemical substances and mixtures in commercial production...
(not including drugs, pesticides, and food additives), only a limited number have been tested thoroughly on animals for reproductive effects.

Sources of information about chemicals that pose a risk to human reproduction include:

- The chemical list generated pursuant to the State of California’s Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65). This list, which includes chemicals known to the State of California to cause reproductive/developmental toxicity (and cancer).
- SDS for those chemicals.
- Harvard University EH&S and/or Wyss EH&S staff.

**Acutely Toxic Substances**

Acutely toxic substances are defined in Appendix A of the OSHA Hazard Communication Standard. Any substance or mixture classified as an acutely toxic by ingestion, skin absorption, or inhalation, Category 1 or two must be treated as a particularly hazardous substance.

- Substances with a median oral lethal dose (LD50) in rats of 50 mg/kg or less of body weight;
- Substances with a median skin contact lethal dose (LD50) in rabbits of 200 mg/kg or less of body weight; or
- Substances with a median inhalation lethal concentration (LC50) of 500 parts per million (ppm) or less by volume of gas, vapor or 2 mg/l or less of vapor and 0.5 mg/l dust or mist.

Information concerning lethal doses and other measures of acute toxicity for particular substances is available on the SDS for a particular substance, from the manufacturer or the Harvard University EH&S and/or Wyss EH&S staff.

**Excluded Select Agents Toxins**

The Department of Health and Human Services (DHHS) has identified a group of biotoxins, as select agents, which are considered particularly hazardous and acutely toxic to humans and/or animals. These toxins are exempted from most of the Select Agent regulations if the toxin amount does not exceed a designated threshold quantity. If the threshold quantity is exceeded, all Select Agent regulations must be followed. Additionally, transfers of these toxins, even in exempted amounts, require special safety and security procedures. Please contact Harvard University EH&S and/or Wyss EH&S staff for information regarding safe and secure use, information pertaining to threshold quantities exempted from the regulations, and transfer procedures, when applicable.